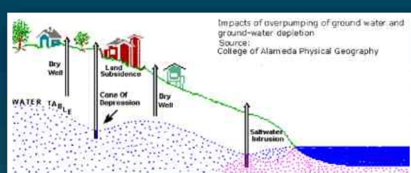
002783.LD14.01

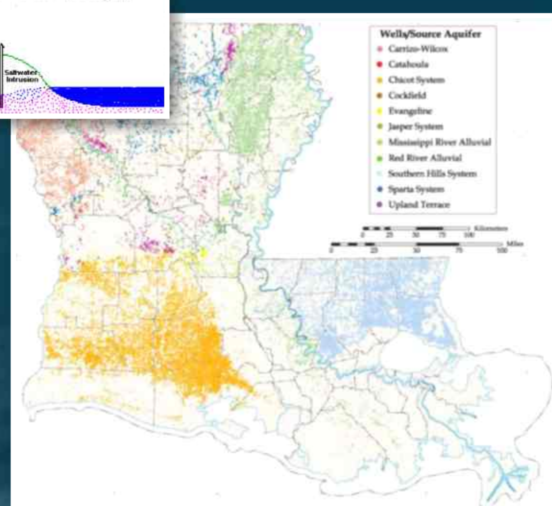
Technical

Recommendations for a Statewide Ground Water Management Plan

December 7, 2011

DNR Contract No. 2215-10-04





Prepared for

Office of Conservation
Louisiana Department of Natural Resources

Prepared by

ecology and environment, inc.
Global Environmental Specialists

Recommendations for a Statewide Ground Water Management Plan

December 7, 2011

Prepared for:

Office of Conservation
Louisiana Department of Natural Resources

Prepared by:

ECOLOGY AND ENVIRONMENT, INC.

Table of Contents

Table of Contents (cont.)

Section **Page**

Table of Contents (cont.)

Section **Page**

List of Tables

List of Tables (cont.)

Table **Page**

List of Figures

List of Abbreviations and Acronyms

^{o}F	Degree Fahrenheit
$	Dollars
>	Greater than
<	Less than
%	Percent
ADEM	Alabama Department of Environmental Management
ADEQ	Arkansas Department of Environmental Quality
ADSWMP	Assistance in Developing the Statewide Water Management Plan; Water System Master Plan
AFY	acre-feet per year
AGC	Area of Groundwater Concern
ARRA	American Recovery and Reinvestment Act of 2009
ASPB	Arkansas State Plant Board
ASSET	Aquifer Sampling and Assessment Program
BESE	Board of Elementary and Secondary Education
BMP	Best Management Practices
CAS	Chicot Aquifer System
CCPCUA	Central Coastal Plain Capacity Use Area (North Carolina)
CWA	Carrizo-Wilcox Aquifer
DEQ	Department of Environmental Quality
DHH	Department of Health and Hospitals
DWR	Department of Water Resources (California)
EIA	Energy Information Administration
EMC	Environmental Management Commission (North Carolina)
FACT	Financing Alternatives Comparison Tool
FIPS	Federal Information Processing Standard
FY	Fiscal Year
GAM	Ground water availability models
GCD	Ground water Conservation Districts (Texas)
GEOREF	GeoRef Database?
GIS	Geographic Information System
GWP	Groundwater Protection Council
GWRP	Ground Water Resources Program
GWRS	Ground Water Replenishment System
ID	Identification
in	inches

List of Abbreviations and Acronyms (cont.)

IOGCC	Interstate Oil and Gas Compact Commission
IRWM	Integrated Regional Water Management
JAS	Jasper Aquifer System
k	thousand
LAC	Louisiana Administrative Code
LDAF	Louisiana Department of Agriculture and Forestry
LDHH	Louisiana Department of Health and Hospitals
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development
LGS	Louisiana Geological Survey
LGWMC	Louisiana Ground Water Management Commission
LRPD	Louisiana Reservoir Priority and Development
µg/L	Micrograms per Liter
mg/L	Milligrams per Liter
MGY	Million gallons per year
M	million
MCL	Maximum Contaminant Levels
MGD	Millions of gallons per day
MRAA	Mississippi River Alluvial Aquifer
MSA	Metropolitan Statistical Areas
NASS	National Agricultural Statistics Service
NPS	Non-point source
NRCS	Natural Resource Conservation Services
NWRC	National Wetland Research Center
NWUDB	National Water Use Database
O&M	Operations and Maintenance
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
OPH	Office of Public Health
OWR	Office of Water Resources
PPP	Public-Private Partnerships
R.S.	Revised Statute
RRAA	Red River Alluvial Aquifer
RWH	Rain water harvesting
SDWIS	Safe Drinking Water Information System
SHAS	Southern Hills Aquifer System
SONRIS	Strategic Online Natural Resources Information System
SPV	Special purpose vehicle
STRONGER	State Review of Oil and Natural Gas Environmental Regulations, Inc.
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TWDB	Texas Water Development Board
UIC	Underground Injection Control
US	United States

List of Abbreviations and Acronyms (cont.)

USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
UTA	Upland Terrace Aquifer
WASA	Neuse Regional Water and Sewer Authority (North Carolina)
WDM	Water Demand Management
WhAEM	Wellhead Analytical Element Model
WIN	Water Independence Now
WRC	Water Resources Commission
WRD	Water Replenishment District

Executive Summary

Foreword

In 2002, the Louisiana Ground Water Resources Commission (LGWMC), Ground Water Management Advisory Task Force, and Commissioner of Conservation developed a report titled *Assistance in Developing the Statewide Water Management Plan*. The report was necessitated by the need to develop rules and regulations governing the determination of critical groundwater sources, emergency situation responses, conservation of groundwater resources, and related matters.

Furthermore, the report became the basis for promulgating Act 49 of 2003 regarding surface and groundwater management and conservation. Act 49 of the 2003 Legislative Session directed the Commissioner of Conservation and State of Louisiana to develop a statewide groundwater resource management program that would evaluate current and projected demands, water use conservation programs, alternatives to groundwater use, incentives for conservation, alternative technologies, and education programs.

This Executive Summary follows the same basic outline of the Recommendations for a Ground Water Management Plan document (document) but is condensed to provide a basic level of understanding to focus more specifically on the major findings and recommendations contained within the document's chapters.

Introduction

Conservation and sustainability of groundwater and surface water resources, hereinafter referenced as "water resources", are the focal points of this document. Recent increases in water demand due in part to persistent drought conditions, especially for the northern region of the state, have precipitated a renewed public interest in how the state's groundwater and surface water resources are managed. For purposes of this document, sustainability shall mean that water demand generally does not exceed supply. As such, a comprehensive approach, from updating the water resources baseline conditions to evaluating possible cost-effective water-resource alternatives, is necessary to ensure that water resources are utilized judiciously and in a sustainable manner.

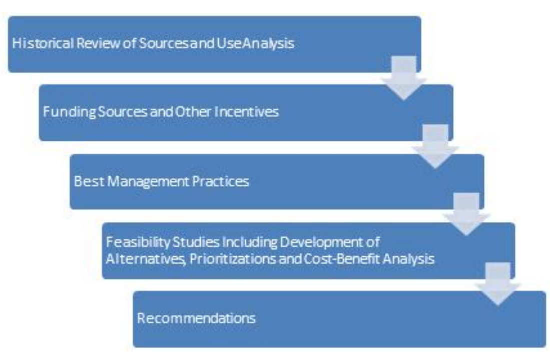
This document contains a compilation and thorough review of the statewide databases on water uses. The State's current system of water use reporting from various users' needs was reviewed in this report. Recommendations for future use and policy are included herein. Among these, the most important encompass the following themes:

- Develop more stringent and discrete well registration and evaluation processes to ensure that conservation and sustainability of water resources are achieved.
- Educate consumers on methods to conserve water resources and how can they benefit from them.
- Build awareness among all water users regarding the value our water resources.
- Develop surface water programs to engage all stakeholders.
- Create potential incentives that can be made available to water resource users.
- Consider initiating discussions on framing and implementing an adequate fee structure for major water users.
- Develop mechanisms assisting State agencies to forecast groundwater and surface water demands for short- and long-term needs such as coordination and data sharing among monitoring agencies, United States Geological Survey (USGS), Louisiana Department of Natural Resources (LDNR), Louisiana Department of Environmental Quality (LDEQ), and Louisiana Department of Transportation and Development (LDOTD).
- In tandem with the LDNR on-line information system, develop and implement a geographic information system (GIS)-based database to monitor and adaptively manage the resources.

In addition, considered in this document were cost-effective alternatives to groundwater and the use of groundwater from sustainable aquifers; using non-potable surface and groundwater for industrial purposes; and innovative funding mechanisms.

Consideration of innovative ways of conserving and re-using surface and groundwater resources are of paramount importance. This document focuses on conservation and sustainability, and is consistent with the State's vision to preserve the quality and sustainability of its groundwater resources.

The management plan recommendations contained in this document have been developed using a strategic planning process. The strategic planning process is a process by which a plan or vision is formulated to solve an identified problem; decisions are then made on how to best allocate funds and resources to achieve and implement that plan.



Regulatory Setting

Prior to 2001, there was no statewide ground water law, other than a 1972 law authorizing the (LDOTD) Department of Public Works to regulate wells drawing more than 50,000 gallons per day. In 2001, Act 446 provided for a commission and a task force to develop comprehensive ground water law. Act 446 also defined 'critical ground water area' and provided for a process for designation of these areas. In 2003, Act 49 (Louisiana Revised Statutes [R.S.] 38:3097.1-3097.6) modified or eliminated provisions of earlier laws and became the basis for ground water law in Louisiana. Louisiana's ground water and its management is described in Title 43, Natural Resources, Part VI. Water Resource Management, Subpart 1, Ground Water Management. For a detailed description of legal regimes applicable to surface water and ground water in the State of Louisiana including private property rights, refer to the ADSWMP, 2002.

Water Resources Setting

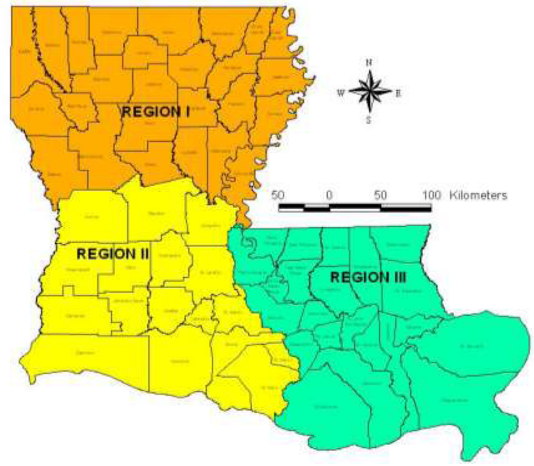
A broad review was performed on historical information from various sources regarding Louisiana's groundwater and surface water management and conservation goals. The literature search was compiled and organized by region and water sources such as groundwater or surface water. In addition, Louisiana Geological Survey (LGS) conducted a review of surface and groundwater resources for this plan. Furthermore, Louisiana aquifers have been studied by the LGS, USGS, and others for more than 80 years. State watersheds have been studied by the United States Army Corp of Engineers (USACE), the USGS, and others for more than 100 years.

Several data sets combining large amounts of hydrologic, hydrogeologic, and water chemistry data are available. For example, the LDNR maintains water well registration and notification databases; the USGS maintains the National Water Information System; the LDEQ maintains the ground water quality and surface water quality databases; and the United States Environmental Protection Agency (USEPA) and the Louisiana Department of Health and Hospitals (DHH) maintain the safe drinking water program databases.

Groundwater flow models have been developed since the 1980s addressing water issues throughout the state. However, most of the models were used for a specific project. With a few exceptions, none have been updated. Few models were developed to holistically study a regional aquifer system, and none were designed to telescope from the regional to a smaller (e.g. sub-parish) scale.

There are approximately 11 aquifer systems that are commonly used for public, domestic, industrial, and irrigation water supplies. These aquifer systems can be grouped within regions established in the *Assistance in Developing the Statewide Water Management Plan*; *Water System Master Plan (ADSWMP).*

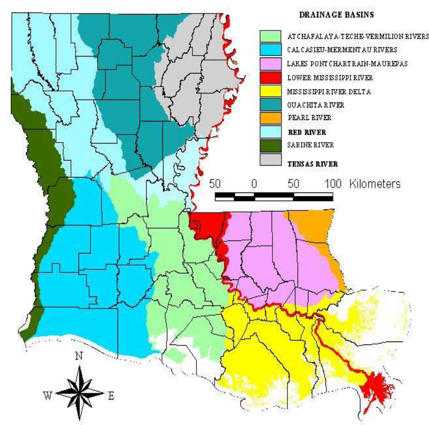
- Within Region I, the Carrizo-Wilcox aquifer and Red River Alluvial aquifer dominate the west, the Sparta Aquifer the center and the Mississippi River Alluvial aquifer the east, with the Upland Terrace aquifer, Catahoula aquifer, and Cockfield aquifer as secondary groundwater sources.



ADSWMP Regional Classification

- Within Region II, the Chicot aquifer system is dominant with the Evangeline aquifer, Jasper aquifer system, and Catahoula Aquifer as secondary groundwater sources.

- Within Region III, the Southern Hills aquifer system is dominant with the Mississippi River Alluvial aquifer as secondary groundwater resources.



Principal Drainage Basins of Louisiana (LGS 2010)

There are 10 recognized surface watersheds in the State of Louisiana including the Atchafalaya /Teche/Vermilion Rivers; Calcasieu/Mermentau Rivers; Lake Pontchartrain/Lake Maurepas; Lower Mississippi River; Mississippi River Delta; Ouachita River; Pearl River; Red River; Sabine River; and Tensas River.

In addition, from West Feliciana Parish, the Lower Mississippi River in Louisiana is confined by levees and has a very small basin area. With the exception of the Red River and smaller bayous in West Feliciana and northwestern East Baton Rouge Parishes, no other Louisiana tributaries flow into the Mississippi River.

Groundwater Resource Use and Impacts

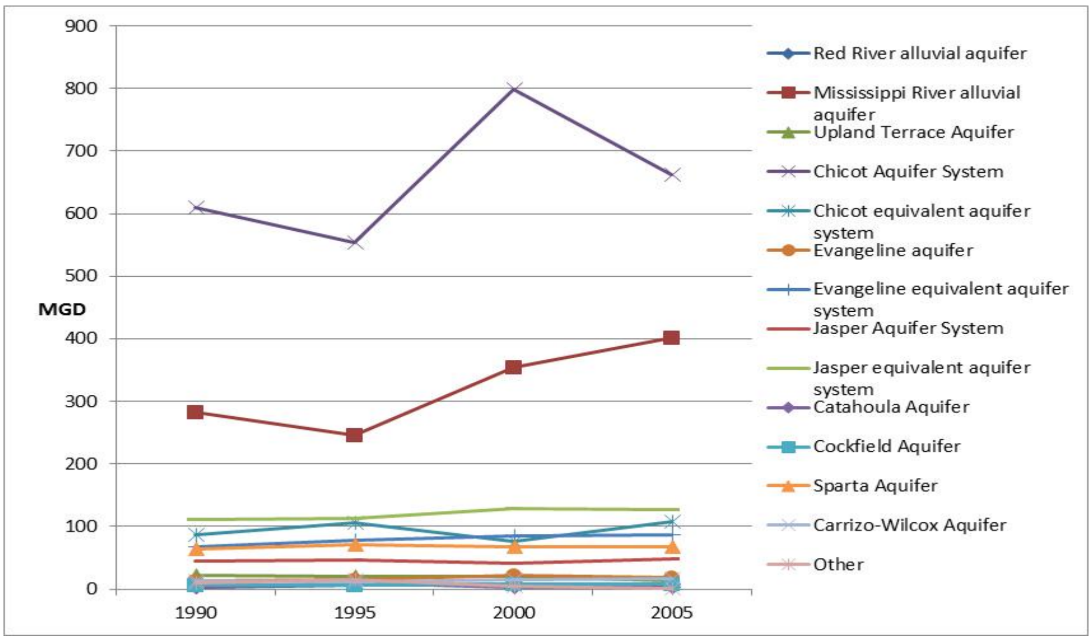
An analysis was conducted of the historic and current (1960-2005) water (surface and groundwater) consumption trends for the diverse universe of water users in the state, including the recent gas development activities in the northern portion of the state.

Total water (both surface and groundwater) use in Louisiana increased from 5,417 millions of gallons per day (MGD) in 1960 to a peak value of12, 500 MGD in 1980, but decreased by 3,000 MGD by 1990. The USGS is currently in the process of compiling data for 2005-2010, thus only the 2010 USGS aggregate statewide water use data for groundwater aquifers are used in this plan.

Water use in the three regions of Louisiana generally followed the total statewide water use trend, except for Region I where a decrease in water use between 1965 and 1970 was documented before reaching its peak value like Regions II and III in 1980. Water use in the state increased moderately in the 1990s reaching a total of 10,400 MGD by the year 2000.

The two primary total water user groups in Louisiana are power generation and industrial use, accounting for over 80 percent (%) of total water use in the State in 2005. As expected, overall water use for the public supply consumer has increased during each of the USGS/LDOTD's water use surveys.

Surface water accounts for over 80% of the source of water for the primary user groups. Over this time frame (1960-2005), total pumpage reached a peak of 12,500 MGD in 1980. Groundwater and surface water use decreased in the 1985



Groundwater Use by Aquifer (LGS, 2007; E&E, Current Study)

and 1990 reporting periods. However, since 1995, both surface and groundwater use show modest increases, returning to 1985 levels.

Of the total water use (10, 298 MGD) in 2005, approximately 15% was pumped from groundwater and 85% was pumped from surface waters. When examined by source, for 2005 the primary ground water users are:

- Rice irrigation (33%)
- Public supply (22%)
- Industry (17%)

- Aquaculture (13%)
- General irrigation (10%)

Groundwater and surface water use follow similar trends and both resource uses peaked in 1990. Groundwater use in Louisiana follows a similar trend as that of surface water with a peak use in 1990 of 1,780 MGD.

As of the 2005, Region I continues to be the primary user of groundwater. Region II accounts for nearly 60% of the groundwater pumpage in the state. Approximately 20% of the pumpage is recorded in Regions I and III and since 1980 Regions I and III roughly exhibit the same percentage of groundwater usage.
The population of Louisiana grew from 3.25 million in 1960 to an estimated 4.49 million in 2009. Most of the growth occurred between 1960 and 1980 where the population increased by more than 949,000 (29%). Growth flattened out between 1980 and 2000 due to out-migration in the state resulting from the stagnant economic conditions during that time period, with the population increasing by just six percent. The population of Louisiana is projected to grow from 4.5 million in 2010 to 4.8 million by 2030 (2010 Census).

The 1960-2005 surface water and groundwater total withdrawals by parish reflect the population trends described above. A steep rise in withdrawals is evident for the 1960-1980 period with the concomitant decrease in the 1980-1995 period. Interestingly, there appears to be a steeper rise of groundwater withdrawals from 1995-2005 than surface water withdrawals during the same period; this increase is reflected in all three regions, especially in Region I where the historical trend of surface water use versus groundwater use has been a steady inverse relation.

The Haynesville Shale gas formation, located in East Texas, Southwestern Arkansas and Western Louisiana, encompasses over 9,000 square miles and is considered to be the second largest natural gas shale formation in the United States (LDNR, 2011). Water is an essential component of shale natural gas development. Drilling a typical Haynesville deep shale gas well requires approximately 600,000 gallons of water, while hydraulically fracturing a typical Haynesville horizontal deep shale gas well requires an average of five million gallons of freshwater per well. Initially, developers decided to use fresh water from the Carrizo-Wilcox aquifer, which was met with swift opposition and complaints by local residents, including complaints of local water level drawdowns in wells.

In Louisiana, the Office of Conservation is responsible for monitoring the impacts that exploration and production of deep shale gas and oil formations have on ground water resources. The Office requires notification to the Commissioner of Conservation prior to drilling or using water wells hydraulic fracturing of shale formations to retrieve natural gas.

In the late summer of 2008, the Commissioner of Conservation provided additional clarification concerning notification requirements for all ground water use at oil and gas exploration and production facilities throughout the state. Additionally, the Commissioner further encouraged oil and gas operators to use available surface water resources or other acceptable alternative water sources in Northwest Louisiana whenever possible. Industry has responded positively to this request.

Many fracking wells have been drilled. Many wells have been permitted to drill and many more will be permitted to extract natural gas. This management plan takes into account the potential scale of impacts resulting from Hayenville Shale operations and similar efforts in the state.

In addition, the State is aware of the implications of future drought impacts combined with prospective fracking permits. The State of Louisiana is also aware of the importance of climate events and changes while managing water resources.

Based on review of groundwater use data and other pertinent public record or published literature, real and potential adverse impacts to Louisiana's major aquifer systems water quality or sustainability were identified and summarized in the following table:

Table E-1: Summary of the Aquifer Impacts

Aquifers	Region	Location	Impacts
Mississippi River Alluvial aquifer (North)	**I**	Aquifer wide Franklin Parish, SE Ouachita Parish	Water quality (total dissolved solids [TDS], metals) Naturally-occurring chlorides
Mississippi River Alluvial aquifer (South)	**III**	Coastal Parishes	Saltwater intrusion from Gulf of Mexico and potential upward migration of saltwater
		Sporadic throughout	Occurrence of natural gas in shallow sands
		Aquifer wide	Agricultural applications (pesticides/herbicides, fertilizers) Water quality (TDS, metals) Naturally-occurring chlorides
Chicot aquifer system	**II**	Iowa, LA	Shallow saltwater, possibly from Iowa Salt Dome
Chicot Equivalent aquifer system	**II**	Lake Charles	200 ' and 500' sand have been impacted by water level decline from industrial activity/over pumping
		Lake Charles	200 ' and 500' sands exhibit the presence of natural gas
		Lake Charles	700' sand is being impacted by saltwater intrusion
		Opelousas	Possible saltwater intrusion from naturally-occurring chlorides, salt domes in the area
		Coastal Zone	Saltwater intrusion from Gulf of Mexico, subsidence, and land loss
		Eastern edge of Chicot	Contact with Atchafalaya Aquifer provides potential increased TDS impact
Jasper aquifer system	**II**	Leesville	Water level decline
Jasper Equivalent aquifer system (Central Louisiana)	**II**	Alexandria	Water level decline
Cockfield Aquifer	**I**	Southern Winn/Northern Grant Parishes	Water level decline
Sparta aquifer	**I**	Monroe	Water level decline and increased chlorides
		Ruston	Water level decline and increased chlorides

Table E-1: Summary of the Aquifer Impacts

Aquifers	Region	Location	Impacts
		Minden	Water level decline
		Jonesboro Hodge	Water level decline
		Winnfield	Water level decline and increased chlorides
Carrizo- Wilcox aquifer	**I**	Sporadic Throughout	Water level decline and increased TDS/chlorides
		South of Shreveport	Water level decline
Southern Hills aquifer system	**III**	Baton Rouge	Water level decline and saltwater intrusion
		Bogalusa	Water level decline

Note: TDS = Total Dissolved Solids (hardness)

Water Well Prior Notification Requirements

A review was conducted of water well notification law under the Louisiana R.S. 38:3097.3.C (4)(a) requiring that an advance notification of intent to drill a water well be submitted by the well owner to the Commissioner of Conservation at least 60 days prior to drilling the well for certain wells.

Based on this review, recommendations are provided in the Plan to improve not only the water well notification and review procedures, but also streamline the registration and tracking of wells from inception to plugging and abandonment:

- Under Louisiana R.S. 38:3097.3.C (4) (a) it is the responsibility of the well owner to file the water well notification. Perhaps this responsibility could be placed on the driller, since most well owners would be unfamiliar with the requirements. Until notification changes are accepted, it is recommended the well drillers notify well owners of the requirement, allow the assistance of the driller in filing the well notification, and introduce regulations that penalize drillers that install wells without proper approval from LDNR.

- The agency should investigate the feasibility of developing a refined drawdown calculation that could be integrated into a GIS macro within the Strategic Online Natural Resources Information System (SONRIS) system to automate the review.

- Current static water level gradient maps need to be maintained as feasible to accurately identify potential impacts caused by new significant drawdown within an aquifer. These maps could be integrated into the SONRIS GIS system, either as a functional or reference layer, to ensure the relative static water levels are utilized when calculating relative drawdown from proposed wells.

- Because the Water Well Notification form , Water Well Registration Long Form , Water Well Registration Short Form , and even the Well Plugging and Abandonment Form share a significant percentage of common data, it should be possible to make these into one unified form with separate sections for the unique data on each of the original forms. These forms could be integrated into SONRIS to allow for online data submittal and quicker review by appropriate parties, as needed.

- Finally, the well identifier should be maintained from the well notification through the plugging and abandonment of the well. Each well should receive a unique identifier consisting of the parish Federal Information Processing Standard (FIPs) and the sequential well number for that parish. This would allow for a well to be located by its identifier (currently not possible in SONRIS).

Groundwater Management and Sustainability Measures

According to the USEPA (USEPA 2009) aquifers in central Louisiana experienced extended water level declines over the last few decades, but have begun to recover as the result of effective water use registration, evaluation, permitting and conservation programs. These efforts include public education, promotion of conservation and water use permitting in certain areas. Similarly, this same USEPA report indicates the overall use of groundwater in Louisiana has declined from approximately 2,800 MGD pump rate in 1980 to approximately 1,500 MGD, which is approximately the same as the 1960 rates.

However, as described earlier, impacts to the various aquifers in the state due to practices such as over-pumping are still occurring. Among these impacted aquifers, Sparta Aquifer and Chicot Aquifer systems are affected the most and the impacts can be classified as major while Jasper, Cockfield, and Carrizo-Wilcox aquifers are impacted only on a medium level.

Highly Impacted Aquifers:

- Sparta aquifer
- Chicot aquifer system

Less Impacted Aquifers:

- Cockfield aquifer
- Carrizo-Wilcox aquifer
- Jasper aquifer

The impacts to these aquifers impacts are discussed below.

Agricultural applications (pesticides/herbicides, fertilizers): Agricultural activities that cause groundwater impacts include confined animal facilities, pesticide spraying, and fertilizing. The major agricultural impacts that result from these activities are nutrients, pathogens, pesticides, herbicides, and salts. Agricultural applications and related water quality issues are discussed in water resources monitoring programs. Occasionally industrial activities and related water quality issues are mentioned in relation to groundwater. This may be due to the non-point pollution potential of agricultural applications as compared to point source pollution potential of industrial activities. Point-source pollution is generally well monitored and regulated.

Salt water intrusion: Saltwater intrusion is the movement of saline water into freshwater aquifers. Most often, it is caused by groundwater pumping from coastal wells or from construction of navigation channels or oil field canals in coastal marshes in addition to other causes. Saltwater intrusion occurs in virtually in all coastal aquifers, where they are in hydraulic continuity with seawater or deeper downdip where the aquifers are saline.

Natural Gas: Natural gas may enter groundwater through natural or industrial processes. Natural gas contains mostly methane, however, since it evaporates out of water, methane is not usually considered to present a health threat in drinking water. However, methane gas can become harmful if it escapes from water and becomes an explosive hazard. Other components of natural gas may be harmful to water quality.

Water level decline: Water level decline can occur on a local scale by withdrawing water at a rate higher than the annual aquifer recharge rate resulting in depleting the aquifer over time and causing cones of groundwater depression.

In this document several alternative actions are identified to mitigate these impacts to the State's aquifers. These actions include the development of specific water infrastructure project alternatives and the implementation of groundwater Best Management Practices (BMP).

These infrastructure alternatives are summarized in the following table.

Table E-2: Alternatives for Impacted Aquifers

Chicot System	Jasper System	Cockfield	Sparta	Carrizo-Wilcox
Wastewater Recycling	Wastewater Recycling	Wastewater Recycling	Wastewater Recycling	Red River Surface Water/Increased Use of Red River Alluvial Aquifer
Reservoirs for Rain Harvesting Conservation Measures	Reservoirs for Rain Harvesting Construction of pipelines for Pipeline Conveyance of Red River Water Conservation Measures	Reservoirs for Rain Harvesting Conservation Measures	Reservoirs for Rain Harvesting Construction of Pipelines for Conveyance of Ouachita River Water, and Surface Water from Lake D'Arbonne Reuse of Groundwater Conservation Measures	Reservoirs for Rain Harvesting Conservation Measures

E&E, 2011, this study

The BMPs were identified from several sources including Federal, State, Local plans, guidelines, and standards of practice. Implementation of BMPs will require capital resources. As such, Tax structures may be suitable for Louisiana to reduce the cost of implementing alternative BMP measures to reduce groundwater depletion. The BMPs considered in this document can be grouped in three major areas as follows:

Demand Management: "Demand management is purposeful and beneficial manipulation of level and timing of water usage" (Water Encyclopedia). Programs of demand reduction are also referred to as Water Demand Management (WDM). WDM applies selective economic incentives to promote efficient and equitable water use, and identifies water conservation measures that are aimed at raising local and regional awareness of groundwater sustainability issues. WDM advocates a wide range of measures that go beyond conservation to broader sustainable resource management. It applies to the protection of water quality sources; reduction of wastage both in infrastructure leakage and by users; improvement of water allocation among competing uses, and creation of appropriate pricing mechanisms.

Supply Augmentation: There are several methods for augmentation of water supply sources. The traditional methods include the use of storage structures on land such as dams, ponds, etc. Another method is the induced recharge of aquifers by artificial methods. The use of desalination plants is also another unconventional source of fresh water.

Water Reuse: According to the USEPA water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a groundwater basin (referred to as groundwater recharge). Water recycling offers resource and financial savings. Wastewater treatment can be tailored to meet the water quality requirements of a planned reuse. Recycled water for landscape irrigation requires less treatment than recycled water for drinking water.

Based on the groundwater use analysis, identification of aquifer impacts and review of mitigation strategies provided in this document, the following are the more immediate recommendations addressing the aquifer impact issues identified in Table E-1.

As a short term measure (0-5 year), BMPs (Demand Management; Supply Augmentation; and Water-Reuse) programs are recommended for the two aquifers that have recently been identified as requiring more immediate attention at this time, mainly:

- The Sparta aquifer, and
- The Carrizo-Wilcox aquifer

These mitigation strategies should encompass:

- Demand management programs to:
  - Protect water quality
  - Reduce wastage ([e.g. conveyance leakage] by all users)
  - Implement conservation measures
- Supply Augmentation to:
  - Develop surface water projects such as reservoirs
  - Develop induced recharge in conjunction with impoundments projects and
  - Identify usable sustainable surface water sources.
- Water Reuse to:
  - Plan and implement urban storm water capture and recycle programs with cities and municipalities, and
  - Assess current wastewater streams for conjunctive use and alternative for grey-water use program

The experience developed in planning and implementing the BMP in the Sparta and Carrizo Wilcox aquifers will be invaluable in developing similar programs across the state.

Supply Gap Estimation and Alternatives Implementation

The implementation of the alternatives described in this plan requires infrastructure development, which involves capital and operations and maintenance (O&M) costs. To that end, a supply gap analysis as well as a preliminary a cost model developed to assess the economic feasibility of the alternatives was prepared. In addition, in this section federal, state, and local funding sources that could be applied to fund the water infrastructure alternatives are identified and summarized.

It is recognized that alternatives have to be developed and implemented to meet the additional demand for groundwater that is being pumped from the impacted aquifers. This additional demand is estimated as a supply gap and is defined as the amount of groundwater that is to be replaced by alternative sources of water. The supply gap is calculated by determining current sustainable yields of impacted aquifers. Summarized in the following table are the estimated supply gaps of impacted aquifers based on 2010 water use.

Table E-3: Estimated Supply Gaps of Impacted Aquifers

Aquifer	2010 Level Use* (MGD)	Sustainable Use as of 2010 (MGD)	Current Gap (MGD)	Current Gap MGD/yr.
Chicot aquifer system	757.9	416.9	341.0	124,468
Jasper aquifer system	184.9	101.7	83.2	30,375
Cockfield aquifer	6.9	3.8	3.1	1,135
Sparta aquifer	64.9	35.4	29.6	10,785
Carrizo-Wilcox aquifer	19.5	10.7	8.8	3197

*USGS, 2011 (personnel communication)

Groundwater availability models (GAM) or groundwater yields models are not available in Louisiana for aquifers in general and impacted aquifers in particular.

The supply gap estimation was carried out for impacted aquifers are based on several assumptions and on one study on Sparta aquifer (McKee et al., 2004). McKee determined that the supply gap for the Sparta Aquifer is approximately 45% of the 2002 water use. Sparta Groundwater Study (2004) forecasted approximately 45% of the current water use (2010) as supply gap for Sparta aquifer. Chicot aquifer system shows a withdrawal of approximately 370 MGD during the rice farming season that is responsible for considerable water level decline (Lovelace, 2004; USGS, 2005). This decline can be assumed as supply gap and is approximately 50% of the sustainable yield.

From the above observations, it can be assumed that 45% of the 2010 water use for Sparta aquifer and Chicot aquifers can be assumed as supply gap. 45% of the 2010 water use is also considered as supply gap for other less impacted aquifers. This assumption is on the conservative side. As part of a framework such as this document, this approach may be sufficient. However, detailed availability modeling and yield estimations for aquifers are necessary to evolve adequate sustainable management decisions for groundwater resources.

In the absence of current groundwater availability models for aquifers in Louisiana, it is suggested that the McKee approach, detailed in this document, is the best way to obtain a feasible forecast and estimate sustainable yields. Ideally, once the alternatives for groundwater are implemented, the sustainability of each aquifer can be reevaluated along with the information from the availability models. This would provide the State with a management tool to reevaluate the supply gaps and adopt appropriate measures for aquifer sustainability.

Initiating and completing groundwater availability models in Louisiana will establish and define future aquifer conditions to be used in defining the sustainability of the aquifer(s) and identify potential quantity of alternative water source requirements for the area of need. It is recommended that groundwater availability model be developed for the two aquifers that recently been identified as requiring more immediate attention at this time, mainly:

- The Sparta aquifer, and
- The Carrizo-Wilcox aquifer

A general analysis of the financial viability and comparative cost of alternative projects intended to fill the estimated water supply gaps are described in this document. Summarized below are the proposed alternatives for closing the estimated supply gaps for each of the five aquifers impacted by over pumping and other sustainability issues:

Table E-4: Impacted Aquifers and Alternatives

Aquifer	Alternatives
Chicot aquifer system	Wastewater Recycling Reservoirs for Rain Harvesting Conservation Measures
Jasper aquifer system	Wastewater Recycling Reservoirs for Rain Harvesting Pipeline Conveyance of Red River Surface Water Conservation Measures
Cockfield aquifer	Wastewater Recycling Reservoirs for Rain Harvesting Conservation Measures
Sparta aquifer	Wastewater Recycling Reservoirs for Rain Harvesting Pipeline Conveyance of Ouachita River Surface Water and or Lake D'Arbonne Surface Water Conservation Measures
Carrizo-Wilcox aquifer	Red River Surface Water use or Red River Alluvial Aquifer Reservoirs for Rain Harvesting Conservation Measures

E&E 2011, this study

It is these alternatives that are subjected to financial viability analysis and cost comparisons. For this analysis it is assumed that each of the alternatives is scalable; that is, each can be scaled up sufficiently to meet the entire supply gap for a particular aquifer. Therefore, only one alternative is required (i.e., the lowest cost alternative) to fill the water supply gap for each aquifer.

As detailed in this document, for each alternative a financial model was constructed to determine the financial viability and the cost of the alternatives. The model considered such project parameters, such as water supplied per year, total capital costs, total annual O&M costs, years to construct and years required to reach 100% capacity, as well as free cash flows, which provide the best measure of the cash provided by a project.

The way in which costs were estimated results in the same price for water (in dollars per thousand gallons) for a given alternative across all five aquifers – with the exception of the lower costs for reservoirs in the Chicot Aquifer System, which reflect the lower capital cost per million gallons and lower O&M costs associated with the large reservoirs proposed for that aquifer system. Based on the assumptions used and financial modeling methodology used in this analysis, the lowest cost alternatives by aquifer are listed below:

- Chicot aquifer system - Reservoirs for rain harvesting;
- Jasper aquifer system - Pipeline conveyance of Red River surface water;
- Cockfield aquifer - Wastewater recycling;
- Sparta aquifer - Pipeline conveyance of Ouachita River/Lake D'Arbonne surface water; and
- Carrizo -Wilcox aquifer- Red River surface water/use Red River alluvial aquifer.

As part of this document, one task was to identify and summarize federal, state, and local funding sources that could be applied to fund the water infrastructure alternatives described above and recommended to reduce groundwater depletion in the state through:

- Pipeline conveyance of surface water /surface water diversion
- Surface water recharge of depleted aquifers
- Rainwater harvesting
- Wastewater recycling

Over 31 Federal and State funding sources were identified and reviewed as to their potential applicability to funding the proposed alternatives. For example, the federal government has set up funds to help finance the programs and upgrades, such as the Clean Water State Revolving Fund which was established in 1987. This fund enables state and local governments to get low interest loans in order to fix aging wastewater treatment facilities and sewer pipes. States are required to match funds they use by at least 20%.

Also, as an aid to states, local agencies, municipalities, utilities, and environmental organizations in selecting the best financing option to fund their water quality and drinking water projects, the Financing Alternatives Comparison Tool (FACT) is a financial analysis tool developed by the USEPA and available on-line that helps identify the most cost-effective method to fund a wastewater or drinking water management project. This tool produces a comprehensive analysis that compares various financing options for these projects by incorporating financing, regulatory, and other important costs.

Other funding strategies were also summarized such as Public-Private Partnerships (PPP). PPP has been used in many communities with private sector companies assisting in the design, rebuilding, and operation of publicly-owned water and wastewater systems. A PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project.

The federal government has no unified PPP policy and programs, as each department has its own unique statutory and regulatory framework to implement PPP, with general guidance set by the Office of Management and Budget.

At the state level only 23 states have legislation in place authorizing PPP. For example, in Louisiana, under law Louisiana R. S. §§ 48:2072 (C), (D)48:2084 to 48:2084.15 authorizes the Louisiana Transportation Authority to pursue PPPs for transportation facilities, including ferry, mass transit, rail or similar systems.

It is recommended that legislation be enacted to provide the appropriate water authority(s) the ability to pursue PPP to fund water infrastructure projects.

Recommendations

Recommendations were developed and categorized in two Tiers, as described below and summarized in their respective tables.

- Tier 1 Recommendations (Table E-5). These are short term solutions (1-5 year) that are implementable within existing Louisiana laws and regulations.

- Tier 2 Recommendations (Table E-6). These are long term solutions (5-30 year) that require legislative law and/or regulatory and law amendments. These recommendations are mainly policy related.

Conclusion and Retrospective Overview

The most significant and fundamental groundwater resource management issue facing Louisiana is the lack of timely and continuous acquisition of comprehensive aquifer-wide groundwater level measurements, water well production and groundwater quality data. Although the state has implemented various methods of obtaining such information, it is clear that the current methods fall short of producing a continuing volume of data in a coordinated manner available in a time frame sufficient for implementing a more efficient and effective means of managing the state's groundwater resources to ensure both short and long term aquifer sustainability. Establishing improvements in data acquisition and dissemination must be adequately addressed in order for the state to develop and implement a successful groundwater management strategy and therefore should be addressed as a matter of priority.

Table E-5: Tier 1: Short-Term Solutions (1-5 Year)

Issue	Discussion	Recommendation
STAKEHOLDER WORKSHOPS COMMENTS		
Stakeholders felt that current Legislation for evaluating sustainability by the Office of Conservation is not adequate and should carry a provision to deny groundwater use by a user if the use is deemed to be unsustainable.	The current Groundwater Resources Management statutory law and Louisiana Administrative Code regulations collectively provide for an effective means for the Agency to evaluate proposed ground water use and, when necessary, restrict ground water use, to prevent adverse impacts to aquifer sustainability.	Continue to improve upon the current procedure to evaluate the sustainability of the ground water resources under the current strict guidelines.
Based on discussions during the workshop and analysis of the available data for the preparation of this report, it was evident that there is an obvious lack of groundwater availability models and accurate data reporting by users. There was a consensus among the stakeholders to use academic and federal agency resources for larger scale groundwater/aquifer modeling.	The objective of the development of this document includes the identification of specific areas of the state's groundwater aquifer systems that may warrant regional or larger scale groundwater aquifer modeling to assist in the management of resource sustainability for those areas delineated in the Plan.	The Groundwater Management Advisory Task Force should study and identify the: ▪ Type and frequency of modeling suggested per area identified in this document; ▪ Initial and, where applicable, annual maintenance (model updating) costs to implement each suggested modeling project per area delineated in this document; ▪ Sustainable funding sources for each project; and ▪ All feasible resource management alternatives for each area identified in this document, and provide a written summary of their findings to the Groundwater Resources Commission.
Managing groundwater resources require adequate characterization of aquifers. Towards meeting this objective, there is a requirement of defining aquifer sustainability and sustainable yield criteria and establish resources to manage the same.	None	The Office of Conservation should: ▪ Research other state and federal legal definitions for aquifer sustainability and sustainable yield criteria; ▪ Implement aquifer modeling if warranted; ▪ Consider proposing regulatory amendments to utilize both concepts under Louisiana Groundwater Management regulations.
Stakeholder involvement and public awareness is critical in evolving management strategies and implementing new and established effective and efficient methods to reach the public.	None	The Groundwater Resources Commission and the Office of Conservation should request and encourage the Secretary of the Louisiana Department of Education and the Louisiana Board of Elementary and Secondary Education (BESE) to take all necessary actions to ensure that ground water conservation education be specifically and directly included in the required teacher grade level expectations (or its replacement) for elementary and/or middle school students from 3rd grade through 6th grade. If funds are available, this effort should be expanded to strategic grades.
Stakeholders felt that there is a need to establish an agency representative standing committee to recommend water quality and quantity emergency actions.	None	The Groundwater Resources Commission should pass a motion to recommend that the commissioner of Conservation initiate, assemble, and maintain an ad-hoc standing committee of agency representatives from DHH, Office of Public Health (OPH), LDEQ, LDNR Office of Conservation LDNR Office of Mineral Resources, and Louisiana Department of Wildlife and Fisheries, NRCS, LDAF to serve to facilitate communication between agencies for emergencies involving ground water resources.
In order for water users to utilize surface water instead of ground water there is a need to implement positive publicity to water users choosing surface water alternatives.	None	The LDNR should develop and implement a groundwater conservation stewardship recognition plan.
As part of the data collection and analysis as a strategy for surface water resource management, stakeholders state that there is a need to increase Surface Water Quantity Measurement temporally and spatially.	None	The LDNR, through its Office of Mineral Resources and in consultation with the USGS should investigate current state practices for measuring surface water quantity and report its findings, including any feasible and practical recommendations to improve current practices for the same, to the Groundwater Resources Commission and Commissioner of Conservation.
There is a need for greater accountability for self-reporting requirements.	None	The Office of Conservation forms that are currently used by well owners and operators to notify the agency of proposed ground water well locations and groundwater use should include signature and certification by the responsible party. This procedure is consistent with legal certification language used by other local, state, and federal governing agencies for related matters.
As an alternative to ground water use, stakeholders would like to see reservoir development.		Additional efforts may be initiated to locate and implement reservoirs in strategic locations.
WATER WELL NOTIFICATION AND EVALUATION		
Water well notification	Under R.S. 38:3097.3.C (4) (a) it is the responsibility of the well owner to file the water well notification at least sixty days prior to well installation. It has been suggested that this responsibility be placed on the driller, since most well owners would be unfamiliar with the requirements. Currently, domestic wells are automatically exempt from prior notification requirement, as are drought relief, rig supply, replacement wells, and other wells that the commissioner may deem fit for exemption (although large wells cannot be exempted). This leaves a pool of more astute well owners that would typically have more knowledge of well notification requirements. Thus, owners of all other new wells for uses such as for public supply, irrigation, and industrial purposes must comply with prior notification requirements.	It may be more appropriate to require the well driller, , who is licensed and should be more familiar with the process, to provide the agency with sixty day prior well installation notification for all non-exempt well installations. At a minimum, water well drillers should notify well owners of the notification, assist the well owner as necessary, and be prevented from installing wells without proper notification to LDNR.
Water well drawdown calculations	Office of Conservation water well installation and groundwater use evaluation is a structured review process which requires, at a minimum, the reviewing staff to perform calculations for	The evaluation procedures form should be revised to clearly document staff's use of drawdown calculations performed for both the nearest well and the shallowest wells within the quarter-mile radius area of

Table E-5: Tier 1: Short-Term Solutions (1-5 Year)

Issue	Discussion	Recommendation
	determining water level drawdown impacts at the well nearest to the proposed well location. Should staff determine the need, additional wells within the standard quarter-mile area of review may also be assessed for potential water level decline impacts or other potential adverse impacts to support agency conclusions of more complex proposed well locations and water production demands. However, based on review of the agency's evaluation process, it is not readily apparent that the agency's evaluation procedures include more in-depth assessment to include water level decline calculations for other wells located within the quarter-mile area of interest as may be needed to address varying well depth, yield, and proposed withdrawal rates, to ensure that potential adverse impacts of the proposed well will not be underestimated. Although it is understood that agency decisions resulting from well evaluation protocol includes consideration of potential adverse cumulative impacts due to the presence of multiple nearby active (pumping) wells, this consideration is not readily apparent on the evaluation guidelines document. Although groundwater numerical models, e.g., MODFLOW, can be used to calculate drawdowns in the well field, this method may be cumbersome to update and implement for evaluation of individual wells.	review to assess potential well interferences for proposed wells. The evaluation procedures form should also be revised to provide clear documentation of a larger radius, or area of review, when large cones of depression are expected. More robust documentation to support agency decisions based well evaluations should be considered by the agency, including the integration of analytical element models in SONRIS to evaluate the cumulative impacts of pumping, sustainability of the aquifer, and potential delineation of wellhead protection areas. Analytical element models, e.g., the wellhead analytical element model (WhAEM), may be an appropriate tool to calculate the cumulative impacts of pumping from multiple wells, as well as additional analytical elements including recharge, drain, and no flow boundaries. WhAEM can also quickly calculate capture zones and be used to delineate wellhead protection areas. US EPA supports the Center for Subsurface Modeling Support (http://www.epa.gov/nrmrl/gwerd/csmos/index.html), which provides descriptions and links for groundwater models.
Static water level gradient maps	None	Current static water level gradient maps should be developed and maintained as feasible to accurately identify potential impacts caused by new significant drawdown within an aquifer. These maps could be integrated into the SONRIS GIS system, either as a functional or reference layer, to provide a more efficient means of determining the relative static water levels to use when calculating relative drawdown from proposed wells.
Well registration	Since the Water Well Notification form , Water Well Registration Long Form , Water Well Registration Short Form , and the Well Plugging and Abandonment Form share a significant percentage of common data it would be possible to make these into one unified form with separate sections for the unique data on each of the original forms	The following changes could be implemented to improve the well registration process, including: ■In addition to the parish and coordinates, the form(s) should require a street address and/or directions from an intersection or applicable landmark. ■ Because the Water Well Notification Form, Water Well Registration Long Form, Water Well Registration Short Form, and the Well Plugging and Abandonment Form share a significant percentage of common data, it may be appropriate to consolidate these forms and provide separate sections requesting applicable information. ■These forms could be integrated into SONRIS to allow for online data submittal and quicker review by appropriate parties, as needed.
Well identifier	None	The well identifier should be maintained from the well notification through the plugging and abandonment of the well. Each well should receive a unique identifier consisting of the parish FIPs and the sequential well number for that parish. This would allow for a well to be located by its identifier, from inception to its plugging and abandonment which is currently not possible in SONRIS.

Table E-6: Tier 2: Long-Term (5 to 30 Years)

Issue	Discussion	Recommendation
The State of Louisiana does not have a program to develop GAMs for areas of groundwater concern.	The development and maintenance of detailed groundwater availability modeling and yield estimations is a valuable tool used to provide sound objective information for management decisions to address aquifer sustainability issues.	It is recommended that Louisiana develop a program to fund the development of aquifer-wide groundwater availability models for impacted aquifers especially for the Sparta and Carrizo-Wilcox aquifers. This program may be extended to additional aquifers that have projected supply gaps.
The State of Georgia's Water Plan (The Water Plan) establishes a regional approach to guide water management in Georgia through the creation of 10 water planning regions, with each region establishing a Planning Council, which in turn will their region's plan, called "Water Development and Conservation Plans" that will guide water management decisions in their region. This approach is an effective way of managing groundwater and surface water resources. The current groundwater management plan for Louisiana is a comprehensive state-wide plan, which will serve as a guidance framework. An approach similar to the State of Georgia's Water Plan is needed to manage Louisiana's water resources more effectively. Currently State of Louisiana aquifers are categorized under 'Regions," which is an administrative delineation. Separate plans based on watershed/aquifer/regional (regions) approach should be evolved. In addition, separate councils representing these regions could be considered as management option to guide water management decisions under the leadership of the Department of Natural Resources.		Appropriate actions may be initiated to create watershed and aquifer based regions and develop strategic regional resource management perspectives.
Stakeholders suggested that the drillers be required to provide prior water well notification to the Office of Conservation.		Should it be determined that water well owners, not well drillers, will continue to be required to provide advanced notification of propose water well installation to the agency, it is recommended that the Office of Conservation propose a rule amendment to LAC Title 56 Part I requiring a water well driller to obtain proof prior to commencing well installation operations that; a) their respective client (well owner) has complied with the pre-installation notification requirements of LAC 43:VI.701 and b) The Office of Conservation has completed its evaluation and provided the well owner a written determination on proposed ground water withdrawal at the well location. The regulatory amendment should require the water well driller to document that such proof was provided by the well owner by certification on the well construction registration form provided to the agency. The regulatory amendment should also clearly state that water well drillers failing to obtain and document proof of the above prior to constructing a water well will be subject to possible enforcement action and assessment of civil penalty issued under the general authority of the Groundwater Resources Management Law and Subsurface Waters – Well Drillers Law, Chapters 13-A-1 and 13-B respectively of Title 38 of the Louisiana R.S., and under the specific authority set forth in Section 3097.3 (F).
Inadequate data reporting system as well as strengthening of water level measurements and enforcement of laws and regulations prompted stakeholders to suggest that there should be comprehensive water metering for all users, statewide water level measurements, agency inspections, and reporting and database entry.		The Groundwater Resources Commission should consider approving the issuance of a letter of recommendation to the Louisiana legislature to amend current statutory law for Groundwater Resources Management Law, Chapter 13-A-1 requiring well owners of all active large volume industrial, irrigation, and public supply groundwater wells that drawing water from at least impacted aquifer systems to: ▪ Install flow monitoring devises on said wells; ▪ Record groundwater withdrawal volumes; and ▪ Report groundwater withdrawal volumes from each well to the agency on a quarterly to semi-annual basis.
For the sustainability of certain aquifer systems alternative use of surface water resources will be necessary. In the opinion of the stakeholders, there is a need to mandate surface water use cooperative endeavor agreements for judicious use of surface water resources.		New Legislation is recommended to extend and build upon the current provisions of ACT 955 of 2010 pursuant to fair and judicious use of surface water resources in the public domain. Such legislation should recognize the interconnectivity of ground water and surface water resources and the importance of that interconnectivity relative to the objective of any such legislation.
It is the stakeholder's opinion that for effective groundwater resource management there is a need to increase task force membership and role in water policy and management decision.		It is recommended that the Groundwater Resources Commission and the Commissioner of Conservation update and revise the role of the Ground Water Management Advisory Task Force, and provide recommends, as appropriate, to enact new legislation.
Although surface and ground water may be hydraulically connected, their interconnectivity is not recognized in legislation and related policy.		New legislation is recommended to extend and build upon the current provisions of ACT 955 of 2010 pursuant to fair and judicious use of surface water resources in the public domain. Such legislation should recognize the interconnectivity of groundwater and surface water resources and the importance that interconnectivity relative to the objective of any such legislation.

Table E-6: Tier 2: Long-Term (5 to 30 Years)

Issue	Discussion	Recommendation
Stakeholders who participated in the workshops felt that the Sparta Aquifer Groundwater Commission statutory authority should be enhanced.		The Sparta Aquifer Groundwater Commission may consider meeting with their legislators to propose draft legislation to amend the statutory authority of the Sparta Groundwater Commission to function in an identical capacity as the Capitol Area Groundwater Conservation Commission and seek assistance from the chair of the Louisiana Senate Natural Resources or House of Representatives Natural Resources and Environment to identify potential author(s) and sponsorship.
Louisiana law Louisiana R.S. §§ 48:2072 (C), (D) and 48:2084 to 48:2084.15 authorizes the Louisiana Transportation Authority to pursue PPPs for transportation facilities, including ferry, mass transit, rail, or similar systems.	Public-Private Partnerships (PPP) are used in many communities and through them private sector companies assist in the design, rebuilding, and operation of publicly-owned water and wastewater systems. A PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical, and operational risk in the project.	Legislation could be enacted to provide the appropriate water authority(s) the ability to pursue PPP to fund water infrastructure projects.
Financial incentives and funding opportunities		The following financial incentives are recommended to promote groundwater sustainability in areas of groundwater concern: ▪ Trust fund for surface / groundwater use fees to subsidize surface water use; ▪ Cost-share funds to facilitate the development surface and wastewater reuse alternatives; ▪ Credit system for alternative users; ▪ Provide incentives / tax reductions to encourage surface water alternatives; and ▪ Incentives to retain forests and agriculture to benefit watersheds.

1 Introduction

1.1 Purpose

In 2002, the Louisiana Groundwater Management Commission, Groundwater Management Advisory Task Force, and Commissioner of Conservation developed a report titled *Assistance in Developing the Statewide Water Management Plan*. The report was necessitated by the need to develop rules and regulations governing the determination of critical ground water sources, emergency situation responses, conservation of water resources, and related matters.

This report became the basis for promulgating Act 49 of 2003 regarding surface and groundwater management and conservation. Act 49 of the 2003 Legislative Session directed the Commissioner of Conservation, State of Louisiana to develop a statewide groundwater resource management program that would evaluate current and projected demands, water use conservation programs, alternatives to groundwater use, incentives for conservation, alternative technologies, and education programs.

Conservation and sustainability of ground and surface water resources are the focal points of this current project; recent increases in water demand due in part to persistent drought conditions, especially for the northern region of the state, have precipitated a renewed public interest in how the state's groundwater and surface water resources are managed. A comprehensive approach, from updating the baseline conditions to evaluating possible cost-effective water-resource alternatives, is necessary to ensure that water resources are utilized judiciously and in a sustainable manner.

This Statewide Groundwater Management Plan contains a compilation and thorough review of statewide database on water uses. The State's current system of water use reporting from various users' needs was reviewed in this report. Recommendations for future use and policy are included herein. Among these, the most important encompass the following themes:

- Develop more stringent and discrete well registration and evaluation processes to ensure that conservation and sustainability of water resources are achieved.

- Educate consumers on methods to conserve water resources and how can they benefit from them.

- Build awareness among all water users regarding the value of this resource.

- Develop surface water programs to engage all stakeholders.

- Create potential incentives that can be made available to water resource users.

- Consider initiating discussions on framing and implementing an adequate fee structure for major water users.

- Develop mechanisms assisting State agencies to forecast groundwater and surface water demands for short- and long-term needs such as coordination and data sharing among monitoring agencies, USGS, LDNR, LDEQ, and LDOTD.

- In tandem with the LDNR on-line information system develop and implement a GIS-based database to monitor and adaptively manage the resources.

This report also considers cost-effective alternatives to groundwater and the use of groundwater from healthy aquifers, using non-potable surface and groundwater for industrial purposes, and innovative funding mechanisms.

Consideration of innovative ways of conserving and re-using surface and groundwater resources are of paramount importance for this project.

1.2 Plan Organization

This Plan is organized in the following manner:

- Section 1 provides a brief introduction to the goals and purpose of this Plan and presents brief discussions on sustainability of groundwater resources and management issues, as well a summary of the current regulatory setting surrounding groundwater management in the state. Comparable plans for surrounding states are also described.

- Section 2 provides a review, description, and distribution of Louisiana's groundwater resources.

- Section 3 provides a historical review of groundwater users and consumption trends in Louisiana.

- Section 4 provides a description of well notification procedures in the state and presents specific recommendations to improve the type and quality of the information provided by this process.

- Section 5 presents a broad discussion on groundwater management and sustainability issues that may apply to impacted aquifers of the state. Section 5 also provides a survey of groundwater BMPs and Incentives.

- Section 6 discusses an alternatives-economic analysis and implementation and provides a summary discussion that identifies federal, state, and local funding sources that could be applied to fund water infrastructure projects in the state of Louisiana.

- Finally Section 7 provides a tiered category of recommendations.

Appendices 1 to 6 contain additional technical information used to prepare the analyses presented in this Plan.

1.2.1 Ground Water or Groundwater?

It has been a longstanding practice within the U.S. Geological Survey (USGS) to spell groundwater as two words and to hyphenate when groundwater is used as a modifier (e.g., ground-water hydrology). Groundwater Branch Technical Memorandum 75.03 (http://water.usgs.gov/admin/memo/GW/gw75.03.html) that was issued 37 years ago specified that the two-word form should be used.

However, per 2009USGS memorandum (Dated March 26, 2009; Office of Groundwater Technical Memorandum 2009.03; Subject: Groundwater: Ground water Versus Groundwater) USGS made a transition to the use of groundwater as one word. Changeover to use of the one-word spelling in their publications and web sites was accomplished as seamlessly as possible. Reports submitted for approval after August 1, 2009, used the one-word form.

However, in this Plan we follow USGS's lead and use the word groundwater as one word except when using ground water as two words in conjunction with Louisiana legislative and regulatory language so that the usage is consistent with the legal documentation.

1.3 Regulatory Overview and Status of Ground Water

Prior to 2001, there was no statewide ground water law, other than a 1972 law authorizing the LDOTD Department of Public Works to regulate (registration, reporting, well construction, and sealing) wells drawing more than 50,000 gallons per day . This DOTD authority was transferred to LDNR in 2009. A 1974 law created the Capital Area Groundwater Conservation District and gave it permitting and funding authority within five parishes surrounding Baton Rouge.

In 2001, Act 446 provided for a commission and a task force to develop comprehensive ground water law. Act 446 also defined 'critical ground water area' and provided for a process for designation of these areas. In 2003, Act 49 (Louisiana R.S. 38:3097.1-3097.6) modified or eliminated provisions of earlier laws and became the basis for groundwater law in Louisiana.

Louisiana's ground water and its management is described in Title 43, Natural Resources, Part VI, Water Resource Management, Subpart 1, Ground Water Management. There are four chapters that are relevant to this report: Chapter 1:

General Provisions; Chapter 3: Area of Ground Water Concern Application Procedure; Chapter 5: Hearings; and Chapter 7: Water Well Notification Requirements in Non-Critical Ground Water Areas. The rules and regulations of this subpart shall be applicable to the Commissioner's jurisdiction regarding: (1) areas of ground water concern, (2) ground water emergencies, and (3) management of the State's ground water resources.

The rules and regulations are self-explanatory. However, on September 9, 2009 Act 225 of 2005 replaced Act 49's definition of 'critical ground water area' with a new definition and created a new category, 'area of ground water concern'.
The areas of ground water concern are defined as the following:

> "an area in which, under current usage and normal environmental conditions, sustainability of an aquifer is not being maintained due to either movement of a salt water front, water level decline, or subsidence, resulting in unacceptable environmental, economic, social, or health impacts, or causing a serious adverse impact to an aquifer, considering the aerial and temporal extent of all such impacts."

If an area is characterized by these conditions, an owner of a well has the right to file an application to request that the Commissioner declare that an area underlain by such an aquifer(s) is an area of ground water concern. Once this application is filed providing the adequate information, a hearing takes place. The Commissioner makes a decision on the basis of scientifically-sound data gathered from the application. A draft order is issued that contains the designation and a recommended plan to preserve and manage the groundwater resources of the area of ground water concern.

The following is a brief discussion on various acts, orders, and memos highlighting Louisiana's regulatory context with regard to ground water resources:

- **Act No. 49; Regular Session 2003, Senate Bill No. 99.** This act describes the powers, duties, functions, and responsibilities of the Commissioner of Conservation regarding ground water management. This act mandates the creation of the Ground Water Resource Commission and provides the Commission its powers, duties, functions, and responsibilities. In addition, Act 49 provides the following: determination of areas of ground water concern; preservation and management methods of ground water resources in the areas of concern; and a description of the duties of the Sparta Ground Water Conservation District and the Capital Area Ground Water Conservation District.

- **Office of Conservation- Memorandum from the Commissioner; August 2011- Order No. ENV 2011-GW014. Order declaring a temporary ground water emergency to implement conservation measures and limit the use of Carrizo-Wilcox and Upland Terrace aquifer.** Through this memorandum, the Commissioner limits the use of ground water withdrawals from the Carrizo-Wilcox –Upland terrace aquifers from industrial, irrigation, domestic, and public water supply wells located in certain areas in Southern Caddo Parish (Keithville and South Shreveport) during extended extraordinary drought conditions.

- According to the memorandum the emergency order shall remain in effect until the Commissioner has "sound and objective" information demonstrating that aquifer water levels have recovered to a level "that no longer poses a significant risk of adverse impact to the aquifer or existing water wells."

- **Office of Conservation- Memorandum from the Commissioner; August 2005-Area of Ground Water Concern (AGC)-1-05 (Sparta Aquifer, Areas of Ground water Concern).** Through this memorandum, the Commissioner declared the following three areas overlying the Sparta Aquifer to be areas of ground water concern:

  - Monroe-West Monroe Area (Ouachita Parish)
  - Ruston Area (Lincoln Parish), and
  - Jonesboro-Hodge Area (Jackson and Bienville Parish).

  The Commissioner also ordered the following remedial actions to take place:

  - An aggressive water conservation education program
  - Owners of non-domestic Sparta wells to submit a monthly water usage report, and
  - Use of alternative source of water to reduce the amount of Sparta aquifer ground water.

- **Order No. ENV 2009-GW001.** The Commissioner of Conservation issued an order concerning installation of drought wells to assure the sustained production of agricultural products in the State.

- **R.S. 38: Parts 3092 through 3097** describe pertinent rules, regulations, and other requirements.

1.4 Groundwater Resources Management – State's Vision and Goals

R.S. 38: 3091.1 provides the regulatory framework for the State's intent to sustainably manage ground water resources, and it is stated that:

> "(A) (the) State must have a comprehensive ground water management program. This program must take into consideration the requirements, needs, and obligations of all stakeholders of water in the State of Louisiana. The program shall be based on good management practices, sound science, and economics according to generally accepted principles in those disciplines. It must include as a goal the long-term sustainability of the State's ground water

> aquifers and the preservation of the State's ecological welfare, while considering the economic value thereof to the state's role in interstate commerce and the economic welfare of its citizens. Further, it must provide for the efficient administration in the utilization and management of ground water resources, including the gathering of data related to the state's water resources. Thus the State's water resources must be protected, conserved, managed, and replenished in an effective manner, with due regard for the foregoing considerations and in the best interest of all the citizens of the state.
>
> (B) The legislature hereby recognizes the need for uniformity in the establishment of a comprehensive ground water management program. Therefore, the state shall have exclusive jurisdiction over the management of ground water. However, nothing contained in this chapter shall be construed to deny such local government the authority over siting facilities pursuant to any general land use planning or zoning or to deny soil and water conservation districts powers granted pursuant to R.S. 3:1208.
>
> (C) In accordance with the legislative intent provided herein, the statewide ground water resource management program and any rule, regulation, or order of the commissioner shall recognize historic use of ground water resources in the state and may incorporate the use of appropriate incentives to encourage conservation of ground water resources and the appropriate utilization of alternative water supplies where appropriate. Consistent with the provisions of this Chapter and in consultation with the commissioner, the incentives and provisions of alternative water resources may be provided by the state, or any local subdivision thereof, by virtue of tax incentives, tax credits, and physical projects transporting or providing alternative water sources to existing groundwater users and by any private person with an interest in conserving such groundwater resources for public use."

Therefore, this Plan focuses on conservation and sustainability, and is consistent with the State's vision to preserve the quality and sustainability of its groundwater resources.

1.5 Groundwater Sustainability in the Ecosystem

Sustainability of the groundwater resource in both an ecosystem and an economic sense is the capacity of this resource to have a portion removed and yet maintain itself indefinitely. This means that on average, groundwater that is removed is replenished over the long term. If this removal is greater than the natural or artificial replenishment, the aquifer will be depleted (Job 2010). Consistent with State's vision and for the purpose of this document sustainability shall mean that water demand generally does not exceed supply. It is the State's intent to develop and implement strategies that will help make impacted aquifers sustainable.

Groundwater exists under continental landmass and can be accessed by people. Groundwater is a finite resource that exists in a complex environment. The USEPA (USEPA 1985) has identified 48 different typical groundwater environments (hydrogeologic settings) in the U.S. Each hydrogeologic setting has a chemistry that has been affected by the geological environment within which it exists. The type of geologic environment influences the cost of producing groundwater from it and its use. The quality of groundwater and adjacent surface water is related: groundwater and surface water flow interact in watersheds as a single resource and components of the hydrological cycle and ecosystem.

Recognition of conjunctive management of groundwater and surface water together in watersheds holds significant potential to improve water resource availability.

Groundwater constitutes both an economic opportunity as well as a challenge (Jon 2010). As a resource, groundwater is often used without charge or cost to the user. The principal question triggering the State's groundwater management plan is that of ecological economics, that is, "how can the ecosystem be sustained with sufficient groundwater of adequate quality to provide for economic needs of human and animal populations which are undersupplied now and for similar needs in the future" (Job 2010).

There are issues that need to be considered while developing a comprehensive groundwater management plan. These issues also become plan principles and/or boundary conditions under which the plan is developed. Significant issues and/or questions when dealing with groundwater sustainability (adapted from Job 2010) are as follows:

- How to address issues regarding groundwater sustainability in isolation without giving due importance to hydrological cycle and other significant parts of it? Ideally, focus is to be on watersheds for groundwater evaluations and to develop sustainable solutions.

- What water quality is required for different uses?

- Conservation is proven to be cheaper than other options such as developing new sources of supply. As per Tsur et al., 2004, conservation can significantly increase available water quantities.

- How financing may be utilized to deploy conservation technologies to reduce groundwater demand?

- How to improve awareness and understanding of groundwater issues?

- How to manage the open-access nature of groundwater that contributes to conflicts over property rights?

- How to reconcile the current approach in open-access situations? Groundwater can be withdrawn for any use at the cost of production without regard to the ecosystem, market considerations, or impacts on other users (Young, R. A. 2005).

- Consideration of issue of scale, i.e., the quantity of groundwater that can be produced at levels that allow all critical activities to continue.

1.6 Selected States - Groundwater Management Plans

After discussing the State's vision and objectives and reviewing the salient issues, opportunities, and constraints relating to groundwater as a resource, it is helpful to take a brief look at other groundwater management plans developed by other surrounding states with similar land use practices, climates, and geology. Additional in depth-discussion of these Plans are provided in Appendix A.

1.6.1 Georgia

With fourteen major river systems and multiple groundwater aquifer systems, Georgia has abundance water resources. Although their water is abundant, it is not an unlimited resource and must be carefully managed to meet long-term water needs. Sustaining water resources supports the state's economy, protects public health and natural systems, and enhances the quality of life for its citizens.

Georgia's State Environmental Protection Division (EPD) under the guidance of Water Council developed a comprehensive statewide water management plan in 2008. The Water Council is comprised of a basin advisory committee, a statewide advisory committee, and technical advisory committees. EPD and the Water Council included public involvement from agricultural and business interests, local governments, non-profit agencies, trade associations, and others in preparing the plan. The plan is a framework to guide future decisions regarding water management across the state while providing flexibility and adaptability for future water management. The framework consists of:

- Integrated water policies that will govern water management decisions throughout the state;

- Assessment of the water resources capacity;

- Management Practices for water quantity and water quality; and

- Allows for regional planning to select the management practices that account for resource conditions and uses throughout the state.

Water supply management practices as identified by the regional water plans will ensure water resource infrastructure are identified early and properly addressed or mitigated. A water supply technical assistance program will provide assistance to those developing multi-jurisdictional projects to supplement water supply. The program will:

- Forecast demands over a 50-year planning period;
- Investigate all reasonable water supply resource alternatives;
- Select sites to minimize environmental impacts;
- Provide provisions for water supply watershed protection;
- Ensure design and operation provide flows necessary to meet in-stream flow criteria and support flow regimes identified in the water quantity resource assessment; and
- Provide water quality protection.

The adopted plan will identify state resources and funding mechanisms to help achieve water conservation goals. All water management concepts are consistent and support state laws. Provisions in state law remain that address emergencies such as water shortage with the priorities for human consumption and farm use.

1.6.2 Arkansas

Groundwater is an important natural resource in the state of Arkansas. Arkansas ranks fourth in the U.S. for the groundwater usage despite the state's relatively small population. Nearly 55% of the public-supply systems and 25% of the population rely on the state's groundwater resources. Three principal aquifers serve as the main supply system for the state. They contain readily accessible high quality water and are the basis for heavily populated areas. Despite the abundance of groundwater resources, the continuous withdrawal and lack of conservation are contributing to serious declines in some areas.

The task of managing groundwater resources, including conservation and protection, is handled by primarily by three different agencies. The Arkansas Natural Resources Commission (Commission) is currently responsible for the management and planning of the state's water resources. The Commission's strategy for water resource protection is to encourage conservation, education, and the conjunctive use of ground and surface water instead of water resource allocation measures. This is accomplished through monitoring of aquifer water levels and water quality, encouraging implementation of BMPs, and enforcement of the proper construction of water wells.

Additional state agencies, including the Arkansas State Plant Board (ASPB) and the Arkansas Department of Environmental Quality (ADEQ), have groundwater monitoring programs designed to protect the state's groundwater from pollution and over use.

The ASPB monitoring program was created to prevent agricultural pollution of the state's groundwater. Groundwater is monitored in areas vulnerable to agricultural pesticide contamination under an USEPA approved Pesticide Management Plan. ASPB works in conjunction with the Arkansas Department of Health to determine actions to be taken in the event pesticide contamination is confirmed. The program is voluntary and focuses on both point and non-point source contamination.

The ADEQ groundwater protection program responsibilities include groundwater quality planning and water-quality monitoring, addressing gaps in groundwater protection through the development of guidelines and regulations, and budgeting and grant administration. Groundwater quality parameters in various aquifers throughout the State are sampled every three years through the ambient groundwater monitoring program. These data are used to document trends and changes in water quality over time. The monitoring program currently consists of 195 well and spring sites in nine different monitoring areas within the State. A full suite of inorganic parameters are analyzed from the samples, including all major cations, anions, and trace metals. Published reports for each area of the State are produced following each sampling event.

Although the state does not have a formal set of groundwater standards, the Water Division uses federal standards and health advisory limits to establish cleanup levels at contaminated sites.

1.6.3 Alabama

Alabama is unique and fortunate to have an abundance of valuable water resources throughout the state. Approximately, 33 trillion gallons of freshwater flow every year into 77,000 miles of stream channels throughout 14 river basins. Additionally, over 550 trillion gallons of water is stored in underground aquifers. These high quality and functioning aquifers serve as a source of potable water for half of the state's citizen and as a source for the majority of the public water systems. Despite the size and magnitude of these resources, overuse and exploitation, poorly planned development, and climate variation threaten to overwhelm the state's groundwater supply.

The Alabama Water Resources Act tasks the Office of Water Resources (OWR) and the Water Resources Commission (WRC) with the power and responsibility to develop plans and strategies for the management of the waters of the state. The OWR coordinates with several state agencies in protection and conservation of groundwater resources. The Alabama Department of Environmental Management (ADEM), the Alabama Department of Public Health, the Geological Survey of Alabama, and the Alabama Surface Mining Commission also provide various groundwater management programs.

Groundwater protection programs in Alabama are primarily focused on prevention of contamination from point sources such as underground storage tanks, facilities regulated under the Hazardous Waste Program, and onsite domestic waste disposal. These programs are largely funded by grants from USEPA or state under any established federal program. These include releases from point sources such as pipelines, bulk storage tanks, spills of commonly used organic solvents, and septic tanks.

The Groundwater Branch of ADEM administers and provides technical support for regulatory programs related to groundwater protection or cleanup. The Underground Storage Tank (UST) Program and the Underground Injection Control (UIC) Program are administered by this department. Incidents of contamination of groundwater that do not fall within one of the programs above are dealt with under the authority of the Alabama Water Pollution Control Act. This statute provides the legal basis to require investigation and cleanup where groundwater has been contaminated.

The Water Investigations Program of the Geological Survey of Alabama conducts basic water resource investigations of surface and groundwater quantity and quality. The Water Investigations Program conducts a wide array of investigations for the state's groundwater resources related to aquifer recharge, water availability, groundwater quality, and regional stratigraphy as related to aquifers. The group also collects a variety of information including water-well drilling data, aquifer data, and general hydrologic data. This group also maintains a statewide network of monitoring sites to assess the yearly status of groundwater levels.

Alabama has a registration and reporting system in place for surface and groundwater withdrawals. This system involves the OWR and a division of the Alabama Department of Economic and Community Affairs with oversight by the WRC. The registration program requires any person withdrawing waters of the state to file a Declaration of Beneficial Use with the Office of Water Resources.

1.6.4 Texas

In 1949, the Texas Legislature authorized a petition process for designating "under groundwater reservoirs," the predecessor to groundwater management areas, by the Texas Board of Water Engineers, predecessor to the Texas Water Development Board (TWDB). The TWDB established the regional water planning process. Texas has extensive groundwater resources with the majority of the state lands underlain by one or more of nine major aquifers and 20 minor aquifers. Approximately 57 percent of fresh water use and nearly 80 percent of agricultural water use in Texas come from groundwater resources.

Texas law distinguishes between surface water and groundwater. All surface water, including streams, rivers, and lakes, belongs to the state. The only exception is diffused water, such as storm water runoff, which belongs to the landowner. Surface waters are appropriated through permits and are issued by the Water Uses and Availability Section, Water Quality Division of the Texas Commission on Environmental Quality (TCEQ) in Austin.

In contrast to surface water, groundwater law is based on the "right of capture." This doctrine and its interpretation through case law allow the landowner may withdraw groundwater without limitations and without liability to neighboring landowners for any harmful effects resulting from the withdrawal. Texas is the last remaining state to utilize the rule of capture, a doctrine based on English Common Law, as a means of regulating groundwater resources.

Groundwater conservation districts are charged to manage groundwater by providing for the conservation, preservation, protection, recharge, and prevention of waste of the groundwater resources within their jurisdictions. Groundwater conservation districts have required duties that must be performed, as well as a number of authorized powers that may be invoked.

1.7 Strategic Planning Approach

The planning approach for Louisiana's plan is based on the State's vision, needs, and objectives. Most of the elements discussed regarding other states also use this approach.

This groundwater management plan has been developed using a strategic planning process. The strategic planning process (Figure 1-1) is the process by which a plan or vision is formulated to solve an identified problem; decisions are then made on how to best allocate funds and resources to achieve and implement the plan.

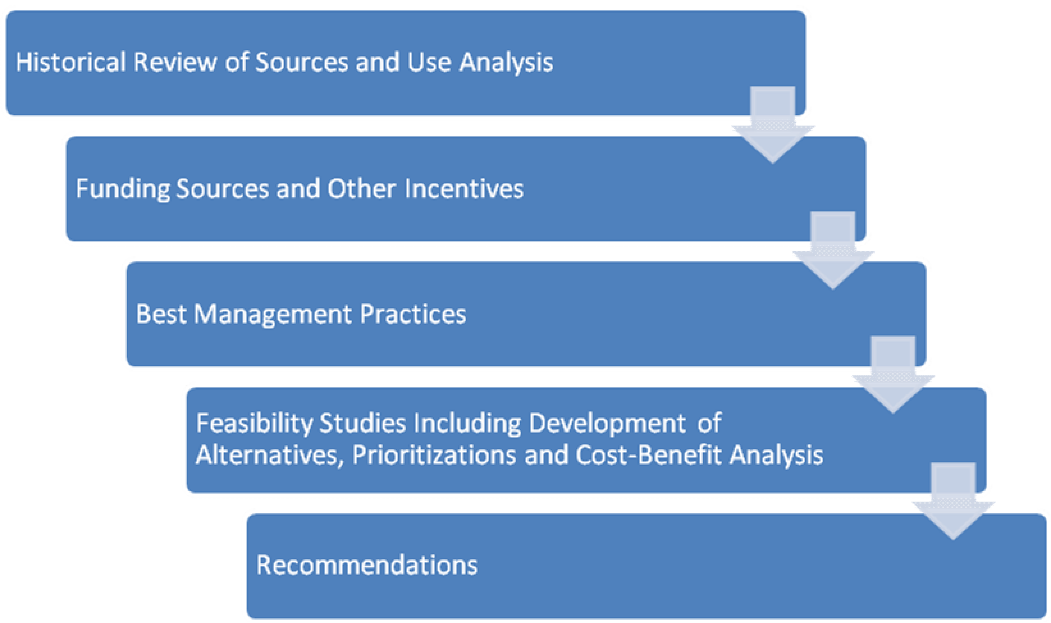


Figure 1-1 Strategic Planning Process

Key to the development of the preferred short- and long-term plan for sustainable use of groundwater resources of the State is the consideration of the steps that are needed to achieve short- and long-term solutions. This approach recognizes that immediate changes, other than implementing conservation and related measures, may not be appropriate, as abrupt changes may slow down vital long-term sustainable approaches. Therefore, strategic management provides a 'road map' for decision makers to move from the present situation towards the future long-term solutions as shown in Figure 1-2.

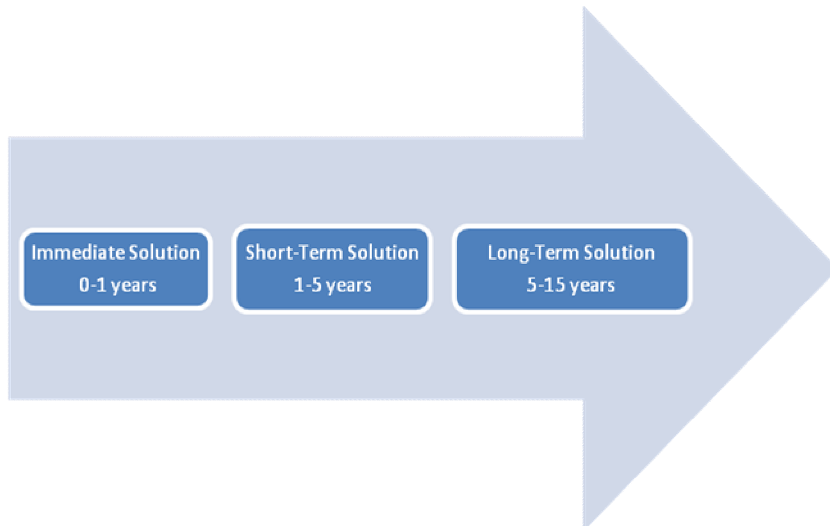


Figure 1-2 Strategic Planning 'Road Map'

While considering this approach, the following are considerations in terms of constraints and opportunities:

- Groundwater is considered as a finite and renewable resource.
- All water user groups will be given fair and proportional importance.
- Recommendations on immediate solutions will consist of implementation of or continuation of existing sustainable/conservation approaches including education and awareness programs and related aspects.
- Short-term recommendations, including conservation measures, will be framed within the viability of current legislations, rules, and regulations.
- Long-term recommendations will include measures that require legislative changes and alternatives measures for substituting groundwater.

2 Louisiana's Groundwater Resources

2.1 Introduction

This section provides a summary discussion of available sources of surface and groundwater quality and usage information and describes the distribution, nature, and general characteristics of Louisiana's groundwater and surface water resources. Specific data analysis and data details are provided in Appendix B.

2.2 Historical Information and Current Sources

A broad cursory review was performed on historical information from various sources regarding Louisiana's groundwater and surface water management and conservation goals. The search included a review of published material from the following sources:

1. Louisiana Geological Survey (LGS)
2. U.S. Geological Survey (USGS)
3. Academic institutions including Louisiana State University, University of New Orleans, Tulane University, Southern University, University of Louisiana at Lafayette, and Louisiana Technical University;
4. U.S. Army Corps of Engineers (USACE
5. Louisiana Department of Transportation and Development (LDOTD)
6. Louisiana Department of Natural Resources (LDNR)
7. Louisiana Department of Environmental Quality (DEQ
8. Louisiana Department of Health and Hospitals (DHH, and
9. Other published literature gathered through queries of the American Geological Institute's GeoRef Database (GEOREF).

Additional sources were researched, including the USEPA Safe Drinking Water Information System (SDWIS), population data from U.S. Census Bureau, farm and ranch irrigation survey data from U.S. Department of Agriculture (USDA) Census of Agriculture, crop and livestock estimates from USDA National Agricultural Statistics Service (NASS), and U.S. Department of Energy (DOE) Energy Information Administration (EIA) facility reports.

Key groundwater management documents, including the 2002 *Assistance in Developing the Statewide Water Management Plan*; *Water System Master Plan* (ADSWMP); as well as studies on major aquifers, i.e., the Sparta, Chicot, and Southern Hills aquifers were reviewed.

The literature search was compiled and organized by region and water sources such as groundwater or surface water. In addition, the LGS conducted a review of surface and groundwater resources for this plan. Their report, *Summary of Surface and Groundwater Resources Publications and Readily Available Data for Louisiana,* is included in Appendix B. This report details the following available data on each aquifer, as well as the source and date of each report and data set:

- **Aquifer Properties**- includes reports that contain information on hydraulic properties, usually transmissivity, hydraulic conductivity, and storage coefficient.

- **Water Quality –** includes historical and recent water quality studies focusing primarily on salinity but also includes data on dissolved iron, manganese, sodium, hardness, and total dissolved solids.

- **Other Studies -** large scale studies, such as regional groundwater flow models.

Furthermore, as part of the review of available water source data, LGS examined historic climate information. As noted in the LGS report:

> *Most of Louisiana lies in a hot humid subtropical climate. Louisiana averages 57 inches of precipitation per year, with the precipitation relatively evenly spread throughout the year (monthly average). Based upon the review of existing data, it can be observed that the distribution of precipitation is changing within the state. Precipitation amounts and frequency of severe storms are increasing. Temperatures are increasing, primarily the daily minimum and winter values, resulting in a decreased differential between daily and yearly highs and lows.*
>
> *Northern Louisiana exhibits a shift of precipitation toward the winter and spring, and a decrease in severe drought frequency, but an increase in runoff and possible flooding events. Southern Louisiana exhibits a shift of precipitation toward the summer and fall, and an increase in severe drought frequency. In addition, the compounding effect of sea-level rise and coastal subsidence may result in increased coastal flooding during storm events.*

In this Report, LGS collected average monthly precipitation data, average monthly temperature data, average monthly Palmer Drought Severity Index data that covers the period from January 1895 to January 2010, and determined the trend for each data set over the collected period for nine general areas of the State: northwest, north central, northeast, west central, central, east central, southwest, south central, and southeast (see Figures 37, 38, and 39 of the LGS Report).

As summarized in the LGS report:

- **Precipitation** - Precipitation is increasing at a small, but quantifiable rate for all nine regions. The observed monthly increase ranges from 0.43 in. (north central) to 0.72 in. (northeast). Rainfall (~57 in.) through Louisiana is distributed relatively evenly during the year.

- **Temperature** – In the southern half of the state (east central, southwest, south central, and southeast), the temperature is increasing at a small, but quantifiable rate. In the northern portion of the state, the trend shows no change, or a very slight decrease. Crowe and Quayle (2000) report over the past ten years a 1.5° F increase for the daily minimum temperature, and 0.7° F for the daily maximum temperature.

- **Drought** – The Palmer Drought Severity Index, based upon temperature and precipitation, indicated that droughts in the northern half of the state were more common during the first half of twentieth century. In contrast, droughts in the southern half of the state were more common during the second half of the twentieth century.

2.3 Groundwater Data Availability

Louisiana aquifers have been studied by the LGS, USGS, and others for more than 80 years and Louisiana watersheds have been studied by the USACE, the USGS, and others for more than 100 years.

The geohydrologic properties of all the state aquifers have been characterized by researchers since 1940. The available data contains information on hydraulic properties (e.g., transmissivity, hydraulic conductivity, and storage coefficient). In addition, depictions of the aquifer surface and profile have been drafted for most aquifers. Similarly, piezometric surface maps are available for some parts of most of the aquifers.

A substantial portion of this work was done by the USGS in collaboration with the LGS during the 1960s. Recent work updating this information has also been done by the LGS and USGS, in collaboration with the LDOTD.

Several data sets combining large amounts of hydrologic, hydrogeologic, and water chemistry data are available. For example, the USGS maintains the National Water Information System; the LDEQ maintains the ambient groundwater and the ambient surface water databases; and the Louisiana DHH maintains the safe water program database.

Groundwater flow models have been developed since the 1980s addressing water issues throughout the state. However, most of the models were used for a specific project. With a few exceptions, none have been updated or kept up-to-date. Few models holistically studied a regional aquifer system, and none were designed to telescope from the regional to a smaller (e.g., sub-parish) scale.

2.3.1 Water Usage

Statewide surface and groundwater usage data has been collected in Louisiana since 1960 by the USGS in collaboration with State agencies and water user/providers. In addition, several major metropolitan water systems have maintained records of this type of information for longer periods of time.

The most detailed water usage information for any given area of Louisiana has been collected by the Capital Area Groundwater Conservation Commission since 1975. According to this data set in 1960, an estimated 1,030 million gallons per day (MGD) of groundwater and 4,387 MGD of surface water were consumed in Louisiana for domestic, public, agricultural, industrial, and other uses. The most recent estimate (2005) shows that 1,600 MGD of groundwater and 8,700 MGD of surface water were consumed. This represents a 55% and 98% increase, respectively. USGS is in the process of collecting 2010 data; however, the data have not been processed and verified to be used in this Plan. It should be noted that the 2010 data would include changes related to population shifts from Hurricane Katrina after August 2005 and increased water use related to recent development for Haynesville shale gas recovery.

Current aggregate data for all groundwater aquifers have been provided by USGS for trend analysis and supply gap estimates provided in this Plan. During the preparation of this Plan, USGS has been working to compile the updated and verified 2010 data.

2.3.2 Aquifer Properties

Many reports contain a properties section with information on hydraulic properties, such as transmissivity, hydraulic conductivity, and storage coefficient. The hydraulic conductivity values reported by various authors from the USGS are typically derived from a small number of full-scale aquifer tests. Other studies report transmissivity or hydraulic conductivity results from analyses of specific capacity tests. Information from specific capacity tests, pump tests, and/or grain size analyses are occasionally reported by water well drillers on the forms submitted formerly to the DOTD and, currently, to the LDNR.

2.3.3 Water Levels

Water levels are generally reported on the State's water well registration form. However, the USGS has been monitoring water levels consistently in only a few wells across the state, and many more on a specific study basis. Similarly, private facilities and public water suppliers are monitoring water levels. Water levels in this case refer to the measurement of the depth to water in a well casing for which a surveyed elevation is available for the measuring point.

2.3.4 Water Quality

There are few water quality maps for the aquifers of Louisiana: Winslow et al. (1968) determined the base of freshwater throughout Louisiana, which they demarcated by a concentration of 10,000 milligrams per liter (mg/L) total dissolved solids. Smoot (1988) determined the base of freshwater in Louisiana aquifers.

A new version of the map was prepared by Van Biersel et al in 2008 (Figure 2-1). Tomaszewski (1992) created a series of statewide water quality maps for dissolved iron, manganese, sodium, hardness, and total dissolved solids.

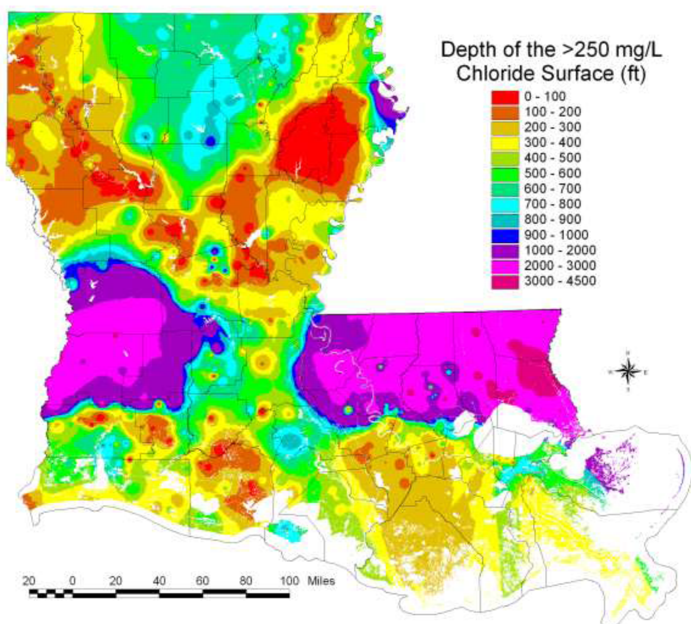


Figure 2-1 Depth to Saline Groundwater

The map shown as Figure 2-1 is based on very limited data. Certain areas that are shown to be very near to saline groundwater can be misleading. In addition, there are areas such as Lake Ponchartrain has been omitted from this analysis in spite of having available data. Therefore, it is necessary to collect adequate data to modify this map.

2.3.5 Water Quality Information from Louisiana DEQ's Aquifer Sampling and Assessment Program

The LDEQ Aquifer Sampling and Assessment Program (ASSET) is an ambient monitoring program established to determine and monitor the quality of groundwater produced from Louisiana's major freshwater aquifers. The ASSET Program samples approximately 200 water wells located in aquifers and aquifer systems across the State. The sampling process is designed so that all aquifers and aquifer systems are monitored on a rotating basis, within a three-year period so that each well is monitored every three years.

Specific details can be obtained from the Louisiana DEQ publications for the aquifers listed on the Louisiana DEQ website.

2.4 Groundwater Resources

In 2002, the ADSWMP report was submitted to the Louisiana Groundwater Management Commission (LGWMC 2002). This document was the first to compile the information available for the aquifers and basins that provide Louisiana with its water supplies.

This report classifies the groundwater aquifers into three regions (Figure 2-2). Classification under regions is not very useful approach since the regions are merely administrative delineations for Louisiana DOTD. However, many studies and literature detail data and observations under the regional classification, therefore, for the sake of consistency and to avoid confusion, this Plan uses these descriptions under regional classification followed by data description and interpretations under each aquifer.

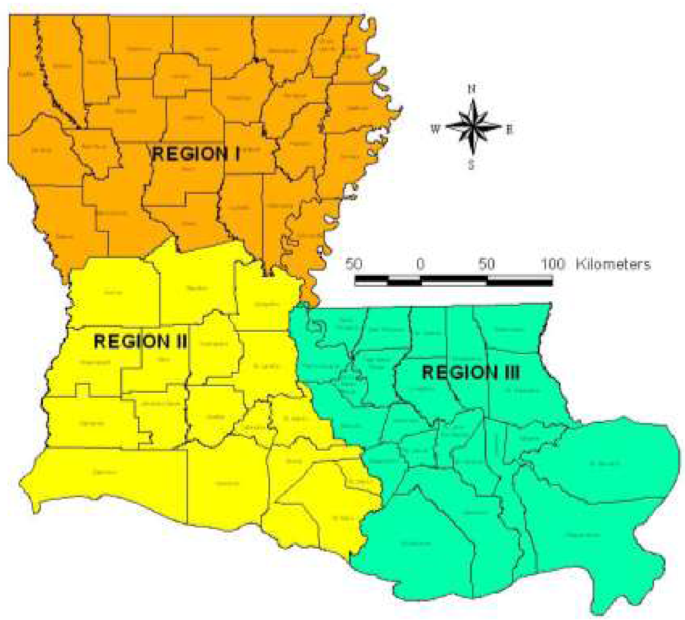
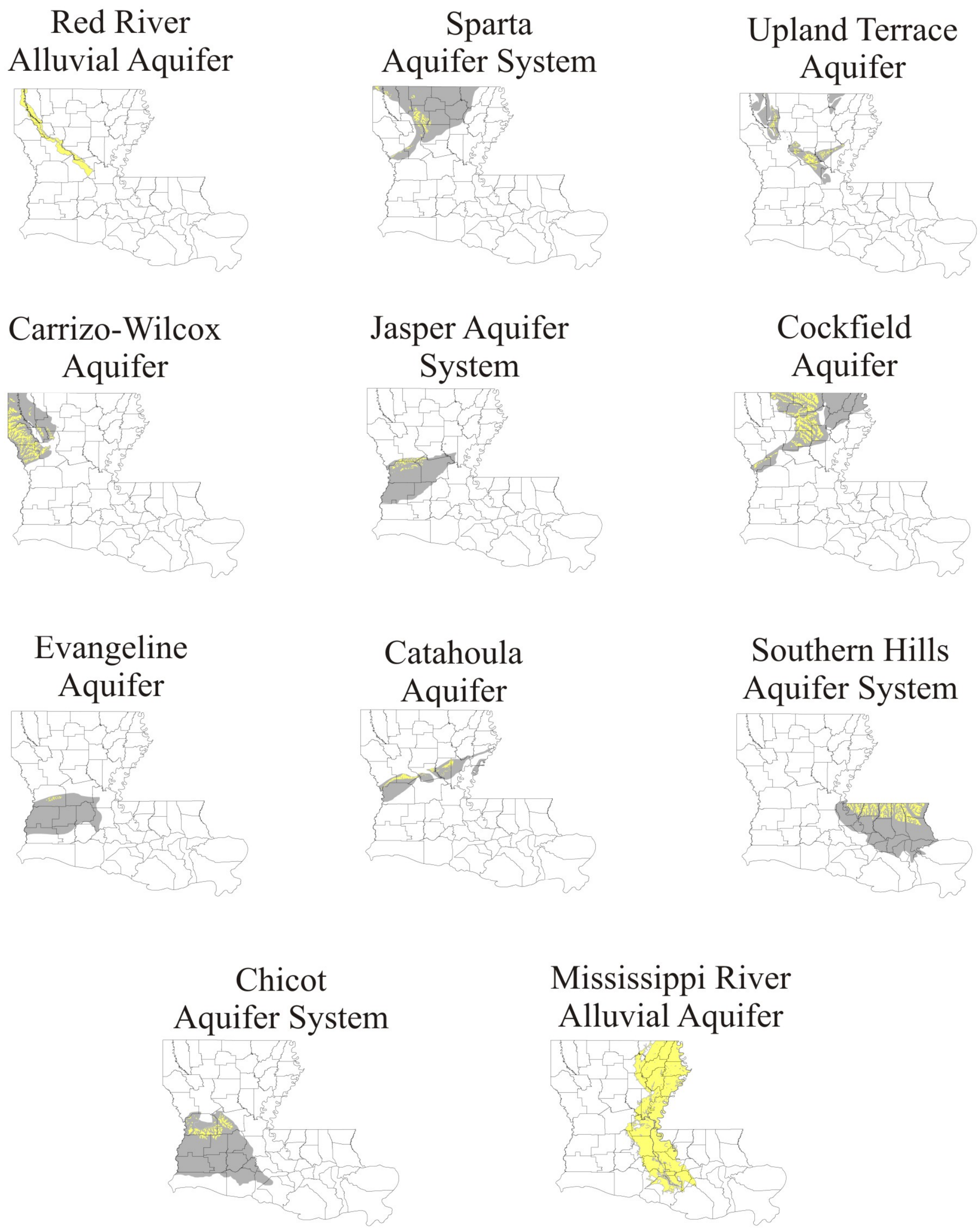


Figure 2-2 ADSWMP Regional Classification

There are approximately 11 aquifers/aquifer systems that are commonly used for public, domestic, industrial, and irrigation water supplies (Figure 2-3). In general, these aquifers can be grouped regionally, per ADSWMP classification.

Louisiana's Principal Freshwater Supply Aquifers



Disclaimer: These maps were generated by the Louisiana Geological Survey. No claims are made to the completeness or accuracy of the information included herein. The aquifers are depicted in yellow where they outcrop and in gray where they are confined (modified from Van Biersel and Milner, 2009).

Figure 2-3 Louisiana Principal Fresh Water Aquifers

Within Region I, the Carrizo-Wilcox aquifer (CWA) and Red River Alluvial aquifer (RRAA) dominate the west, the Sparta aquifer the center and the Mississippi River Alluvial aquifer (MRAA) the east, with the Upland Terrace aquifer (UTA), Catahoula aquifer, and Cockfield aquifer as secondary groundwater sources.

Within Region II, the Chicot aquifer system (CAS) is dominant with the Evangeline aquifer, Jasper aquifer system (JAS), and Catahoula aquifer as secondary sources.

Within Region III, the Southern Hills aquifer system (SHAS) is dominant with the Mississippi River Alluvial aquifer as secondary groundwater source. The Chicot equivalent, Evangeline equivalent, and Jasper equivalent in Southeast Louisiana are collectively known as the Southern Hills aquifer system.

The Southern Hills and Chicot aquifer systems were designated "Sole Source Aquifers" by the EPA in 1988. Sole Source Aquifer designation is one means to protect drinking water supplies in areas with few or no alternative sources to the groundwater resource, and where if contamination occurred, use of an alternative source would be prohibitively expensive.

Table 2-1 summarizes and updates the designation and age of the aquifers. Table 2-1 also attempts to correlate the aquifers stratigraphically within Louisiana, and with the adjacent states of Texas, Arkansas, and Mississippi. It should be noted that old USGS and LDOTD nomenclature included UTA for shallow wells in southeastern Louisiana. This nomenclature is inconsistent with the geologic age of those deposits. Those wells are incorporated in the SHAS in this report. Similarly, the Chicot Aquifer System of southwest Louisiana is classified as Pleistocene in age, which correlates with surficial deposits in southeast Louisiana. Generally, these are not used for aquifer purposes (e.g., there is no Chicot equivalent aquifer in southeastern Louisiana), with the exception of the relatively unused shallow sands [Table 2-1]).

Because of the dynamic/tectonic nature of geological deposits in Louisiana, it should be noted that faults are present throughout much of the state. Faults, including some with surface expressions cut through the SHAS, the MRAA, the CAS, the CWA, and the Sparta Aquifer. These faults (e.g., the Baton Rouge-Tepetate Fault System) represent, in most cases, leaky barriers to groundwater flow.

The recharge areas for the eleven principal aquifers were studied and mapped in detail by Boniol and Hanson (Boniol 1988 and Boniol and Hanson 1988). A copy of the map is shown in Figure 2-4. Significant portions of the recharge zones of the Southern Hills Aquifer System, Carrizo Wilcox Aquifer, Upland Terrace, and Cockfield Aquifers are located in adjacent states.

Table 2-1 Generalized Aquifer Designation in Louisiana (from LGS, 2011)

Stratigraphy	REGION I/North Louisiana			REGION II/Southwest Louisiana				REGION II/Southeast Louisiana					Texas	Arkansas	Mississippi
	Northwest	North Central	Northeast	West	Central	East	Atchafalaya	Mississippi River Valley	New Orleans Area	Baton Rouge Area	Western Florida Parishes	Eastern Florida Parishes			
Recent Alluvium	Red River Alluvial	Alluvium	Mississippi River Alluvial	Alluvium	Alluvium	Alluvium	Atchafalaya Alluvial	Mississippi River Alluvial	Shallow Sand				Alluvium	Alluvium	
Prairie and Intermediate allogroups	Upland Terrace	Upland Terrace		200-Foot Sand 500-Foot Sand 700-Foot Sand	Upper Chicot Lower Chicot	Chicot			Gramercy Norco Gonzales-New Orleans	Shallow Sand	Shallow Sand	Shallow Sand	Chicot	Terrace/ Sand & Gravel	Post-Graham Ferry
Upland allogroup				Evangeline	Evangeline	Evangeline			1,200-Foot Sand	400-foot Sand	Upland Terrace	Upper Ponchatoula			Citronelle
Blounts Creek			Evangeline					1,000-Foot Sand 1,200-Foot Sand		600-Foot Sand 800-Foot Sand 1,000-Foot Sand 1,200-Foot Sand	Upper Ponchatoula Lower Ponchatoula	Lower Ponchatoula Big Branch	Evangeline		Upper Graham Ferry Lower Graham Ferry
Castor Creek	Not Present	Not Present						1,500-Foot Sand		1,500-Foot Sand	Kentwood	Abita		Not Present	Upper Pascagoula
Williamson Creek								1,700-Foot Sand		1,700-Foot Sand	Slidell	Covington Slidell			Lower Pascagoula
Dough Hills			Jasper	Jasper	Jasper			2,000-Foot Sand		2,000-Foot Sand	Hammond	Tchefuncte/ Hammond	Jasper		
Carnahan Bayou								2,400-Foot Sand		2,400-Foot Sand	Amite	Amite			Upper Hattiesburg
Lena										2,800-Foot Sand	Ramsay	Ramsay			Lower Hattiesburg
Anahuac															Upper Catahoula
Frio	Catahoula	Catahoula	Catahoula	Catahoula							Catahoula	Franklinton	Catahoula		Lower Catahoula
Vicksburg Group															
Jackson Group								No Freshwater							
Cockfield	Cockfield	Cockfield	Cockfield										Yegua	Cockfield	Cockfield
Cook Mountain															
Sparta	Sparta	Sparta	Sparta										Sparta	Sparta	Sparta
Cane River													Queen City		
Carrizo														Carrizo	Meridian
Wilcox Group	Carrizo-Wilcox												Carrizo-Wilcox	Wilcox	Wilcox
Midway.															

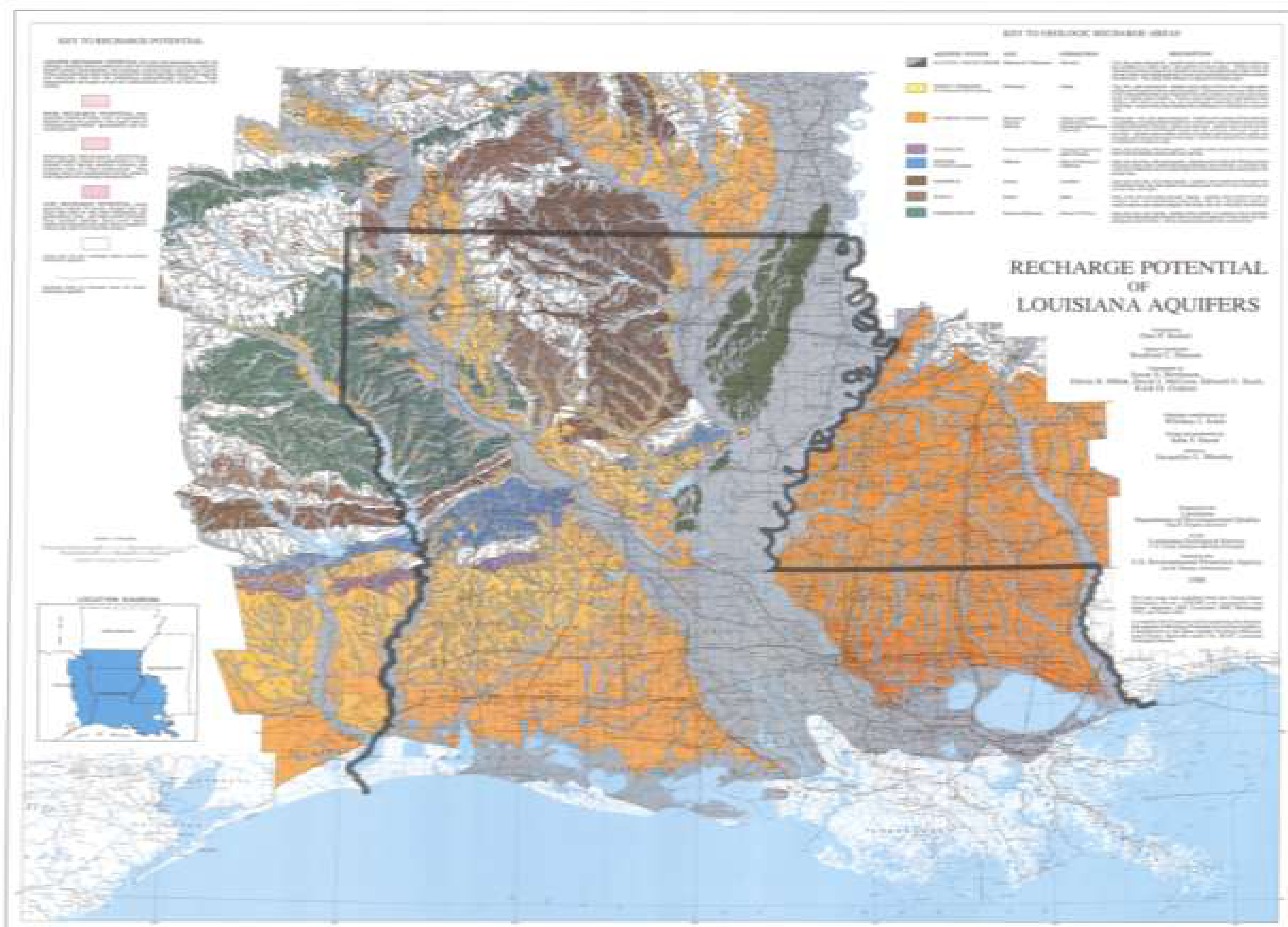


Figure 2-4 Recharge Potential Map (from Boniol and Hanson, 1988)

2.4.1 Dominant Aquifers Characteristics and Water Quality Summary

This section provides a brief discussion of the hydrogeological and water quality (summarized from the ASSET data) characteristics of the state's dominant aquifers. Additional information on these and other aquifers is presented in the LGS Report in Appendix B. The information below is synthesized from LDEQ, 2009.

2.4.1.1 Sparta Aquifer System

Analytical and field data contained in this summary were collected from wells producing from the Sparta aquifer during Louisiana Fiscal Year (FY) 2007 (July 1, 2006 - June 30, 2007).

The Sparta aquifer system is within the Eocene Sparta formation of the Claiborne group. The aquifer units consist of fine to medium sand with interbedded coarse sand, silty clay, and lignite. Interconnected sands become more massive and coarsen slightly with depth and are laterally discontinuous. The Sparta aquifer is confined downdip by the clays of the overlying Cook Mountain formation and the clays and silty clays of the Cane River formation.

The Sparta aquifer is recharged through direct infiltration of rainfall, the movement of water through overlying terrace and alluvial deposits, and leakage from the Cockfield and Carrizo-Wilcox aquifers. The Sparta aquifer is pumped in a large area of north-central Louisiana and in a narrow band through Natchitoches and Sabine Parishes.

Water quality data show that the groundwater produced from this aquifer is soft and is of good quality when considering short-term or long-term health risk guidelines. None of the ASSET Sparta wells sampled during FY2007 had exceedances for primary maximum contaminant levels (MCL). The data also show that this aquifer is of fair quality when considering taste, odor, or appearance guidelines, with 20 secondary MCLs exceeded in 10 wells.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Sparta Aquifer, with nine parameters showing consistent increases in concentration, seven parameters decreasing in concentration, and one parameter showing no consistent change over the previous 12 years.

2.4.1.2 Carrizo-Wilcox Aquifer

Analytical and field data contained in this summary were collected from wells producing from the Carrizo-Wilcox aquifer during Louisiana FY2007 (July 1, 2006 - June 30, 2007).

The Carrizo-Wilcox aquifer system consists of the Carrizo Sand of the Eocene Claiborne group and the undifferentiated Wilcox group of Eocene and Paleocene age. The Wilcox deposits, outcropping in northwestern Louisiana, are the oldest deposits in the state containing fresh water. The Carrizo is discontinuous and consists of well-sorted, fine to medium grained, cross-bedded sands, with some silt and lignite. Well yields are restricted because the sand beds are typically thin, lenticular, and fine textured. The system is confined downdip by the clays and silty clays of the overlying Cane River formation and the regionally confining clays of the underlying Midway group.

Primary recharge of the Carrizo-Wilcox aquifer occurs from direct infiltration of rainfall in interstream, upland outcrop-subcrop areas. Water also moves between overlying alluvial and terrace aquifers, the Sparta Aquifer, and the Carrizo-Wilcox Aquifer, according to hydraulic head differences. Water level fluctuations are mostly seasonal, and the hydraulic conductivity varies between 2 and 40 feet/day.

The maximum depths of occurrence of freshwater in the Carrizo-Wilcox Aquifer range from 200 feet above sea level to 1,100 feet below sea level. The range of thickness of the fresh water interval in the Carrizo-Wilcox aquifer is 50 to 850 feet. The depths of the Carrizo-Wilcox aquifer wells that were monitored in conjunction with the ASSET Program range from 105 to 410 feet below land surface.

Water quality data show that groundwater produced from this aquifer is soft and of good quality when considering short-term or long-term health risk guidelines. None of the ASSET Carrizo-Wilcox wells sampled during the FY2007 had exceedances for primary MCLs. Data also show that this aquifer is of fairly good quality when considering taste, odor, or appearance guidelines, with 13 secondary MCLs exceeded in nine wells, and one well reporting a very low concentration of the volatile organic compound chloroform. Chloroform, which has no established MCL, was reported at 3.4 µg/L in Caddo Parish industrial well CD-642.

Comparison to historical ASSET-derived data show some change in the quality or characteristics of the Carrizo-Wilcox aquifer, with eight parameters showing consistent increases in average concentration, five parameters decreasing in average concentration, and four parameters showing no consistent change over the previous 12 years.

2.4.1.3 Red River Alluvial Aquifer

Analytical and field data contained in this summary were collected from wells producing from the Red River Alluvial aquifer during Louisiana FY2007 (July 1, 2006 - June 30, 2007).

The Red River alluvium consists of upward sequences of gravel, sand, silt, and clay. The aquifer is poorly to moderately well-sorted, with fine-grained to medium-grained sand near the top, grading to coarse sand and gravel in the lower portions. It is confined by layers of silt and clay of varying thicknesses and extent.

The Red River Alluvial Aquifer is hydraulically connected with the Red River and its major streams. Recharge is accomplished by direct infiltration of rainfall in the river valley, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding. The amount of recharge from rainfall depends on the thickness and permeability of the silt and clay layers overlying it. Water levels fluctuate seasonally in response to precipitation trends and river stages. Water levels are generally within 30 to 40 feet of the land surface and movement is down gradient and toward rivers and streams. Natural discharge occurs by seepage of water into the Red River and its streams, but some water moves into the aquifer when stream stages are above aquifer water levels. The hydraulic conductivity varies between 10 and 530 feet/day.

The maximum depths of occurrence of freshwater in the Red River Alluvial range from 20 feet above sea level to 160 feet below sea level. The range of thickness of the fresh water interval in the Red River Alluvial is 50 to 200 feet. The depths of the Red River Alluvial wells that were monitored in conjunction with the ASSET Program range from 58 to 89 feet.

The water quality data show that the groundwater produced from this aquifer is very hard, but is of good quality when considering short-term or long-term health risk guidelines. None of the ASSET wells sampled in FY2007 had an exceedance for primary MCLs. Data also show that this aquifer is of fair to poor quality when considering taste, odor, or appearance guidelines, with at least one secondary MCL being exceeded in each of the wells monitored.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Red River Alluvial Aquifer, with two parameters showing consistent increases in concentration and nine parameters decreasing in concentration.

2.4.1.4 Evangeline Aquifer

Analytical and field data contained in this summary were collected from wells producing from the Evangeline aquifer during Louisiana FY2007 (July 1, 2006 - June 30, 2007).

The Evangeline aquifer is comprised of unnamed Pliocene sands and the Pliocene-Miocene Blounts Creek member of the Fleming formation. The Blounts Creek consists of sands, silts, and silty clays, with some gravel and lignite. The sands of the aquifer are moderately well to well sorted and fine to medium grained with interbedded coarse sand, silt, and clay. The mapped outcrop corresponds to the outcrop of the Blounts Creek member, but downdip, the aquifer thickens and includes Pliocene sand beds that do not outcrop. The confining clays of the Castor Creek member (Burkeville aquiclude) retard the movement of water between the Evangeline and the underlying Miocene aquifer systems. The Evangeline aquifer is separated in most areas from the overlying Chicot aquifer by clay beds; in some areas the clays are missing and the upper sands of the Evangeline aquifer are in direct contact with the lower sands and gravels of the Chicot.

Recharge to the Evangeline aquifer occurs by the direct infiltration of rainfall in interstream, upland outcrop areas and the movement of water through overlying terrace deposits, as well as leakage from other aquifers. Fresh water in the Evangeline aquifer is separated from water in stratigraphically equivalent deposits in southeast Louisiana by a saltwater ridge in the Mississippi River valley. The hydraulic conductivity of the Evangeline aquifer varies between 20 and 100 feet/day. The maximum depths of occurrence of freshwater in the Evangeline range from 150 feet above sea level to 2,250 feet below sea level. The range of thickness of the fresh water interval in the Evangeline is 50 to 1,900 feet. The depths of the Evangeline aquifer wells that were monitored range from 170 to 1,715 feet.

The water quality data show that groundwater produced from this aquifer is generally soft and of good quality when considering short-term or long-term health risk guidelines. None of the ASSET wells sampled had an exceedance for primary MCLs. Data also show that this aquifer is of good quality when considering taste, odor, or appearance guidelines. A comparison to historical ASSET data show that six analytes have increased in their average concentrations, eight have decreased, and two have remained constant or below its detection limit.

2.4.1.5 Catahoula Aquifer

Analytical and field data contained in this summary were collected from wells producing from the Catahoula Aquifer during Louisiana FY2007 (July 1, 2006 - June 30, 2007).

The Catahoula Formation consists primarily of sands with some silty to sandy clays and overlies the regional confining clays of the Vicksburg and Jackson groups. Within the Catahoula Aquifer, fine to coarse sands are discontinuous and inter-bedded with silt and clay.

Recharge takes place primarily as a result of the direct infiltration of rainfall in interstream, upland outcrop area, movement of water through overlying terrace deposits, and leakage from other aquifers. Saltwater ridges under the Red River and Little River valleys in central Louisiana divide the Catahoula aquifer. The hydraulic conductivity of the Catahoula aquifer varies between 20 and 260 feet/day.

The maximum depths of occurrence of freshwater in the Catahoula aquifer range from 250 feet above sea level to 2,200 feet below sea level. The range of thickness of the fresh water interval in the Catahoula aquifer is 50 to 450 feet. The depths of the Catahoula aquifer wells that were monitored in conjunction with the ASSET Program range from 208 to 852 feet.

The water quality data show that groundwater produced from this aquifer is soft and of good quality when considering short-term or long-term health risk guidelines. None of the ASSET wells sampled during FY2007 had an exceedance for primary MCLs. Data also show that this aquifer is of good quality when considering taste, odor, or appearance guidelines, with only one secondary MCL exceeded in one well.

Comparison to historical ASSET-derived data show some change in the quality or characteristics of the Catahoula aquifer, with nine parameters showing consistent increases in average concentration (four with only slight increases), four parameters decreasing in average concentration, one parameter showing no consistent change, and one parameter remaining below its detection limit over the previous 12 years.

2.4.1.6 Mississippi River Alluvial Aquifer

These data show that from July to September 2007 and in January 2008, 23 wells were sampled that produce from the Mississippi River Alluvial aquifer.

Mississippi River alluvium consists of fining upward sequences of gravel, sand, silt, and clay. The aquifer is poorly to moderately well sorted, with fine-grained to medium-grained sand near the top, grading to coarse sand and gravel in the lower portions. It is confined by layers of silt and clay of varying thicknesses and extent. The Mississippi River Alluvial aquifer consists of two distinct components; valley trains and meander-belt deposits that are closely related hydrologically.

The Mississippi River Alluvial aquifer is hydraulically connected with the Mississippi River and its major streams. Recharge is accomplished by direct infiltration of rainfall in the river valley, lateral and upward movement of water from adjacent and underlying aquifers, and overbank stream flooding. The amount of recharge from rainfall depends on the thickness and permeability of the silt and clay layers overlying it. Water levels fluctuate seasonally in response to precipitation trends and river stages. Water levels are generally within 30 to 40 feet of the land surface, and movement is down-gradient and toward rivers and streams. Natural discharge occurs by seepage of water into the Mississippi River and its streams, but some water moves into the aquifer when stream stages are above aquifer water levels. The hydraulic conductivity varies between 10 and 530 feet/day.

The maximum depths of occurrence of freshwater in the Mississippi River Alluvial range from 20 feet below sea level to 500 feet below sea level. The range of thickness of the fresh water interval in the Mississippi River Alluvial is 50 to 500 feet. The depths of the Mississippi River Alluvial aquifer wells that were monitored in conjunction with ASSET program range from 30 to 352 feet below land surface.

The water quality data show that groundwater produced from the Mississippi River Alluvial Aquifer is very hard. The primary MCL for arsenic was the only short-term or long-term health risk guideline that was exceeded; however, this exceedance occurred in six of the 23 wells sampled in this aquifer. The data also show that this aquifer is of poor quality when considering taste, odor, or appearance guidelines, with 33 secondary MCLs exceeded in 19 wells.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Mississippi River Alluvial aquifer, with seven parameters showing consistent increases in concentration and 10 parameters decreasing in concentration. This comparison also shows a smaller total number of secondary standards exceeded for this reporting period, with 33 secondary MCLs exceeded, whereas there were 55 secondary MCLs exceeded in the previous sampling in FY2005.

The occurrence of arsenic in the Mississippi River Alluvial aquifer has been established by historical activities of this program, with current sampling results supporting those previous findings. Sampling results, for the FY2008 reporting period, show that a total of 10 wells reported detections of arsenic, while six of those 10 exceeded the 0.010 milligram per liter (mg/L) MCL for arsenic.

As a standard procedure of the ASSET Program, all well owners receive the results of their well sampling, while those well owners with primary MCL exceedances are given additional information about the particular compound, its health effects, and possible treatment methods.

2.4.1.7 Cockfield Aquifer

Analytical and field data contained in this summary were collected from wells producing from the Cockfield aquifer during Louisiana FY2008 (July 1, 2007 - June 30, 2008).

The Cockfield aquifer is within the Eocene Cockfield formation of the Claiborne Group, which consists of sands, silts, clays, and some lignite. The aquifer units consist of fine sand with interbedded silt, clay, and lignite, becoming more massive and containing less silt and clay with depth. Beneath the Ouachita River, the Cockfield Aquifer has been eroded by the ancestral Ouachita River and replaced by alluvial sands and gravels. The regional confining clays of the overlying Vicksburg and Jackson Groups confine the Cockfield.

In the Mississippi River valley, the Cockfield is overlain by and hydraulically connected to the alluvial aquifers. Recharge to the Cockfield aquifer occurs primarily by the direct infiltration of rainfall in interstream, upland outcrop-subcrop areas, the movement of water through the alluvial and terrace deposits, and vertical leakage from the underlying Sparta aquifer. The Cockfield aquifer contains fresh water in north-central and northeast Louisiana in a narrowing diagonal band extending toward Sabine Parish. Saltwater ridges under the Red River valley and the eastern Ouachita River valley divide areas containing fresh water in the Cockfield aquifer. The hydraulic conductivity varies between 25 and 100 feet/day.

The maximum depths of occurrence of freshwater in the Cockfield range from 200 feet above sea level to 2,150 feet below sea level. The range of thickness of the fresh water interval in the Cockfield is 50 to 600 feet. The depths of the Cockfield wells that were monitored in conjunction with the ASSET Program range from 70 to 445 feet.

In summary, data show that groundwater produced from this aquifer is moderately hard and that one MCL was exceeded for the volatile organic compound methylene chloride. Data also show that this aquifer is of fair quality when considering taste, odor, or appearance guidelines, with 22 secondary MCLs exceeded in 12 of the 14 wells sampled.

Comparison to historical ASSET-derived data shows some change in the quality or characteristics of the Cockfield aquifer, with eight parameters showing consistent increases in concentration, seven parameters decreasing in concentration, while two parameters showed no consistent change over the 12-year period.

2.5 Surface Water Resources Summary

There are 10 watersheds in the State of Louisiana (see Figure 2-5), including the Atchafalaya /Teche/Vermilion Rivers, Calcasieu/Mermentau Rivers, Lake Pontchartrain/Lake Maurepas, Mississippi River, Mississippi River Delta, Ouachita River, Pearl River, Red River, Sabine River, and Tensas River.

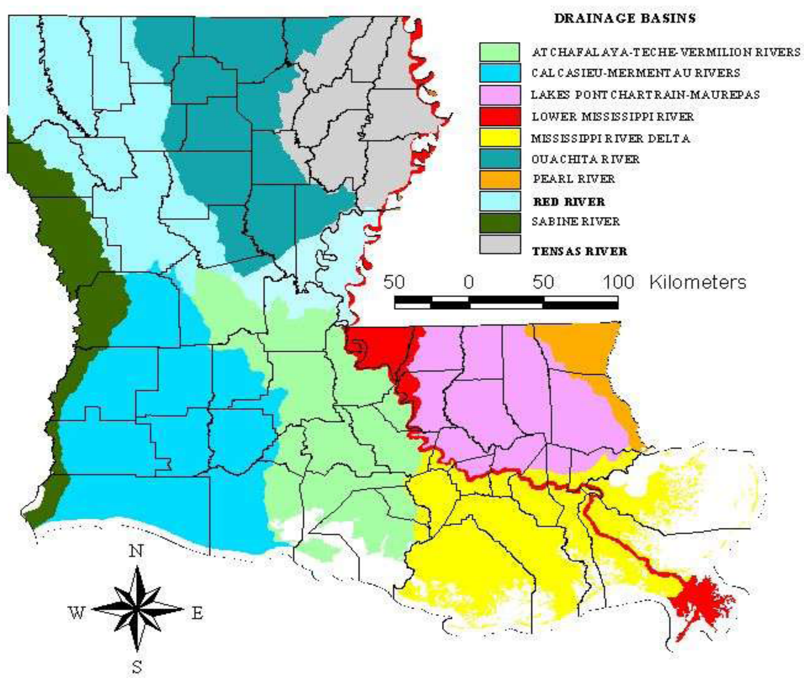


Figure 2-5 Principal Drainage Basins of Louisiana (LGS, 2010)

With the exception of West Feliciana Parish, the Lower Mississippi River in Louisiana is confined by levees and has a very small basin area. With the exception of the Red River and smaller bayous in West Feliciana and northwestern East Baton Rouge Parishes, no other Louisiana tributaries flow into the Mississippi River.

3 Groundwater Resource Use

An analysis was conducted using surface and groundwater consumption data from 1960 to 2005 for the diverse water users in the state. In addition, a summary discussion of aquifer versus user type, as well as a summary of identified aquifer impacts is presented for the 12 dominant aquifers. Note that more detail discussion of the nature of these impacts and their potential mitigation action are discussed elsewhere in the report. The usage data for these areas, and others, were compared to usage estimates projected by other available databases for additional water demand corrections.

E & E reviewed available data, including but not limited to:

- USEPA SDWIS;
- U.S. Census Bureau population estimates and projections;
- USDA Farm and Ranch Irrigation Survey;
- USDA Census of Agriculture;
- USDA NASS crop and livestock estimates;
- USDOE EIA facility reports;
- USGS National Water Use Database (NWUDB);
- USACE surface water data;
- USGS National Wetland Research Center (NWRC) water quality, vegetation, and habitat data;
- LDNR Groundwater Resources Program (GWRP);
- LDEQ groundwater monitoring programs;
- Louisiana DHH select groundwater well data and drinking water monitoring programs; and
- Various regional surface and groundwater conservation data sources.

For consistency with the 2002 ADSWMP report, water use will be discussed using the three regions (Region I-North Louisiana, Region II-Southwest Louisiana, and Region III-Southeast Louisiana) established in that report (see Figure 2-1). Also, for sake of clarity and brevity, all the data tables compiled and used in this section are provided in Appendix C.

3.1 Water Usage

As indicated in the Chapter 2, the LGS conducted a review of surface and groundwater resource data for this plan, as detailed in their report in Appendix B. As summarized in their report:

> *Statewide surface and groundwater usage data has been collected in Louisiana since 1960 by the USGS, in collaboration with state agencies and water user/providers. In addition, several major metropolitan water systems have maintained records of this type of information for longer periods of time.*
>
> *The most detailed water usage information for any given area of Louisiana has been collected by the Capital Area Groundwater Conservation Commission since 1975. In 1960, an estimated 1,030 million gallons per day (MGD) of groundwater, and 4,387 MGD of surface water was consumed in Louisiana for domestic, public, agricultural, industrial and other uses. The most recent estimate (2005) shows that 1,600 MGD of groundwater and 8,700 MGD of surface water were consumed. This represents a 55% and 98% increase, respectively.*

The USGS is in the process of compiling data for the 2010 water-use report, but the full data set will not be available until 2012.

3.1.1 Water Use Data

Water use information is derived from a wide variety of sources, including direct pumpage data, census data estimates, irrigation application per acreage, etc. As noted in the LGS report:

> *Use of groundwater in northern parishes of Louisiana has been determined by parish, category of use and aquifer in a series of ten reports by the US Geological Survey. These reports summarize groundwater use every five years 1960 to 2005.*
>
> *Water use data for public-supply, industrial and power-generation categories was obtained directly from the facilities. The rural-domestic use was determined by multiplying population as determined from census data by an estimate of 80 gallons per person per day of use (Sargent 2007). For irrigation use data was a combination of acreage data and application rate data. Application rate data was collected from US consolidated farm service agency collected from farmers during the spring, which is when most of the application of water occurs. Acreage data is determined from irrigation survey within the national agricultural statistics service reports (Sargent 2007). Determination of aquaculture use was determined from application rate and acreage data determined by the Louisiana Cooperative Extension Service (Sargent 2007). Live-*

stock use was determined from livestock population and rate of use data provide by county agents (Cardwell and Walter 1979).

For 2005, directly reported water use data was obtained for 87% (Power Generation, Industrial, and Public Supply) of surface water use, which accounted for 85% of total water use. For groundwater, directly reported water use data was available for only about 40% of total water use.

3.2 Total Water Use by Region

Total surface and groundwater use in Louisiana increased from 5,400 MGD in 1960 to a peak value of 12,500 MGD in 1980, but decreased by 3,000 MGD by 1990. The USGS is in the process of compiling data for 2005 to 2010, thus only the USGS aggregate data for groundwater aquifers are. Because there is no current reliable data, the 2005 to 2010 period is not included in this discussion.

Water use in the three regions of Louisiana generally follow the total water use trend, except for Region I where a decrease in water use between 1965 and 1970 was documented before reaching its peak value like Regions II and III in 1980. Water use in the state has increased moderately in the 1990s reaching a total of 10,400 MGD by the year 2000. The 2005 LDOTD report showed very little change in the overall water use in the state since 2000.

Region III accounted for most of the pumpage, ranging from 40% in 1960 to 75% in 2005, predominantly because the majority of Louisiana's population and industry are concentrated near the cities of New Orleans and Baton Rouge. Region II accounted for 30 to 40% of the total pumpage and Region I accounted for 5 to 20% of the total pumpage for the 45 year period.

Average water use over this 45 year time period has been 870 MGD for Region I; 2,360 MGD for Region II; 6,325 MGD for Region III; and 9,555 MGD for the State. Based on preliminary USGS data, it appears water use in both Regions I and II are currently below their average, while Region III is using water at a rate above its historical average.

3.3 Total Water Use by User

Water use was analyzed by the following user groups:

- Aquaculture;
- General irrigation;
- Rice irrigation;
- Rural domestic;
- Public supply;
- Power generation;
- Livestock; and
- Industrial

The two primary total water user groups in Louisiana are power generation and industrial use, accounting for over 80% of total water use in the State in 2005. Power generation surpassed industry between 1970 and 1975 as the largest user of water. The rice irrigation and industry groups' water use peaked in 1980, rural domestic water use peaked in 1970, and the livestock water usage peaked in 1960. As expected, overall water use for public supply consumer has increased during each of the USGS/LDOTD water use surveys.

Surface water accounts for over 80% of the source of water for the eight primary user groups (Figure 3-1b). Over this time frame, total pumpage reached a peak of 12,444 MGD in 1980. Groundwater and surface water use decreased in the 1985 and 1990 reporting periods. However, since 1995, both surface and groundwater use show modest increases, returning to 1985 levels.

Of the total water use (10,298 MGD) in 2005, approximately 15% was pumped from groundwater and 85% was pumped from surface waters. When examined by source, for 2005 the primary groundwater users are:

- Rice irrigation (33%)
- Public supply (22%)
- Industry (17%)
- Aquaculture (13%)
- General irrigation (10%)

3.4 Surface Water Use

3.4.1 Surface Water Use by User Group

Power generation and industrial are the primary surface water users in Louisiana. Power generation surface water use peaked at 5,931 MGD in 1985 and industrial surface water use peaked at 3,658 MGD in 1970. The industrial user group surface water use declined by 45% (1,500MGD) between 1980 and 1985 reaching a low surface water use of 1,790 MGD. Since then, this user group has seen a steady increase in its surface water use.

The rice irrigation user group is the third largest user of surface water in the state peaking at 1,124 MGD in 1980 but this user group's water use declined 78% to 248 MGD by 1990. Since 1990, rice irrigation surface water use stabilized in the 250 to 280 MGD range, with the exception of a moderate decline in 2000 to 206 MGD (its lowest surface water use). The public supply user group surpassed the rice irrigation user group as the third largest user of surface water in 1990 peaking at 404 MGD in 2000.

Power generation and industrial user groups have accounted for 80 to 90% of the surface water use in the state since 1960. The rice irrigation user group was the primary user of the remaining 10 to 20% of surface water in the state between 1960 and 1985. Since 1985, the public supply and rice irrigation groups have used roughly half of the remaining 10% of surface water in the state.

3.4.2 Surface Water Use by Region

Surface water use in Louisiana peaked in 1980 at 10,664 MGD, which was reflective of surface water use in the three regions of Louisiana: Region I at 871 MGD, Region II at 2,108 MGD, and Region III at 7,684 MGD.

Between the 1980 and 1990 reporting periods, surface water use in the state decreased by 25% (roughly 2,600 MGD) with Region I water use decreasing by 66% (577 MGD), Region II water use decreasing by 40% (833 MGD), and Region III water use decreasing by 16% (1,241 MGD).

Surface water increased in the 1990 reporting period in Regions I and III. The 2005 study indicates that surface water use in Region III has continued to increase since 1990 to its highest levels since its peak in 1980. Region II surface water use has generally decreased since 1980 and is at its lowest rate of water use since 1960.

Region III has continued to pump the largest percentage of surface water in the state followed by Regions I and II. Region III percentage of total surface water use has increased from roughly 50% in 1960 to generally 80% in 1985 to 2005 reporting periods. Since 1985, the distribution of surface water use has remained fairly constant between Regions I, II, and III.

3.4.2.1 Surface Water Use – Region I

All user groups except for the rural domestic user group (supplied by groundwater) in Region I rely on surface water. Surface water use in Region I has been concentrated in the power generation user group since it was reported separately from the industrial user group in 1965. Power generation peaked at 648 MGD in 1980. Even with the power generation group being removed from the industrial user group, the industrial user group is the second largest user of surface water in this region.

Industrial surface water use (after power generation being removed) peaked at 116 MGD in 1965 and shows a stable water use since 1970. Public supply has been the third largest user group for surface water in Region I being over taken by the rice irrigation user group briefly during the 1980s. Rice irrigation peaked at 97 MGD in 1980 and public supply, which remained relatively stable between 1980 and 1995, has increased moderately in 2000 and reached a water use of 84 MGD at the time of the 2005 LDOTD/USGS report.

In summary, the industrial and power generation user group accounted for roughly 95% of surface water use in Region I in 1960. Power generation has since been responsible for nearly 80% of the surface water use until this user group saw its surface water use decrease by 69% (260 MGD). At the same time rice irrigation surface water use decreased by 72% (60 MGD)

3.4.2.2 Surface Water Use – Region II

Surface water use in Region II has been concentrated into three main areas over the reporting periods of 1960 through 2005. These areas are rice irrigation, industrial, and power generation.

Rice irrigation dominated the supply from 1965 through 1985, peaking at 1061 MGD in 1975 followed by a decline to its lowest usage of 161 MGD in 2000. Power generation became the main surface water user in 1990 peaking at 715 MGD in 2000. Industrial use, once power generation is removed, peaked at 729 MGD in 1970 and then fell to a low of 194 MGD in 1995. This decline in industrial use has been fairly stable since 1975 after a sharp decline from 1970. Although aquaculture is not a dominant user of surface water, it has been a significant user since 1980.

Industrial, with the power generation user group included, accounted for roughly 65% of surface water use in Region II in 1960. Rice irrigation was responsible for approximately 50% of the surface water use from 1965 to 1985 until it was overtaken by power generation, which consumed nearly 50% from 1990 to 2005.

3.4.2.3 Surface Water Use – Region III

In Region III, power generation utilizes majority of surface water followed by industrial. In 1985, power generation use peaked at 5,282 MGD. The trend is similar for public supply, which peaked in 1980 at 2,904 MGD.

The second largest user, industrial, dominated from 1965 to 1970 with its peak occurring in 1980 at 2,904 MGD. The third highest user of surface water in Region III is public supply which rose at a stable rate after a sharp increase from 1970 to 1975 and peaked in 2000 at 311 MGD.

Since 1975, nearly 60% or more of surface water use in Region III has been used for power generation, whereas nearly 30 to 40% has gone to industrial use. Public supply remained at less than 10% of surface water use over the 45-year period from 1960 through 2005.

3.5 Groundwater Use

Groundwater use in Louisiana follows a similar trend as that of surface water with a peak use in 1980 of 1,780 MGD. However, unlike surface water use, only Region II reached its peak groundwater use in 1980 (1,084 MGD).

Region II accounts for nearly 60% of the groundwater pumpage in the state. Approximately 20% of the pumpage is contained in Regions I and III. Since 1980 Regions I and III roughly exhibit the same percentage of groundwater usage. But overall, the percentage of water use by Region I, II, and III has remained relatively stable since 1985.

The 2005 USGS/LDOTD study indicates Regions I and III have continued an increase in water use since the 1990 study, eclipsing their previous peak values in

2000 and establishing new peak water use values in 2005 at 400 MGD and 391 MGD, respectively. As of the 2005 study, Region I continues to be the primary user of groundwater. Region I passed Region III as the second largest user of groundwater in 1985 and again in 2000.

3.5.1 Groundwater Use by User Group

The rice irrigation group is the leading user of groundwater in the State reaching a peak of 907 MGD in 1980, before decreased by 56% (500 MGD) during the 1980s to a lower water use of 398 MGD in 1990. Since then, it has steadily increased in the 1990s.

The industrial and public supply groups represent the other large users of groundwater in the State. The industrial user groups' groundwater use peaked at 496 MGD in 1970 and this user group was overtaken as the second largest user group of surface water by the public supply user group in 2000. The public supply user groups' groundwater use peaked at 354 MGD in 2000 and has remained stable through 2005. The public supply user groups' groundwater use has increased moderately during each one of the LDOTD/USGS studies since 1960.

Over 65% of the groundwater pumpage from 1960 to 1985 was by the industrial and rice irrigation user groups with rice irrigation alone being responsible for 50% of the pumpage during that time period (Figure 3-20). Rice irrigation groundwater pumpage decreased to roughly 30% of the pumpage in 1990, whereas the public supply and aquaculture user groups' groundwater pumpage increased to 20% and 15% respectively.

Since 2000, general irrigation user group percentage of groundwater pumpage has been increasing. As of 2005, it is responsible for nearly 10% of the groundwater pumpage while rice irrigation water pumpage has declined.

3.5.2 Groundwater Use by Region

3.5.2.1 Groundwater - Region I

Groundwater use in this region is centered on rice irrigation; it surpassed industrial in 1975 as the leading user group in this region. Rice irrigation groundwater use peaked at 204 MGD in 1985 and then decreased to 60% of groundwater use (130 MGD). Since then, this user group has shown a moderate increase in groundwater use.

According to the 2005 LDOTD/USGS study, general irrigation has overtaken rice as the largest user group of groundwater in this region reaching a groundwater use of 149 MGD. The industrial group peak groundwater use occurred at 74 MGD in 1970 and was the leading user of groundwater in this region until 1975. It remained the second highest user group until 1980, when it was passed by the public supply user group. The public supply user group groundwater use peaked at 68 MGD in 2000, the same year it was overtaken by the general irrigation user group as the second leading user of groundwater in this region.

The industrial user group accounted for 40 to 50% of the groundwater use in Region I from 1960 to 1970, before decreasing 20% in 1975. About that time, rice irrigation groundwater use increased from 30% in 1970 to 50% in 1975, tripling its water use between 1970 and 1975. The rice irrigation group returned to a 30% allocation of the groundwater use in Region I in 1990. Since 2000, irrigation (general and rice) has accounted for nearly 70% of groundwater use in Region I.

3.5.2.2 Groundwater - Region II

Groundwater use in Region II is also centered on rice irrigation, which was the leading user group in this region from 1960 through 2005. Rice irrigation groundwater use peaked at 718 MGD in 1980, then dropped by 28% to 319 MGD in 1990. Since then, this user group has shown a moderate increase in groundwater use.

Industrial users were the second largest consumer of groundwater from 1960 to 1980 with a peak of 202 MGD in 1975 followed by a 57% drop to 87 MGD in 1985 when it was overtaken by public supply as the second largest consumer of groundwater. Public supply has steadily increased since 1980 to its peak in 2005 of 134 MGD. Aquaculture bypassed public supply in 1990 to become the second largest consumer of groundwater in that year only reaching its peak of 171 MGD.

The rice irrigation group accounted for 60 to 70% of the groundwater use in Region II from 1960 to 1985. Its allocation subsequently decreased to 40 to 50% of the groundwater use until 1995. Similarly, during this period, aquaculture groundwater use more than doubled from less than 10% in 1985 to more than 20% in 1990 and remained a significant user through 2005. Additionally, public supply increased by nearly 32% from 1975 to 1980 and continued a steady increase through 2005. The rice irrigation group again grew in dominance from 2000 to 2005 with a usage of 50 to 60%.

3.5.2.3 Groundwater - Region III

Groundwater use in this region is dominated by the industrial user group, which has been the leading user group in this region from 1960 through 2005. Industrial groundwater use peaked at 221 MGD in 1970 with a steep decline of 18% from 1980 to 1985 when it fell to 167 MGD. Since then, this user group has been fairly stable with only a slight decline in groundwater use from its peak.

Public supply use was the second largest consumer of groundwater from 1960 to 1980 with a steady increase to its peak of 146 MGD in 2005. It was overtaken by aquaculture as the second largest consumer of groundwater in Region III in 1990 only when aquaculture dramatically increased by 191% from 1985 and then drastically fell by 71% again in 1995. Except for the 1990 period, aquaculture groundwater consumption remained fairly stable since its introduction in 1980 until it fell to zero in 2005. Power generation is the fourth largest consumer of groundwater with rural domestic coming in fifth.

The industrial user group accounted for more than 40% of the groundwater use in Region III from 1960 to 2005, with the exception of 1990 when it was just under

40% due to the 191% increase in groundwater usage from aquaculture. Industrial use accounted for more than 60% from 1960 to 1975. Additionally, public supply increased by 9% from 1990 to 1995 and then by 25% from 1995 to 2000.

3.6 Population and Water Use

The population of Louisiana grew from 3.25 million in 1960 to an estimated 4.49 million in 2009. Most of the growth occurred between 1960 and 1980 where the population increased by more than 949,000 (29%). The growth rate decreased between 1980 and 2000 because emigration from the state resulting from the stagnant economic conditions during that time period, where the population increasing by just six percent.

Between July 1, 2005 and July 1, 2006, the population of Louisiana decreased by 252,382 people primarily due to effects of Hurricane Katrina and Rita. The 2009 population statistics indicate that Louisiana regained most of its lost population.

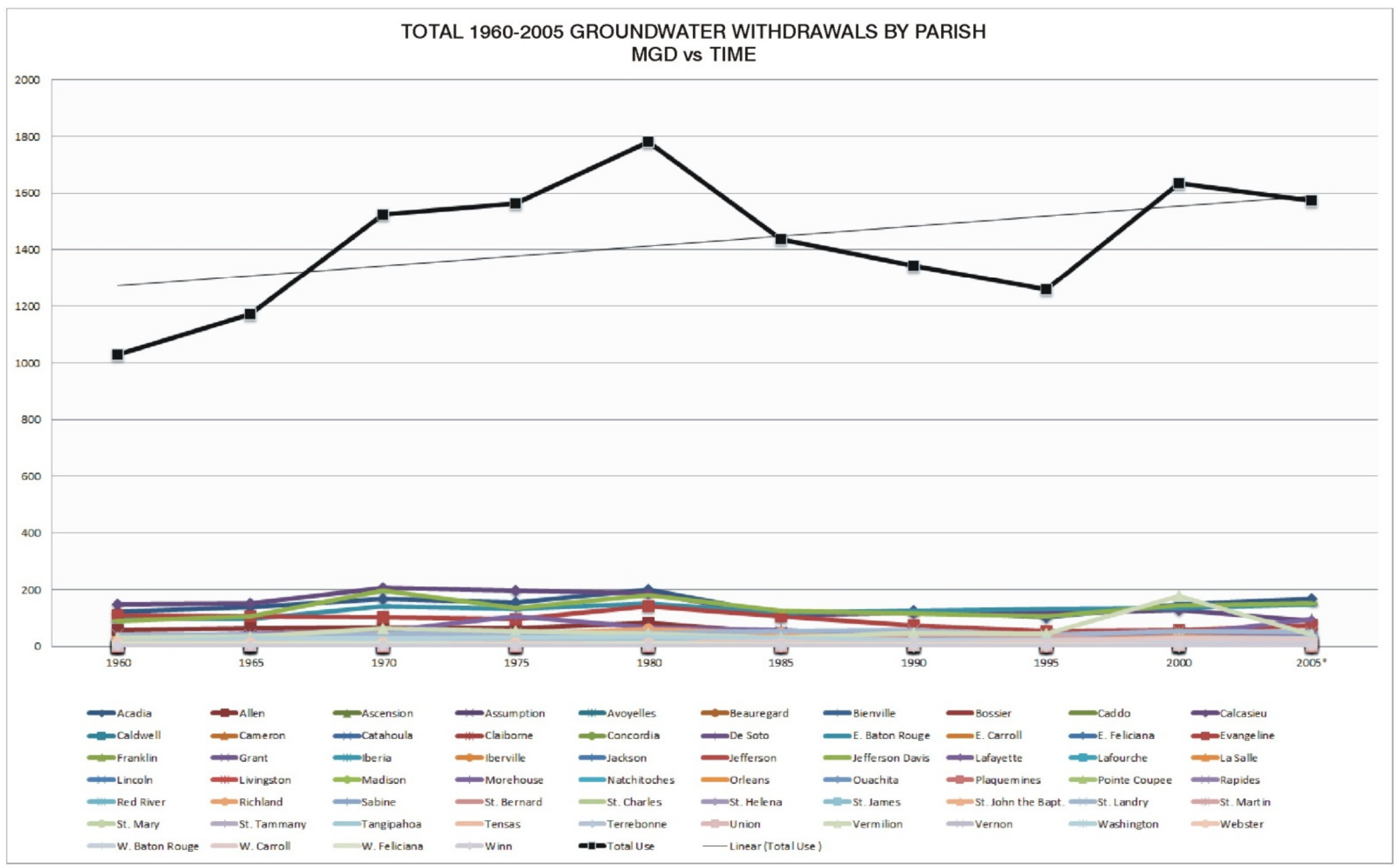
The majority of the State's population is concentrated in the Baton Rouge, Houma, and New Orleans Metropolitan Statistical Areas (MSAs) in Region III. Flooding in New Orleans due to Hurricane Katrina forced an estimated 246,640 residents to abandon their homes in Orleans Parish in Region III.

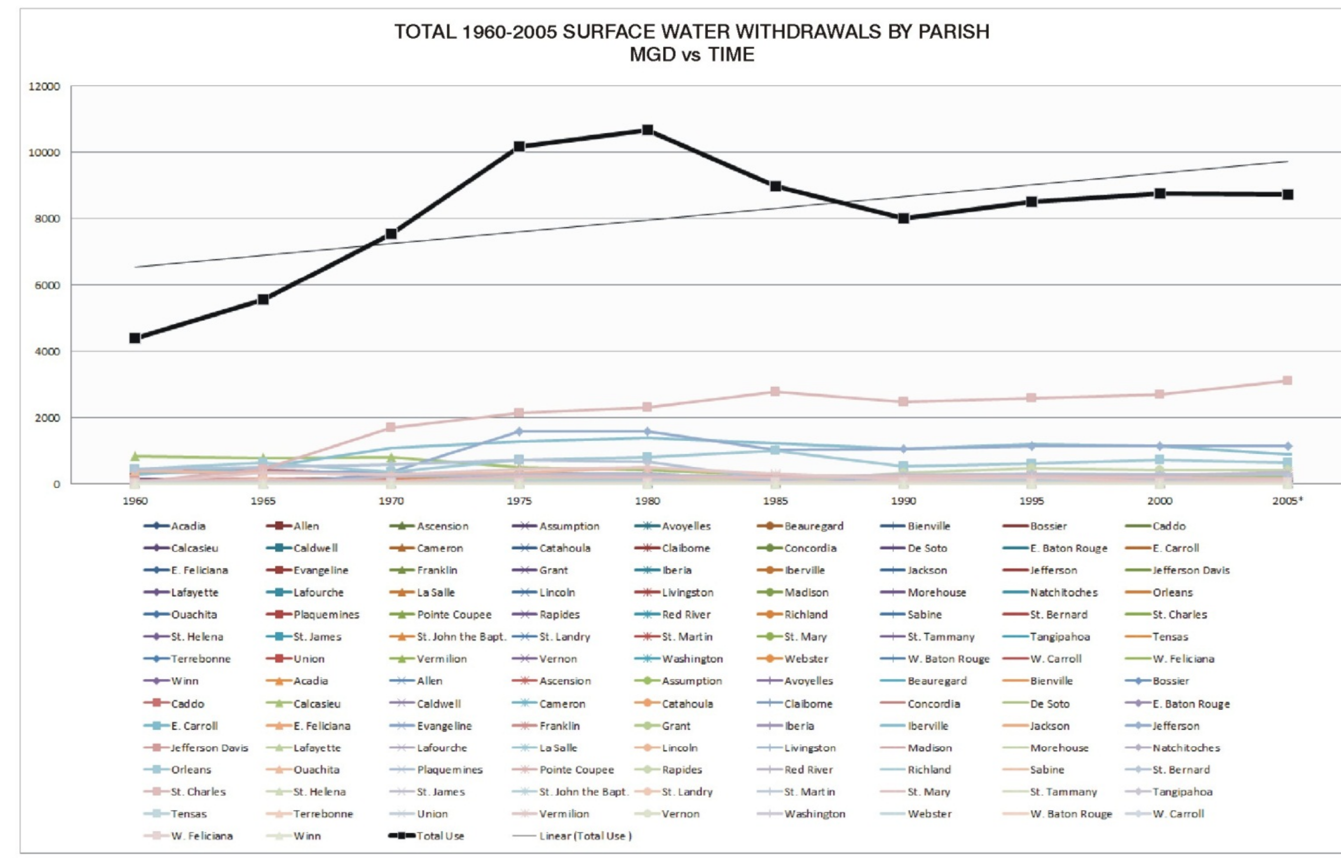
However, recent (2009) population estimates indicate Region III has shown the largest growth of the three regions and has gained 233,750 people and is now nearly equal to its population prior to Hurricane Katrina. Region I and Region II are only showing modest growth 0.5% and 3.3% respectively since 2000. However, it should be noted that there appears to be a permanent shift of approximately 200,000 from the New Orleans MSA to the Baton Rouge MSA.

The population of Louisiana is projected to grow from 4,369,760 in 2010 to 4,813,420 by 2030 at the end of the 20 year planning horizon for this project based on an analysis of parish growth trends conducted by the Louisiana Population Data Center (LPDC, http://www.lapop.lsu.edu).

As shown on Figure 3-1A and 3-1B, the 1960 to 2005 surface water and groundwater total withdrawals by parish reflect the population trends described above. A steep rise in withdrawals is evident for the 1960 to 1980 period with the subsequent decrease during the 1980 to 1995 period. Interestingly, there appears to be a steeper rise of groundwater withdrawals from 1995 to 2005 than surface water withdrawals during the same period. As shown in Figure 3-1B, this increase is reflected in all three regions, especially in Region I where the historical trend of surface water use versus groundwater use has been a steady inverse relation.

06:2783LD14A.CDR



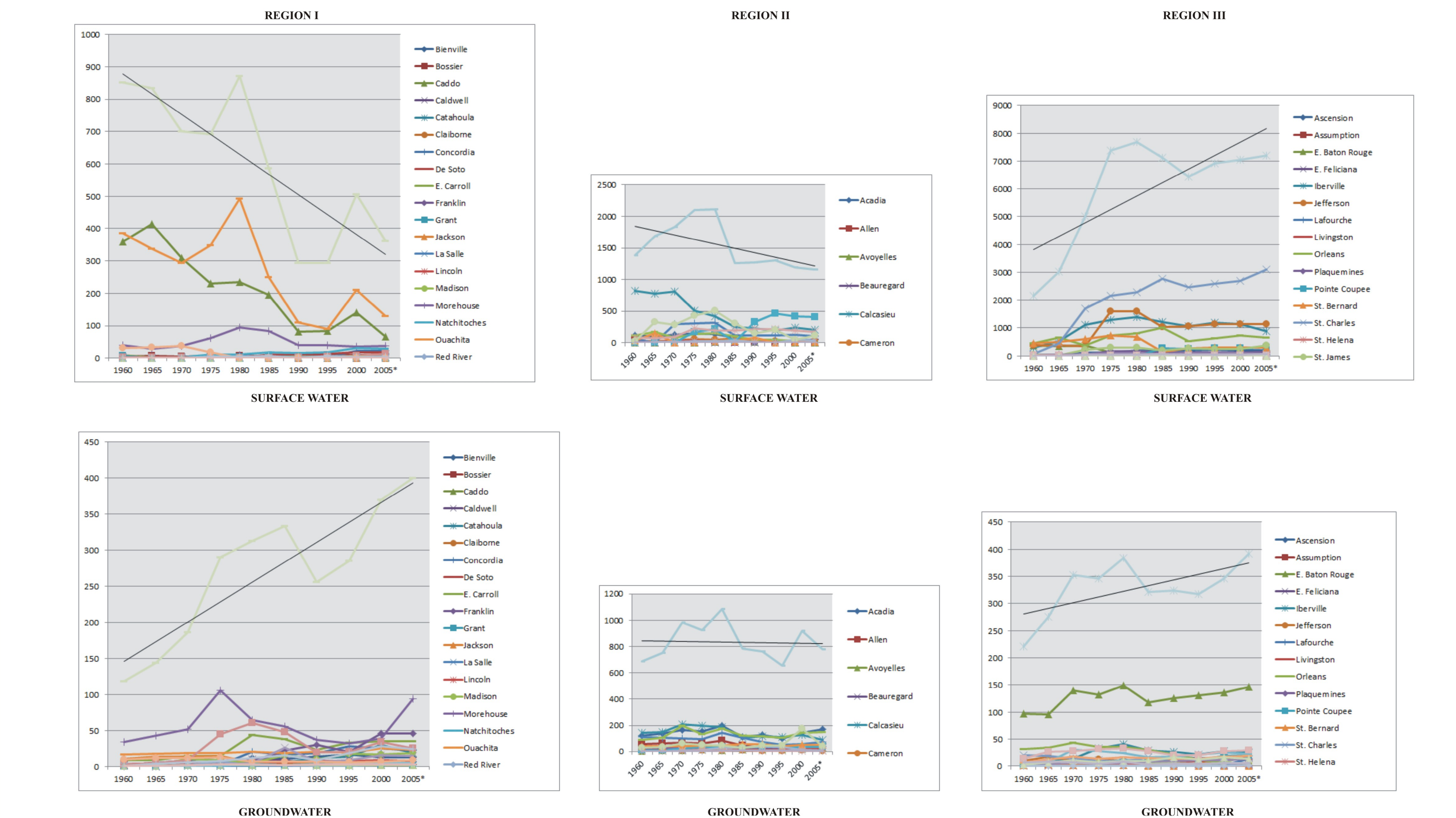


JOB No. 002783.LD14.01

SEPTEMBER 2011

Figure 3-1A Total Groundwater and Total Surface Water Use by Parish (E&E, this study)

06:2783LD14B.CDR



002783.LD14.01 SEPTEMBER 2011

Figure 3-1B Total Groundwater and Total Surface Water Use by Region (E&E, this study)

3.7 Unconventional Gas Development

The Haynesville Shale gas formation, located in East Texas, Southwestern Arkansas, and Western Louisiana, encompasses over 9,000 square miles and is considered to be the second largest natural gas shale formation in the United States (LDNR, 2011).

The Louisiana Department of Natural Resources estimates that there could be up to 251 trillion cubic feet of natural gas in the Haynesville Shale. The shale rock ranges in depth from 10,500 to 13,500 feet, about two miles below the surface, and is about 200 to 300 feet thick, and is underlain by sandstone of the Cotton Valley Group and overlain by limestone of the Smackover Group. The most active exploration and production areas have been Caddo, Bienville, Bossier, Desoto, Red River, and Webster Parishes.

Prior to 2008, the expense and inefficient technology limited the benefit of extracting methane from shale formations. However, due to rising fuel prices and innovative drilling techniques, the removal of natural gas from shale formations has become economically beneficial through extraction methods such as hydraulic fracturing and directional drilling.

Water is an essential component of shale natural gas development. Common extraction methods require water for drilling, where a mixture of clay and water is used to carry rock cuttings to the surface, as well as to cool and lubricate machinery. Water is also used in hydraulic fracturing, where a mixture of water and sand is injected into the deep shale at a high pressure to create small cracks in the rock, which allows gas flow.

Drilling a typical Haynesville deep shale gas well requires approximately 600,000 gallons of water, while hydraulically fracturing a typical Haynesville horizontal deep shale gas well requires an average of five million gallons of freshwater per Well. Initially, developers decided to use fresh water from the Carrizo-Wilcox aquifer, which was met with swift opposition and complaints by local residents, including complaints of local water level drawdowns in wells. Review of the aquifers resources quickly indicated the volume of fresh water was not sufficient to support hydraulic fracturing.

State oil and gas regulatory programs place great emphasis on groundwater conservation and protection. The Louisiana Department of Natural Resources' Office of Conservation is charged with conserving and regulating oil, gas, and lignite resources of the state. The primary responsibility of the Office of Conservation is to regulate the exploration and production of oil, gas, and other hydrocarbons and lignite; to control and allocate energy supplies and distribution; and to protect public safety and the environment from oilfield waste, including regulation of underground injection and disposal practices. Additionally, the Office of Conservation is responsible for monitoring the impacts that exploration and production of deep shale gas and oil formations have on groundwater resources.

The Office of Conservation requires notification to the commissioner of conservation prior to drilling or using water wells for any purposes other than drilling rig supply operations, including hydraulic fracturing of shale formations to retrieve natural gas for all issued oil and gas operators and water well owners throughout the state.

Similarly, the Office of Conservation is required to ensure that notifications for water wells used for this purpose are properly evaluated prior to well installation pursuant to Louisiana Revised Statute 38:3097.3. Upon receipt of the required water well notification, Office of Conservation staff reviews the submitted information to determine whether the proposed well location and use will pose any significant adverse impacts to the sustainability of an aquifer system or nearby water wells. Throughout this process, local, state, and federal agencies are notified and allowed to comment.

The Commissioner of Conservation provided additional clarification concerning notification requirements for all groundwater use at oil and gas exploration and production facilities throughout the state in the late summer of 2008. Additionally, the Commissioner further encouraged oil and gas operators to use available surface water resources or other acceptable alternative water sources in Northwest Louisiana whenever possible.

In 2011, State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER) published an evaluation the Office of Conservation program compared to the 2010 Hydraulic Fracturing Guidelines issued by the Interstate Oil and Gas Compact Commission (IOGCC). The in-depth review of the Louisiana hydraulic fracturing regulatory program indicates that the Office of Conservation program is, over all, well-managed, professional, and meeting its program objectives. The review team identified the following strengths of the program:

- The Office of Conservation issued Order No. U-HS effective August 1, 2009. The order establishes practices, safeguards, and regulations relating to the exploration and production of gas from the Haynesville Shale in urban areas.

- In addition to advising operators to use sources of water other than the Carrizo-Wilcox aquifer, in a separate letter to operators, the Commissioner instituted the requirement that the water source and associated volume must be reported on page two (2) of the Well History and Work Resume Report (Form WH-1), which must be filed within twenty days after completion or recompletion operations. The water sources must be identified by either the water well number or water body name, as appropriate. Separate water volumes for rig supply use and stimulation operation use must be provided.

- The use of alternate sources of water (such as using water from the Toledo Bend Reservoir) and recycling of waste fluids for hydraulic fracturing in the Haynesville Shale is encouraged. Regulatory changes have been adopted to further streamline permitting of commercial waste fluid treatment and reclamation operations for fracturing water supply purposes (LAC 43:XIX.565).

3.8 Summary Aquifer Use vs. Impacts Analysis

The following discussions, as well as the groundwater by user graphs presented in Figures 3-2Aa and 3-2B, provide a summary of the 1990 to 2005 consumption trends for the 11 dominant aquifers in the state of Louisiana. In addition, Table 3-1 provides a summary of the documented impacts to the aquifers discussed in this section. A more detail discussion of the nature of these impacts and their potential mitigation action are discussed in Chapters 5 and 6.

Carrizo-Wilcox aquifer: In 2005, the Carrizo-Wilcox aquifer was predominantly used for public supply with 42.7% of the total usage. The second highest draw on the aquifer came from rural domestic use at 26.2%, followed by industrial use at 13.00%. The remaining 18.00% of aquifer use that year was due to livestock, rice irrigation, general irrigation, and aquaculture, each responsible for less than 10% of the aquifer's total use that year.

Catahoula aquifer: In 2005, the large majority of the Catahoula Aquifer was used for public supply with 81.88% of the total usage. The second highest draw on the aquifer came from rural domestic use at 8.70%. The remaining 9.40% of aquifer use that year was due to industry, livestock, rice irrigation, and general irrigation, each responsible for less than 5% of the aquifer's total use that year.

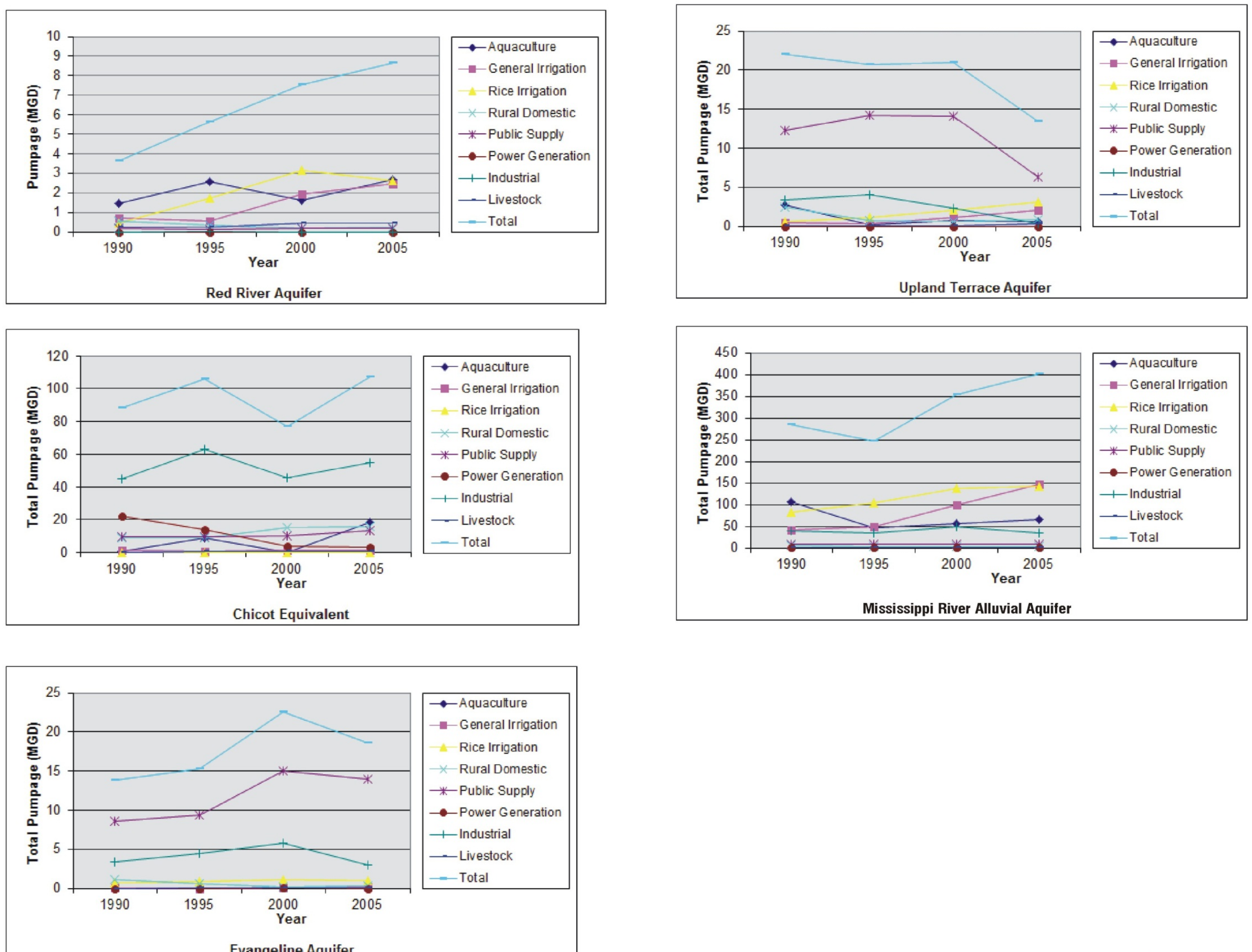
Cockfield aquifer: In 2005, the Cockfield Aquifer was predominantly used for public supply with 84.00% of the total usage. The second highest draw on the aquifer came from rural domestic use at 6.20%. The remaining 9.70% of aquifer use that year was due to livestock, rice irrigation, general irrigation, and aquaculture, each responsible for less than 5% of the aquifer's total use that year.

Chicot aquifer system: In 2005, the Chicot Aquifer System was predominantly used for rice irrigation with 57.00% of the total usage. The second largest consumer was aquaculture use at 17.10%, followed by public supply use at 14.13% and industrial use at 8.83%. The remaining 2.90% use came from rural domestic, power generation, general irrigation, and livestock use.

Evangeline aquifer: In 2005, public supply use was the main draw on the Evangeline Aquifer with 75.20% of the total usage. The second highest draw on the aquifer came from industry use at 16.10%. The remaining 8.7% of aquifer use that year was due to rice irrigation, rural domestic use, general irrigation, aquaculture, and livestock uses with rice irrigation leading the group at 5.10% use.

Jasper aquifer system: In 2005, public supply and industry uses were the predominant draws on the Jasper Aquifer with public supply with 64.70% of the total usage followed by industry with 31.40% use for a combined use of 96.18%. The largest majority of the remaining 3.80% of aquifer use that year came from rural domestic use at 2.10%.

06:2783LD14C.CDR

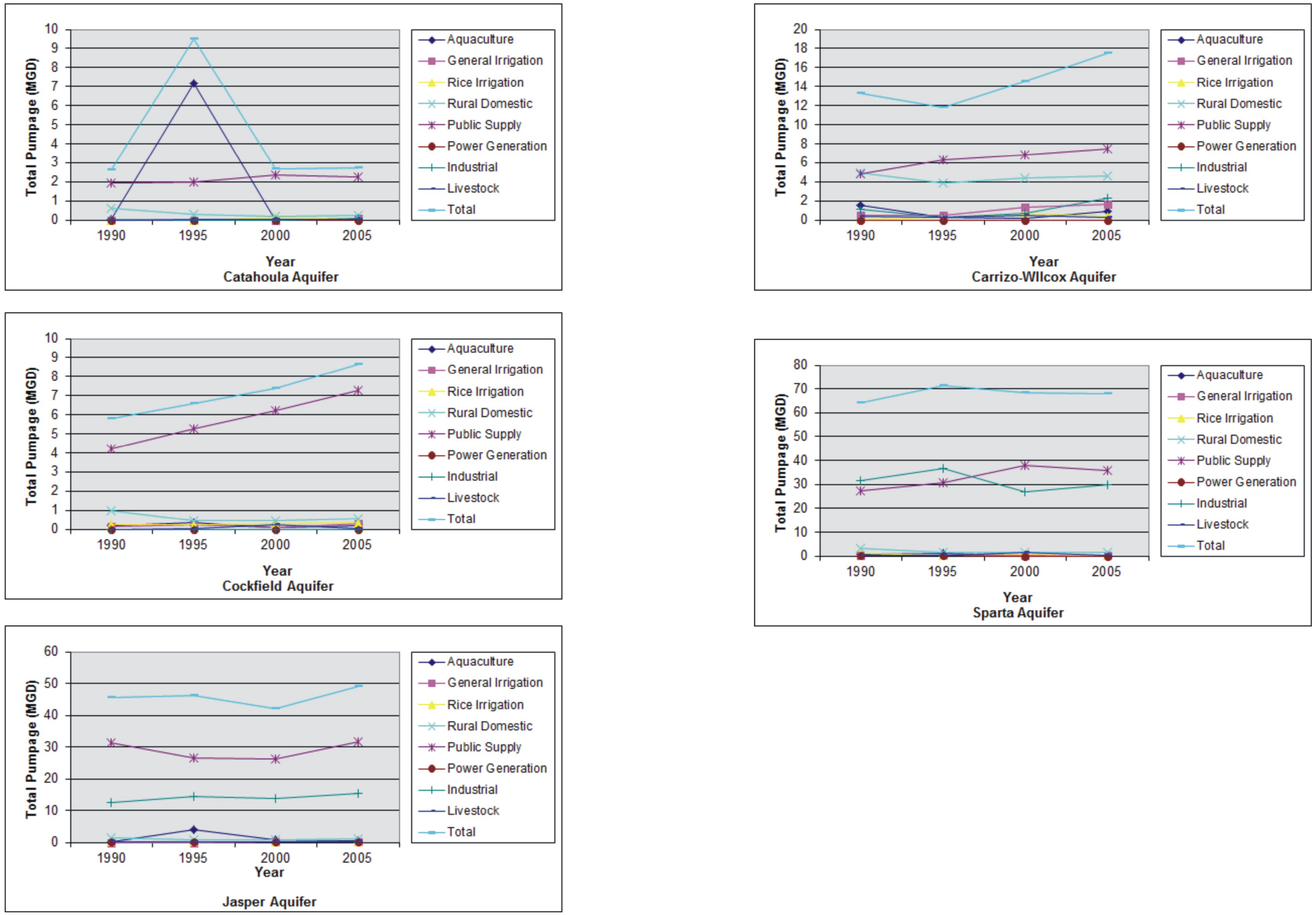


JOB No. 002783.LD14.01

SEPTEMBER 2011

Figure 3-2A Groundwater Use by Aquifer (E&E, this study)

06:2783LD14D.CDR



JOB No. 002783.LD14.01

SEPTEMBER 2011

Figure 3-2B Groundwater Use by Aquifer (E&E, this study)

Red River Alluvial aquifer: In 2005, the main draws on the Red River Alluvial Aquifer came from aquaculture, rice irrigation, and general irrigation with a combined use of 89.59%. Their individual uses were 30.80%, 30.60%, and 28.20%, respectively. Approximately half of the remaining 10.40% of aquifer use that year was due to livestock at 5.40%. Rural domestic and public supply use each drew less than 3% from the aquifer's total draw that year.

Sparta aquifer system: In 2005, the Sparta Aquifer System was predominantly used for public supply and industrial purpose with respective uses of 52.70% and 44.10%. The next highest draw on the aquifer came from rural domestic use at 2.10%. This was followed by livestock, rice irrigation, general irrigation, and aquaculture, each responsible for less than 1% of the aquifer's total use that year.

Southern Hills aquifer system: In 2005, the Southern Hills Aquifer was predominantly used for public supply and industry for a combined use of 83.70% with public supply use topping the consumption at 45.20% and industry coming in second at 38.40%. The next largest draws on the aquifer came from rural domestic use and aquaculture at 5.70% and 5.78%, respectively. The largest portion of the remaining 7.00% consumption was due to power generation at 4.00%.

Upland Terrace aquifer: In 2005, the Upland Terrace Aquifer was predominantly used for public supply with 47.10% of the total usage, followed by rice irrigation at 23.30% use. The next largest consumer of the aquifer was general irrigation use at 15.60%. The remaining draws on the aquifer that year were due to rural domestic, aquaculture, industrial, and livestock uses, with respective allocations of 6.80%, 4.20%, 2.67%, and 1.0%

Table 3-1 Summary of The Aquifer Impacts

Aquifers	Region	Location	Impacts
Mississippi River Alluvial aquifer (North)	**I**	Aquifer wide	Water quality (TDS, metals)
		Franklin Parish, SE Ouachita Parish	Naturally-occurring chlorides
Mississippi River Alluvial aquifer (South)	**III**	Coastal Parishes	Saltwater intrusion from Gulf of Mexico and potential upward migration of saltwater
		Sporadic throughout	Occurrence of natural gas in shallow sands
		Aquifer wide	Agricultural applications(pesticides/herbicides, fertilizers) Water quality (TDS, metals) Naturally-occurring chlorides
Chicot aquifer system	**II**	Iowa, LA	Shallow saltwater, possibly from Iowa Salt Dome
Chicot Equivalent aquifer system	**II**	Lake Charles	200 ' and 500' sand have been impacted by water level decline from industrial activity/over pumping
		Lake Charles	200 ' and 500' sands exhibit the presence of natural gas
		Lake Charles	700' sand is being impacted by saltwater intrusion
		Opelousas	Possible saltwater intrusion from naturally-occurring chlorides, salt domes in the area (
		Coastal Zone	Saltwater intrusion from Gulf of Mexico, subsidence, and land loss
		Eastern edge of Chicot	Contact with Atchafalaya Aquifer provides potential increased TDS impact
Jasper aquifer system	**II**	Leesville	Water level decline
Jasper Equivalent aquifer system (Central Louisiana)	**II**	Alexandria	Water level decline
Cockfield aquifer	**I**	Southern Winn/Northern Grant Parishes	Water level decline
Sparta aquifer	**I**	Monroe	Water level decline and increased chlorides
		Ruston	Water level decline and increased chlorides
		Minden	Water level decline
		Jonesboro Hodge	Water level decline
		Winnfield	Water level decline and increased chlorides
Carrizo- Wilcox aquifer	**I**	Sporadic Throughout	Water level decline and increased TDS/chlorides
		South of Shreveport	Water level decline
Southern Hills aquifer	**III**	Baton Rouge	Water level decline and saltwater intrusion
		Bogalusa	Water level decline

Note: TDS = Total Dissolved Solids

4 Well Water Notification Requirements

This Section summarizes Louisiana Revised Statute (R.S.) 38:3097.3.C (4)(a), which requires a well owner to submit an advance notification of intent to drill a non-exempt water well to the Commissioner of Conservation (Commissioner) at least 60 days prior to drilling the well. The Water Well Notification form (GWR-01) provides the Commissioner with the basic information necessary to document new water wells and their pumping rates in each aquifer. New water wells are also required to be registered with Office of Conservation, LDNR within 30 days after completion pursuant to Louisiana Administrative Code (LAC) 57: I. et seq. LAC 43:VI.701.A.

The statute addresses the following well classifications:

- Dewatering,
- Power generation,
- Irrigation,
- Industrial,
- Public water supply, and
- Frac water supply for shale gas development.

The following types of water wells are exempt from notification per LAC 43: VI. §701.C and D:

- Drilling rig supply wells;
- Drought relief wells;
- Replacement wells,
- Domestic wells; and
- Other wells the commissioner exempts for just cause.

Per LAC 43: VI. §701.D, no just cause exceptions shall be granted to use large volume wells for hydraulic fracturing for natural gas production. Large volume wells are defined as having an eight-inch or greater diameter screen size or as being well or well group capable producing 1,500 gallons per minute. A 60 day notification is required to convert a drilling rig supply well to a frac water supply well or other well use except for domestic use. If this well is also to be used for drilling rig supply, the owner must provide in an attachment to Form GWR-01 that projects the pumping rate (gallons per day), number of days of use, and the date drilled or anticipated drill date.

This Plan provides recommendations to improve not only the water well notification and review procedures, but also streamline the registration and tracking of wells from inception to plugging and abandonment. Forms and other information referenced in this section are provided in Appendix D.

4.1 Groundwater Resources Review - Procedures

4.1.1 Water Well Notification Form

The water well notification data is submitted to Louisiana Office of Conservation, Environmental Division, GWR, via Water Well Notification form (GWR-01), which is provided in Appendix D.

In addition to the Well Use, Form GWR-01 requests:

- Owner information,
- Driller information,
- Well location,
- Well construction details,
- Rate and duration of water withdrawal,
- Estimated or actual completion date, and
- Certification statement.

After Form GWR-01 is reviewed and entered into the Louisiana DNR Strategic Online Natural Resources Information System (SONRIS), the Office of Conversation assigns a GWR identification (ID) number, an AGC order number, the name of the reviewer and date of review. Louisiana DNR is working to make the GWR ID Number a subset of the Louisiana DOTD Well Number so the well will have one number from pre-permitting to plugging and abandonment.

4.1.2 GWR Well Review

The Environmental Division conducts a Technical Staff Review following the Groundwater Well Prior Notification Form Evaluation Checklist, which is provided in Appendix D. The checklist is designed to evaluate the well location for the following criteria:

- Applicable restrictions and permitting requirements,

- Regional or local groundwater related issues or immediate effects near the proposed location, as identified by the USGS, DEQ, and DHH/OPH databases and other resources, and

- Potential well interference issues with registered wells screened in the target aquifer zone, as identified from the Louisiana DNR Office of Conservation and Louisiana DOTD databases, within a quarter-mile radius of the proposed location. If potential well interference issues are identified, Louisiana DNR estimates the potential drawdown in impacted wells due to pumping in the proposed well. Appendix D provides drawdown calculations used by LDNR.

Based on these criteria, GWR evaluates potential for adverse effects on nearby water wells and the sustainabili1y of the aquifer from which the proposed well is to produce. If warranted, GWR may request the well owner to provide a Groundwater Use Impact Study to evaluate potential effects on surrounding wells and aquifer sustainabili1y. If the study confirms adverse impacts to the area wells, or if no study was submitted or if the study is deemed unacceptable, GWR may provide recommendations, including restrictions, production limits, or relocation of the well, in accordance with statutory and regulatory requirements.

GWR typical calculates drawdown in the well nearest to the proposed well location, which limits the evaluation of other wells within the quarter-mile area of interest. Because potentially impacted wells differ in depth, yield, and use, the impacts of the proposed well may be underestimated. This method also does not address the cumulative impacts of multiple pumping wells.

Although groundwater numerical models, e.g., MODFLOW, can be used to calculate drawdowns in the well field, this method may be cumbersome to update and implement for evaluation of individual wells. Analytical element models, e.g., the wellhead analytical element model (WhAEM), may be an appropriate tool to calculate the cumulative impacts of pumping from multiple wells, as well as additional analytical elements including recharge, drain, and no flow boundaries. WhAEM can also quickly calculate capture zones and be used to delineate wellhead protection areas. EPA supports the Center for Subsurface Modeling Support (http://www.epa.gov/nrmrl/gwerd/csmos/index.html), which provides descriptions and links for groundwater models.

With the migration of the State's Registered Water Well database to the Strategic Online Natural Resources Information System (SONRIS), regional steady-state drawdown can be readily calculated and expressed in geologic information system layers. Regularly updated static water level gradient maps could also be integrated into the SONRIS GIS system, and used to calibrate and validate model predictions, and enhance aquifer sustainability management.

4.2 Well Registration Forms

4.2.1 Current Registration Forms

Louisiana uses three separate water well registration forms, including:

- Water Well Registration Long Form used to register community public supply wells, non-community public supply wells, industrial wells, irrigation/agricultural wells, power generation wells, observation wells, dewatering wells, and test holes;

- Water Well Registration Long Form used to register domestic wells, rig-supply wells, monitoring wells, heat pump supply wells, heat pump holes (closed loop system), and abandoned pilot holes; and

- Water Well Plugging and Abandonment Form used to document the plugging and abandonment procedures utilized when abandoning any of the above-listed wells.

Appendix D provides information on water well registration.

4.2.2 SONRIS Electronic Data Entry

SONRIS was originally designed to track oil and gas information, but was later expanded to track coastal information and to import the existing Louisiana DOTD water well database. SONRIS tracks wells by owner, operator, and driller. The system has separate tables for well information and owner/driller information, which allows system-wide updates for newly generated tables. The system could allow updates to static water levels, water analysis, etc. Data can be retrieved online as needed.

SONRIS could allow for electronic filing of the Water Well Notification Form , the Registration Long Form , the Water Well Registration Long Form , and the Water Well Plugging and Abandonment Form under a secure system similar to the Louisiana Tax Filing system. The system could be modified to allow reporting of annual water usage.

4.3 Summary Recommendations

The following recommendations are made to improve not only the water well notification and review procedures but also streamline the registration and tracking of wells from inception to plugging and abandonment.

4.3.1 Water Well Notification

Under Louisiana R.S. 38:3097.3.C (4) (a) it is the responsibility of the well owner to file the water well notification. Perhaps this responsibility could be placed on the driller, since most well owners would be unfamiliar with the requirements. Until notification changes are accepted, it is recommended the well drillers notify well owners of the requirement, allow the assistance of the driller in filing the well notification, and introduce regulations that penalize drillers that install wells without proper approval from Louisiana DNR.

4.3.2 Groundwater Resources Review

The agency should investigate the feasibility of developing a refined drawdown calculation that could be integrated into a GIS macro within the Strategic Online Natural Resources Information System (SONRIS) system to automate the review.

4.3.3 Static Water Level Gradient Maps

Current static water level gradient maps need to be maintained as feasible to accurately identify potential impacts caused by new significant drawdown within an aquifer. These maps could be integrated into the SONRIS GIS system, either as a functional or reference layer, to ensure the relative static water levels are utilized when calculating relative drawdown from proposed wells.

4.3.4 Well Registration

Several changes could be implemented to improve the well registration process, including:

- In addition to the parish and coordinates, the form(s) should require a street address and/or directions from an intersection or applicable landmark.
- Because the Water Well Notification form (GRW-01), Water Well Registration Long Form (GW-1), Water Well Registration Short Form (GW-1S), and even the Well Plugging and Abandonment Form (GW-2) share a significant percentage of common data, it should be possible to make these into one unified form with separate sections for the unique data on each of the original forms. These forms could be integrated into SONRIS to allow for online data submittal and quicker review by appropriate parties, as needed.
- These forms could be integrated into SONRIS to allow for online data submittal and quicker review by appropriate parties, as needed.
- Finally, the well identifier should be maintained from the well notification through the plugging and abandonment of the well. Each well should receive a unique identifier consisting of the parish Federal Information Processing Standard (FIPs) and the sequential well number for that parish. This would allow for a well to be located by its identifier (currently not possible in SONRIS).

5 Groundwater Management and Sustainability Measures

Aquifers in central Louisiana experienced extended water level declines over the last few decades, but have begun to recover as the result of effective water use permitting and conservation programs (USEPA, 2009). For example, the conservation programs that the State of Louisiana has implemented have helped reduce water withdrawals in Sparta Aquifer as much as 45% since 1980.

These efforts include public education, promotion of conservation, and water use permitting in certain areas. Similarly, this same USEPA report indicates the overall use of groundwater in Louisiana has declined from approximately 2,800 MGD in 1980 to approximately 1,500 MGD in 2005, which is approximately the same as the 1960 rates. Nevertheless, many aquifers in the state continue to be impacted by over-pumping.

This section presents a summary discussion of the impacts identified in each of the dominant aquifers and provides a discussion in the type and nature of these impacts. Potential measures, alternatives, and best management practices are discussed that can be implemented to reduce, or maintain sustainable aquifer levels throughout the state.

5.1 Impacted Aquifers

Historical water resources data and water use data analysis helped to identify areas of declining groundwater levels and impacts. Among all the aquifers studied, only five major aquifers are impacted by over pumping and other sustainability issues. These are:

- Chicot aquifer system (major impacts)
- Jasper aquifer (medium impacts)
- Cockfield aquifer (medium impacts)
- Sparta aquifer, (major impacts)
- Carrizo-Wilcox aquifer (medium impacts), and
- Southern Hills aquifer system (major (Baton Rouge) to medium impacts)

Table 5-1 describes water use (year 2010) in MGD by various users for each of these aquifers.

Table 5-1 Impacted Aquifers and Water Use by Users (year 2010)

	Aquifers, MGD				
Sectors	**Chicot**	**Jasper**	**Cockfield**	**Sparta**	**Carrizo-Wilcox**
Aquaculture	131.13	0.49	0.17	0.19	0.88
General irrigation	4.16	0.19	0.29	0.3	1.59
Rice irrigation	**377.23**	0.2	0.36	0.18	0.42
Rural domestic	28.24	1.31	0.54	1.44	4.6
Public supply	106.67	**104.21**	**7.29**	**35.7**	**7.49**
Power generation	6.5	5.22	0	0	0
Industrial	**113.11**	63.37	0	**30.01**	2.29
Livestock	1.65	0.16	0.02	0.15	0.28

USGS, 2011 (personal communication)

Table 5-1 does not discuss the details of Southern Hills aquifer system; this aquifer system has two sands (1500 foot and 2000 foot) in the Baton Rouge area have been subjected to significant impacts in the form water level declines and salt water intrusion.

Major pumping centers associated with each of these aquifers are presented on Figure 5-1. These centers represent areas of declined water levels. In addition, the color shaded areas show recharge areas for the aquifers and the surface water stream net.

As summarized in Table 5-2, the documented impacts to these aquifers impacts are:

- Agricultural Applications;
- Salt water intrusion;
- Natural gas; and
- Water level decline

A brief discussion of these impacts is provided below:

**Agricultural Applications (pesticides/herbicides, fertilizers): ** Agricultural activities that cause groundwater impacts include confined animal facilities, pesticide spraying, and fertilizing. The major agricultural impacts that result from these activities are nutrients, pathogens, pesticides, herbicides, and salts.

Salt water intrusion: Saltwater intrusion is the movement of saline water into freshwater aquifers. Most often, it is caused by groundwater pumping from coastal wells or from construction of navigation channels or oil field canals in coastal marshes. Saltwater intrusion occurs in virtually in all coastal aquifers, where they are in hydraulic continuity with seawater or deeper downdip where the aquifers are saline.

Natural Gas: Natural gas may enter groundwater through natural or industrial processes. Natural gas consists predominantly of methane and since it evaporates out of water, methane is not usually considered to present a health threat in drinking water. However, methane gas can become harmful if it escapes from water and becomes an explosive hazard. Other components of natural gas may be harmful to water quality; and

Water level decline: Water level decline can occur on a local scale by withdrawing water at a rate higher than the annual aquifer recharge rate resulting in depleting the aquifer over time and causing cones of groundwater depression.

An example of an impacted aquifer is the Chicot; it shows impacts such as water level decline and saltwater intrusion. Historical groundwater data indicates seasonal variations in water levels for the Chicot aquifer related to demand. For example, during June 2002, water levels in the Chicot aquifer system were more than 40 feet below the surface in parts of Acadia, Calcasieu, Evangeline, and Jefferson Davis Parishes, in an area that generally coincides with rice farming areas (Lovelace et al., 2004). However, the same study also observes that from June 2002 to January 2003, water levels recovered throughout most of the Chicot aquifer system in response to reduced withdrawals after rice farming season.

Several alternative actions are identified to mitigate these impacts to state’s aquifers. These actions include the development of specific water infrastructure project alternatives and implementation of groundwater best management practices.

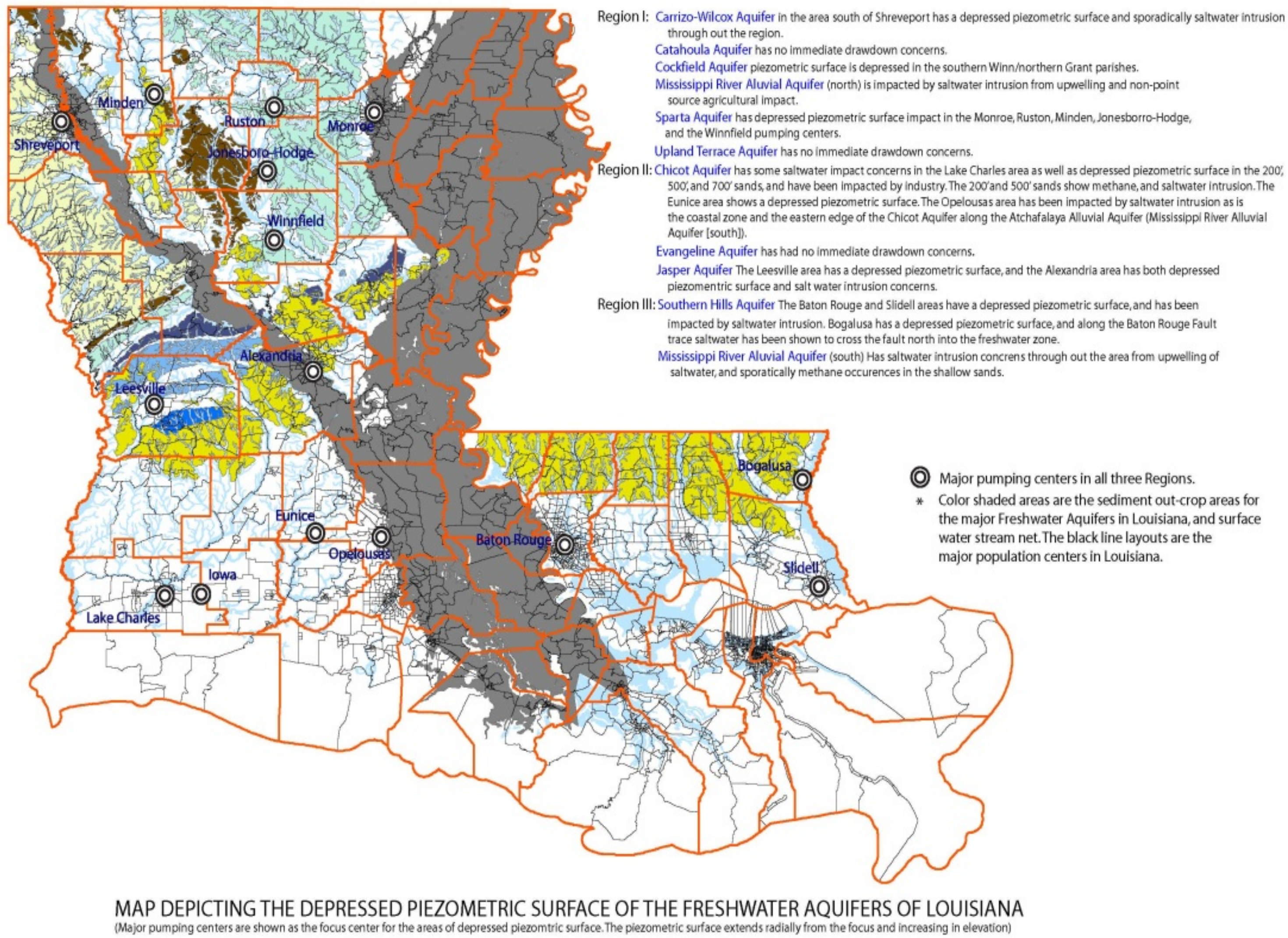


Figure 5-1 Major Pumping Centers

Table 5-2 Aquifers, Impacts, Corrective Actions, and Alternatives (E&E, 2011, this study)

Aquifers	Region	Location	Impacts	Corrective Action	Alternatives	Other Alternatives
Mississippi River Alluvial aquifer (North)	I	Aquifer wide	Agricultural Applications (pesticides/herbicides, fertilizers)	Best management practices	Establish BMPs	
		Aquifer wide Franklin Parish, SE Ouachita Parish	Water quality (TDS, metals), Naturally occurring chlorides	Salt water is in the base of the aquifer	No action	
Mississippi River Alluvial aquifer (South)	III	Coastal Parishes	Saltwater intrusion from Gulf of Mexico and potential upward migration of saltwater	Increase flow from the old river structure	Mississippi River water at old river structure	
		Sporadic throughout	Occurrence of natural gas in shallow sands in shallow sands	Change source water	Mississippi River water at old river structure	
		Aquifer wide	Agricultural applications, Water quality (TDS, metals) Naturally occurring chlorides	Best management practices	Establish BMPs	
Chicot aquifer system	II	Iowa,	Shallow saltwater, possibly impact from Iowa Salt Dome	Drill to a depth deeper than the impacted zone, or move the well location		Treated waste water for agricultural use
Chicot Equivalent aquifer system		Lake Charles	200 ' and 500' sand have been impacted by industrial activity and over pumping	Reduce use of groundwater in both 200' and 500' sand		Reservoirs and rain harvesting
		Lake Charles	200 ' and 500' sands exhibit the presence of methane	Use 700' sand		
		Lake Charles	700' sand is being impacted by saltwater intrusion	Reduce use of groundwater in 700' sand		
		Opelousas	Possible saltwater intrusion from salt domes in the area (farmer pumps saltwater)	Relocate wells or reduce the pumping rate to minimize saltwater movement		
		Coastal zone	Saltwater intrusion from Gulf of Mexico sea level rise, subsidence, and land loss	Supply water from other sources		
		Eastern edge of Chicot	Contact with Atchafalaya Aquifer provides potential impact from saltwater intrusion	Move well location, reduce pumping, use alternative sources of water		
Jasper aquifer system	II	Leesville	Water level decline	Reduce pumping and use alternative surface water sources		Treated waste water for agricultural use
Jasper Equivalent aquifer system (Southeast Louisiana)		Alexandria	Water level decline	Reduce pumping and use alternative surface water sources	Red River	Reservoirs and rain harvesting
Cockfield aquifer	I	Southern Winn/Northern Grant Parishes	Water level decline	Reduce pumping/spread wells farther apart		
Sparta aquifer	I	Monroe	Water level decline and increased chlorides	Reduce pumping and use alternative surface water sources	Ouachita River	Treated waste water for agricultural use
		Ruston	Water level decline and increased chlorides	Reduce pumping and use alternative surface water sources		Reservoirs and rain harvesting
		Minden	Water level decline	Reduce pumping and use alternative surface water sources		
		Jonesboro Hodge	Water level decline	Reduce pumping and use alternative surface water sources		
		Winnfield	Water level decline and increased chlorides	Reduce pumping and use alternative surface water sources		
Carrizo- Wilcox aquifer	I	Sporadic throughout	Water level decline and increased chlorides/TDS	Reduce pumping and use alternative surface water sources	Red River or Red River Alluvial Aquifer	
		South of Shreveport	Water level decline	Reduce pumping and use alternative surface water sources		
Southern Hills aquifer	III	Baton Rouge	Water level decline and saltwater intrusion	Decrease pumpage and or move well field far apart	Mississippi River	
		Bogalusa	Water level decline	Reduce pumping and use alternative surface water sources	Pearl River	

5.2 Alternatives Identification

It is important to consider the type of groundwater use while developing cost effective alternatives and implement these alternatives to match the demands. Alternatives considered to mitigate the demand are provided in Table 5-3.

Table 5-3 Alternatives for Impacted Aquifers*

Chicot System	Jasper System	Cockfield	Sparta	Carrizo-Wilcox
Wastewater recycling	Wastewater recycling	Wastewater recycling	Wastewater recycling	Red River Surface water or Increased use of Red River Alluvial aquifer
Reservoirs for rain harvesting	Reservoirs for rain harvesting	Reservoirs for rain harvesting	Reservoirs for rain harvesting	Reservoirs for rain harvesting
	Construction of Pipeline for conveyance of Red River water		Construction of Pipeline for conveyance of Ouachita River water and divert water from Lake D'Arbonne	
			Reuse of groundwater	
Conservation measures	Conservation measures	Conservation measures	Conservation measures	Conservation measures

E&E, 2011 (this study)

* Southern Hills aquifer system is impacted (major in the Baton Rouge area). Use of Mississippi River water is recommended as an alternative.

A brief discussion of these alternatives is provided below:

5.2.1 Pipeline Conveyance of Surface Water

Pipelines can be used to transport surface water or groundwater from one area to another (intrabasin and interbasin) without causing erosion and with limited potential for evaporation. Water supply pipelines are typically constructed as large diameter pipes to supply water to communities and industries over both short and long distances, and can be installed underground or above ground. They can be used to bring in freshwater, or to transport and dispose of wastewater. Water can be directly taken from a surface water source. Water can be transported through the pipelines using combinations of gravity, siphons, and pumps.

There are environmental and economic benefits associated with utilizing river water as an alternative to groundwater. This is especially true when certain industries are located along the banks of rivers. River water could be utilized for these industries' function using very short pipelines.

USACE has carried out a study that details viability of water conveyance from Mississippi River of diverting surface water from Arkansas into various rivers and bayous of northeast Louisiana.

There are several drawbacks that accompany pipelines. The lead time to obtain all right-of-way and environmental clearances and permits and design considerations can take years, as well as securing water rights. Also, the construction of a major water pipeline is extremely expensive. With pipe manufacturing costs, labor, and installation, pipeline projects can cost billions of dollars.

In addition, maintenance must be done every day in order to keep the pipeline working effectively, and because of the great distances that major water pipelines can cover, operation and maintenance costs are high. Furthermore, pipelines need to be monitored continually and water quality must be constantly checked

The installation of water pipelines implies major land impacts. The pipeline right-of-ways can disrupt ecosystems, affect scenery, social and cultural resources, and act as an obstruction. But the most pressing conflict related to surface water conveyances concerns the source from which the water is being taken. Whether it is from an aquifer, a reservoir, or a watershed basin, the diverted water is being taken away from an ecosystem in which it is needed. Transferring water from these sources can cause severe damage, such as water level drawdowns, which can affect coastlines, aquatic life, plant life, and economic activity. The water replenishment rate may not be fast enough to rejuvenate water sources that are being reduced through large-scale transfer.

Freshwater diversion projects needs to be considered as part of developing surface water infrastructure. This approach will be particularly suitable for Chicot aquifer system.

5.2.2 Surface Water Recharge

Surface water can be used to recharge groundwater reservoirs using suitable civil construction techniques that connect surface and groundwater resources. The ability of the surface water bodies, such as ponds, tanks, and canals, to naturally replenish groundwater is limited by the availability of suitable land and surface water in the aquifer recharge zone, the depth of the aquifer, silting of the surface water body, and evaporation.. As illustrated by the artificial recharge projects currently in use and proposed for California, the construction and operations of these can run in the hundreds of millions of dollars.

5.2.3 Rainwater Harvesting

Rain water harvesting is the practice of collecting rainfall for beneficial use. Examples of RWH systems can be found throughout history. In industrialized countries, sophisticated RWH systems have been developed to reduce water bills or to meet the needs of remote communities or individual households in arid regions.

RWH is most applicable where other sources of water are either not available or are too expensive. Applicable places include places with inadequate surface water resources, with prohibitively expensive the tap fees for homeowners to connect to water supply pipelines, and with poor quality groundwater. RWH is therefore becoming the obvious choice in rural areas.

Rainwater collected from roof surfaces is stored in cisterns and either pumped back into the house for indoor use, or can be used for landscape irrigation. Generally, in rural areas the stored water is filtered, treated, and used for all indoor purposes. In towns where municipal water systems are available, harvested rainwater is used primarily for landscape irrigation, thus reducing the overall demand for municipal water. Either way, RWH provides conservation of water supplies.

RWH, in essence, is the collection, conveyance, and storage of rainwater. The scope, method, technologies, system complexity, purpose, and end uses vary from rain barrels for garden irrigation in urban areas to the large-scale collection of rainwater for all domestic uses. Regional examples of this practice are summarized below:

- For supplemental irrigation water, the Wells Branch Municipal Utility District in North Austin captures rainwater, along with air conditioning condensate, from a new 10,000-square-foot recreation center into a 37,000-gallon tank to serve as irrigation water for a 12-acre municipal park with soccer fields and offices.

- The Lady Bird Johnson Wildflower Research Center in Austin, Texas, harvests 300,000 gallons of rainwater annually from almost 19,000 square feet of roof collection area for irrigation of its native plant landscapes. A 6,000-gallon stone cistern and its arching stone aqueduct form the distinctive entry to the research center.

- The Advanced Micro Devices semiconductor fabrication plant in Austin, Texas uses captured rainwater and augmented groundwater for irrigation, which saves the facility $1.5 million per year in water costs.

- Reynolds Metals in Ingleside, Texas, uses storm water captured in containment basins as process water in its metal-processing plant, greatly offsetting the volume of purchased water.

5.2.4 Wastewater Recycling

The use of reclaimed water for non-potable purposes offers the potential for exploiting a “new” resource that can be substituted for existing potable sources. This idea, known as “source substitution” is not new. In fact, the United Nations Economic and Social Council enunciated a policy in 1958 that, “No higher quality water, unless there is a surplus of it, should be used for a purpose that can tolerate a lower grade.” Many urban, commercial, and industrial uses can be met with water of less than potable water quality.

With respect to potable water sources, USEPA policy states, “Because of human frailties associated with protection, priority should be given to selection of the purest source” (USEPA, 1976). Therefore, when the demand exceeds the capacity of the purest source, and additional sources are unavailable or available only at a high cost, lower quality water can be substituted to serve the non-potable purposes.

Since few areas enjoy a surplus of high quality water, and demand often exceeds capacity, many urban residential, commercial, and industrial uses can be satisfied with water of less than potable water quality. In many instances, treated wastewater may provide the most economical and/or available substitute source for such uses as irrigation of lawns, parks, roadway borders, and medians; air conditioning and industrial cooling towers; stack gas scrubbing; industrial processing; toilet flushing; dust control and construction; cleaning and maintenance, including vehicle washing; scenic waters and fountains; and environmental and recreational purposes.

In many instances, reclaimed water or recycled water, is former wastewater (sewage) or grey-water that is treated to remove solids and certain impurities, and used in sustainable landscaping irrigation or to recharge groundwater aquifers. The purpose of these processes is sustainability and water conservation, rather than discharging the treated wastewater to surface waters such as rivers and oceans.

The first reclaimed water facility in the US was built at San Francisco's Golden Gate Park in 1932. Currently, the Irvine Ranch Water District and Orange County Water District in Southern California are leaders in reclaimed water through their Green Acres Project.

This "new" water source may also be used to replenish overdrawn water sources and rejuvenate or reestablish impacted aquifers. A number of projects use recycled water indirectly for potable purposes. These projects include recharging groundwater aquifers and augmenting surface water reservoirs with recycled water. In groundwater recharge projects, recycled water can be spread or injected into groundwater aquifers to augment groundwater supplies, and to prevent salt water intrusion in coastal areas. For example, since 1976, the Water Factory 21 Direct Injection Project, located in Orange County, California, has been injecting highly treated recycled water into the aquifer to prevent salt water intrusion and augmenting the potable groundwater supply.

West Monroe Graphic Packaging Water Re-Use Project is one of the best recent examples of utilizing recycled waste water as a substitute for groundwater. The pilot project consists of providing 1 million gallons per day and the ultimate goal is to substitute groundwater in the amount of 10 million gallons per day.

Miscellaneous/Other Approaches: the State should consider identifying, characterizing, and utilizing marginal quality deeper aquifers as an alternative to fresh water sources.

5.3 Best Management Practices

Groundwater Best Management Practices (BMP) were identified from several sources, including Federal, State, and local plans, guidelines, standards of practice, and tax structures. Some of these can be adopted by the State of Louisiana to provide ***BMP Incentives*** that may reduce the cost of implementing alternative management measures to reduce groundwater depletion.

The identified incentives were matched to specific measures in Table 5-4. For example, demand management incentives were matched with recommended demand management conservation measures. Some incentives are designed to encourage private sector participation in meeting the policy goals of the statewide groundwater management plan through ***Tax Incentives***. Tax incentives, like funding sources, were evaluated *relative to effectiveness of the Tax Incentive program and with reference to the incentive's relevance to the State's program goals and objectives*.

The types of groundwater depletion mitigation measures that could be stimulated and aided by tax incentives were described and related back to the alternative measures and short and long-term recommendations identified in this Plan.

In addition, tax incentives related to promoting ***conservation*** and ***water reuse*** were researched and evaluated for future potential relevance and application to Louisiana. Using the survey of existing BMPs, additional incentives that are needed, or incentives that have not been successfully implemented are described and evaluated so that the appropriate tax incentives can be applied within Louisiana.

There are perceived disincentives to substitution of surface water for existing use of groundwater. This perception arises from the State of Louisiana's levy on surface water usage. The state may consider either reducing levy amounts or exempting certain entities from this levy for utilizing surface water as a substitution for groundwater or to utilize this levy as a funding opportunity for constructing the infrastructure to convey surface water.

As summarized in Table 5-4, BMP incentives were identified from Federal, State, and local programs for the following alternative measures and short and long-term recommendations identified in previous chapters, mainly:

- Demand management,
- Supply augmentation, and
- Water reuse.

Table 5-4 Best Management Practices: Tax, Grant, Rebate, and Funding Incentives Summary (E&E, 2011, this study)

Source	Name of Incentive	Year	BMP	Reduces GW Depletion	Water Conservation Measure	Cost	Participation	Degree of Support	Eligibility	Demand Management	Supply Augmentation	Water Reuse	Relative Program Effectiveness	Relevance to Louisiana
Alabama	Air and water pollution control exemption	2001	Any system, method, construction, device, or appliance for the primary purpose of eliminating, preventing, or reducing air and water pollution.	No	No	N/A	High	High	Acquisition of property stored, used, or consumed shall be the control, reduction, or elimination of air or water pollution.	No	No	No	3	3
Arizona	City of Peorias Water Conservation Rebate Program	2003	Updating of fixtures, and water heaters within the home. Updating irrigation systems and converting high water use landscaping to low water use (xeriscape).	Yes	Yes	$50k/Yr	High	High	Available to all water/sewer customers including residential, HOAs, commercial, and industrial properties.	Yes	No	No	4	4
Arkansas	Water Resource Conservation Development Incentives Act (Conversion)		For the conversion from groundwater use to surface water use outside/within a critical groundwater area	Yes	Yes	N/A	Unknown	Unknown	Awaiting data	Yes	Yes	Yes	4	5
Arkansas	Water Resource Conservation Development Incentives Act (Leveling)		For agricultural land leveling projects that conserve irrigation water	Yes	Yes	N/A	Unknown	Unknown	awaiting data	Yes	Yes	Yes	4	5
Arkansas	Water Resource Conservation Development Incentives Act (Impoundment)		For the construction of impoundments of at least 20 acre-feet, must be used for the storage of water to be used primarily for agricultural irrigation	Yes	Yes	N/A	Unknown	Unknown	Individuals, partnerships, and corporations are all eligible	Yes	Yes	Yes	4	5
California	Natural Heritage Preservation Tax Credit Act of 2000	2000	Donations of private land to non-profit organizations, conservancies, and or government agencies	Yes	Yes	Yes	High	High	Approval from the Wildlife Conservation Board	Yes	Yes	Yes	4	5
California	California Ground and Surface Water Conservation (GSWC) Initiative		Improvements to irrigation systems; improvements to water storage capability; promotion of "water banking"	Yes	Yes	N/A	High	High	Eligible producers engaged in livestock or crop production on eligible land	Yes	Yes	Yes	4	5

Table 5-4 Best Management Practices: Tax, Grant, Rebate, and Funding Incentives Summary (E&E, 2011, this study)

Source	Name of Incentive	Year	BMP	Reduces GW Depletion	Water Conservation Measure	Cost	Participation	Degree of Support	Eligibility	Demand Management	Supply Augmentation	Water Reuse	Relative Program Effectiveness	Relevance to Louisiana
California	Agricultural Water Enhancement Program (AWEP) (part of the 2008 Farm Bill)	2008	Any BMP that helps the implementation of improving water quality and water conservation on agricultural lands	Yes	Yes	N/A	High	High	AWEP partners include federally recognized Indian tribes, states, units of local government, agricultural associations and non-governmental organizations	Yes	Yes	Yes	4	5
Georgia	Georgia Environmental Finance Authority (GEFA)	2011	Governor's Water Supply Program						GEFA provides loans, grants, and services for a variety of infra-structure projects.		Yes			
Florida	Florida Water Star Gold (Incentives)	Not in effect yet	Increasing water efficiency in landscapes, irrigation systems, and indoor fixtures	Yes	Yes	N/A	High	High	Unknown	Yes	No	No	Currently Unknown	5
Texas	Exemption of sales taxes for equipment, services, or supplies used for desalination of surface or groundwater	2002	Using desalination equipment to conserve groundwater	Yes	Yes	N/A	Unknown	Unknown	Compliance with Rule 3.318(a)(2)	Yes	Yes	No	Currently Unknown	4
Texas	Exemption of sales taxes for the purchase of equipment or services used exclusively for water conservation	2002	Any equipment that aids in groundwater conservation	Yes	Yes	N/A	Unknown	Unknown	Compliance with Rule 151.355	Yes	Yes	Yes	Currently Unknown	4
Texas	Municipal rebates and discounts	2001	Rainwater and condensate recovery systems	Yes	Yes	N/A	High	High	Property owner	Yes	No	Yes	4	4
Texas	Property tax exemption	1993 2001	Rainwater harvesting system	Yes	Yes	N/A	High	High	Determination of use by TCEQ and review by appraisal district	Yes	No	Yes	4	4

Table 5-4 Best Management Practices: Tax, Grant, Rebate, and Funding Incentives Summary (E&E, 2011, this study)

Source	Name of Incentive	Year	BMP	Reduces GW Depletion	Water Conservation Measure	Cost	Participation	Degree of Support	Eligibility	Demand Management	Supply Augmentation	Water Reuse	Relative Program Effectiveness	Relevance to Louisiana
Virginia	Land Preservation Tax Credit	2006 2008	Donations of land or conservation easements expressly given for one or more conservation purposes	No	Yes	N/A	High	High	Land or conservation easement must be conveyed for one of the eight conservation purposes: agricultural use, forest use, natural habitat and biological diversity, historic preservation, natural resource based outdoor recreation or education, watershed preservation, preservation of scenic open space.	Yes	Yes	No	4	5
Federal	Water Savings Incentives Grant		Water conservation technology projects	Yes	Yes	Up to $50K	Under review	Under review	Offers matching funds up to the amount of $50,000 for water saving projects	Under review*	Under review*	Under review*	Under review*	Under review*
Federal	Land and Water Conservation Fund	1965	Local water conservation efforts	Yes	Yes	N/A	Under review	Under review	All 50 states	Under review*	Under review*	Under review*	Under review*	Under review*
Federal	Environmental quality incentives program		Installation of structural, vegetative and management practices on eligible land	Yes	Yes	N/A	Under review	Under review	Applicant must be actively engaged in livestock or crop production, eligible land includes: cropland, rangeland, pasture, and private forestland.	Under review*	Under review*	Under review*	Under review*	Under review*

- Currently under review by Federal agencies

A brief discussion of each is presented below:

Demand management: Programs of demand reduction are referred to as Water Demand Management (WDM). This differs from the traditional supply driven method, which makes all existing water available. WDM applies selective economic incentives to promote efficient and equitable water use, and identifies water conservation measures that are aimed at raising local and regional awareness of the scarcity and finite nature of the groundwater.

WDM advocates a wide range of measures that go beyond conservation to broader sustainable resource management. It applies to the protection of water quality sources; reduction of wastage both in infrastructure leakage and by users, improvement of water allocation among competing uses, and creation of appropriate pricing mechanisms. Further water conservation can be achieved after delivery by improving use practices in households.

Water conservation measures have reduced demand by as 40 percent. By reducing demand, substantial reductions in the source volumes could be achieved. WDM may obviate the need for some of the proposed large-scale physical or infrastructure investments (GWP, 2005a).

Typically, conservation measures are not readily implemented, or accepted, particularly where water is perceived as abundant. However, the benefits in the extended useful life of water supply and treatment plants and in the operating efficiency and duration of sewage disposal systems can be considerable in terms of higher economic return on investment. (UNESCO, the United Nations World Water Development Report 2 (2006)).

On the environmental front, WDM conservation allows for the diversion of the unused volumes to sustain ecosystems and also lowers the pollution loadings to lakes, rivers, and groundwater. Such steps lead to improved protection of drinking water sources and overall ecological balance (Environment Canada, 2005b- Environment Canada. 2005a. Water – The Transporter (www.atl.ec.gc.ca/udo/mem.html)).

Supply Augmentation: There are several methods for augmentation of water supply sources. The traditional methods include the use of storage structures on land such as dams and ponds. Another method is the induced recharge of aquifers by artificial methods.

Desalination plants are also another unconventional source of water. For example, Tampa Bay Water, the wholesale water developer and supplier for the greater Tampa Bay area, reduced their groundwater use from 158 MGD to 90 MGD in part due to construction of the 25 MGD Tampa Bay Desalination Plant, which was completed by American Water-Acciona Agua. This is largest desalination plant in the United States and is used as a model for multiple coastal areas.

Water Reuse: According to the EPA (www.epa.gov/region9/water/recycling), water recycling is the reuse of treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a groundwater basin (referred to as groundwater recharge). Water recycling offers resource and financial savings. Wastewater treatment can be tailored to meet the water quality requirements of a planned reuse. Recycled water for landscape irrigation requires less treatment than recycled water for drinking water. No documented cases of human health problems have been reported due to contact with recycled water that has been treated to applicable standards, criteria, and regulations.

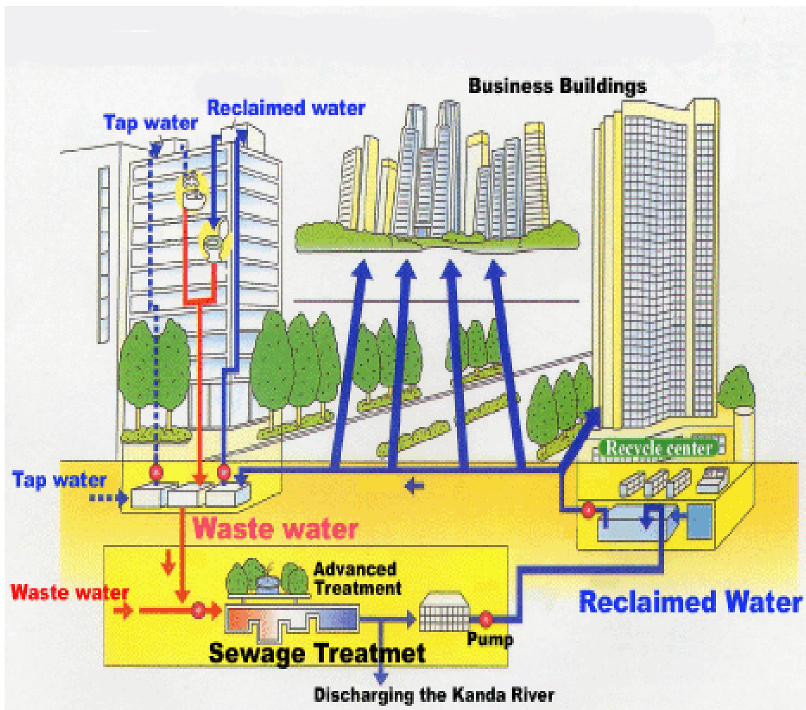


Figure 5-2 Scheme of Area Recycling System in Shinjuku (Tokyo, Japan)

Similarly, EPA indicates through the natural water cycle, the earth has recycled and reused water for millions of years. Water recycling, though, generally refers to projects that use technology to speed up these natural processes. Water recycling is often characterized as "unplanned" or "planned." A common example of unplanned water recycling occurs when cities draw their water supplies from rivers, such as the Colorado River and the Mississippi River, that receive wastewater discharges upstream from those cities. Water from these rivers has been reused, treated, and piped into the water supply a number of times before the last downstream user withdraws the water. Planned projects are those that are developed with the goal of beneficially reusing a recycled water supply.

As indicated earlier, Table 5-4 summaries of state and federal BMPs that have been evaluated to date that may be applicable in the implementation of groundwater management practices in Louisiana. The two right hand columns in Table 5-4 subjectively qualify the effectiveness of the BMP and its associated state program for its relevance in Louisiana. For example, for the Arkansas BMP of conversion from groundwater to surface water in critical areas, the effectiveness and relevance are rated as high.

5.4 Summary Recommendations

The 2010 Louisiana Reservoir Priority and Development Program (LRPD Program) (MWH, 2009) found several issues that can affect water resources conditions throughout Louisiana. The LRPD Program Report summarizes the condition of water resources throughout the state and found a set of common issues (MWH 2009). The Report presented a framework for water resources management focused on increased coordination and development of information on sustainable water use. A more detailed summary of this report is presented in Appendix E.

2010 Louisiana Reservoir Priority and Development Program (LRPD Program), which identified several issues, that can affect water resources conditions throughout Louisiana.

Based on the groundwater use analysis, identification of impacts and review of mitigation strategies provided in this document and the following are the more immediate recommendations addressing the identified impact issues

As a short term measure (0-5 year), it is recommended that BMP (Demand Management; Supply Augmentation; and Water-Reuse) programs for the two aquifers that have recently been identified as requiring more immediate attention at this time, mainly:

- The Sparta aquifer
- The Carrizo-Wilcox aquifer

In addition, BMP programs need to be implemented for the following impacted aquifers as well:

- The Chicot aquifer
- The Jasper aquifer
- The Cockfield aquifer

These mitigation strategies should encompass:

- Demand management programs to:
  - Protect water quality;
  - Reduce wastage (e.g. conveyance leakage) by all users); and
  - Implement conservation measures.
- Supply Augmentation to:
  - Develop surface water projects such as reservoirs, surface water diversion, and pipeline conveyance of surface water
  - Develop induced re-charge in conjunction with impoundments projects, and

  - Identify usable sustainable surface water sources.
- Water-Re-use to:
  - Plan and implement urban storm water capture and recycle programs with cities and municipalities and
  - Assess current wastewater streams for conjunctive use and alternative for grey-water use program.

The experience developed in planning and implementing the BMP in the Sparta-Carrizo Wilcox aquifers will be invaluable in developing similar programs across the state.

6 Supply Gap and Alternatives Implementation

This section discusses supply gaps that are identified for Louisiana's aquifers, and discusses means to quantify and scale infrastructure needed to resolve the supply gaps. This section evaluates preliminary alternatives, and presents a cost model to assess the economic feasibility of these alternatives. Additionally, this section identifies federal, state, and local funding sources that could be applied to fund the water infrastructure alternatives.

6.1 Supply Gap Analysis

Supply gaps occur when the projected demand outstrips the sustainable yield of the aquifer. The supply gap is calculated as the difference between the projected demand and the current estimated sustainable yield. In unpublished data, the USGS projected supply gaps for Louisiana's aquifers. The USGS projected that five of Louisiana's aquifers are projected to have supply gaps, including the Chicot, Jasper, Cockfield, Sparta, and Carrizo-Wilcox aquifers. This is consistent with the impact analysis that is carried out for the preparation of this document. Table 6-1 shows the estimated supply gaps of impacted aquifers for years 2000, 2010, 2015, and 2030. For these aquifers, alternative water supplies are necessary to augment the groundwater supply in order to maintain the current yield of the aquifers. This plan assumes that the remaining aquifers are currently sustainable and that BMPs and conservation practices can be applied to continue their sustainability.

Sustainable yield is most accurately estimated by developing groundwater availability models (GAM) that simulate the recharge and withdrawal in the aquifer. Louisiana has not implemented state-wide programs to develop GAMs for the areas of groundwater concern. However, limited modeling has been performed.

In 2001, Meyer, Meyer, LaCroix & Hixson, Inc. (MMLH) and URS Corporation, et al. (2001) developed a MODFLOW model for the Cockfield and Sparta aquifers for the Sparta Groundwater Conservation District. The model was used to simulate the following scenarios:

- No changes,
- Demographic-based changes,
- Enhanced aquifer recharge,
- 40% reduction by major users by surface water augmentation,

- Water use reduction through conservation or recycling, and
- High water use estimate.

Table 6-1 Groundwater Supply Gap Estimation (E&E, 2011, this study)

Aquifer	Year (Water Use in MGD)							Major/ Medium Impacts (Yes or No)	Supply Gap (MGD) of Impacted aquifers as of:			
	1990	1995	2000***	2005	2010*	2015**	2030**		2000	2010	2015	2030
Red River Alluvial aquifer	3.65	5.61	7.52	8.64	16.37	12.26	17.32	No				
Mississippi River Alluvial aquifer	283.5	245.4	353.6	402	393.4	483	622	No				
Upland Terrace aquifer (Northern Louisiana)	21.97	20.73	20.56	13.47	28.4	10.48	2.857	No				
Chicot aquifer system	609.33	554.53	797.86	661.64	667.97	795	916	Major	359.04	300.59	356.18	477.17
Chicot Equivalent aquifer system	88.48	105.84	74.26	107.03	89.83	105	115	Major	33.42	40.42	64.16	74.16
Evangeline aquifer	13.78	15.25	22.49	18.54	23.77	25	31	No				
Evangeline Equivalent aquifer system	67.78	78.2	85.64	87.1	99.93	102	122	No				
Jasper aquifer system	45.68	46.34	42.07	49	65.3	47	49	Medium	18.93	29.39	23.86	25.86
Jasper Equivalent aquifer system (Southeast Louisiana)	11.77	113.5	125.46	126.28	119.63	140.49	158.39	Medium	56.46	53.83	71.49	89.39
Catahoula aquifer	2.6	9.51	2.68	2.74	4	2.13	0.26	No				
Cockfield aquifer	5.77	6.58	7.38	8.65	6.92	10	13	Medium	3.5	3.114	6.12	9.12
Sparta aquifer	64.1	71.32	68.28	67.96	64.99	70.89	73.45	Major	37.81	29.25	40.42	42.98
Carrizo-Wilcox aquifer	13.32	11.84	14.56	17.56	19.46	19	24	Medium	6.75	8.757	11.19	16.19

* Data from USGS, Unpublished
** Projected withdrawal of groundwater
***McKee et. al 2004 supply gap determination based on 2000 data
Southern Hills aquifer data is included along with data from the Mississippi River alluvial aquifer, the Chicot equivalent aquifer system, the Evangeline equivalent aquifer system, and the Jasper equivalent aquifer system.

The Sparta Groundwater Study report (MMLH, 2001) also evaluated the financing for several development alternatives. These included the use of several nearby surface water resources, which was favored over wastewater re-use.

Subsequently, McKee et al. (2004) developed a large scale conjunctive-use optimization model to calculate the sustainable yield for the Sparta aquifer, primarily in southern Arkansas and north central Louisiana. The groundwater model was developed using MODFLOW and calibrated to the 1990 to 1997 water withdrawals. The steady-state withdrawals were then optimized using MODMAN. The model optimized the total surface and groundwater withdrawal using 1,152 groundwater withdrawal and seven surface water withdrawal decision variables and solutions were constrained by maintaining aquifer hydraulic heads above a minimum altitude and maintaining a minimum stream flow. McKee et al. (2004) estimated that 52 to 59% of the baseline withdrawal 1990 to 1997 is sustainable and that the remaining unmet demand, or supply gap, could be obtained from large, sustainable surface water withdrawals.

Groundwater availability models (GAM) or groundwater yields models are not available in Louisiana for aquifers in general and impacted aquifers in particular. The supply gap estimation was carried out for impacted aquifers is based on several assumptions and based on one such study on Sparta aquifer (McKee et al., 2004). McKee et al., 2004 determined that the supply gap for the Sparta Aquifer is approximately 45% of the 2002 water use. Sparta Groundwater Study (2004) forecasted approximately 45% of the current water use (2010) as supply gap for Sparta aquifer. Chicot aquifer system shows a drawdown of approximately 377 MGD during the rice farming season that is responsible for considerable water level decline (Lovelace, 2004; USGS Data 2005). The 2010 level supply gap estimated for Chicot aquifer is 392 MGD. Therefore, the decline can be assumed as supply gap and is approximately 45%-50% of the sustainable yield.

From the above observations, it can be assumed that 45% of the 2010 water use for Sparta and Chicot aquifers can be assumed as supply gap. 45% of the 2010 water use is also considered as supply gap for other less impacted aquifers. This assumption is on the conservative side. As part of a framework such as this plan, this approach may be sufficient. However, detailed availability modeling and yield estimations for aquifers are necessary to evolve adequate sustainable management decisions for groundwater resources.

Table 6-2 Estimated Supply Gaps in 2010 for Aquifers

Aquifer	Total Withdrawal in 2010 (MGD)	Estimated Sustainable Withdrawal in 2010 (MGD)	Estimated Supply Gap in 2010 (MGD)	Estimated Supply Gap in 2010 (MG/yr.)
Chicot aquifer system	757.9	416.89	341.01	124,468
Jasper aquifer system	184.93	101.71	83.22	30,375
Cockfield aquifer	6.92	3.81	3.11	1,135
Sparta aquifer	64.99	35.44	29.55	10,785
Carrizo-Wilcox aquifer	19.46	10.7	8.76	3,197

E&E, 2011 (this study)

6.2 Groundwater Availability Models

The State of Louisiana does not have a program to develop GAMs for areas of groundwater concern. The development of detailed availability modeling and yield estimations is necessary to inform management decisions that address the sustainability of areas of groundwater concern.

Of all the states surrounding Louisiana, only Texas has developed a sophisticated state-wide GAM program. In 2001, the Texas Legislature directed the Texas Water Development Board (TWDB) to develop GAMs for all of the major and minor aquifers of the state. The TWDB web page indicates that GAMs will be developed for all or parts of major and minor aquifers in the state by 2011, and GAMs will be developed for each of the groundwater management areas by 2015.

The GAMs in Texas are developed using the MODFLOW, a finite-difference code, which simulates the potential head in the aquifer. The MODFLOW are developed using regional aquifer boundaries, properties, and recharge estimates. GAMs are generally calibrated to predevelopment (before there was pumping) conditions and to at least 20 years of historical data (generally 1980 to 2000).

The TWDB has developed GAMs for extensions or similar aquifers as the impacted aquifers in Louisiana. For example, the TWDB, in cooperation with the USGS, the Harris-Galveston Coastal Subsidence District, City of Houston, San Jacinto River Authority, and the Fort Bend Subsidence District, developed a model of the northern part of the Gulf Coast aquifer (equivalent to the Chicot-Evangeline- Jasper in Louisiana), which borders Louisiana. The TWDB developed a model of the northern part of the Carrizo-Wilcox Aquifer in 2003. Subsequently in 2005, the model was modified by adding the Queen City and Sparta aquifers as additional layers to the existing three Carrizo-Wilcox models (Northern Carrizo-Wilcox [bordering Louisiana], Central Carrizo-Wilcox, and Southern Carrizo-Wilcox).

A similar groundwater availability program was implemented under the State of Georgia’s 2004 Water Management Planning Act. Georgia also uses MODFLOW to conduct their modeling estimates of all the state aquifers.

Texas has the most robust GAM program, but the TWBD has not developed rules that specify how frequent the GAMs need to be revised. Very few of the initial models have been modified. Modifications have mostly been due to special circumstances such as the development of new MODFLOW code that decreases the calibration errors or the incorporation additional groundwater use or aquifer data.

The highest costs to conduct a GAM are the upfront planning and data gathering costs. Constructing an accurate groundwater model requires gathering detailed information on the hydrogeologic characteristics of the aquifer, its water quality, and its connection with the environment and other aquifers. It also involves using data on recharge, river interaction, water levels, hydraulic properties, and pumping levels. Once the model is calibrated to accurately reproduce water levels measured in the past, it then can be used to make reasonable predictions on how water levels will change over time. The potential costs to conduct a GAM can range from $500,000 to $2,000,000 depending on the size of the aquifer and level of information available to input.

This document recommends that Louisiana develop a program to fund the development of aquifer-wide GAMs for the areas requiring immediate attention, specifically:

- The Sparta aquifer
- The Carrizo-Wilcox aquifer

This program may be extended to additional aquifers that have projected supply gaps.

6.3 Financial Viability Analysis and Cost Comparison of Alternatives

This section contains a general analysis of the financial viability and comparative cost of alternative projects intended to fill the estimated water supply gaps. Table 6-2 summarizes the current estimated water supply gaps for the five identified aquifers and Table 6-3 summarizes the proposed alternatives to mitigate the supply gaps.

Table 6-3 Alternative Water Supply Projects by Aquifer

Aquifer	Alternative
Chicot aquifer system	Wastewater recycling Reservoirs for rain harvesting
Jasper aquifer system	Wastewater recycling Reservoirs for rain harvesting Pipeline conveyance from Red River
Cockfield aquifer	Wastewater recycling Reservoirs for rain harvesting
Sparta aquifer	Wastewater recycling Reservoirs for rain harvesting Pipeline conveyance from Ouachita River/Lake D'Arbonne
Carrizo-Wilcox aquifer	Use of Red River or Red River alluvial aquifer Reservoirs for rain harvesting

These alternatives are subjected to financial viability analysis and cost comparisons in this section. This analysis assumes that the alternatives are scalable; that is, each can be scaled up sufficiently to meet the entire supply gap for a particular aquifer. Therefore, only one alternative is required (i.e., the lowest cost alternative) to fill the water supply gap each aquifer.

6.3.1 Methods

Estimation of Capital and Annual Operations and Maintenance Costs

The financial viability analysis and cost comparisons were developed using estimates of the capital and annual O&M costs for each alternative. Capital costs were estimated per million gallons of water supplied and annual O&M costs were estimated as a percentage of capital costs. Table 6-4 summarizes the estimated cost drivers for the applicable alternatives shown in Table 6-3.

Table 6-4 Estimates of Capital Cost per Million Gallons and Annual Operations and Maintenance Costs as a Percentage of Capital Costs for the Alternatives

	Alternative							
	Pipeline Transport from River to Terminal Point (e.g. Reservoir)		Reservoir Construction		Wastewater Recycling		Pumping and Conveyance from Unutilized Aquifer	
Aquifer	Capital Cost (Per Million Gallons)	Annual O&M Cost (% of Capital Costs)	Capital Cost (Per Million Gallons)	Annual O&M Cost (% of Capital Costs)	Capital Cost (Per Million Gallons)	Annual O&M Cost (% of Capital Costs)	Capital Cost (Per Million Gallons)	Annual O&M Cost (% of Capital Costs)
Chicot aquifer system			$5,875	0.12%	$5,629	13.70%		
Jasper aquifer system	$7,381	5.00%	$14,750	0.28%	$5,629	13.70%		
Cockfield aquifer			$14,750	0.28%	$5,629	13.70%		
Sparta aquifer	$7,381	5.00%	$14,750	0.28%	$5,629	13.70%		
Carrizo-Wilcox aquifer			$14,750	0.28%			$7,436	7.00%

E&E, 2011 (current study); Costs are based on RS Means, 2011; for details, refer Appendix F

Costing Methodology

The capital and O&M unit prices listed in Table 6-4 are planning level estimates and are intended to be high-level comparative costs between different alternative water source types. Similar existing and proposed projects in the region were evaluated to develop a mean average for the water supply alternatives based upon capital and O&M costs required for a certain water supply delivery.

The purpose of preparing costs for these alternatives is to compare the relative costs among the four alternatives. These costs are based on engineering judgment and review of other specific and similar project types. If any of these alternatives are carried forward, more detailed cost evaluations will need to be performed as the concepts and designs became more refined.

These planning level costs are estimates of the project costs, which include typical land acquisition, conflict resolution, environmental mitigation, permitting, design and engineering, construction, and contingency. Although not applied, cost variances should be for differences in specific site conditions.

The capital and O&M costs for reservoir construction, pipeline transport from a river to terminal point such as a reservoir, and pumping and conveyance from an unutilized aquifer were derived from the engineering cost estimates for proposed projects in the Comprehensive Sabine Watershed Management Plan (Freese and Nichols, 1999). The capital and O&M costs for wastewater recycling were based upon the 2009 Business Case for Funding of the West Monroe/Graphic Packaging's Wastewater Recycle Project.

Six reservoir projects were reviewed and grouped into projects delivering greater than 100,000 million gallons per year (MGY) (Waters Bluff and Carthage projects) and those delivering less than 100,000 MGY (Carl L. Estes, Big Sandy, Prairie Creek, and State Hwy 322). The average capital cost per MGY yield was calculated for the large and small reservoir projects. The average capital cost per MGY for reservoir projects less than 100,000 MGY was used in all of the aquifers except for the Chicot aquifer, which used the capital cost per MGY for projects greater than 100,000 MGY. The average capital cost per MGY in both cases was adjusted from 1999 costs to present day costs using RS Means 2011 cost index. O&M costs are presented as a percentage of capital costs. The large reservoir projects (>100,000 MGY) had an average capital cost per MGY of $3,735 ($5,875 per MGY present cost) with an annual O&M costs of 0.12% of capital cost. The small reservoir projects (<100,000 MGY) had an average capital cost of $9,376 per MGY ($14,750 per MGY present cost) with an annual O&M cost of 0.28% of capital costs.

Two pipeline transport projects were reviewed, which included an 87 mile project (Prairie Creek) and a 65 mile project (Highway 322). For both projects, Freese and Nichols prepared cost estimates for three different delivery capacity options (45, 67, and 89 million MGD, respectively). Therefore, six projects were reviewed, grouped by capacity (3 groups) and a respective capital cost per MGY was calculated for each project. For each group the capital cost per MGY was averaged and a corresponding present day cost adjustment was made using the RS Means 2011 cost index. O&M costs are presented as a percentage of capital costs. The average capital cost per MGY for pipeline transport projects in the 45 MGD (16,300 MGY) group was used in all of the aquifers except for the Chicot aquifer, which used the average capital cost per MGY for the larger pipeline project group with an 89 MGD (32,600 MGY) capacity. The average capital cost per MGY was $4,692 ($7,381 present cost) for 45 MGD capacity projects and $3,603 ($5,668 present cost) for 89 MGD capacity projects. The O&M costs were 5% and 4.64% of capital cost, respectively.

Upon review of the West Monroe/Graphic Packaging's Wastewater Recycle Project, the project would have a recycling capacity of 10 MGD at a capital cost of $20M ($5,479 per MGY) and an O&M cost of $0.75 per 1,000 gallons (13.7% of capital cost). These capital costs were converted to present day costs using RS Means 2011 cost index ($5,629 per MGY). O&M costs are presented as a percentage of capital costs.

6.3.2 Estimation of Free Cash Flows

The analysis of the financial viability of the alternatives is conducted using the free cash flows arising from the implementation of the alternatives. The free cash flows include the initial investment outlay on the project, the net cash inflows during its operation, and the net cash flows arising when the project comes to an end (Brigham and Gapenski 1994).

The "free" part of free cash flows relates to the fact that the cash flows that are analyzed do not reflect the financing structure for that project (e.g., loan repayments) because financing costs are implicitly taken into account through the discount rate applied to the cash flows (Lumby 1991). Free cash flows provide the best measure of the cash provided by a project (Benninga 2008). The components of a project's free cash flows are listed in Appendix F

The alternatives were analyzed on a stand-alone basis as if they were individually operated by a company. Free cash flows arising during a 26-year period starting in 2001 were estimated. The free cash flows were estimated in real (i.e., inflation adjusted) terms, in line with standard practice for such analyses. Their estimation involved the creation of a pro-forma income statement (i.e., a projected income statement) and the estimation of other cash flows using the estimates of the water supply gaps and capital and annual O&M costs in combination with certain general assumptions and some alternative-specific assumptions.

The general assumptions used in calculating free cash flows are listed in Table 6-5.

Table 6-5 General Assumptions Used in Estimating Free Cash Flows

Start Year	2011	Comment
Discount Rate:	5%	Per Jason El Koubi, Director of State Economic Competitiveness
Depreciation Rate	3.33%	Straight line over 30 years
Debt Financing	50%	Of total capital costs
Interest Rate on Debt	3.90%	Per year
Debt Term	20	Years
Receivables, Days Outstanding	30	Days of revenue
Payables, Days Outstanding	15	Days of annual operations and maintenance costs
Salvage Value	5%	Of total capital costs
Years Covered by Modeling	26	
Combined Federal and State Corporate Income Tax Rate	38.5%	

E&E, 2011 (current study)

These general assumptions are discussed in more detail in Appendix F.

The alternative-specific assumptions relate to the time required to construct the alternative and the time required thereafter for the alternative to achieve full production. These alternative-specific assumptions are shown in Table 6-6.

Table 6-6 Alternative-Specific Assumptions Used in Estimating Cash Flows

Aquifer	Alternative	Years to Construct	Years Required to Reach 100% Capacity
Chicot aquifer system	Wastewater recycling	5	2
	Reservoirs for rain harvesting	5	2
Jasper aquifer system	Wastewater recycling	5	2
	Reservoirs for rain harvesting	5	2
	Pipeline conveyance from Red River	5	2
Cockfield aquifer	Wastewater recycling	5	2
	Reservoirs for rain harvesting	5	2
Sparta aquifer	Wastewater recycling	5	2
	Reservoirs for rain harvesting	5	2
	Pipeline conveyance from Ouachita River	5	2
Carrizo-Wilcox aquifers	Use of Red River or Red River alluvial aquifer	5	2
	Reservoirs for rain harvesting	5	2

E&E, 2011 (current study)

This analysis assumes that equal quantities of cash would be expended in each year of construction and that output would increase in equal amounts each year during the production ramp up period.

Table 6-7, provided in Appendix F shows an example, for the wastewater recycling alternative in the Chicot aquifer system, of the financial model used to determine the financial viability and the cost of the alternatives. At the top of the table are listed the project parameters, such as water supplied per year, total capital costs, total annual O&M costs, years to construct, and years required to reach 100% capacity.

The remainder of the table is split into seven components. The first four components are the alternative cash flows as categorized by Brigham and Gapenski (1994). A detailed discussion of these four components is provided in Appendix 6.

The payback period of the project is the number of years before the alternative repays its original investment (Brigham and Gapenski 1994). In other words, it is the year in which the alternative's cumulative cash flows turn positive.

The internal rate of return is the discount rate that results in a present value of zero when applied to the alternative's net cash flows, and is also the rate of return on the investment in the alternative (Seitz 1990).

The net present value is the sum of the discounted values of the annual net cash flows (Seitz 1990). If it is greater than zero, then the alternative's net cash flows are more than sufficient to generate a rate of return greater than the discount rate. Conversely, a net present value of less than zero indicates that the alternative's net cash flows are insufficient to generate a rate of return greater than the discount rate. A net present value of zero indicates that the alternative's net cash flows are just sufficient to generate a rate of return equal to the discount rate.

It is not possible to know the price at which the water supplied by the alternatives will be sold. The water will be supplied to numerous retail water supply companies, each with their own tariffs and with their own specific mix of different types of customers (e.g., residential, commercial, industrial, municipal, and agricultural) paying different tariffs. So, instead, the financial model was used to calculate the minimum price at which the water would have to be sold to ensure that its net present value was zero (i.e., that the alternative's net cash flows are just sufficient to generate a rate of return equal to the discount rate). The Solver tool (i.e., a numerical optimization tool) in Excel 2010 was used to find the water price at which the financial model's net present value was zero.

A series of levelized values are shown at the bottom of Table 6-7. The purpose of the levelized cost of water, for instance, is to provide a universal measure of cost that can be applied to disparate water supply alternatives. Water supply alternatives differ in the distribution of their costs over time. Some are characterized by relatively high initial capital costs and low operating costs thereafter; and others are characterized by relatively low capital costs and relatively high O&M costs.

By levelizing the lifetime costs (i.e., all of the costs incurred throughout the lifetime of an alternative including initial capital costs, expected salvage value, fuel costs, O&M costs, replacement costs, etc.) of each supply alternative and normalizing those costs to provide levelized costs per unit of water produced (e.g. per thousand gallons), the levelized cost of water allows comparisons to be made between the cost of water from different supply alternatives.

The levelized cost of water supply is a constant cost per thousand gallons of water supplied, and can be calculated by finding L (the levelized cost) in the following formula[1]:

$$\sum_{t=0}^{n} \frac{\mathrm{L.Q_t}}{(1+\mathrm{r})^{\mathrm{t}}} = \sum_{t=0}^{n} \frac{\mathrm{C_t}}{(1+\mathrm{r})^{\mathrm{t}}}$$

Where:

L = Levelized cost of water
Q_t = Quantity of water produced in year t
r = Discount rate (5%)
= Year, starting with the first year (t = 0)
$_t$ = Non-discounted annual costs

Or:

$$\mathrm{PV(L.Q)=PV(C)}$$

Where:

PV(C) = Net present value of costs (sum of discounted costs)
PV(Q) = Net present value of the quantity of water produced (sum of discounted output)

1

Since L is the same in each year, multiplying the net present value of the quantity of water by L gives the same result as taking the net present value of $L.Q_t$ in each year. Consequently the above expression can be rearranged to yield:

$$L = PV(C)/PV(Q)$$

The levelized cost of water is calculated, therefore, by dividing the net present value of costs by the net present value of the output of water. The levelized revenue and profit per thousand gallons are calculated in a similar manner but by replacing the net present value of costs with the net present values of revenues and net cash flows, respectively.

In the case of the wastewater recycling alternative in the Chicot aquifer system, it can be seen that a price of $1.49 per thousand gallons of water is required to ensure its financial viability. With water at that price, the alternative has an internal rate of return of 5%, the net present value of net cash flows is zero, the levelized cost of water is also $1.49, the levelized profit is zero, and the payback period is 17 years.

Because the output of water is the same for all alternatives within an aquifer, the identification of the least cost alternative for meeting the supply gap can be made either on the basis of the net present value of costs or the levelized cost of water.

6.3.3 Sensitivity Analysis

The financial viability analysis of the alternatives relates to what is known as the "base case" analysis. The base case analysis represents the results of applying assumed values for the major quantifiable variables (e.g., costs, revenues) that affect the alternative's viability.

Because actual values are anticipated to differ from assumed values, a sensitivity analysis was undertaken. Sensitivity analysis involves examining the extent to which the viability of an alternative is affected by changes in the values of major quantifiable variables (e.g., a decline in the volume of water supplied).

The major variables considered in the sensitivity analysis are the volume of water supplied, capital costs, annual O&M costs and the time required for construction. In particular, the impacts of the following changes are considered:

1. A 10% decrease in the volume of water
2. A 10% increase in capital costs
3. A 10% increase in annual O&M costs
4. A one year delay in construction

A sensitivity index is used to show the relative size of the impact of each of the above-listed changes on an alternative's internal rate of return. The sensitivity index is calculated as the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume of water).

For each of the alternatives listed in Table 6-6, a financial model identical in design to that shown in Table 6-7 was constructed and the results from these models are discussed in this section.

Table 6-8 shows, for the base case for each alternative, the price of water that results in a 5% internal rate of return and the net present value of costs. The lowest cost alternative for each aquifer is shown in bold.

Table 6-8 Results of the Financial Analysis

Aquifer	Alternative	Net Present Value of Costs ($ Millions)	Water Price ($ per 1,000 Gallons)
Chicot aquifer system	Wastewater Recycling	$1,811	$1.49
	Reservoirs for Rain Harvesting	**$917**	**$0.75**
Jasper aquifer system	Wastewater Recycling	$442	$1.49
	Reservoirs for Rain Harvesting	$569	$1.92
	Pipeline Conveyance from Red River	**$388**	**$1.31**
Cockfield aquifer	Wastewater Recycling	**$17**	**$1.49**
	Reservoirs for Rain Harvesting	$21	$1.92
Sparta aquifer	Wastewater Recycling	$157	$1.49
	Reservoirs for Rain Harvesting	$202	$1.92
	Pipeline Conveyance from Ouachita River	**$138**	**$1.31**
Carrizo-Wilcox aquifers	Use of Red River or Red River alluvial aquifer	**$46**	**$1.47**
	Reservoirs for Rain Harvesting	$60	$1.92

E&E, 2011 (current study); Refer to Appendix F

The way in which costs were estimated results in the same price for water (in dollars per thousand gallons) for a given alternative across all five aquifers – with the exception of the lower costs for reservoirs in the Chicot aquifer system, which reflect the lower capital cost per million gallons and lower annual O&M costs associated with the large reservoirs proposed for that aquifer system. The lowest cost alternatives by aquifer are listed below:

- Chicot aquifer system - Reservoirs for rain harvesting;
- Jasper aquifer system - Pipeline conveyance of Red River water;
- Cockfield aquifer - Wastewater recycling;
- Sparta aquifer - Pipeline conveyance of Ouachita River water; and
- Carrizo–Wilcox aquifer – Use of Red River water or Red River alluvial aquifer.

Table 6-9 shows the results of the sensitivity analysis.

Table 6-9 Results of the Sensitivity Analysis

Aquifer	Alternative	Base Case	10% Lower Volume	10% Higher Capital Costs	10% Higher Operations and Maintenance Costs	One Year Construction Delay
Chicot aquifer system	Wastewater Recycling	5.0%	**3.4% (3.2)**	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rain Harvesting	5.0%	**4.2% (1.5)**	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
Jasper aquifer system	Wastewater Recycling	5.0%	**3.4% (3.2)**	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rain Harvesting	5.0%	**4.2% (1.5)**	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
	Pipeline Conveyance of Red River Water	5.0%	**4.0% (2.1)**	4.3% (1.3)	4.7% (0.6)	4.5% (0.5)
Cockfield aquifer	Wastewater Recycling	5.0%	**3.4% (3.2)**	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rain Harvesting	5.0%	**4.2% (1.5)**	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
Sparta aquifer	Wastewater Recycling	5.0%	**3.4% (3.2)**	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rain Harvesting	5.0%	**4.2% (1.5)**	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
	Pipeline Conveyance of Ouachita River Water	5.0%	**4.0% (2.1)**	4.3% (1.3)	4.7% (0.6)	4.5% (0.5)
Carrizo-Wilcox aquifer	Red River/Use Red River Alluvial Aquifer	5.0%	**3.8% (2.3)**	4.3% (1.3)	4.6% (0.8)	4.5% (0.5)
	Reservoirs for Rain Harvesting	5.0%	**4.2% (1.5)**	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)

E&E, 2011 (current study); Refer to Appendix F

By design, the internal rate of return for the base case is 5% for all alternatives. The percentage figures are the internal rates of return and the figures in parentheses are the sensitivity index values (i.e., the percentage changes in the internal rate of return divided by the percentage changes in the parameters of interest).

For all alternatives, the internal rate of return, and hence the financial viability of the alternatives, is most sensitive to a decline in the volume of water. Because the changes in capital cost and the construction delay of one year cause the same proportionate changes in net cash flows in each year irrespective of the alternative, the impacts on the internal rates of return and sensitivity index values are the same across all alternatives.

6.4 Potential Funding Sources

This plan identifies and summarizes federal, state, and local funding sources that could be applied to fund the following water infrastructure alternatives:

- Pipeline conveyance of surface water,
- Surface water recharge,
- Rainwater harvesting, and
- Wastewater recycling.

Table 6-10 provides a description of these programs and their potential applicability to funding these alternatives in Louisiana. Each of these funding sources was subjectively assessed in regard of its potential applicability in Louisiana in implementing the identified alternatives.

Table 6-10 Summary of Potential Funding Sources for Alternatives (E&E, 2011; this study)

	Program Description	ALTERNATIVES			
		Pipeline Conveyance Of Surface Water	Surface Water Recharge	Rainwater Harvesting	Wastewater Recycling
FEDERAL PROGRAMS					
Public Works and Economic Development Program www.eda.gov/AboutEDA/Programs.xml	CFDA No. 11.300. The Economic Development Administration was created by Congress pursuant to the Public Works and Economic Development Act of 1965 to provide financial assistance to both rural and urban distressed communities.	PA	PA	PA	PA
United States Department of Agriculture (USDA) www.rurdev.usda.gov	Water and Environmental Program issues grants and loans to create a sustainable long-term water supply. Other improvements include installation of water meters to improve billing and support water conservation efforts, upgrade pups, emergency generators, and loop existing water lines to improve service	A	A	A	A
USDA Rural Development's Water and Environmental Program (WEP) - http://www.rurdev.usda.gov/tx/ USDA Technical Assistance and Training http://www.usda.gov/rus/water/tag.htm	The objectives of the Technical Assistance and Training Grant Program are to: identify and evaluate solutions to water and waste disposal problems in rural areas, assist applicants in preparing applications for water and waste grants made at the State level offices, and improve operation and maintenance of existing water and waste disposal facilities in rural areas. Rural areas are defined as any areas not in a city or town with a population in excess of 10,000 according to the latest decennial census of the U.S. RUS is designed for private, non-profit organizations. RUS provides financial and technical assistance to help communities bring safe drinking water and sanitary, environmental sound waste disposal facilities to rural Americans. RFP grant funds are awarded to establish a lending program for eligible entities. Eligible entities for the revolving fund will be the same entities eligible to obtain a loan, loan guarantee, or grant from the Water and Waste Disposal loan and grant programs.	A	A	A	A
Natural Resource Conservation Service (NRCS) Watershed and Flood Development Program www.nrcs.usda.gov/programs/watershed/index.html Flood Prevention Authorized by Public Law 534	The Flood Control Act of 1944 authorizes the Secretary of Agriculture to install watershed improvement measures to further the conservation, development, utilization, and disposal of water. The Public Works and Water Resources Section provides engineering support and advice for local sponsors and financial cost sharing for the development of watershed improvement projects in conjunction with the U.S. Department of Agriculture, Natural Resources and Conservation Service Plans.	AI	PA	PA	PA
Watershed Operations Authorized by Public Law 566	The Watershed Protection and Flood Prevention Act of 1954 provide cooperation between federal and state governments to further the conservation, development, utilization, and disposal of water. Under the Watershed Program NRCS cooperates with States and local agencies to carry out works of improvement for soil conservation and other purposes including flood prevention, conservation, development, utilization and disposal of water; and conservation and proper utilization of land. These programs have similar objectives and qualifying criteria.	A	A	A	A
United States Army Corps of Engineers Water Resources Development Act U.S. Army Corps of Engineers Water Development Program http://www.dotd.la.gov/intermodal/division/water/Proj_Review.aspx	The Water Resources Development Act of 1992 (WRDA 1992), Pub. L. 102-580, was enacted by Congress of the United States on October 31, 1992. [1] Most of the provisions of WRDA 1992 are administered by the United States Army Corps of Engineers. The authorization enables the Public Works and Water Resources Section to: provide for the State's coordination, and local assurance to the US for federal water development projects; present the State's viewpoint by negotiating feasibility, scope, funding, design, operation and maintenance of projects; coordinate with other state agencies and the federal government; and to ensure the State and local viewpoints are incorporated in the federal program. The section is responsible for presenting the flood control, hurricane protections, navigation and water resources concerns of the State at various public hearings including the Mississippi River Commission's high and low water inspections. Increasingly, the Department will act as the non-federal sponsor for water resources development projects.	A	A	A	A
US Fish and Wildlife Service Wetland conservation matching grants program http://www.fws.gov/coastal/CoastalGrants/	The National Coastal Wetlands Conservation Grant Program was established by Title III of P.L. 101-646, Coastal Wetlands Planning, Protection and Restoration Act of 1990. Under the Program, the U.S. Fish and Wildlife Service provides matching grants to States for acquisition, restoration, management or enhancement of coastal wetlands. The Act also establishes a role for the Fish and Wildlife Service in interagency wetlands restoration and conservation planning in Louisiana. To date, about $183 million in grant monies have been awarded to 25 coastal States and one U.S. Territory and to acquire, protect or restore over 250,000 acres of coastal wetland ecosystems. Typically, between $13 million and $17 million in grants are awarded annually through a nationwide competitive process. Funding for the program comes from excise taxes on fishing equipment and motorboat and small engine fuels. States provide 50 percent of the total costs of a project. If, however, the State has established and maintains a special fund for acquiring coastal wetlands, other natural areas or opens spaces, the Federal share can be increased to 75 percent. Territories and Commonwealths are not required to share the costs of projects except for Puerto Rico. Grants awarded under the National Coastal Wetlands Conservation Grant Program cannot exceed $1 million for an individual project. Projects are selected based on ranking factors contained in Title 50, Part 84 of the Code of Federal Regulations (CFR). The Act itself provides that projects will be given priority if they are: Consistent with the National Wetlands Priority Conservation Plan. Located in States with dedicated land acquisition programs. Located in maritime forests on coastal barrier islands. Additional ranking factors developed by the Service include giving credit to projects that benefits to threatened and endangered species, promote partnerships, and support conservation and recovery programs. The program will not provide grants to support planning, research, monitoring activities, or construction or repair of structures for recreational purposes.	AI	PA	PA	NA

Table 6-10 Summary of Potential Funding Sources for Alternatives (E&E, 2011; this study)

		ALTERNATIVES			
	Program Description	**Pipeline Conveyance Of Surface Water**	**Surface Water Recharge**	**Rainwater Harvesting**	**Wastewater Recycling**
United States Environmental Protection Agency Clean Water Act, Section 319 State Revolving Fund Program www.epa.gov/owow/nps/sec319cwa.html	The United States Environmental Protection Agency (EPA) administrator shall make cost sharing grants under this subsection to such States for the purpose of assistance in carrying out groundwater quality protection activities that will advance the State toward implementation of a comprehensive nonpoint source pollution control. The federal share of the cost of each management program implemented with federal assistance under this subsection in any fiscal year shall not exceed 60% of the cost incurred by the State. The program is to assist States that have implemented or proposing to implement management programs that will control particularly difficult or serious nonpoint source pollution problems, implement innovative methods or practices for control of nonpoint sources of pollution, and carry out groundwater quality protection activities which the Administrator determines are part of a comprehensive nonpoint source pollution control program including research, planning, groundwater assessments, demonstration programs, enforcement, technical assistance, education, and training to protect groundwater quality from nonpoint sources of pollution.	A	A	A	A
Pollution Prevention Grant Program EPA, Office of Prevention, Pesticides and Toxic Substances, Office of Pollution Prevention and Toxics www.epa.gov/p2/pubs/grants/ppis/ppis.htm	The Pollution Prevention (P2) grant program supports state and tribal technical assistance programs which help businesses identify better environmental strategies and solutions for recurring or eliminating waste at the source. Awards are issued and managed by EPA's Regional Pollution Prevention Program Office. Criteria for a P2 grant in Region 6 are to promote projects that use P2/source reduction techniques and strategies (e.g., energy efficiency, lean and green) and achieve measurable results by reducing pollution. P2 grant recipients must provide at least 50% match of the total allowable project cost.	AI	AI	PA	PA
United States Environmental Protection Agency Water Quality Management Planning (66.454)	Objective is to assist States, Regional Public Comprehensive Planning Organizations (RPCPOs) and Interstate Organizations in carrying out water quality management (WQM) planning. Grant funds are used to determine the nature and extent of point and non-point water pollution and to develop water quality management plans. States are encouraged to give priority watershed restoration planning.	PA	PA	PA	PA
United States Environmental Protection Agency Public Water System Supervision (PWSS) Grant Program	Since 1976 EPA has annually received a Congressional appropriation under section 1443(a) of the Safe Drinking Water Act (SDWA) to assist states, territories, and tribes in carrying out their Public Water System Supervision programs. Designated state agencies in the 50 states, receive grants. Currently, all states and territories have been delegated authority, with the exception of Wyoming and the District of Columbia (neither of which has sought delegation. Funds allotted for a State, Territory, or Indian Tribe that does not have an approved Primacy Program is used by EPA for the operation of a program in that jurisdiction. These grants help eligible states, territories, and tribes develop and implement a PWSS program adequate to enforce the requirements of the SDWA and ensure that water systems comply with the National Primary Drinking Water Regulations. Key activities carried out under a PWSS program include: developing and maintaining state drinking water regulations; developing and maintaining an inventory of public water systems throughout the state; developing and maintaining a database to hold compliance information on public water systems; conducting sanitary surveys of public water systems; reviewing public water system plans and specifications; providing technical assistance to managers and operators of public water systems; carrying out a program to ensure that the public water systems regularly inform their consumers about the quality of the water that they are providing; certifying laboratories that can perform the analysis of drinking water that will be used to determine compliance with the regulations; and carrying out an enforcement program to ensure that the public water systems comply with all of the state's requirements.	PA	AI	PA	PA
United States Environmental Protection Agency Underground Injection Control (UIC) Program:	Each year, grant money is allocated to help UIC Programs enforce the minimum federal UIC requirements. These funds are authorized by Congress under Section 1443 of the Safe Drinking Water Act (SDWA). These state and tribal assistance grants are distributed by the national UIC Program. The annual amount of the grant varies slightly but is approximately $11 million per year. The grant allotment formula is based on criteria identified in the SDWA. The formula directs available resources toward the highest risk wells in order to achieve the maximum level of public health protection. The formula considers: Well status. The inventory of injection wells in classes I to IV that is active, temporarily abandoned, or under construction is included in the formula. The number of Class V wells is temporarily held constant in the formula because of the difficulties in verifying the inventory. Well type. The grant formula targets classes of wells that have the greatest potential to contaminate an Underground Source of Drinking Water (USDW) and threaten public health — in particular, Class IV wells (inject hazardous wastes directly into or above USDWs) and Class I wells (inject hazardous, industrial, and municipal wastes below USDWs). State population. The number of people to be protected from the risks posed by injection activities has an effect on the grant allocation. State size. This variable influences resources needed to maximize field activities such as inspections of permitted facilities to ensure compliance with safe operating requirements or to locate and address endangering injection wells.	NA	PA	NA	PA

Table 6-10 Summary of Potential Funding Sources for Alternatives (E&E, 2011; this study)

	Program Description	ALTERNATIVES: Pipeline Conveyance Of Surface Water	Surface Water Recharge	Rainwater Harvesting	Wastewater Recycling
Water Quality Cooperative Agreements (66.463) Public Law 92-500 www.federalgrantswire.com/water-quality-cooperative-agreements.html	To assist States, Indian Tribes, interstate agencies, and other public or nonprofit organizations in developing, implementing, and demonstrating innovative approaches relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution through both permitted and non-permitted areas. Funding priorities include, but are not limited to: watershed approaches for solutions to wet weather activities (i.e., combined sewer overflow, sanitary sewer overflows, storm water discharge, and animal feeding operations); pretreatment and bio-solids (sludge) program activities, decentralized systems; and alternative ways to enhance or measure the effectiveness of point source programs. Trading, water efficiency, asset management, and sustainable infrastructure are also areas of consideration. This program has no statutory formula, no matching requirements and does not have MOE requirements.	AI	PA	A	A
U.S. Department of the Interior | Bureau of Reclamation SECURE Water Act http://www.usbr.gov/WaterSMART/	Under the legislation, the Bureau of Reclamation would initiate a climate change adaptation program to study and address water shortages and other climate change-related impacts on water users. The Bureau would also be authorized to offer grants to states and localities within its jurisdictional area to construct improvements that increase water conservation and efficiency or to develop advanced treatment technologies that boost water supplies. Other portions of the bill require an expansion of the National Stream flow Information Program, the development of a systematic groundwater-monitoring program, the formation of a water use and availability assessment program, and the creation of an intra-governmental panel to connect the members of the scientific community and water managers who can work together to improve water availability forecasts and to implement adaptation strategies. To implement the SECURE Water Act, and ensure that the Department of the Interior is positioned to meet these challenges, Secretary Salazar established the WaterSMART program in February 2010. WaterSMART allows all bureaus of the Department to work with States, Tribes, local governments, and non-governmental organizations to pursue a sustainable water supply for the Nation by establishing a framework to provide federal leadership and assistance on the efficient use of water, integrating water and energy policies to support the sustainable use of all natural resources, and coordinating the water conservation activities of the various Interior offices. Reclamation plays a key role in the WaterSMART program as the Department's main water management agency. Focused on improving water conservation and helping water and resource managers make wise decisions about water use, Reclamation's portion of the WaterSMART program is achieved through administration of grants, scientific studies, technical assistance and scientific expertise.	AI	PA	PA	PA
American Recovery and Reinvestment Act of 2009, Public Law 111-5; Water Quality Act of 1987, Public Law 100-4; Clean Water Act, Section 205(j)&604(b), Public Law 97-117.Public Law 97-117 www.federalgrantswire.com/water-quality-management-planning.html	To assist States (including territories and the District of Columbia), Regional Public Comprehensive Planning Organizations (RPCPOs), and Interstate Organizations (IOs) in carrying out water quality management (WQM) planning. Funding Priority - Fiscal Year 2010: Funds are allotted by State in accordance with Section 604(b) of the Clean Water Act. Grant funds are used to determine the nature and extent of point and non-point source water pollution and to develop water quality management plans. States are encouraged to give priority to watershed restoration planning. EPA is requesting States to emphasize a watershed approach in developing their State work plans. This will complement the Agency's overall watershed effort as stated in the Agency's Strategic Plan. Grant funds to determine the nature and extent of point and non-point source water pollution and to develop water quality management plans were also made available under the American Recovery and Reinvestment Act (Recovery Act) of 2009. EPA encouraged States to use Recovery Act funds to conduct appropriate planning activities with regard to green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities.	AI	AI	AI	AI
Water Pollution Control-State and Interstate Program Support (66.419) Public Laws 95-217, 33 USC1251 www.federalgrantswire.com/water-pollution-controlstate-and-interstate-program.support.html	The objective of this program is to assist States and interstate agencies in establishing and maintaining adequate measures for prevention and control of surface and groundwater pollution from both point and non-point sources. In efforts for States to continue to focus on fulfilling their basic CWA responsibilities and based upon a shared understanding with EPA, states will identify and prioritize program activities that will best support environmental improvements. State priority efforts include: implementing monitoring strategies and the statistically valid surveys to determine water quality status and trends; fostering a watershed approach, including TMDLs and watershed plans designed to meet water quality standards; and implementing concentrated animal feeding operations and storm water permitting programs.	NA	PA	PA	PA
STATE OF LOUISIANA PROGRAMS					
Louisiana Community Development Authority – Environmental Facilities Bonds http://www.louisianacda.com/index.htm http://www.louisianacda.com/assets/ http://www.louisianacda.com/assets/lcda-rules.pdf	Funds used to finance water supply infrastructure in support of the Plan could also be sourced from the Louisiana Community Development Authority bond programs. The mission of the Authority is "to provide economic development, infrastructure, and environmental facilities, to assist political subdivisions in constructing, extending, rehabilitating, repairing, and renewing infrastructure and environmental facilities, and to assist in the financing of such needs by political subdivisions of this state".	A	A	A	A
State of Louisiana, DOA, Office of Facility Planning and Control http://doa.louisiana.gov/fpc/qualitifications.htm Capital Outlay Program www.dotd.la.gov/intermodal/division/water/public_assistance.aspx	Capital Outlay Bonds provides source of funding for public improvement type projects not eligible for funding through any of the dedicated funding programs. The funds are provided through the sale of State General Obligation Bonds and can be used for acquiring lands, buildings, equipment or other properties, or for their preservation or development of permanent improvements. DOTD will assist local governments in the preparation of Capital Outlay applications.	A	A	A	A

Table 6-10 Summary of Potential Funding Sources for Alternatives (E&E, 2011; this study)

		ALTERNATIVES			
	Program Description	**Pipeline Conveyance Of Surface Water**	**Surface Water Recharge**	**Rainwater Harvesting**	**Wastewater Recycling**
State of Louisiana's Intended Use Plan (IUP) Clean Water State Revolving Loan Fund (CWSRF)	Available revenues consist of the cash balance forwarded from the previous year, federal grants, state matching funds, interest earnings on loans, administrative fee and investments, and principal repayments. The plan uses grant proceeds and cash available to provide below market rate loans on eligible projects, to protect human health, improve the water quality and economic viability of Louisiana's rivers, lakes and groundwater, to assist in hurricane recovery, and to administer the CWSRF program. The program, administered by the Louisiana Department of Environment Quality (LDEQ), will pursue loans, refinancing of debt, and cooperative endeavors to assist in meeting the goals of the CWSRF. The State of Louisiana agrees to provide match monies in an amount equal to 20% of each grant payment. The State's Project Priority List is used to obtain SRF funding. A project must have water quality improvement or protection health as its intended result to be eligible for SRF assistance.	AI	A	A	A
Drinking Water Revolving Loan Fund (DWRLF) www.dhh.louisiana.gov/offices/page.asp?id=203&detail=5707	DWRLF, created by Louisiana state legislation and legislation by the U.S. Congress, assist public water systems in financing needed drinking water infrastructure improvements (treatment plants, distribution main replacement, and storage facilities). The DWRLF is administered by the Louisiana Department of Health and Hospitals (LDHH), Office of Public Health (OPH). Similar to CWSRF administered by LDEQ, the program provides low-interest loans for eligible water system projects. The program provides a significant financial incentive for public water supplies to upgrade treatment facilities to meet current and future regulatory requirements designed to protect public health and to rehabilitate and/or replace aging infrastructure. The funds are available to both publicly and privately owned community water systems and non-profit, non-community publicly owned water systems.	AI	A	A	A
Louisiana Department of Transportation and Development Public Works and Water Resources Section www.dotd.la.gov/intermodal/division/water/Proj_Review.aspx	The Public Works and Water Resources Section provides engineering support and advice for local sponsors and financial cost sharing for the development of watershed improvement projects in conjunction with the U.S. Department of Agriculture, NRCS programs (see above).	AI	PA	PA	PA
Louisiana's Community Development Block Grant www.doa.louisiana.gov/cdbg/brochure.htm	Community Development Block Grant (The State has a two-year funding cycle for housing and public facilities applications. The primary objective of Louisiana's Community Development Block Grant Program is to provide assistance to units of general local government in non-entitlement areas for the development of viable communities by providing decent housing and a suitable living environment and expanding economic opportunities, principally for persons of low and moderate income. Non-entitlement areas are municipalities with a population of less than 50,000 and parishes with an unincorporated population of less than 200,000. Each activity funded under the CDBG Program must address one of the following three national objectives: Principal benefit to low and moderate income persons (at least 51 percent); elimination or prevention of slums and blight; and urgent need.	NA	NA	NA	NA
Louisiana's Community Development Block Grant www.doa.louisiana.gov/cdbg/brochure.htm Public Facilities	To improve or construct new water systems (potable and fire protection), sewer systems, residential streets and to construct multi-purpose community centers. Funds Available - Approximately $19 million Maximum Grant Amounts - $1,000,000 (sewer treatment), $800,000 (sewer collection rehabilitation), $800,000 (new sewer system), $500,000 (fire protection), $800,000 (potable water), $600,000 max. and $150,000 min. (streets), $800,000 (multi-purpose community center) Funding Criteria - (a) At least 51 percent of the beneficiaries served by the projects must be of low/moderate income. (b) Water and sewer projects must remedy existing conditions which violate a state or federal standard established to protect public health and safety.	AI	PA	PA	PA
Louisiana's Community Development Block Grant www.doa.louisiana.gov/cdbg/brochure.htm Housing	To provide safe and sanitary living conditions. Funds Available - $5,000,000 (including rehabilitation/reconstruction and physical accessibility). Maximum Grant Amount - $700,000 (rehabilitation/reconstruction) and $200,000 (physical accessibility) Funding Criteria - (a) all units to be rehabilitated or replaced must be owned and occupied by low/moderate income persons; (b) the number of housing target areas may not exceed two; (c) at least 75 percent of the needs in the identified target area must be addressed.	NA	NA	NA	NA
Louisiana's Community Development Block Grant www.doa.louisiana.gov/cdbg/brochure.htm Demonstrated Needs	To alleviate critical/urgent community needs involving improvements to existing water, sewer, and gas systems Funds Available - $1 million Maximum Grant Amount - $250,000 Funding Criteria - (a) must address a critical/urgent need that developed within three months prior to the submittal of the application; (b) at least 51 percent of the beneficiaries served by the system must be of low/moderate income.	PA	PA	PA	PA
LaSTEP	To solve water and sewer problems through the Small Towns Environmental Program (STEP) self-help techniques. Funds Available - $500,000 Maximum Grant Amount - $500,000 Funding Criteria - (a) proposed activities can be completed through self-help; (b) self-help methods will result in significantly reduced project cost; (c) applicant is totally committed to utilizing self-help; (d) at least 51 percent of the beneficiaries served by the system must be of low/moderate income.	PA	PA	PA	PA

Table 6-10 Summary of Potential Funding Sources for Alternatives (E&E, 2011; this study)

		ALTERNATIVES			
	Program Description	**Pipeline Conveyance Of Surface Water**	**Surface Water Recharge**	**Rainwater Harvesting**	**Wastewater Recycling**
Economic Development	To provide loans to local governing bodies that will assist a for-profit business and to provide grants to local governing bodies for infrastructure improvements that will assist a for-profit business. Funds Available - $4 million. Maximum Grant Amount - $639,000 (loan or grant or loan/grant combination for the creation of a new business), no funding ceiling (loan or loan/grant combination for the expansion of an existing business), $1,039,000 (grant for infrastructure improvements) Funding Criteria - (a) Loan - the State will fund up to 80 percent of value; (b) Grant - private funds/public funds ratio must be 1:1; (c) cost per job created or retained cannot exceed $15,000 for a loan or $10,000 for a grant; (d) minimum of ten jobs must be created or retained; (e) at least 51 percent of the employment will be made available to persons who at the time of their employment have a family income that is at or below the low/moderate income limit; (f) project must be feasible from management, marketing, financial, and economic standpoints.	PA	PA	PA	PA
Office of Community Development Local Government Assistance Program	The Local Government Assistance Program (LGAP) was established to fill the gaps where there are no federal funds available for needed infrastructure and long-term capital improvements in rural areas which will identify and resolve basic human health and safety needs. All Louisiana parishes are eligible for the LGAP except the following HUD entitled cities: Alexandria, Baton Rouge, Bossier City, Kenner, Lafayette, Lake Charles, Monroe, New Orleans, and Shreveport. Grant ceilings are based on population ranges as follows: Villages 1-999 $25,000 Towns 1,000-4,999 $35,000 Cities 5,000-35,000 $50,000 Parishes are eligible for up to $100,000. If a parish's communities' combined maximum ceiling amounts are less than the allocation for the entire parish area, the parish can then apply for more than $100,000. Eligible projects and activities include, fire protection, sewer, water, renovations to essential government buildings, police protection, land acquisition, demolition, equipment, roads, drainage, and reasonable engineering costs.	AI	AI	AI	AI
Special Interest Groundwater Advocacy Grants www.ngwa.org/programs/affiliate/grant_program.aspx	This matching grant program is available for public awareness and legislative initiatives on key groundwater issues. The match expectation is proportionate to fees that Affiliated State or Associated State Society organizations paid to NGWA and the total number of the state association membership. For memberships between 1 and 50, the state association must match 33% of the NGWA funds. For memberships 51-100, the match is 50%. For memberships of 101-200, the match is 77%; and 200 members or more the match is 100%.	PA	PA	PA	PA
LA. REV. STAT. §§ 48:2072 (C), (D)48:2084 to 48:2084.15	LA. REV. STAT. §§ 48:2072 (C), (D)48:2084 to 48:2084.15 authorizes the Louisiana Transportation Authority to pursue PPPs for transportation facilities, including ferry, mass transit, rail or similar systems.	AI	AI	AI	AI

With 85% of the nation's water infrastructure serviced by the public sector, the burden to finance new programs and upgrades rests mainly on municipalities, local communities, and ultimately, state and local governments. To assist, the federal government has set up funds to help finance the programs and upgrades, such as the Clean Water State Revolving Fund (see Table 6-10 for details), which was established in 1987. This fund enables state and local governments to get low interest loans in order to fix aging wastewater treatment facilities and sewer pipes. States are required to provide matching funds of least 20%.

Additional funding mechanisms and measures have been proposed, such as The Water Quality Financing Act of 2007 (H.R. 720), which would commit $14 billion to communities for fixing their antiquated infrastructure. Cities also have the option to apply for municipal bonds to finance their work. Other solutions point to the private-sector funding, by which private-sector companies invest the money needed for water and/or wastewater infrastructure improvements.

Public-Private Partnerships

Public-Private Partnerships (PPP) has been used in many communities and with private sector companies assist in the design, rebuilding, and operation of publicly-owned water and wastewater systems.

A PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical, and operational risk in the project. In some types of PPP, the cost of using the service is borne exclusively by the users of the service and not by the taxpayer. In other types (notably the private finance initiative), capital investment is made by the private sector on the strength of a contract with government to provide agreed services and the cost of providing the service is borne wholly or in part by the government. Government contributions to a PPP may also be in kind (notably the transfer of existing assets).

In projects that are aimed at creating public goods like in the infrastructure sector, the government may provide a capital subsidy in the form of a one-time grant, so as to make it more attractive to the private investors. In some cases, the government may support the project by providing revenue subsidies, including tax breaks or by providing guaranteed annual revenues for a fixed period.

Typically, a private sector consortium forms a special company called a "special purpose vehicle" (SPV) to develop, build, maintain, and operate the asset for the contracted period. In cases where the government has invested in the project, it is typically (but not always) allotted an equity share in the SPV. The consortium is usually made up of a building contractor, a maintenance company, and bank lender(s).

It is the SPV that signs the contract with the government and with subcontractors to build the facility and then maintain it. In the infrastructure sector, complex arrangements and contracts that guarantee and secure the cash flows make PPP projects prime candidates for project financing.

An example of a successful PPP water infrastructure project is the 2008 commissioning of the 25 MGD Tampa Bay Desalination Plant completed by American Water-Acciona Agua and owned by Tampa Bay Water, the wholesale water developer and supplier that serves the Greater Tampa Bay region. The Tampa Bay Seawater Desalination Plant decreased the use of groundwater from 158 MGD to 90 MGD, meeting its primary project objective. This is largest desalination plant in the United States is now used as a model for multiple coastal areas.

The federal government has no unified PPP policy and programs, as each department has its own unique statutory and regulatory framework to implement PPP, with general guidance set by the Office of Management and Budget.

At the state level only 23 states have legislation in place authorizing PPP. For example, in Louisiana, R.S. §§ 48:2072 (C), (D)48:2084 to 48:2084.15 authorizes the Louisiana Transportation Authority to pursue PPPs for transportation facilities, including ferry, mass transit, rail, or similar systems.

This plan recommends that legislation be enacted to provide the appropriate water authority(s) the ability to pursue PPP to fund water infrastructure projects.

USEPA Financing Alternatives Comparison Tool (FACT)

The Financing Alternatives Comparison Tool (FACT) is a financial analysis tool developed by the USEPA and available on-line (that helps identify the most cost-effective method to fund a wastewater or drinking water management project. This tool produces a comprehensive analysis that compares various financing options for these projects by incorporating financing, regulatory, and other important costs (http://water.epa.gov/grants_funding/cwsrf/fact.cfm.)

FACT creates a variety of useful reports to effectively communicate the results of a comprehensive analysis. A summary report is provided, which compares various financing options using key financial figures. This tool can also create graphical comparisons of annual and total costs of various financing options over time. FACT will aid municipalities, utilities, and environmental organizations in selecting the best financing option to fund their water quality and drinking water projects.

State Programs for Funding Water Infrastructure Examples

Various nationwide water infrastructure projects were selected describing the nature and scope as well as the funding approach taken by the sponsoring entities. What appears to be a common theme is all projects took advantage of federal and state programs to fund all of part of the project.

California's Water Independence Now (WIN) Program

Scope: Water Replenishment District (WRD) of Southern California's Water Independence Now (WIN) Program is a suite of projects that will develop local resources to eliminate up to 26,000 acre-feet per year (AFY) of imported water demand and allow southern Los Angeles County independence from its historical reliance on Northern California and the Colorado River for its supply of replenishment water to recharge the Central and West Coast groundwater basins within WRD's service area, and the main San Gabriel, and Orange County groundwater basins within partnering agency service areas.

WIN includes projects to increase the use of stormwater and recycled wastewater for indirect potable use by means of groundwater recharge and seawater intrusion prevention. These multi-benefit projects will beneficially use water currently discharged to the ocean, develop local water infrastructure to sustain potable supply, and reliably protect water quality in the area basins.

Funding: WRD is partnering and seeking to share costs with local, state, and federal agencies. USACE is assisting WRD and Los Angeles County Flood Control District on funding strategies on the Whittier Narrows Conservation Pool project. The U.S. Bureau of Reclamation awarded Title XVI American Recovery and Reinvestment Act of 2009 (ARRA) funding to the Vander Lans Expansion project. WRD will receive planning grants from the State Water Resources Control Board for GRIP and Vander Lans Expansion. Two of the four WIN projects (Whittier Narrows Conservation Pool and Leo J. Vander Lans Expansion) are currently in the Greater Los Angeles County Integrated Regional Water Management (IRWM) top ten projects to be recommended to Department of Water Resources to receive funding in the first round of Proposition 84.

Orange County, California, Groundwater Replenishment Program

Scope: The Groundwater Replenishment System (GWRS), the world's largest wastewater purification system for indirect potable reuse, takes highly treated wastewater that would have previously been discharged into the Pacific Ocean and purifies it using a three-step advanced treatment process consisting of microfiltration, reverse osmosis, and ultraviolet light and hydrogen peroxide. The process produces high-quality water that exceeds all state and federal drinking water standards. Operational since January 2008, this state-of-the-art water purification project can produce up to 70 million gallons of high-quality water every day. This is enough water to meet the needs of nearly 600,000 residents in north and central Orange County, California.

Funding: Federal, state and local funding totaling $92.8 million was secured for the project. Grants included $37 million from the State Water Bond (Proposition 13) approved by California voters in 2000, $30 million from the California Department of Water Resources, $5 million from the State Water Resources Control Board awarded in 2002, $20 million from the U.S. Bureau of Reclamation's Title XVI program, $300,000 from the California Energy Commission, and $500,000 from the Environmental Protection Agency. Orange County Water District and Orange County Sanitation District (OCWD and OCSD respectively) cost shared the remaining $388 million. Two public agencies have worked together for more than 30 years.

California's Local Groundwater Management Assistance Act of 2000

Scope: The State of California Department of Water Resources (DWR) provides grant funds and low-interest loans for local groundwater management and monitoring programs to help local agencies better understand how to manage groundwater resources effectively to ensure the safe production, quality, and storage of groundwater in the State.

Eligible projects include groundwater studies, groundwater monitoring, and groundwater basin management.

Texas Groundwater Conservation Districts

Scope: The Texas Legislature provided a way for groundwater resources to be managed and protected locally, through the creation of groundwater conservation districts (GCDs). A GCD is a local unit of government authorized by the Texas Legislature and ratified at the local level to manage and protect groundwater. Groundwater conservation districts were first created in Texas in 1949. In 1951, the High Plains Groundwater Conservation District became the first local district.

In 1985, 1997, and 2001, the Texas Legislature passed additional laws to encourage the establishment of more GCDs. This legislation is codified in Chapter 36 of the Texas Water Code. The water code stresses the importance and responsibility of GCDs in developing and implementing comprehensive management plans to conserve and protect groundwater resources.

By law, GCDs must develop a groundwater management plan. A management plan outlines the GCD's goals and the steps needed to reach those goals. The plan must be developed in coordination with appropriate surface water management entities. The goals of a management plan are to:

- Provide for the most efficient use of groundwater;
- Control and prevent waste of groundwater;
- Control and prevent subsidence;
- Address conjunctive surface water issues;
- Address natural resources issues;
- Address drought conditions; and
- Address conservation

Funding: The primary methods used by districts to finance their operations include property taxes, well production fees, and administrative fees for well permits and export permits. By statute, most districts may levy taxes if the tax is approved by majority vote at an election in the district held for that purpose. Districts may also accept outside funding for their operations in the form of grants and loans (Texas Water Code § 36.207). For example, some districts are supported in part by the county with which they share jurisdiction and some receive grants from state agencies such as the Texas Water Development Board.

North Carolina's Use of Capacity Use Areas to Manage Groundwater Use.

Scope: The Water Use Act of 1967 G.S. 143-215.11 through 22 is North Carolina's principal way of allocating water (other than the common law). It provides for the designation by the Environmental Management Commission (ECM) of capacity use areas; i.e., areas in which the supply of water (surface and/or groundwater) is insufficient to meet demand. Water withdrawals in capacity use areas require coordination and regulation in order to protect the interests and rights of residents and property owners and of the public interest.

The Environmental Management Commission is a 19-member Commission appointed by the Governor, the Senate Pro Tempore, and the Speaker of the House. The Commission is responsible for adopting rules for the protection, preservation, and enhancement of the State's air and water resources. Commission members are chosen to represent various interests, including the medical profession, agriculture, engineering, fish and wildlife, groundwater, air and water pollution control, municipal or county government, and the public at large. The Commission oversees and adopts rules for several divisions of the Department of Environment and Natural Resources, including the Divisions of Air Quality, Land Resources, Water Quality, and Water Resources.

An example of implementing capacity use areas, in order to reverse declining water levels and salt water intrusion in the important Cretaceous aquifers, the EMC passed rules for groundwater use in the fifteen county Central Coastal Plain Capacity Use Areas (CCPCUA) to reduce Cretaceous aquifer withdrawals by up to 75% by 2018. Of 122 public water supply systems in the CCPCUA, 36 water systems have to reduce Cretaceous aquifer withdrawals by a total of 25 MGD by 2018.

Most of the utilities in Lenoir County, Pitt County, and Greene County, all within the CCPCUA, obtained 100% of their water supply from deep wells supplied from Cretaceous aquifers. To reduce groundwater withdrawals, the Neuse Regional Water and Sewer Authority ("WASA") was formed in 2000. Current members include the Town of Ayden, Bell Arthur Water Corporation, Deep Run Water Corporation, Eastern Pines Water Corporation, Town of Grifton, City of Kinston, North Lenoir Water Corporation, and the Town of Pink Hill.

Funding: The WASA receives revenues through member contributions, which are proportionate to the number of customers served by each member. Therefore, costs are shared equitably based on the benefits received. The WASA is funding ongoing design and construction work through grants and low-interest loans from the USDA, State of North Carolina, USEPA, The Rural Center, Tobacco Trust Fund, and other local sources and funding is being sought for future projects.

7 Recommendations

Recommendations were developed and categorized in three tiers, as described below and summarized in their respective tables:

- Tier 1 Recommendations (Table 7-1). These are short-term solutions (1-5 years) that are implementable within existing Louisiana laws and regulations.
- Tier 2 Recommendations (Table 7-2). These are long-term solutions (5 to 30 years) that require legislative law and/or regulatory and law amendments. These recommendations are mainly policy related.

Conclusion and Retrospective Overview

The most significant and fundamental groundwater resource management issue facing Louisiana is the lack of timely and continuous acquisition of comprehensive aquifer-wide groundwater level measurements, water well production and groundwater quality data. Although the state has implemented various methods of obtaining such information, it is clear that the current methods fall short of producing a continuing volume of data in a coordinated manner available in a time frame sufficient for implementing a more efficient and effective means of managing the state's groundwater resources to ensure both short and long term aquifer sustainability. Establishing improvements in data acquisition and dissemination must be adequately addressed in order for the state to develop and implement a successful groundwater management strategy and therefore should be addressed as a matter of priority.

Table 7-1: Tier 1: Short-Term Solutions (1-5 Year)

Issue	Discussion	Recommendation
STAKEHOLDER WORKSHOPS COMMENTS		
Stakeholders felt that current Legislation for evaluating sustainability by the Office of Conservation is not adequate and should carry a provision to deny groundwater use by a user if the use is deemed to be unsustainable.	The current Groundwater Resources Management statutory law and Louisiana Administrative Code regulations collectively provide for an effective means for the Agency to evaluate proposed ground water use and, when necessary, restrict ground water use, to prevent adverse impacts to aquifer sustainability.	Continue to improve upon the current procedure to evaluate the sustainability of the ground water resources under the current strict guidelines.
Based on discussions during the workshop and analysis of the available data for the preparation of this report, it was evident that there is an obvious lack of groundwater availability models and accurate data reporting by users. There was a consensus among the stakeholders to use academic and federal agency resources for larger scale groundwater/aquifer modeling.	The objective of the development of this document includes the identification of specific areas of the state's groundwater aquifer systems that may warrant regional or larger scale groundwater aquifer modeling to assist in the management of resource sustainability for those areas delineated in the Plan.	The Groundwater Management Advisory Task Force should study and identify the: ▪ Type and frequency of modeling suggested per area identified in this document; ▪ Initial and, where applicable, annual maintenance (model updating) costs to implement each suggested modeling project per area delineated in this document; ▪ Sustainable funding sources for each project; and ▪ All feasible resource management alternatives for each area identified in this document, and provide a written summary of their findings to the Groundwater Resources Commission.
Managing groundwater resources require adequate characterization of aquifers. Towards meeting this objective, there is a requirement of defining aquifer sustainability and sustainable yield criteria and establish resources to manage the same.	None	The Office of Conservation should: ▪ Research other state and federal legal definitions for aquifer sustainability and sustainable yield criteria; ▪ Implement aquifer modeling if warranted; ▪ Consider proposing regulatory amendments to utilize both concepts under Louisiana Groundwater Management regulations.
Stakeholder involvement and public awareness is critical in evolving management strategies and implementing new and established effective and efficient methods to reach the public.	None	The Groundwater Resources Commission and the Office of Conservation should request and encourage the Secretary of the Louisiana Department of Education and the Louisiana Board of Elementary and Secondary Education (BESE) to take all necessary actions to ensure that ground water conservation education be specifically and directly included in the required teacher grade level expectations (or its replacement) for elementary and/or middle school students from 3rd grade through 6th grade. If funds are available, this effort should be expanded to strategic grades.
Stakeholders felt that there is a need to establish an agency representative standing committee to recommend water quality and quantity emergency actions.	None	The Groundwater Resources Commission should pass a motion to recommend that the commissioner of Conservation initiate, assemble, and maintain an ad-hoc standing committee of agency representatives from DHH, Office of Public Health (OPH), LDEQ, LDNR Office of Conservation LDNR Office of Mineral Resources, and Louisiana Department of Wildlife and Fisheries, NRCS, LDAF to serve to facilitate communication between agencies for emergencies involving ground water resources.
In order for water users to utilize surface water instead of ground water there is a need to implement positive publicity to water users choosing surface water alternatives.	None	The LDNR should develop and implement a groundwater conservation stewardship recognition plan.
As part of the data collection and analysis as a strategy for surface water resource management, stakeholders state that there is a need to increase Surface Water Quantity Measurement temporally and spatially.	None	The LDNR, through its Office of Mineral Resources and in consultation with the USGS should investigate current state practices for measuring surface water quantity and report its findings, including any feasible and practical recommendations to improve current practices for the same, to the Groundwater Resources Commission and Commissioner of Conservation.
There is a need for greater accountability for self-reporting requirements.	None	The Office of Conservation forms that are currently used by well owners and operators to notify the agency of proposed ground water well locations and groundwater use should include signature and certification by the responsible party. This procedure is consistent with legal certification language used by other local, state, and federal governing agencies for related matters.
As an alternative to ground water use, stakeholders would like to see reservoir development.		Additional efforts may be initiated to locate and implement reservoirs in strategic locations.
WATER WELL NOTIFICATION AND EVALUATION		
Water well notification	Under R.S. 38:3097.3.C (4) (a) it is the responsibility of the well owner to file the water well notification at least sixty days prior to well installation. It has been suggested that this responsibility be placed on the driller, since most well owners would be unfamiliar with the requirements. Currently, domestic wells are automatically exempt from prior notification requirement, as are drought relief, rig supply, replacement wells, and other wells that the commissioner may deem fit for exemption (although large wells cannot be exempted). This leaves a pool of more astute well owners that would typically have more knowledge of well notification requirements. Thus, owners of all other new wells for uses such as for public supply, irrigation, and industrial purposes must comply with prior notification requirements.	It may be more appropriate to require the well driller, , who is licensed and should be more familiar with the process, to provide the agency with sixty day prior well installation notification for all non-exempt well installations. At a minimum, water well drillers should notify well owners of the notification, assist the well owner as necessary, and be prevented from installing wells without proper notification to LDNR.
Water well drawdown calculations:	Office of Conservation water well installation and groundwater use evaluation is a structured review process which includes, at a minimum, the reviewing staff to perform calculations for	The evaluation procedures form should be revised to clearly document staff's use of drawdown calculations performed for both the nearest well and the shallowest wells within the quarter-mile radius area of

Table 7-1: Tier 1: Short-Term Solutions (1-5 Year)

Issue	Discussion	Recommendation
	determining water level drawdown impacts at the well nearest to the proposed well location. Should staff determine the need, additional wells within the standard quarter-mile area of review may also be assessed for potential water level decline impacts or other potential adverse impacts to support agency conclusions of more complex proposed well locations and water production demands. However, based on review of the agency's evaluation process, it is not readily apparent that the agency's evaluation procedures include more in-depth assessment to include water level decline calculations for other wells located within the quarter-mile area of interest as may be needed to address varying well depth, yield, and proposed withdrawal rates, to ensure that potential adverse impacts of the proposed well will not be underestimated. Although it is understood that agency decisions resulting from well evaluation protocol includes consideration of potential adverse cumulative impacts due to the presence of multiple nearby active (pumping) wells, this consideration is not readily apparent on the evaluation guidelines document. Although groundwater numerical models, e.g., MODFLOW, can be used to calculate drawdowns in the well field, this method may be cumbersome to update and implement for evaluation of individual wells.	review to assess potential well interferences for proposed wells. The evaluation procedures form should also be revised to provide clear documentation of a larger radius, or area of review, when large cones of depression are expected. More robust documentation to support agency decisions based well evaluations should be considered by the agency, including the integration of analytical element models in SONRIS to evaluate the cumulative impacts of pumping, sustainability of the aquifer, and potential delineation of wellhead protection areas. Analytical element models, e.g., the wellhead analytical element model (WhAEM), may be an appropriate tool to calculate the cumulative impacts of pumping from multiple wells, as well as additional analytical elements including recharge, drain, and no flow boundaries. WhAEM can also quickly calculate capture zones and be used to delineate wellhead protection areas. US EPA supports the Center for Subsurface Modeling Support (http://www.epa.gov/nrmrl/gwerd/csmos/index.html), which provides descriptions and links for groundwater models.
Static water level gradient maps	None	Current static water level gradient maps should be developed and maintained as feasible to accurately identify potential impacts caused by new significant drawdown within an aquifer. These maps could be integrated into the SONRIS GIS system, either as a functional or reference layer, to provide a more efficient means of determining the relative static water levels to use when calculating relative drawdown from proposed wells.
Well registration	Since the Water Well Notification form , Water Well Registration Long Form , Water Well Registration Short Form , and the Well Plugging and Abandonment Form share a significant percentage of common data it would be possible to make these into one unified form with separate sections for the unique data on each of the original forms	The following changes could be implemented to improve the well registration process, including: ■In addition to the parish and coordinates, the form(s) should require a street address and/or directions from an intersection or applicable landmark. ■ Because the Water Well Notification Form, Water Well Registration Long Form, Water Well Registration Short Form, and the Well Plugging and Abandonment Form share a significant percentage of common data, it may be appropriate to consolidate these forms and provide separate sections requesting applicable information. ■These forms could be integrated into SONRIS to allow for online data submittal and quicker review by appropriate parties, as needed.
Well identifier	None	The well identifier should be maintained from the well notification through the plugging and abandonment of the well. Each well should receive a unique identifier consisting of the parish FIPs and the sequential well number for that parish. This would allow for a well to be located by its identifier, from inception to its plugging and abandonment which is currently not possible in SONRIS.

Table 7-2: Tier 2: Long-Term (5 to 30 Years)

Issue	Discussion	Recommendation
The State of Louisiana does not have a program to develop GAMs for areas of groundwater concern.	The development and maintenance of detailed groundwater availability modeling and yield estimations is a valuable tool used to provide sound objective information for management decisions to address aquifer sustainability issues.	It is recommended that Louisiana develop a program to fund the development of aquifer-wide groundwater availability models for impacted aquifers and especially for the Sparta and Carrizo-Wilcox aquifers. This program may be extended to additional aquifers that have projected supply gaps.
The State of Georgia's Water Plan (The Water Plan) establishes a regional approach to guide water management in Georgia through the creation of 10 water planning regions, with each region establishing a Planning Council, which in turn will their region's plan, called "Water Development and Conservation Plans" that will guide water management decisions in their region. This approach is an effective way of managing groundwater and surface water resources. The current groundwater management plan for Louisiana is a comprehensive state-wide plan, which will serve as a guidance framework. An approach similar to the State of Georgia's Water Plan is needed to manage Louisiana's water resources more effectively. Currently State of Louisiana aquifers are categorized under 'Regions," which is an administrative delineation. Separate plans based on watershed/aquifer/regional (regions) approach should be evolved. In addition, separate councils representing these regions could be considered as management option to guide water management decisions under the leadership of the Department of Natural Resources.		Appropriate actions may be initiated to create watershed and aquifer based regions and develop strategic regional resource management perspectives.
Stakeholders suggested that the drillers be required to provide prior water well notification to the Office of Conservation.		Should it be determined that water well owners, not well drillers, will continue to be required to provide advanced notification of propose water well installation to the agency, it is recommended that the Office of Conservation propose a rule amendment to LAC Title 56 Part I requiring a water well driller to obtain proof prior to commencing well installation operations that; a) their respective client (well owner) has complied with the pre-installation notification requirements of LAC 43:VI.701 and b) The Office of Conservation has completed its evaluation and provided the well owner a written determination on proposed ground water withdrawal at the well location. The regulatory amendment should require the water well driller to document that such proof was provided by the well owner by certification on the well construction registration form provided to the agency. The regulatory amendment should also clearly state that water well drillers failing to obtain and document proof of the above prior to constructing a water well will be subject to possible enforcement action and assessment of civil penalty issued under the general authority of the Groundwater Resources Management Law and Subsurface Waters – Well Drillers Law, Chapters 13-A-1 and 13-B respectively of Title 38 of the Louisiana R.S., and under the specific authority set forth in Section 3097.3 (F).
Inadequate data reporting system as well as strengthening of water level measurements and enforcement of laws and regulations prompted stakeholders to suggest that there should be comprehensive water metering for all users, statewide water level measurements, agency inspections, and reporting and database entry.		The Groundwater Resources Commission should consider approving the issuance of a letter of recommendation to the Louisiana legislature to amend current statutory law for Groundwater Resources Management Law, Chapter 13-A-1 requiring well owners of all active large volume industrial, irrigation, and public supply groundwater wells that drawing water from at least impacted aquifer systems to: ▪ Install flow monitoring devises on said wells; ▪ Record groundwater withdrawal volumes; and ▪ Report groundwater withdrawal volumes from each well to the agency on a quarterly to semi-annual basis.
For the sustainability of certain aquifer systems alternative use of surface water resources will be necessary. In the opinion of the stakeholders, there is a need to mandate surface water use cooperative endeavor agreements for judicious use of surface water resources.		New Legislation is recommended to extend and build upon the current provisions of ACT 955 of 2010 pursuant to fair and judicious use of surface water resources in the public domain. Such legislation should recognize the interconnectivity of ground water and surface water resources and the importance of that interconnectivity relative to the objective of any such legislation.
It is the stakeholder's opinion that for effective groundwater resource management there is a need to increase task force membership and role in water policy and management decision.		It is recommended that the Groundwater Resources Commission and the Commissioner of Conservation update and revise the role of the Ground Water Management Advisory Task Force, and provide recommends, as appropriate, to enact new legislation.
Although surface and ground water may be hydraulically connected, their interconnectivity is not recognized in legislation and related policy.		New legislation is recommended to extend and build upon the current provisions of ACT 955 of 2010 pursuant to fair and judicious use of surface water resources in the public domain. Such legislation should recognize the interconnectivity of groundwater and surface water resources and the importance that interconnectivity relative to the objective of any such legislation.

Table 7-2: Tier 2: Long-Term (5 to 30 Years)

Issue	Discussion	Recommendation
Stakeholders who participated in the workshops felt that the Sparta Aquifer Groundwater Commission statutory authority should be enhanced.		The Sparta Aquifer Groundwater Commission may consider meeting with their legislators to propose legislation to amend the statutory authority of the Sparta Groundwater Commission to function in an identical capacity as the Capitol Area Groundwater Conservation Commission and seek assistance from the chair of the Louisiana Senate Natural Resources or House of Representatives Natural Resources and Environment to identify potential author(s) and sponsorship.
Louisiana law Louisiana R.S. §§ 48:2072 (C), (D) and 48:2084 to 48:2084.15 authorizes the Louisiana Transportation Authority to pursue PPPs for transportation facilities, including ferry, mass transit, rail, or similar systems.	Public-Private Partnerships (PPP) are used in many communities and through them private sector companies assist in the design, rebuilding, and operation of publicly-owned water and wastewater systems. A PPP involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical, and operational risk in the project.	Legislation could be enacted to provide the appropriate water authority(s) the ability to pursue PPP to fund water infrastructure projects.
Financial incentives and funding opportunities		The following financial incentives are recommended to promote groundwater sustainability in areas of groundwater concern: ▪ Trust fund for surface / groundwater use fees to subsidize surface water use; ▪ Cost-share funds to facilitate the development surface and wastewater reuse alternatives; ▪ Credit system for alternative users; ▪ Provide incentives / tax reductions to encourage surface water alternatives; and ▪ Incentives to retain forests and agriculture to benefit watersheds.

8 References

ADSWMP, 2002. Louisiana Ground Water Management Commission, 2002, Assistance in developing the statewide water management plan, Volumes, 1, 2, and 3.

Asian Development Bank. (1999). Handbook for the Economic Analysis of Water Supply Projects. Manila, Philippines: Asian Development Bank.

Benninga, S. (2008). Financial modeling (Third edition). Cambridge, Massachusetts: The MIT Press

Brigham, E. F. & Gapenski, L. C. (1994). Financial management: Theory and practice (Seventh edition). Fort Worth, Texas: The Dryden Press.

Bureau of Labor Statistics. (2011). Consumer Price Index - All Urban Consumers. Online. Available at: http://data.bls.gov/cgi-bin/surveymost. Accessed on: July 29, 2011.

Damodaran, A. (2009). WACC09. (An Excel Workbook). Online. Available at: http://pages.stern.nyu.edu/~adamodar/. Accessed on: July 28, 2011.

El Koubi, J. (2011) jason.elkoubi@la.gov. RE: Discount Rate. 25th July 2011.

Groundwater Protection Council (2009) Modern Shale Gas Development in the United States: A Primer. http://dnr.Louisiana.gov/haynesvilleshale/ShalegasPrimer2009

Job, C.A., 2010. Groundwater Economics, CRC Press, p 661.

LDEQ, 2009. Triennial Summary Reports, Aquifer Summaries, 2007.

LDNR, 2011. Louisiana Hydraulic Fracturing State Review, March 2011, STRONGER, p.25.

Lumby, S. (1991). Investment appraisal and financing decisions: A first course in financial management (Fourth edition). London, England: Chapman and Hall.

McKee, P.W., Clark, B.R., Czarnecki, J.B., 2004. Conjunctive-Use Optimization Model and Sustainable-Yield Estimation for the Sparta Aquifer of South-eastern Arkansas and North Central Louisiana, U.S. Geological Survey, Water Resources Investigations Report 03-4231.

Nola.com. (2011). Barclay's buys up $300 million in Louisiana bonds. http://www.nola.com/business/index.ssf/2011/03/barclays_buys_up_300_million_i.html Accessed: July 26, 2011.

Nyman, D.J., 1984. The occurrence of high concentrations of chlorides in the Chicot aquifer system of southwestern Louisiana: southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no 33, 75p.

Nyman, D.J., Halford, K.J., and Martin, angel, Jr., 1990. Geohydrology and simulation of flow in the Chicot aquifer system of southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 33, 75p.

Seitz, N. E. (1990). Capital budgeting and long-term financing decisions. Fort Worth, Texas: The Dryden Press.

Tax Foundation (2011). National and State Corporate Income Tax Rates, U.S. States and OECD Countries, 2011. Online. Available at: http://www.taxfoundation.org/taxdata/show/23034.html. Accessed: July 26, 2011.

Tomaszewski, D.J., Lovelace, J.K., and Ensminger, P.A., 2002. Water withdrawals and trends in groundwater levels and stream discharge in Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 68, 30p.

Sargent, B.P., 2002, Water use in Louisiana, 2000. Louisiana Department of Transportation and Development Water Resources Technical report no. 15, 133 p.

SGCD (2010) Sparta Aquifer in Louisiana and its Management, September 2010. http://spartaaquifer.com

Sparta Groundwater Study (2002) Sparta Groundwater Conservation District Commission. Application of portions of the Sparta Groundwater Aquifer to be declared a critical groundwater area submitted to the Louisiana Groundwater Management Commission, final revision 8/15/2002.

Tsur et al., 2004. Pricing Irrigation Water: Principles and Cases from Developing Countries, Resources for the Future, Washington DC, 2004.

USEPA. 1985. DRASTIC: A standardized system for evaluating groundwater pollution potential using hydrogeological settings. EPA/600/2-85/018.

USEPA. 2009. State of Groundwater Report, USEPA, Region 6, January 2009.

Water Encyclopedia, http://www.waterencyclopedia.com/Da-En/index.html (October 25, 2011).

Young R.A., 2005. Determining the economic value of water: Concepts and methods. Resources for the future Press, Washington D.C., 357 pp.

Zack, A.L., 1971. Groundwater pumpage and related effects, southwestern Louisiana, 1970, with a section on surface water withdrawals: Department of Conservation, Louisiana Geological Survey and Louisiana Department of Public Works Resources Pamphlet no. 27, 33p.

Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana: Bibliography

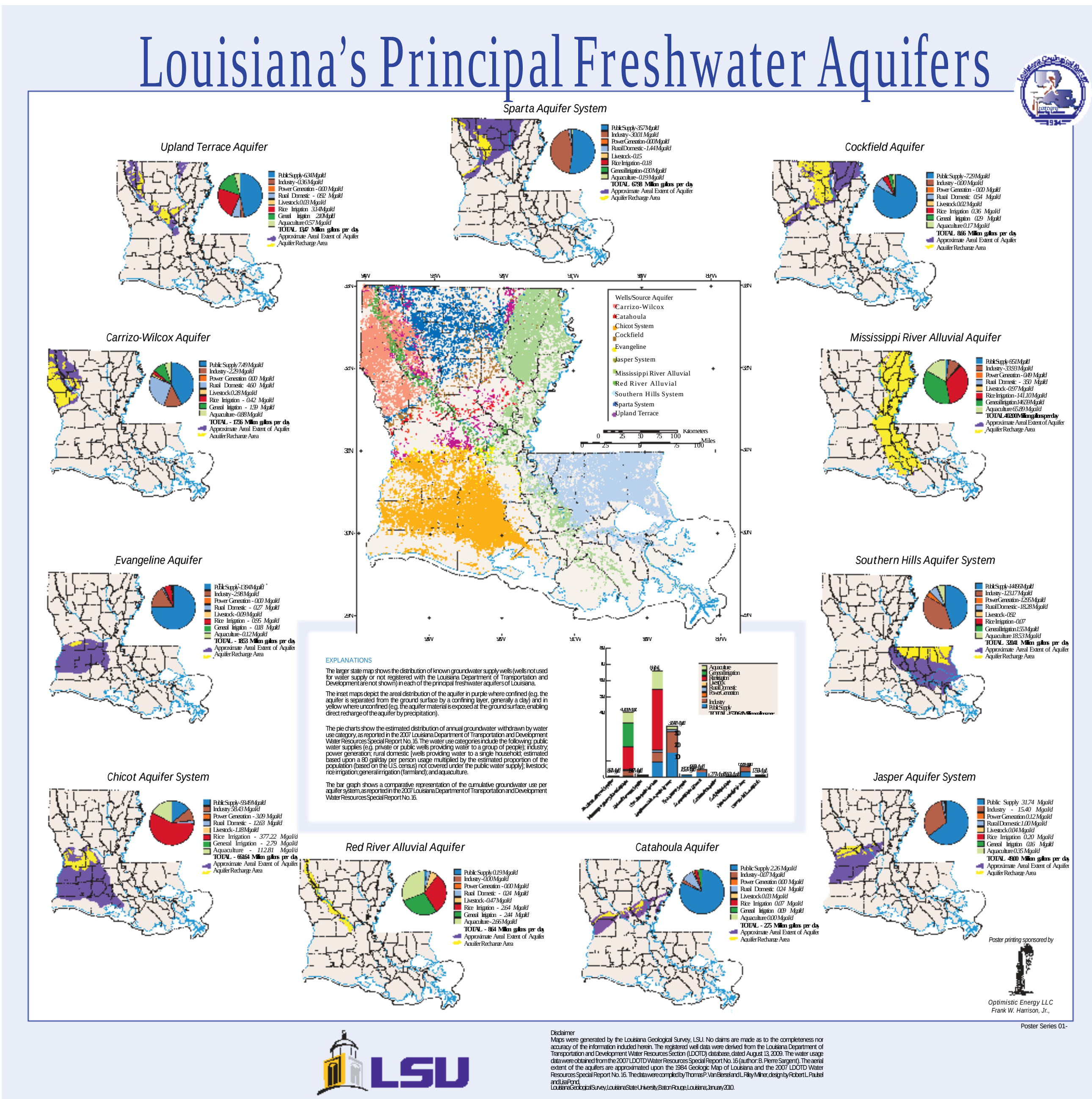
Presented to:

Ecology & Environment, Inc. – Baton Rouge, LA
November 11, 2010

Presented by:

Thomas P. Van Biersel[1], Douglas A. Carlson and L. Riley Milner

Louisiana Geological Survey - Louisiana State University
[1] Now at the Louisiana Department of Natural Resources



Report of Investigation 10-01

State of Louisiana

Bobby J. Jindal, Governor

Louisiana State University, Baton Rouge

Michael Martin, Chancellor

Louisiana Geological Survey

Chacko J. John, Director and State Geologist

This public information document is part of a series published periodically by the Louisiana Geological Survey, whose offices are located at Louisiana State University, Room 3079 Energy, Coast & Environment Building, Baton Rouge, LA 70803-4101. This information is distributed free of charge. The publisher does not guarantee the accuracy or correctness of any information. Contact the LGS business office at (225) 578-5320 for extra copies or for more information, or visit the web site at http://www.lgs.lsu.edu.

Report of Investigation 10-01

Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana: Bibliography

by:

Thomas P. Van Biersel[1], Douglas A. Carlson and L. Riley Milner
Louisiana Geological Survey - Louisiana State University
[1] Now at the Louisiana Department of Natural Resources

(Alphabetical listing of all references contained in the Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana report provided to Ecology & Environment, Inc. – Baton Rouge, LA November 11, 2010)

Bibliography

Ackerman, D.J., 1996, Hydrology of the Mississippi River valley alluvial aquifer, south-central United States: U.S. Geological Survey Professional Paper 1416-D, 56 p. and 8 plates.

Allen, Y.C., Constant, G.C. and Couvillion, B.R., 2008, Preliminary classification of water areas within the Atchafalaya Basin Floodway System by using Landsat imagery" U. S. Geological Survey Open-File Report OF 2008-1320, 12 p.

Andersen, H.V., 1960, Geology of Sabine Parish: Louisiana Geological Survey Geology Bulletin #34, 164 pp. plus map pack.

Anderson, H.V., 1960, Geology of Sabine Parish: Louisiana Geological Survey, Bulletin, 164p.

Anderson, J.B., Taviani, M. and Lawrence, J., 1991, Origin and evolution of Sabine Lake, Texas-Louisiana: Gulf Coast Association of Geological Societies Transaction vol. 41, p. 12-16.

Anonymous, 2001, Active Faults in East Baton Rouge Parish, Louisiana: Louisiana Geological Survey Public Information Series #8, 8 pp.

Arcement, G.J., Colson, B.E., and Ming, C.O., 1978, Backwater at bridges and densely wooded flood plains, Comite River near Olive Branch, Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-602, 3 sheets.

Arcement, G.J., Colson, B.E., and Ming, C.O., 1979, Backwater at bridges and densely wooded flood plains, Alexandria Creek near St. Francisville, Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-600, 3 sheets.

Arcement, G.J., Colson, B.E., and Ming, C.O., 1979, Backwater at bridges and densely wooded flood plains, Beaver Creek near Kentwood, Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-601, 3 sheets.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1991, Water resources data—Louisiana, water year 1990: U.S. Geological Survey Water-Data Report LA-90-1, 419 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1992, Water resources data—Louisiana, water year 1991: U.S. Geological Survey Water-Data Report LA-91-1, 435 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1993, Water resources data—Louisiana, water year 1992: U.S. Geological Survey Water-Data Report LA-92-1, 439 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1989, Water resources data—Louisiana, water year 1988: U.S. Geological Survey Water-Data Report LA-88-1, 413 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1990, Water resources data—Louisiana, water year 1989: U.S. Geological Survey Water-Data Report LA-89-1, 395 p.

Arcement, G.J., Jr., 1984, Discharge and sediment data for Barataria Pass, Louisiana, 1983: U.S. Geological Survey Open-File Report 84-701, 22 p.

Autin, W. J., 1987, Soil Geomorphology of the Amite River: Louisiana Geological Survey Open File Series #87-01, 20 pp.

Autin W. J. and McCulloh, R.P., 1991, Geologic and Derivative Engineering Geology Hazard Maps of East Baton Rouge Parish, Louisiana: Louisiana Geological Survey Open File Series #91-01.

Autin, W. J., Boniol, D.P. and Hanson, B.C., 1985, Soils Recharge Potential: Louisiana Geological Survey Water Resources Plate #4, scale 1:250,000.

Baker, N.T., 1988, Hydrologic features and processes of the Vermilion River, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4019, 49 p.

Ballard, W.J., 1994, The development of methods for calculating transmissivity from specific capacity within the Mississippi River alluvial aquifer in northeastern Louisiana: New Orleans, Louisiana, University of New Orleans, M.S. Thesis, 117p.

Barber, L. B., II, 1989, The occurrence and distribution of semi-volatile organic compounds in the lower Calcasieu River, Louisiana, by use of the closed-loop-stripping isolation procedure: U. S. Geological Survey Water-Resources Investigations WRI 88-4089, 11 p.

Barks, C.S., Petersen, J.C., and Usrey, F.D., 2002, Water-quality, biological, and habitat assessment of the Boeuf River basin, southeastern Arkansas, 1994-96: U. S. Geological Survey Water-Resources Investigations WRI 02-4187.

Barrilleaux, J., 1986, The geomorphology and Quaternary history of the Houston barrier segment of the Ingleside strandplain, Calcasieu Parish, Louisiana: unpublished M.S. thesis, University of Southwestern Louisiana.

Barton, D.C., 1925, Pine Prairie salt dome [Evangeline Parish, Louisiana]: American Association of Petroleum Geologists Bulletin #9, p. 738-755.

Baumann, T., Goree, B.B., Lovelace, W.M., Montgomery, P.A., Ross, G.B., Walters, D.J., and Ward, A.N., 2006, Water resources data--Louisiana, water year 2005: U.S. Geological Survey Water-Data Report LA-05-1, 909 p.

Baumann, Todd, Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Ross, Garron B., Sasser, D.C., Jr., and Walters, D.J., 2004, Water resources data—Louisiana, water year 2003: U.S. Geological Survey Water-Data Report LA-03-1, 970 p.

Bengtson, R L., Carter C.E. and Fouss, J.L., 1991, Water management research in Louisiana: Transaction of the American Society of Agricultural Engineers 1991 Summer Meeting.

Benton, O.L., and Higgins, P.C., 1981, Index to water-resources data for Louisiana--surface-water records, water-quality records: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 10, 138 p.

Bieber, P.P., and Forbes, M.J., Jr., 1966, Pumpage of water in Louisiana, 1965: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 20, 8 p.

Biedenham, D, N. Raphelt, and C. Montague, 1984, Long term stability of the Ouachita River in River Meandering (editor Elliott, C.M.): American Society of Civil Engineers, New York, New York, p 126-137.

Birbiglia, G.V., 1995, A geophysical investigation of the fresh-water/salt-water interface beneath Grand Isle, Louisiana: unpublished M.S. thesis, University of New Orleans.

Blakey, J.F. and Skinner, P.W., 1973, A network for continuous monitoring of water quality in the Sabine River basin, Texas and Louisiana: U. S. Geological Survey Open-File Report OF 72-0025.

Boniol, D., 1988, Recharge Potential of Louisiana Aquifers: A Supplement to the State Aquifer Recharge Map and Atlas Plates: Louisiana Geological Survey Open File Series #88-07, 50 pp. plus appendix.

Boniol, D.P. and B.C. Hanson, 1985, Potential Risk to Ground Water: Louisiana Geological Survey Water Resources Plate #5, scale 1:250,000.

Bookman, M., 1968. Legal and economic aspects of salt-water encroachment into coastal aquifers: Louisiana State University Coastal Studies Institute Vol. 3: 169-186.

Brantly, J.A., and Seanor, R.C., 1996, Louisiana ground-water map no. 9: Potentiometric surface, 1993, and water-level changes, 1968-93, of the Cockfield aquifer in northern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4241, 2 sheets.

Brantly, J.A., and Seanor, R.C., 2005, Louisiana ground-water map no. 18, potentiometric surface, 2003, Jasper aquifer system in west-central Louisiana: U. S. Geological Survey Scientific Investigations Map.

Brantly, J.A., Seanor, R.C., and McCoy, K.L., 2002, Louisiana ground-water map no. 13: Hydrogeology and potentiometric surface, October 1996, of the Sparta aquifer in northern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 02-4053, 3 sheets.

Brazelton, S.R., 1994, Water resources abstracts of publications of the Louisiana Department of Transportation and Development and the U.S. Geological Survey, 1954-94: Louisiana Department of Transportation and Development Water Resources Special Report no. 7, 185 p.

Breyer, R.H., 2001, A Groundwater model to facilitate dewatering of overburden at the Dolet Hills lignite mine, De Soto Parish, Louisiana: Fort Worth, Texas, Texas Christian University, Master Thesis, 37p.

Buono, A., 1983, The Southern Hills regional aquifer system of southeastern Louisiana and southwestern Mississippi: U.S. Geological Survey Water-Resources Investigations Report 83-4189, 38 p.

Calandro, A.J., 1978, Time of travel of solutes in Louisiana streams: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 17, 32 p.

Calandro, A.J., 1981, Time of travel of solutes in the Vermilion River, Louisiana: U.S. Geological Survey Open-File Report 81-1065, 19 p.

Calandro, A. J., Broussard, W.L., and Hosman, R.L., 1970, Water resources of the Belmont-Marthaville-Robeline area, Louisiana: Louisiana Department of Public Works Water Resources Pamphlet no. 25, 21 p.

Calandro, A. J., Whiteman, C.D., and Gaydos, M.W., 1966, Water, in East Feliciana Parish Resources and Facilities: Louisiana Department of Public Works and East Feliciana Parish Development Board, p. 32-37. 16

Callihan, J. B., 1988, Quaternary and environmental geology of northwestern Iberia Parish, Louisiana: unpublished M.S. thesis, Southwestern Louisiana university, 116 p.

Cardwell, G., Forbes M. and Gaydos, M., 1967, Water Resources of the Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #12, 105 p.

Cardwell, G.T. and Rollo, J.R., 1960, Interim Report on Ground-Water Conditions Between Baton Rouge and New Orleans, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #9, 44 pp.

Cardwell, G.T., and Walter, W.H., 1979, Pumpage of water in Louisiana, 1975: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 2, 15 p.

Cardwell, G.T., Forbes, M.J. and Gaydos, M.W., 1966, Progress Report on the Availability of Fresh Water, Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #18, 24 pp.

Cardwell, G.T., Forbes M.J., and Gaydos, M.W., 1967, Water Resources of the Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #12, 105 pp.

Cardwell, G.T., McWreath, H.C., III, and Rogers, J.E., 1985, Louisiana ground-water resources, in U.S. Geological Survey, National water summary 1984--Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, p. 229-235

Cardwell, G.T., Rollo, J.R., and Long, R.A., 1963, Basic ground-water data for the Mississippi River parishes south of Baton Rouge, Louisiana: Louisiana Department of Public Works, 5 p.

Cardwell, G.T., Sloss, Raymond, and Duncan, A.C., 1965, Water, in Assumption Parish Resources and Facilities: Louisiana Department of Public Works and Assumption Parish Development Board, p. 25-38.

Carlson, 2005, Louisiana's Groundwater Resources: Louisiana Geological Survey, Educational Series, no. 4, 27 p.

Carlson, D., 2004a, Characterization/Conductivities of Louisiana Aquifer Explored Conductivities: Louisiana Geological Survey, NewsInsights, v. 14, no.2, p. 3-6.

Carlson, D., 2004b, Sparta Aquifer: First-Year Study Completed: Louisiana Geological Survey, NewsInsights, v. 14, no. 2, p. 6-9.

Carlson, D., 2005, Louisiana Aquifer Characterization Aquifer Properties: Louisiana Geological Survey, NewsInsights, v. 15, no. 2, p. 1-5

Carlson, D., 2007a, Estimate of Vertical Anisotropy of Hydraulic Conductivity for Western Louisiana Aquifers from Grain-Size Data: Gulf Coast Association of Geological Societies, Transactions, v. 57, no. 115-124.

Carlson, D., 2007b, Estimate of Vertical Anisotropy of Hydraulic Conductivity for Northern Louisiana Aquifers from Grain-Size data: Proceedings of Baton Rouge Geological Society's 1 st Annual Louisiana Groundwater Symposium, March 8, 2007, Baton Rouge, Louisiana, v. 1, p. 32-42.

Carlson, D., 2010a, Influence of Lithology on Scaling Effects for Louisiana Stratigraphic Units' Permeability: Gulf Coast Association of Geological Societies, Transactions, v. 60, p. 87-102.

Carlson, D. and Milner, R., 2004, Hydrologic Differences Arising from Source Material Differences Between Southwestern Louisiana Aquifers and their Age Equivalents in Southeastern Louisiana: Gulf Coast Association of Geological Societies, Transactions, v. 54, p 101-111.

Carlson, D. and Van Biersel, T., 2009, Monitoring Saltwater Front Sparta Aquifer in North Central Louisiana: Draft report submitted to the Louisiana Department of Transportation and Development

Carlson, D.D., 1986, Louisiana surface-water resources, in Moody, D.W., Chase, E.B., and Aronson, D.A., comps., National water summary 1985--Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, p. 251-258.

Carlson, D.D., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1985, Water resources data—Louisiana, water year 1985: U.S. Geological Survey Water-Data Report LA-85-1, 605 p.

Carlson, D.D., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1986, Water resources data—Louisiana, water year 1986: U.S. Geological Survey Water-Data Report LA-86-1, 547 p.

Carlson, D.D., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1988, Water resources data—Louisiana, water year 1987: U.S. Geological Survey Water-Data Report LA-87-1, 445 p.

Carlson, D.D., Garrison, C.R., Jordan, M.M., Dantin, L.J., and Montgomery, P.W., 1989, Index to surface-water data in Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 17, 228 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1982, Water resources data—Louisiana, water year 1982, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-82-1, 422 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1982, Water resources data—Louisiana, water year 1982, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-82-2, 404 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1983, Water resources data—Louisiana, water year 1983, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-83-1, 392 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1983, Water resources data—Louisiana, water year 1983, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-83-2, 360 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1984, Water resources data—Louisiana, water year 1984: U.S. Geological Survey Water-Data Report LA-84-1, 608 p.

Carlson, D., Milner, R. and Hanson, B.C., 2003, Evaluation of Aquifer Capacity to Sustain Short-, Long-Term Ground Water Withdrawal from Point Sources in the Chicot Aquifer for Southwest Louisiana: Part I: Louisiana Geological Survey, Report of Investigations Series, no. 03-01, 90 p.

Case, H.L., III, 1979, Ground-water resources of Washington Parish, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 18, 33 p.

Chawner, W.D. , 1936, Geology of Catahoula and Concordia Parishes: Louisiana Geological Survey Geology Bulletin #9, 232 pp.

Chiou, C. T. and Leenheer, J.A., 1988, Properties of Calcasieu River and Suwannee River humic substances that affect contaminant solubility enhancement. J. A.. United States, U. S. Geological Open-File Report OF 87-0764, p. 81-84.

Clark, B.R., and R.M. Hart, 2009, The Mississippi Embayment Regional Aquifer Study (MERAS): Documentation of a Groundwater-Flow Model Constructed to Assess Water Availability in the Mississippi Embayment: U.S. Geological Survey Scientific Investigations Report 2009-5172 44p.

Clinton, C. A., 1979, A field test of environmental impact assessment in the Tensas Basin: Proceedings - Mississippi Water Resources Conference Issue 14, pp.27-32.

Collier, D.L., 1999, Water resources publications of the U.S. Geological Survey, 1904-98: Louisiana Department of Transportation and Development Water Resources Special Report no. 13, 155 p.

Collier, D.L., 2002, Ground-water and related publications of the Louisiana District of the U.S. Geological Survey, 1904-2000: Louisiana Department of Transportation and Development Water Resources Special Report no. 14, 182 p.

Conger, R.M., 1986, The environmental safety of underground injection of oilfield brines in Louisiana. United States, Gulf Coast Association of Geological Societies: New Orleans, LA, United States. 36: 65-69.

Covay, K.J., 1985, Ground-water resources of the Rayville-Delhi area, northeastern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 37, 22 p.

Crow, M. and Quayle, R., 2000, Observed climate trends for the globe and the southeastern United States. In Current Stress and Potential Vulnerability-Implications of Global Climate Change for the Gulf Coast Region, Ning, Z. and Abdollahi, K. eds: GCRCC and Franklin Press, Baton Rouge, LA.

Curwick, P.B., 1988, Simulation of flow and transport in the lower Mississippi River, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4361, 38 p.

Curwick, P.B., 1988, Use of dye-tracing techniques to determine mixing and circulation in the loops and lakes of the lower Calcasieu River: U.S. Geological Survey Open-File Report 87-764, p. 67-69.

Cushing, E.M., and Jones, P.H., 1945, Ground-water conditions of the Baton Rouge area, Louisiana, with special reference to the shallow artesian sands of the industrial district--A progress report: Louisiana Department of Public Works, 33 p.

Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1994, Water resources data—Louisiana, water year 1993: U.S. Geological Survey Water-Data Report LA-93-1, 458 p.

Demas, C.R., 1976, Analyses of native water, bed material, and elutriate samples of major Louisiana waterways, 1975: U.S. Geological Survey Open-File Report 76-853, 304 p.

Demas, C.R., 1977, Analyses of native water, core material, and elutriate samples collected from the Atchafalaya River and Atchafalaya Bay: U.S. Geological Survey Open-File Report 77-769, 17 p.

Demas, C.R., 1983, Hydrology, water quality, and biology of Baptiste Collette Bayou in relation to the lower Mississippi River at Venice, Louisiana: Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 31, 49 p.

Demas, C.R., 1988, Objectives and preliminary results of reconnaissance sampling for selected hazardous substances in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 61-64.

Demas, C.R., 1989, Reconnaissance study of water and bottom material quality in the lower Calcasieu River, southwestern Louisiana, May 29-30, 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4089, 51 p.

Demas, C.R., and Curwick, P.B., 1987, Suspended-sediment, bottom-material, and associated chemical data from the lower Mississippi River, Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 14, 117 p.

Demas, C.R., and Demcheck, D.K., 1989, Fate and transport of organic compounds and trace elements in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program--proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 271-281.

Demas, C.R., and Demcheck, D.K., 1989, Uptake of manmade organic compounds by Rangia cuneata in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program--proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 309-319.

Demas, C.R., and Higgins, P.C., 1977, Analyses of native water and dredged material from southern Louisiana waterways, 1975-76: U.S. Geological Survey Open-File Report 77-503, 180 p.

Demas, C.R., Brazelton, S.R., and Powell, N.J., 2002, The Atchafalaya Basin--river of trees: U.S. Geological Survey Fact Sheet FS-021-02, 2 p.

Demas, C.R., Demcheck, D.K., and Curwick, P.B.,1988, Occurrence and fate of volatile organic compounds under different wind and sampling conditions in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 99-102.

Demas, C. R., Demcheck, D.K. and Curwick, P.B., 1989, Occurrence of nutrients, minor elements, and organic compounds in water and bottom material in the lower Calcasieu River, Louisiana: U. S. Geological Survey Water-Resources Investigations WRI 88-4089, p. 1-17.

Demas, C.R., Demcheck, D.K., Anderson, M.L., and Garon, J.D., 1999, National water quality assessment program--Acadian Pontchartrain study unit, 1999, U.S. Geological Survey Fact Sheet FS-185-99, 4 p.

Demcheck, D.K., 1988, Automated instrumentation used for the lower Calcasieu River study, in Mallard, G.E., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 65-66.

Demcheck, D.K., 1991, Louisiana hydrologic atlas map no. 6: Water-quality survey of the Barataria Basin, 1988: U.S.G.S. Water-Resources Investigations Report 90-4170, 2 sheets.

Demcheck, D.K., 1994, Louisiana hydrologic atlas map no. 7: Water-quality survey of the Mermentau River basin, 1989-90: U.S. Geological Survey Water-Resources Investigations Report 92-4181, 3 sheets.

Demcheck, D.K., 1995, The Lake Pontchartrain watershed: A unique resource of the Louisiana coast: U.S. Geological Survey Fact Sheet FS-118-95, 2 p.

Demcheck, D.K., 1996, Analysis of selected water-quality data for surface water in St. Tammany Parish, LA, April-August 1995: U.S. Geological Survey Open-File Report 96-345, 59 p.

Demcheck, D.K., and Leone, H.L., Jr., 1983, Water quality of the upper Vermilion River, Louisiana, April-August 1980: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 30, 37 p.

Demcheck, D. K., and Skrobialowski, S.C., 2003, Fipronil and degradation products in the rice-producing areas of the Mermentau River basin, Louisiana, February-September 2000: U. S. Geological Survey Fact Sheet FS 0010-03, 6 p.

Demcheck, D. K., Demas, C.R. and Curwick, P.B., 1990, Plan of study for selected toxic substances in the Calcasieu River, Louisiana: U. S. Geological Survey Open-File Report OF 90-0148, 29 p.

Demcheck, D.K., Garrison, C.R., and McGee, B.D., 1996, Selected water-quality data for the lower Mississippi River, Bonnet Carré Spillway, and Lake Pontchartrain area, Louisiana, April through June 1994 and 1974-84: U.S. Geological Survey Open-File Report 96-652A, 125 p.

Demcheck, D.K., Tollett, R.W., Mize, S.V., Skrobialowski, S.C., Fendick, R.B., Jr., Swarzenski, C.M., and Porter, Stephen, 2004, Water Quality in the Acadian-Pontchartrain Drainages, Louisiana and Mississippi, 1999-2001: U.S. Geological Survey Circular 1232, 41 p.

Dial, D.C., 1968, Water-Level Trends in Southeastern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #22, 11 pp.

Dial, D.C., 1970a, Public water supplies in Louisiana: Louisiana Department of Public Works Basic Records Report no. 3, 460 p.

Dial, D.C., 1970, Pumpage of Water in Louisiana, 1970: Louisiana Geological Survey Water Resources Pamphlets #26, 10 pp.

Dial, D.C., 1983, Ground-water data for the Mississippi River parishes in the greater New Orleans area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 11, 47 p.

Dial, D.C., and Huff, G.F., 1989, Occurrence of minor elements in ground water in Louisiana including a discussion of three selected sites having elevated concentrations of barium: Louisiana Department of Transportation and Development Water Resources Technical Report # 47, 88 p.

Dial, D.C., and Kilburn, C., 1980, Ground-water resources of the Gramercy area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 24, 39 p. 17

Dial, D.C., and Sumner, D.M., 1989, Geohydrology and simulated effects of pumpage on the New Orleans aquifer system at New Orleans, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 46, 54 p.

Dial, D.C., and Tomaszewski, D.J., 1988, Geohydrology, water quality, and effects of pumpage on the New Orleans aquifer system, northern Jefferson Parish, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4097, 34 p.

Duex, T.W., 2003, Water supply in Lafayette, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 53, p. 205-209.

Duex, T.W., 2005, A brief summary of water supply in Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 55: 147-147.

Duex, T.W., 2006, A brief summary of water supply in the State of Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 56: 163-170.

Duncan, A.C., 1967, Chemical quality of surface waters of Louisiana 1959-63: Louisiana Department of Public Works Basic Records Report no. 2, 137 p.

Dupuy, A.J., and Couvillion, N.P., 1979, Analyses of native water, bottom material, and elutriate samples of southern Louisiana waterways, 1977-78: U.S. Geological Survey Open-File Report 79-1484, 414 p. 36

Eddards, M.L., Kister, L.R., and Scarcia, G., 1956, Water resources of the New Orleans area, Louisiana: U.S. Geological Survey Circular 374, 41 p.

Ensminger, P.A., 1999, Bathymetric survey and physical and chemical-related properties of False River, Louisiana, June and July 1998: U.S. Geological Survey Water-Resources Investigations Report 99-4193, 1 sheet.

Ensminger, P.A., 1999, Bathymetric survey and physical and chemical-related properties of Raccourci Lake, Louisiana, July 1998 and April 1999: U.S. Geological Survey Water-Resources Investigations Report 99-4292, 1 sheet.

Ensminger, P.A., and Wright, L.S., 2003, Low-flow characteristics of Louisiana streams: Louisiana Department of Transportation and Development Water Resources Technical Report no. 70, 160 p.

Everett, D.E., 1971, Hydrologic and quality characteristics of the lower Mississippi River: Louisiana Department of Public Works Technical Report no. 5, 48 p.

Everett, D.E., Fayard, L.D., and Wells, F.C., 1973, Water quality and waste assimilative capacity of the Pearl River below Bogalusa, Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 7, 28 p.

Fader, S.W., 1954, An Analysis of Contour Maps of Water Levels in Wells in Southwestern Louisiana, 1952 and 1953: Louisiana Geological Survey Water Resources Pamphlets #1, 7 pp.

Fader, S.W., 1955, An Analysis of Contour Maps of Water Levels in Southwestern Louisiana, 1954: Louisiana Geological Survey Water Resources Pamphlets #2, 13 pp.

Fader, S.W., 1957, An Analysis of Contour Maps of 1955 Water Levels, With a Discussion on Salt-Water Problems in Southwestern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #4, 27 pp.

Fader, S.W., 1958, Water Levels and Water-Level Contour Maps for Southwestern Louisiana, 1956 and 1957: Louisiana Geological Survey Water Resources Pamphlets #5, 23 pp.

Faiers, G., Keim, B. and Muller, R., 1997, Rainfall frequency/magnitude atlas for the south-central United States: Southern Regional Climate Center Technical Report 97-1.

Fajardo, I., 1969, A study of the connate waters and clay mineralogy in southern Louisiana: unpublished M.S. thesis, University of Tulsa, 68 p.

Falk, L.H. and Stober, W.J., 1970, An economic reappraisal of the Toledo Bend multiple-purpose water project: Louisiana Water Resources Research Institute Bulleting 16, 36 p.

Fayard, L.D., 1971, Relation between oxidation potential and the occurrence of iron in ground water from the Chicot aquifer, Lafayette, Louisiana, in Geological Survey Research 1971: U.S. Geological Survey Professional Paper 750-D, p. D182-D186.

Fayard, L.D., and Nyman, D.J., 1976, Surface-water resources of the Tangipahoa, Tchefuncta, and Natalbany River basins, southeastern Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 11, 49 p.

Fendick, R.B., 2005, Louisiana ground-water map no. 21; generalized potentiometric surface of the Evangeline Aquifer in south-central Louisiana, January-March 2004: U. S. Geological Survey Scientific Investigations Map.

Fendick, R.B., Jr., 1989, Louisiana ground-water map no. 2: Potentiometric surface, 1987, of the Gonzales-New Orleans aquifer in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 89-4016, 1 sheet.

Fendick, R.B., Jr., and Nyman, D.J., 1987, Louisiana ground-water map no. 1: Potentiometric surface, 1985, and water-level changes, 1983-85, of the Chicot aquifer in southwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4348, 2 sheets.

Fisk, H.N., Richards, H.G., Brown, C.A. and Steere, W.C., 1938, Contributions to the Pleistocene History of the Florida Parishes of Louisiana: Louisiana Geological Survey Geology Bulletin #12, 137 pp.

Forbes, M.J., 1988, Hydrologic investigations of the lower Calcasieu River, Louisiana: United States, U. S. Geological Survey Water-Resources Investigations WRI 87-4173, 61 p.

Forbes, M.J., Jr., 1980, Low-flow characteristics of Louisiana streams: Louisiana Department of Transportation and Development Water Resources Technical Report no. 22, 95 p.

Frederick, C.P., 2003, Water quality characteristics of urban storm runoff at selected sites in East Baton Rouge Parish, Louisiana, February 1998 through April 2002: U.S. Geological Survey Water-Resources Investigations Report 03-4212, 24 p.

Fryar, D., Senger, R., Deeds, N., Pickens, J., and T. Jones, 2003, Groundwater Availability Model for the Northern Carrizo-Wilcox Aquifer: Report for Texas Water Development Board, unnumbered pages.

Garrison, C.R., 1982, Water quality of the Barataria Unit, Jean Lafitte National Historical Park, Louisiana (April 1981-March 1982): U.S. Geological Survey Open-File Report 82-691, 34 p.

Garrison, C.R., 1997a, Statistical summary of surface-water quality in Louisiana--Ouachita River basin, 1908-94: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55C, 96 p.

Garrison, C.R., 1997b, Statistical summary of surface-water quality in Louisiana--Red River basin, 1943-94: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55B, 136 p.

Garrison, C.R., 1997, Statistical summary of surface-water quality in Louisiana--Calcasieu-Mermentau River basin, 1943-95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55E, 78 p.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana--Mississippi River mainstem, 1905--95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55I, 91 p.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana--Pearl River basin, 1943-95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55J, 50 p.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana--Tensas River basin, 1943-93: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55D, 76 p.

Garrison, C.R., 1999, Statistical summary of surface-water quality in Louisiana-- Lake Pontchartrain-Lake Maurepas basin, 1943-95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55G, 100 p.

Garrison, C.R., and Covay, K.J., 1994, Statistical summary of surface-water quality in Louisiana–Sabine River basin, 1952-85: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55A, 63 p.

Garrison, C.R., Goree, B.B., Lovelace, W.M., Montgomery, P.A., and Resweber, J.C., 1998, Water resources data—Louisiana, water year 1997: U.S. Geological Survey Water-Data Report LA-97-1, 495 p.

Garrison, C.R., Goree, B.B., Lovelace, W.M., Montgomery, P.A., and Resweber, J.C., 1999, Water resources data—Louisiana, water year 1998: U.S. Geological Survey Water-Data Report LA-98-1, 547 p.

Garrison, C.R., Lovelace, W.M., and Montgomery, P.A., 1995, Water resources data—Louisiana, water year 1994: U.S. Geological Survey Water-Data Report LA-94-1, 547 p.

Garrison, C.R., Lovelace, W.M., and Montgomery, P.A., 1996 [1997], Water resources data—Louisiana, water year 1996: U.S. Geological Survey Water-Data Report LA-96-1, 500 p.

Garrison, C.R., Lovelace, W.M., and Montgomery, P.A., 1996, Water resources data—Louisiana, water year 1995: U.S. Geological Survey Water-Data Report LA-95-1, 510 p.

Garrison, C.R., Seanor, R.C., Walters, D.J., and Arcement, G.J., Jr., 1995, Louisiana water-resources conditions, October 1993 through September 1994: Louisiana Department of Transportation and Development Water Resources Special Report no. 10, 24 p.

Gaydos, M.W., Rogers, J.E., and Smith, R.P., 1973, Water resources of the Little River basin, Louisiana: U.S. Geological Survey Water-Supply Paper 1989, 74 p.

Gilbert, J.J., 1993, Louisiana stream water quality in Paulson, R.W., Chase, E.B., Williams, J.S., and Moody, D.W., comps., National water summary 1990-91--Hydrologic events and stream water quality: U.S. Geological Survey Water-Supply Paper 2400, p. 293-299.

Gillip, J.A.; Czarnecki, J.B., 2009, Validation of a Ground-Water Flow Model of the Mississippi River Valley Alluvial Aquifer Using Water-Level and Water-Use Data for 1998-2005 and Evaluation of Water-Use Scenarios: U.S. Geological Survey Scientific Investigations Report 2009-5040, 23 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., and Walters, D.J., 2000, Water resources data—Louisiana, water year 1999: U.S. Geological Survey Water-Data Report LA-99-1, 635 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Labbe, C.K., and Walters, D.J., 2003, Water resources data—Louisiana, water year 2002: U.S. Geological Survey Water-Data Report LA-02-1, 671 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Sasser, D.C., Jr., and Walters, D.J., 2001, Water resources data—Louisiana, water year 2000: U.S. Geological Survey Water-Data Report LA-00-1, 563 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Sasser, D.C., Jr., and Walters, D.J., 2002, Water resources data—Louisiana, water year 2001: U.S. Geological Survey Water-Data Report LA-01-1, 638 p.

Gregory, J.D., 2001, Effects of surface water accumulation from the 1991 flood on the groundwater hydraulics of the Sparta Aquifer in north-central Louisiana: Monroe, Louisiana, University of Louisiana at Monroe, Masters Thesis, 102p.

Gresham, D.M., 2007, Potential arsenic sources for groundwater of the Cow Island area, Vermilion Parish, Louisiana: unpublished M.S. thesis, University of Southwest Louisiana, 108 p.

Griffith, J., 2003, Hydrogeologic Framework of Southeastern Louisiana: Louisiana Dept. of Transportation and Development Water Resources Technical Report No. 72, 21 p. and map folio, 18 plates.

Griffith, J.M., 2007, Fluoride concentrations in freshwater aquifers in Louisiana, 1931-2006: Louisiana Department of Transportation and Development Water Resources Technical Report No. 77, 18 p.

Griffith, J.M., 2009, Water resources of St. Tammany Parish: U.S. Geological Survey Fact Sheet 2009-3064, 6 p.

Griffith, J.M., and Fendick, R.B., 2009, Water resources of Ascension Parish: U.S. Geological Survey Fact Sheet 2009-3063, 4 p.

Griffith, J.M., and Lovelace, J.K., 2003a, Louisiana ground-water map no. 15: Potentiometric surface of the "1,200-foot" sand of the Baton Rouge area, Louisiana, spring 2001: U.S. Geological Survey Water-Resources Investigations Report 03-4020, 2 sheets.

Griffith, J.M., and Lovelace, J.K., 2003b, Louisiana ground-water map no. 16: Potentiometric surface of the "1,500-foot" sand of the Baton Rouge area, Louisiana, spring 2001: U.S. Geological Survey Water-Resources Investigations Report 03-4021, 2 sheets.

Grimsley, K.J., and D'Arconte, P.J., 2003, Annotated bibliography of water-related information and studies, Acadian-Pontchartrain Study Unit, Louisiana, 1863-2000: U.S. Geological Survey Open File Report no. 03-9, 249 p.

Halford, K.J., and Lovelace, J.K., 1994, Analysis of ground-water flow in the "1,200-foot" aquifer, Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 54, 68 p.

Hansen, F.N., Irelan, B. and Aertker, D.R., 1954, Supplemental surface-water supplies report for the Vermillion River basin, Louisiana: U.S. Geological Survey Open-File Report 54-115, 50 p.

Hanson, B.C. and Boniol, D.P., 1985, Capital Area Recharge Region Study Based on Geologic and Hydrologic Studies in Southeastern Louisiana and Southwestern Mississippi: Louisiana Geological Survey Water Resources Series #3, 64 pp.

Haque, S.M. , 1982, Water Level Trends in the Florida Parishes, Louisiana: Louisiana Geological Survey Water Resources Series #1, 34 pp.

Haque, S.M. , 1984, Ground-Water Quality in the Lake Charles Area, Louisiana: Louisiana Geological Survey Water Resources Series #2, 57 pp.

Harder, A.H., 1960, The geology and ground-water resources of Calcasieu Parish, Louisiana: U.S. Geological Survey Water-Supply Paper 1488, 102 p.

Harder, A.H., 1960, Water levels and water-level contour maps for southwestern Louisiana, 1958 and 1959: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 8, 27 p.

Harder, A.H., 1961, Water levels and water-level contour maps for southwestern Louisiana, 1959 and spring 1960, with a discussion of ground-water withdrawals: Department of Conservation and Louisiana Department of Public Works Water Resources Pamphlet no. 10, 25 p.

Harder, A.H., Kilburn, C., Whitman, H.M., and Rogers, S.M., 1967, Effects of ground-water withdrawals on water levels and saltwater encroachment in southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 10, 56 p.

Harder, A.H., Sauer, V.B. and W.L. Broussard, 1968, Water Resources of the Lettsworth-Innis-Batchelor Area, Pointe Coupee Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #21, 28 pp.

Harris, G.D., 1904, Underground waters of southern Louisiana, with discussions of their uses for water supplies and for rice irrigation, by M.L. Fuller: U.S. Geological Survey Water-Supply Paper 101, 98 p.

Hartono, S., 2005, Spatial and temporal estimation of pumping recharge in groundwater system analysis: unpublished PhD dissertation, Louisiana State university, 91 p.

Hays, P.D., 2001, Simulated Response of the Sparta Aquifer to Outcrop Area Recharge Augmentation, Southeastern Arkansas: U.S. Geological Survey, Water-Resources Investigations, no. 01-4039, 14p.

Hays, P.D., Lovelace, J.K., and Reed, T.B., 1998, Simulation response to pumping stress in the Sparta Aquifer of southeastern Arkansas and north-central Louisiana, 1998-2007: U.S. Geological Survey, Water-Resources Investigations, no. WRI 98-4121, 25p.

Heggem, D.T., 2000, A landscape ecology assessment of the Tensas River basin: Environmental Monitoring and Assessment Vol. 64(1), pp.41-54

Heinrich, P.V., 2005, Distribution and origin of fault-line scarps of southwest Louisiana, USA: Transaction of the Gulf Coast Association of Geological Societies vol. 55, p. 284-293.

Heinrich, P.V., 2008, Loess Map of Louisiana: Louisiana Geological Survey Public Information Series #12, 4 pp.

Heinrich, P.V. and Autin, W.J., 2000, The Baton Rouge Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #2, scale = 1:100,000.

Heinrich, P.V. and McCulloh, R.P., 2000, Baton Rouge West, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2000-02, scale = 1:24,000.

Heinrich, P.V. and McCulloh, R.P., 2001, Lacombe, LA 7.5-minute geologic quadrangle:Louisiana Geological Survey Open-File Map 2001-05, scale = 1:24,000.

Heinrich, P.V. and McCulloh, R.P., 2002, Haaswood, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2002-05, scale = 1:24,000.

Heinrich, P.V. and McCulloh, R.P., 2003, Industrial, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2003-04, scale = 1:24,000.

Heinrich, P.V. and McCulloh, R.P., 2007, Port Hudson, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2007-01, scale = 1:24,000.

Heinrich, P.V., McCulloh, R.P. and Snead, J.I., 2003, The Ponchatoula Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #5, scale = 1:100,000.

Heinrich, P.V., McCulloh, R.P. and Snead, J.I., 2004, The Gulfport Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #7, scale = 1:100,000.

Heinrich, P.V., McCulloh, R.P. and Snead, J.I., 2007, The Bogalusa Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #10, scale = 1:100,000.

Hern, S.C., Lambou, V.W. and Butch, J.R., 1980, Descriptive water quality for the Atchafalaya Basin, Louisiana: U.S. Environmental Protection Agency Report EPA-600/4-80-014, 168 p.

Hill, J.M., 1982, Source determination of rice irrigation water in southwestern Louisiana using Landsat data: Transaction of the International symposium on rainfall-runoff modeling, Mississippi State, MS, p. 545-554.

Hodges, A.L., Jr., Rogers, S.M., and Harder, A.H., 1963, Gas and brackish water in fresh-water aquifers, Lake Charles area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 13, 35 p.

Holland, W.C., Hough, L.W. and Murray, G.E., 1952, Geology of Beauregard and Allen Parishes: Louisiana Geological Survey Geology Bulletin #27, 224 pp. plus map pack.

Hosman, R.L., 1972, Ground Water Resources of the Norco Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #18, 61 pp.

Hosman, R.L., 1974, Soft-water zone in the Chicot aquifer, Bayou Teche area, Louisiana: U.S. Geological Survey Open-File Report 74-65, 20 p.

Hosman, R.L., Broussard, W.L. and Calandro, A.J., 1970, Water Resources of Northwestern St. Landry Parish and Vicinity, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #23, 29 pp.

Howe, H.H., 1962, Subsurface Geology of St. Helena, Tangipahoa, Washington and St. Tammany Parishes, Louisiana: Gulf Coast Association of Geological Societies Transactions Vol. 12, p. 121-125.

Howe, H.V. and Moresi, C.K., 1931, Geology of Iberia Parish: Louisiana Geological Survey Geology Bulletin #1, 187 pp.

Howe, H.V. and Moresi, C.K., 1933, Geology of Lafayette and St. Martin Parishes: Louisiana Geological Survey Geology Bulletin #3, 238 pp.

Howe, H.V., Russell, R.J., Kniffen, F.B., McGuirt, J.H. and. McDonald, S.M., 1938, Reports on the Geology of Iberville and Ascension Parishes: Louisiana Geological Survey Geology Bulletin #13, 223 pp.

Howe, H.V., Russell, R.J., McGuirt, J.H., Craft, B.C. and Stephenson, M.B., 1935, Reports on the Geology of Cameron and Vermillion Parishes: Louisiana Geological Survey Geology Bulletin #6, 242 pp.

Huff, G.F., Fendick, R.B., Stuart, C.G., and Cramer, G., 1988, Louisiana ground-water quality in Moody, D.W., Carr, J.E., Chase, E.B., and Aronson, D.A., comps., National water summary 1986--Hydrologic events and ground-water quality: U.S. Geological Survey Water-Supply Paper 2325, p. 273-278.

Hughes, L.S. and Leifeste, D., 1965, Reconnaissance of the chemical quality of surface waters of the Sabine River basin, Texas and Louisiana: U. S. Geological Survey Water-Supply Paper W 1809-H, 71 p.

Huntzinger, T.L., Whiteman, C.D., Jr., and Knochenmus, D.D., 1985, Simulation of ground-water movement in the "1,500- and 1,700-foot" aquifer of the Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 34, 52 p.

Jennings, M.E. and Land, L.F., 1977, Simulation studies of flow and sediment transport using a mathematical model, Atchafalaya River basin, Louisiana: U. S. Geological Survey Water-Resources Investigations WRI 77-0014, 55 p.

Jennings, M.E. and O'Neil, C.P., 1976, Simulation of forest changes related to hydrologic variables in the Atchafalaya River basin, Louisiana: Journal of Research of the U. S. Geological Survey vol. 4, p. 481-489.

Johnson-Thibaut, P.M., Demcheck, D.K., Swarzenski, C.M., and Ensminger, P.A., 1998, Water use and quality of fresh surface-water resources in the Barataria-Terrebonne Basins, Louisiana: U.S. Geological Survey Open-File Report 98-632, 47 p., 1 pl.

Jones, P. H., 1945, Water, in Iberville Parish Resources and Facilities: Louisiana Department of Public Works and Iberville Parish Planning Board, p. 21-25.

Jones, P. H., 1946, Water, in Pointe Coupee Parish Resources and Facilities: Louisiana Department of Public Works and Pointe Coupee Parish Planning Board, p. 30-34.

Jones, P. H., 1947, Water, in West Baton Rouge Parish Resources and Facilities: Louisiana Department of Public Works and West Baton Rouge Parish Development Board, p. 29-33.

Jones, P.H., 1951, An investigation of the relation between stream flow and ground-water conditions in Beauregard Parish, Louisiana: U.S. Geological Survey Open-File Report, 22 p.

Jones, P.H., Hendricks, E.L., Irelan, B., and others, 1956, Water resources of southwestern Louisiana: U.S. Geological Survey Water-Supply Paper 1364, 460 p.

Jones, P.H., Turcan, A.N. and Skibitzke, H.E. 1954, Geology and Ground-Water Resources of Southwestern Louisiana: Louisiana Geological Survey Geology Bulletin #30, 285 pp. plus map pack.

Kane, H.E., 1959, Late Quaternary geology of Sabine Lake and vicinity, Texas and Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 9, p. 225-235.

Kane, H.E., 1964, Geology of Sabine Lake and vicinity, Louisiana and Texas: Proceeding of the Indiana Academy of Science vol. 73, p. 171-176.

Kapustka, S.F., 1964, Chemical composition of surface waters of Louisiana, 1943-58: Louisiana Department of Public Works, 212 p.

Keim, B. and Muller, R., 1992, Temporal fluctuations of heavy rainfall magnitudes in New Orleans, Louisiana: 1871-1991: American Water Resources Association Water Resources Bulletin vol. 28(4), p. 721-730.

Keim, B. D., Faiers, G. E., Muller, R. A., Grymes, J. M. and Rohli, R. V., 1995, Long-term trends of precipitation and runoff in Louisiana, USA. International Journal of Climatology, 15: 531–541.

Kerfoot, H.B., Brady, W., Schramm, B. and Allendorf, M.A., 2007, Geochemical and hydrologic characterization to identify the source of low level benzene in the Chicot Aquifer groundwater Transaction of the Gulf Coast Association of Geological Societies vol. 57, p. 397-407.

Kerschbaum, S.J., 1995, Simulation of pumping scenarios using numerical flow modeling with particle tracking to optimize water quality at Minden, Louisiana: New Orleans, Louisiana, University of New Orleans, Master Theses, 212p.

Kilburn, C. and Whitman, H.M., 1962, Water levels in southwestern Louisiana, April 1960 to April 1961, with a discussion of water-level trends from 1950 to 1960: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 11, 21 p.

Kilpatrick, J.M., 1992, Simulated Reponse to Future Pumping in the Sparta Aquifer, Union County, Arkansas: U.S. Geological Survey Water-Resources Investigations, no. 91-4161, 25p.

Kinsland, G.L., 1998, Vermilion River flood gates; to mitigate Lafayette, Louisiana flooding: Transaction of the Gulf Coast Association of Geological Societies vol. 48: 159-163.

Kinsland, G.L. and Wildgen, J., 2006, Evolution of the morphology of the Vermilion River near Lafayette, Louisiana, USA; consequent flooding problems and a mitigation plan; some features on the surface of the Prairie Complex; all illustrated with lidar imagery: Transaction of the Gulf Coast Association of Geological Societies vol. 56: 353-365.

Klug, M.L., 1955, Geology and Ground-Water Resources of the Alexandria Area, Rapides Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #3, 23 pp.

Kuniansky, E.L., 1984, Hydrology of Fritchie Marsh, coastal Louisiana: U.S. Geological Survey Water-Resources Investigations Report 84-4324, 23 p.

Kuniansky, E.L., 1989, Geohydrology and simulation of ground-water flow in the "400-foot," "600-foot," and adjacent aquifers, Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 49, 90 p.

Kuniansky, E.L., Dial, D.C., and Trudeau, D.A., 1989, Maps of the "400-foot," "600-foot," and adjacent aquifers and confining beds, Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 48, 16 p.

Larson, J.M., 1987, A three-dimensional simulation of the CECOS injection well near Lake Charles, Louisiana: unpublished M.S. thesis, Ohio University, 189 p.

Lee, F.N., 1985, Analysis of the low-flow characteristics of streams in Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 35, 41 p.

Lee, F.N., 1985, Floods in Louisiana, magnitude and frequency (4th ed.): Louisiana Department of Transportation and Development Water Resources Technical Report no. 36, 30 p.

Lee, F.N., and Arcement, G.J., Jr., 1981, Hydrologic analysis of Pearl River floods, April 1979 and April 1980, in Louisiana and Mississippi: Louisiana Department of Transportation and Development, Office of Highways Research Study no. 81-1-SS, 37 p.

Leone, H.L., Jr., 1976, Analyses of water, core material, and elutriate samples collected near New Orleans, Louisiana (Lake Pontchartrain, Louisiana, and vicinity hurricane protection project): U.S. Geological Survey Open-File Report 76-758, 22 p.

Leone, H.L., Jr., 1977, Analyses of water, core material, and elutriate samples collected near Buras, Louisiana (New Orleans to Venice, Louisiana, hurricane protection project): U.S. Geological Survey Open-File Report 77-310, 14 p.

Leone, H.L., Jr., 1977, Analyses of water, core material, and elutriate samples collected near Galliano, Louisiana (Larose to Golden Meadow, Louisiana, hurricane protection project): U.S. Geological Survey Open-File Report 77-576, 12 p.

LGWMC (Louisiana Ground Water Management Commission), 2002, Assistance in developing the statewide water management plan: report prepared by C.H. Fenstermaker & Associates, Inc., LBG-Guyton Associates, Hydro-Environmental Technology, Inc., and Onebane, Bernard, Torian, Diaz, McNamara & Abell, 3 volumes.

Lock, B.E., 1993, The proposed Cade II landfill site, South Louisiana; threat to the Chicot Aquifer: Transaction of the Gulf Coast Association of Geological Societies vol. 43, p. 211-217.

Long, R.A., 1965, Feasibility of a Scavenger-Well System as a Solution to the Problem of Vertical Salt-Water Encroachment: Louisiana Geological Survey Water Resources Pamphlets #15, 27 pp.

Long, R.A., 1965, Ground Water in the Geismar-Gonzales Area, Ascension Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #7, 67 pp.

Lovelace, J.K., 1991, Water use in Louisiana, 1990: Louisiana Department of Transportation and Development Water Resources Special Report no. 6, 131 p.

Lovelace, J.K., 1998, Distribution of saltwater in the Chicot aquifer system in the Calcasieu Parish area, Louisiana, 1995-96: Louisiana Department of Transportation and Development Water Resources Technical Report no. 62, 59 p.

Lovelace, J.K., 1999, Distribution of saltwater in the Chicot aquifer system of southwestern Louisiana, 1995-96: Louisiana Department of Transportation and Development Water Resources Technical Report no. 66, 61 p.

Lovelace, J.K., and Johnson, P.M., Water use in Louisiana, 1995: Louisiana Department of Transportation and Development Water Resources Special Report no. 11, 127 p.

Lovelace, J.K., and Lovelace, W.M., 1995, Hydrogeologic unit nomenclature and computer codes for aquifers and confining units in Louisiana: Louisiana Department of Transportation and Development Water Resources Special Report no. 9, 12 p.

Lovelace, J.K., Fontenot, J.W., and Frederick, C.P., 2002, Louisiana ground-water map no. 14: Potentiometric surface, January 2001, and water-level changes, June 2000 to January 2001, of the Chicot aquifer system in southwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 02-4088, 2 sheets.

Lovelace, J.K., Fontenot, J.W., and Frederick, C.P., 2004: Withdrawals, water levels, and specific conductance in the Chicot aquifer system in southwestern Louisiana, 2000-03: U.S. Geological Survey Scientific Investigations Report 2004-5212, 56 p.

Lovelace, J.K., Frederick, C.P., Fontenot, J.W., and Naanes, M.S., 2001, Louisiana ground-water map no. 12: Potentiometric surface of the Chicot aquifer system in southwestern Louisiana, June 2000: U.S. Geological Survey Water-Resources Investigations Report 01-4128, 1 sheet.

Lovelace, W.M., 2002, Water-level measurements and chloride concentrations for selected wells in Louisiana, January 1988-October 1997, Water Resources Basic Records Report no. 23, 168 p.

Ludwig, A.H., and Terry, J.E., 1980, Methods and applications of digital-model simulation of the Red River alluvial aquifer, Shreveport to the mouth of the Black River, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 79-114, 103 p.

Lurry, D.L., 1985, Public water supplies in Louisiana, volume 1: Northern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 13, 119 p.

Lurry, D.L., 1987, Pumpage of water in Louisiana, 1985: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 4, 14 p.

Lurry, D.L., 1987, Pumpage of water in Louisiana, 1985: U.S. Geological Survey Water-Resources Investigations Report 87-4059, 1 sheet.

Maher, J.C. and Jones P.H., 1945, Ground-water exploration at Alexandria, Louisiana: Economic Geology vol. 40, p. 164-182.

Mahon, G. L. and Poynter, D. T., 1993, Development, calibration, and testing of ground-water flow models for the Mississippi River Valley alluvial aquifer in eastern Arkansas using one-square-mile cells: U.S. Geological Survey Water-Resources Investigations Report 92-4106, 33 p.

Maloney, J.W., 2005, Geology and hydrogeology of the area within a 2-mile radius of Judice sand mine, Lafayette Parish, Louisiana. Unpublished M.S. thesis, University of Louisiana at Lafayette, 68 p.

Marie, J.A., 1971, Ground Water Resources of Avoyelles Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #15, 70 pp.

Marshall, S.L., 1978, Index to water-resources data for Louisiana, ground-water records: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 9, 176 p.

Marsh, R.E., 1939, Reports on the Surface Water Supply of Louisiana to September 30, 1938: Louisiana Geological Survey Geology Bulletin #16, 198 pp.

Martin, A., Jr., and Early, D.A., 1987, Statistical analysis of aquifer-test results for nine regional aquifers in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4001, 26 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1985, Map showing generalized potentiometric surface of aquifers of Pleistocene Age, southern Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4331, 1 sheet.

Martin, A., Jr., and Whiteman, C. D., Jr., 1985, Map showing generalized potentiometric surface of the Evangeline and equivalent aquifers in Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4359, 1 sheet.

Martin, A., Jr., and Whiteman, C.D., Jr., 1986, Generalized potentiometric surface of the Catahoula aquifer in central Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 86-4059, 1 sheet.

Martin, A., Jr., and Whiteman, C.D., Jr., 1989, Geohydrology and regional ground-water flow of the coastal lowlands aquifer system in parts of Louisiana, Mississippi, Alabama, and Florida--A preliminary analysis: U.S. Geological Survey Water-Resources Investigations Report 88-4100, 88 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1990, Calibration and sensitivity analysis of a ground-water flow model of the coastal lowlands aquifer system in parts of Louisiana, Mississippi, Alabama, and Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4189, 54 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1991, Hydrology of the coastal lowlands aquifer system in parts of Alabama, Florida, Louisiana, and Mississippi: U.S. Geological Survey Open-File Report 91-72, 115 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1999, Hydrology of the Coastal Lowlands aquifer system in parts of Alabama, Florida, Louisiana, and Mississippi: U.S. Geological Survey Professional Paper 1416-H, 51 p. 1

Martin, A., Whiteman, C.D. and Becnel, M.J., 1988, Generalized potentiometric surfaces of the upper and lower Jasper and equivalent aquifers in Louisiana, 1984: U. S. Geological Survey Water-Resources Investigations WRI 87-4139.

Martinez, J.D. and Haag, W.G., 1986, Engineering geology and cultural history of the Atchafalaya River basin: Transaction of the Gulf Coast Association of Geological Societies vol. 36: 1-11.

Martinez, J.D. and Haag, W.G., 1987, The Atchafalaya River and its basin; a field trip: Louisiana Geological Survey Guidebook Series #4.

McCulloh, R.P., 1991, Surface Faults in East Baton Rouge Parish: Louisiana Geological Survey Open File Series #91-02, 25 pp., plus five plates.

McCulloh, R.P., 1992, Surface Geologic Mapping in Louisiana: History, Present Status, and Future Prospects: Louisiana Geological Survey Open File Series #92-01, 20 pp.

McCulloh, R.P., 1996, Topographic Criteria Bearing on the Interpreted Placement of the Traces of Faults of the Baton Rouge System in Relation to Their Fault-line Scarps: Louisiana Geological Survey Open File Series #96-01, 23 pp.

McCulloh, R.P., 2008, The Scotlandville, Denham Springs, and Baton Rouge Faults: A Map Guide for Real Estate Buyers, Sellers and Developers in the Greater Baton Rouge Area: Louisiana Geological Survey Public Information Series #13, 38 pp.

McCulloh, R.P. and Heinrich, P.V., 2000, Baton Rouge East, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2000-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2000, Scotlandville, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2000-01, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2001, Comite, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2001-01, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2001, Denham Springs, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2001-02, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2001, St. Tammany, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2001-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2002, Geology of the Fort Polk Region, Sabine, Natchitoches, and Vernon Parishes, Louisiana: Louisiana Geological Survey Report of Investigations Series #02-01, 82 pp. plus appendix and CD.

McCulloh, R.P. and Heinrich, P.V., 2002, Mandeville, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2002-04, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2002, Slidell, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2002-06, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2003, Bush, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2003-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2007, Fred, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2007-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2007, Zachary, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2007-02, scale = 1:24,000.

McCulloh, R.P., Heinrich, P.V. and J.I. Snead, 2009, The Amite Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #12, scale = 1:100,000.

McGee, B.D. 1997, Occurrence of nitrate in the Mississippi River alluvial aquifer in Louisiana, June through December 1993: Louisiana Department of Transportation and Development Water Resources Technical Report no. 61, 21 p.

McGinnis, L.D., Thompson, M.D., Kuecher, G.J., Wilkey P.L. and Isaacson, H.R., 1995, Salinity and hydrodynamics of the Holocene and upper Pleistocene beneath the Louisiana wetlands from electrical measurements: Proceedings of the symposium on the Application of geophysics to engineering and environmental problems, p. 261-271.

McKee, P.W., and Clark, B.R., 2003, Development and calibration of a ground-water flow model for the Sparta Aquifer of southeastern Arkansas and north-central Louisiana and simulated response to withdrawals; 1998-2027: U.S. Geological Survey Water-Resources Investigations, no. WRI 03-4132, 71p.

McKee, P.W., Clark, B.R., and Czarnecki, J.B., 2004, Conjunctive-use optimization model and sustainable-yield estimation for the Sparta Aquifer of southeastern Arkansas and north-central Louisiana: U.S. Geological Survey Water-Resources Investigations, no. WRI 03-4231, 30p.

McManus, J., 2002, The history of sediment flux to Atchafalaya Bay, Louisiana: Geological Society of London Special Publication #191, p. 209-226.

McPhee, J., 1987, The control of nature; Atchafalaya: New Yorker Magazine vol. 63, p. 39-100.

McWreath, H.C., III, and Smoot, C.W., 1989, Geohydrology and development of ground water at Fort Polk, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4088, 53 p.

McWreath, H.C., III, Nelson, J.D., and Fitzpatrick, D.J., 1991, Simulated response to pumping stresses in the Sparta aquifer, northern Louisiana and southern Arkansas: Louisiana Department of Transportation and Development Water Resources Technical Report no. 51, 51 p.

Meyer, Meyer, LaCroix & Hixson, Inc., Lazenby and Associates, Louisiana Tech University, URS Corporation, C.W. Smoot, and Frye-Magee, 2002, Sparta Groundwater Study: report for Sparta Groundwater Conservations District, unnumbered pages.

Meyer, R.R., 1953, Summary of ground-water conditions in southwestern Louisiana: U.S. Geological Survey Open-File Report, 7 p.

Meyer, R.R. and Rollo, J.R., 1965, Salt-Water Encroachment, Baton Rouge Area, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #17, 9 pp.

Meyer, R.R., and Turcan, A.N., Jr., 1953, Summary report on the geology and ground-water resources of the Baton Rouge area, Louisiana: U.S. Geological Survey Open-File Report, 23 p.

Meyer, R.R., and Turcan, A.N., Jr., 1955, Geology and ground-water resources of the Baton Rouge area, Louisiana: U.S. Geological Survey Water-Supply Paper 1296, 138 p.

Miller, C.Q., Jr., 1954, The subsurface geology of Vermilion Parish, Louisiana: unpublished M.S. thesis, University of Houston.

Milliken, K. L. T., 2008, Holocene sea-level history and the evolution of Sabine Lake and Calcasieu Lake; East Texas and west Louisiana, USA and the glacial retreat history of Maxwell Bay, South Shetland Islands, Antarctica; implications for ice cap thickness, retreat and Climate Change: unpublished Ph.D. dissertation, Rice University, 164 p.

Milliken, K.T., Anderson, J.B. and Rodriguez, A.B., 2008, Record of dramatic Holocene environmental changes linked to eustasy and climate change in Calcasieu Lake, Louisiana, USA: Geological Society of America Bulletin vol. 443, p. 43-63.

Milner, L.R. and C. Fisher, 2009, Geological Characterization of the Chicot/Atchafalaya Aquifer Region: Southwest Louisiana: Louisiana Geological Survey Water Resources Series #4, 39 pp.

Milner, R., 2003, Chicot Aquifer in Jefferson Davis Parish, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 53, p. 555-556.

Moresi, C. K., 1932, Geology of Lafayette and St. Martin parishes, Louisiana: unpublished M.S. thesis Louisiana State University.

Morgan, C.O., 1961, Ground-Water Conditions in the Baton Rouge Area, 1954-59, with Special Reference to Increased Pumpage: Louisiana Geological Survey Water Resources Bulletins #2, 78 pp. plus map pack.

Morgan, C.O., and Winner, M.D., Jr., 1962, Hydrochemical facies in the "400-foot" and "600-foot" sands of the Baton Rouge area, Louisiana, in Geological Survey research 1962; short papers in geology, hydrology, and topography, articles 1-59: U.S. Geological Survey Professional Paper 450-B, article 50, p. B120-B123.

Mossa, J., 1990, Discharge-suspended sediment relationships in the Mississippi-Atchafalaya rivers system, Louisiana: unpublished Ph.D. thesis Louisiana State University, 195 p.

Murikan, A., 2002, Ground water availability and water usage trends in Lafayette Parish from 1960 to 2000, and a comparison with state-wide trends in Louisiana: unpublished M.S. thesis, University of Louisiana at Lafayette.

Murray, H.E. and Beck, J.N., 1992, Methane in well water from Lake Charles, Louisiana: Environmental Contamination and Toxicology Bulletin vol. 48, p. 768-771.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, Cane Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208040, 34 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, Lake Natchez - Bourbeaux Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208030, 34 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, lower Mermentau River: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC:08080202, 43 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, lower Saline Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208020, 35 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, upper Saline Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208010, 48 p.

NCDC (National Climatic Data Center), 2010, Online Climate Data Directory, http://www.ncdc.noaa.gov/oa/climate/climatedata.html, http://www.ncdc.noaa.gov/oa/climate/climatedata.html, accessed 7/21/2010.

Neely, B.L., Jr., 1968, Tickfaw River at Starns bridge near Magnolia, Louisiana: U.S. Geological Survey Open-File Report, 7 p.

Neely, B.L., Jr., and Stiltner, G.J., 1979, Elevations and discharges produced by a simulated flood wave on the lower Sabine River, Louisiana and Texas, caused by a theoretical dam failure: U.S. Geological Survey Open-File Report 79-678, 15 p.

Newcome, R. and Sloss, R., 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Newcome, R., Jr., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Newcome, Roy, Jr., 1961, Sources of emergency water supply in the Alexandria area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works, 7 p.

Nichol, S.L. Boyd R. and Penland S. 1992, Hydrology of a wave-dominated estuary; Lake Calcasieu, Southwest Louisiana: Gulf Coast Association of Geological Societies : New Orleans, LA. 42: 835-844.

Ning, Z. and Abdollahi, K., 2001, Chapter 5: Gulf coast regional climate, in Climate Change Impacts on the United States. The Potential Consequences of Climate Variability and Change, by the National Assessment Synthesis Team, US Global Change Research Program: US Global Change Research Program, Washington, DC, p. 79-82.

Norriss, D.D. 1991, Distribution and uptake of environmental contaminants in the lower Calcasieu Estuary, Louisiana: unpublished Ph.D. dissertation, Tulane University, 237 p.

Nyman, D.J., 1984, The occurrence of high concentrations of chloride in the Chicot aquifer system of southwestern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 33, 75 p.

Nyman, D.J., 1989, Quality of water in freshwater aquifers in southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 42, 22 p.

Nyman, D.J., and Fayard, L.D., 1978, Ground-water resources of Tangipahoa and St. Tammany Parishes, southeastern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 15, 76 p.

Nyman, D.J., Beck, J.N., Rao, G.N. and Murray, H.E., 1991, The Sabine River diversion canal and groundwater conservation in Calcasieu Parish, Louisiana: American Water Resources Association Technical Publication Series 91-3, p. 253-259.

Nyman, D.J., Halford, K.J., and Martin, A., Jr., 1990, Geohydrology and simulation of flow in the Chicot aquifer system of southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 50, 58 p.

Nyman, D. J., Steinkampf, W.C., Hutchinson, C.B. and Zack, A.L., 1983, Saltwater movement in the coastal areas: U. S. Geological Survey Professional Paper 1983, p. 123-124.

Ocamb, R.D., 1961, Growth faults of South Louisiana. United States: Transaction of the Gulf Coast Association of Geological Societies vol. 11, p. 139-175.

Page, L.V., 1963, Water-supply characteristics of Louisiana streams: Louisiana Department of Public Works Technical Report no. 1, 109 p.

Page, L.V., and May, H.G., 1964, Water resources of Bossier and Caddo Parishes, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 5, 105 p.

Page, L.V. and Poole, J.L., 1958, Water, in West Baton Rouge Parish Resources and Facilities: Louisiana Department of Public Works and West Baton Rouge Parish Development Board, p. 26-35.

Page, L.V. and Pree, H.L., 1964, Water resources of De Soto Parish, Louisiana: U.S. Geological Survey Water Supply Paper #1774, 152 p.

Page, L.V., Newcome, R., Jr., and Graeff, G.D., Jr., 1963, Water resources of Sabine Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 3, 146 p.

Paine, W.R., 1962, Geology of Acadia and Jefferson Davis Parishes: Louisiana Geological Survey Geology Bulletin #36, 277 pp. plus map pack.

Patterson, L.J., Muhammad, Z., Bentley, S.J., Britsch, L.D. and Dillon, D.L., 2003, (super 210) Pb and (super 137) Cs geochronology of the Lake Fausse Pointe region of the lower Atchafalaya Basin: Transaction of the Gulf Coast Association of Geological Societies vol. 53, p. 668-675.

Peele, R. H., 2000. GIS data development of the geology of the Fort Polk region of west-central Louisiana. R. P. McCulloh. United States, U. S. Geological Survey : Reston, VA, United States: 119-124.

Pereira, W.E., Rostad C.E., Keck, R. and Chiou, C.T., 1989, Distribution of organic compounds in the lower Calcasieu River, Louisiana, with special emphasis on haloarenes: U. S. Geological Survey Water Resources Investigation WRI 88-4089, p. 35-51.

Pettijohn, R.A., Busby, J.F. and Layman, T.B., 1993, Properties and chemical constituents in ground water from permeable zone B (lower Pleistocene-upper Pliocene deposits), coastal lowlands aquifer system, south-central United States: U. S. Geological Survey Water-Resources Investigations WRI 91-4152.

Pettijohn, R.A., Weiss, J.S. and Williamson, A.K., 1988, Distribution of dissolved-solids concentrations and temperature in ground water of the Gulf Coast aquifer systems, south-central United States: U. S. Geological Survey Water-Resources Investigations WRI 88-4082.

Phillips, J. D., 2003. Toledo Bend Reservoir and geomorphic response in the lower Sabine River. United Kingdom, Wiley : Chichester, United Kingdom. 19: 137-159.

Phillips, J. D., 2008. Geomorphic controls and transition zones in the lower Sabine River. United States, John Wiley & Sons : New York, NY, United States. 22: 2424-2437.

Poach, M.E., 1999, Soil phosphorus characteristics of natural and created wetlands in the Atchafalaya Delta, Louisiana: unpublished Ph.D. thesis Louisiana State University, 108 p.

Poore, R., Dowsett, H. and Verardo, S., 2003, Millennial- to century-scale variability in Gulf of Mexico Holocene climate records: Paleoceanography vol. 18(2), 13 p.

Prakken, L.B., 1998, Water-quality data for public-supply wells at Fort Polk, Vernon Parish, Louisiana, March and June 1997: U.S. Geological Survey Open-File Report 98-271, 13 p.

Prakken, L.B., 2004, Louisiana ground-water map no. 17: Generalized potentiometric surface of the Kentwood aquifer system and the “1,500-foot” and “1,700-foot” sands of the Baton Rouge area in southeastern Louisiana, March-April 2003: U.S. Geological Survey Scientific Investigations Map 2862, 2 sheets.

Rahman, A., 2003, Incorporating uncertainty into high-resolution groundwater supply models: Proceeding of the Symposium on Groundwater quality modeling and management under uncertainty, p. 122-130.

Rahman, A., Tsai, F.T.C., White, C.D., Carlson, D.A. and Willson, C.S., 2008, Geophysical data integration, stochastic simulation and significance analysis of groundwater responses using ANOVA in the Chicot aquifer system, Louisiana, USA: Hydrogeology Journal vol. 16, p. 749-764.

Rahman, A., Tsai, F. T. C., White, C. D., Carlson, D. A., and Wilson, C., 2006, Geophysical Data integration and conditional uncertainty analysis on hydraulic conductivity estimation: Proceedings of American Society of Civil Engineers/Environmental Water & Resources Institute, May 21-25, 2006, Omaha, Nebraska, unnumbered pages in CD.

Ranganathan, V. and Hanor, J., 1988, Density-driven groundwater flow near salt domes: Chemical Geology vol. 74, p. 173-188.

Rao, G. N. Beck, J. N., Murray, H. E. and Nyman, D. J., 1991, Estimating transmissivity and hydraulic conductivity of Chicot Aquifer from specific capacity data: Water Resources Bulleting vol. 27, p. 47-58.

Rapp, T.R., 1994, Ground-water resources of southern Tangipahoa Parish and adjacent areas, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 92-4182, 47 p.

Rapp, T.R., 1996, Ground-water resources of Caddo Parish, Louisiana, 1992: Louisiana Department of Transportation and Development Water Resources Technical Report no. 58, 89 p.

Ravichandran, M., 1995. Geochronology of sediments in the Sabine-Neches Estuary, Texas, U.S.A. M. Baskaran, P. H. Santschi and T. S. Bianchi. Netherlands, Elsevier : Amsterdam, Netherlands. 125: 291-306.

Reed, T.B., 2003, Recalibration of a ground-water flow model of the Mississippi River Valley alluvial aquifer of northeastern Arkansas, 1918-1998, with simulations of water levels caused by projected ground-water withdrawals through 2049: U.S. Geological Survey Water-Resources Investigations Report 2003-4109, 58 p.

Renken, R.A., 1998, Ground water atlas of the United States; Segment 5; Arkansas, Louisiana, and Mississippi: U. S. Geological Survey Hydrologic Investigations Atlas F1-f28.

Roberts, H.H., 1998, Delta switching; early responses to the Atchafalaya River diversion. United States, Coastal Education and Research Foundation vol. 14, p. 882-899.

Roberts, H.H., Coleman, J.M. and van Heerden, I., 1998, Atchafalaya Basin and deltas field trip: Louisiana State University, Coastal Studies Institute Field trip book, 68 P.

Rogers, J.E., 1981, Water resources of the Kisatchie well-field area near Alexandria, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 26, 57 p.

Rogers, J.E., and Calandro, A.J., 1965, Water resources of Vernon Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 6, 104 p.

Rollo, J.R., 1960, Ground water in Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 1, 84 p.

Rollo, J.R., 1962, Ground water in Plaquemines Parish, Louisiana: U.S. Geological Survey Open-File Report, 8 p.

Rollo, J.R., 1966, Ground-Water Resources of the Greater New Orleans Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #9, 69 pp. plus map pack.

Rollo, J.R., 1969, Salt-Water Encroachment in Aquifers of the Baton Rouge Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #13, 45 pp. plus map pack.

Rouly, K. C. (1989). Quaternary and environmental geology of southwestern St. Martin Parish, Louisiana: unpublished M.S. thesis, University of Southwestern Louisiana, 135 p.

Rowland, M. A. and Hannoura, A. A. A., 1988, Regional groundwater modeling and aquifer characterization: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods vol. 2, p. 1471-1494.

Russell, R.J., Howe, H.V., McGuirt, J.H., Dohm, C.F., Hadley, W., Kniffen, F.B. and Brown, C.A., 1936, Lower Mississippi River Delta: Reports on the Geology of Plaquemines and St. Bernard Parishes: Louisiana Geological Survey Geology Bulletin #8, 454 pp.

Ryals, G.N., 1980, Potentiometric surface maps of the Sparta Sand; northern Louisiana and southern Arkansas, 1900, 1965, 1975, and 1980: U.S. Geological Survey Open-File Report 80-1180, 1 sheet.

Ryals, G.N., 1982a, Regional geohydrology of the northern Louisiana salt-dome basin, part I, Conceptual model and data needs: U.S. Geological Survey Open-File Report 82-343, 23 p.

Ryals, G.N., 1982b, Ground-water resources of the Arcadia-Minden area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 28, 35 p.

Ryals, G.N., 1983a, Regional geohydrology of the northern Louisiana salt-dome basin, part III, potentiometric levels of the Wilcox-Carrizo and Sparta aquifers: U.S. Geological Survey Water-Resources Investigations Report 83-4131, 14 p.

Ryals, G.N., 1984, Regional geohydrology of the northern Louisiana salt-dome basin, part II, geohydrologic maps of the Tertiary aquifers and related confining layers: U.S. Geological Survey Water-Resources Investigations Report 83-4135, 6 p.

Sanford, T.H., Jr., 1973a, Water resources of the Ruston area, Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 8, 32 p.

Sanford, T.H., Jr., 1973b, Ground-water resources of Morehouse Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 19, 90 p.

Sargent, B.P., 2002, Water use in Louisiana, 2000: Louisiana Department of Transportation and Development Water Resources Special Report no. 15, 133 p.

Sargent, B.P., 2004, Thickness of the Chicot aquifer system surficial confining unit and location of shallow sands, southwestern Louisiana:Louisiana Department of Transportation and Development Water Resources Technical Report

Sargent, B.P., 2007, Water use in Louisiana, 2005: Louisiana Department of Transportation and Development Water Resources Special Report no. 15, 133 p.

Sargent, B.P., and McGee, B.D., 1998, Occurrence of nitrate and selected water-quality data, Chicot aquifer system in southwestern Louisiana, July 1994 through January 1996: Louisiana Department of Transportation and Development Water Resources Technical Report no. 64, 53 p.

Sargent, B.P., Frederick C.P. and Roberts, F.C., 2004, Shallow sands and thickness data for the Chicot aquifer system surficial confining unit, southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report #73, 29 p.

Sasser, D.C., Sturrock, A.M., Jr., and Covay, K.J., 1988, Meteorological and microlysimeter data for a rice irrigation study in southwestern Louisiana, 1985 and 1986: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 15, 24 p.

Saucier, R.T., and Snead, J.I., 1989, Quaternary Geology of the Lower Mississippi Valley: Louisiana Geological Survey Geologic Map #7, scale 1:1,000,000.

Sauer, V.B., 1970, Rainfall-runoff-hydrograph relations for northern Louisiana: Louisiana Department of Public Works Technical Report no. 3, 33 p.

Sauer, V. B., 1971. The unit hydrograph; a technique for routing reservoir releases. United States, U. S. Geological Survey : Reston, VA, United States: B259-b264.

Scarcia, Glenn, 1954, Water, in St. Tammany Parish Resources and Facilities: Louisiana Department of Public Works and St. Tammany Parish Planning Board, p. 37-46.

Schrader, T.P., 2004, Status of Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer in Arkansas and the Sparta Aquifer in Louisiana, Spring-Summer 2001: U.S. Geological Survey Scientific Investigations Report 2004-5055, 35p.

Schrader, T.P., 2008, Potentiometric Surface in the Sparta-Memphis Aquifer of the Mississippi Embayment, Spring 2007: U.S. Geological Survey Scientific Investigations Map 3014, 1 sheet.

Schrader, T.P., and Jones, J.S., 2007, Status of Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer in Arkansas and the Status of Water Levels in the Sparta Aquifer in Louisiana, Spring 2005: U.S. Geological Survey Scientific Investigations Report 2007-5029, 35p.

Seanor, R.C., 1994, Water-level measurements, 1986-91, Red River alluvial aquifer, Red River Valley, Louisiana: U.S. Geological Survey Open-File Report 94-69, 218 p.

Seanor, R.C., and Smoot, C.W., 1995a, Louisiana ground-water map no. 6: Potentiometric surface, 1990, and water-level changes, 1974-90, of the Mississippi River alluvial aquifer in northeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4146, 2 sheets.

Seanor, R.C., and Smoot, C.W., 1995b, Louisiana ground-water map no. 8: Potentiometric surface, 1991, of the Carrizo-Wilcox aquifer in northwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4176, 1 sheet.

Seanor, R.C., and W.H. Kress, 2004, Water levels and water quality in the Mississippi River alluvial aquifer, Franklin Parish, Louisiana, 2000-2002: Louisiana Department of Transportation and Development.

Shampine, W.J., 1970, Gazetteer of Louisiana lakes and reservoirs: Louisiana Department of Public Works Basic Records Report no. 4, 31 p.

Shampine, W.J., 1971, Chemical, biological, and physical data for the major lakes and reservoirs in Louisiana: Louisiana Department of Public Works Basic Records Report no. 5, 98 p.

Simon, N.S., 1988, The effect of different methods for removal of organic matter on hydrochloric acid extraction of metals from sediment; Calcasieu River, Louisiana: U. S. Geological Survey Open-File Report OF 87-0764, p. 73-80.

Skrobialowski, S.C., 2002, Trace elements and organic compounds in bed sediment from selected streams in southern Louisiana, 1998: U.S. Geological Survey Water-Resources Investigations Report 02-4089, 39 p.

Skrobialowski, S.C., Mize, S.V. and Demcheck, D.K., 2004, - U. S. Geological Survey. Environmental setting, water quality, and ecological indicators of surface-water quality in the Mermentau River basin, southwestern Louisiana, 1998-2001: U. S. Geological Survey Water-Resources Investigations WRI 03-4185, 73 p. 28

Sloss, R. and Garber, M.S., 1959, Water, in St. Bernard Parish Resources and Facilities: Louisiana Department of Public Works and St. Bernard Parish Development Board, p. 23-33.

Sloss, Raymond, 1971, Drainage area of Louisiana streams: Louisiana Department of Public Works Basic Records Report no. 6, 117 p.

Smoot, C.W., 1983, Records of water-level measurements and lithologic logs, Red River Valley, Louisiana, 1975-80: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 12, 197 p.

Smoot, C.W., 1986, Louisiana hydrologic atlas map no. 2: Areal extent of freshwater in major aquifers of Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4150, 1 sheet.

Smoot, C.W., 1988, Louisiana hydrologic atlas map no. 3: Altitude of the base of freshwater in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4314, 1 sheet.

Smoot, C.W., 1989, Louisiana hydrologic atlas map no. 4: Geohydrologic sections of Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4288, 1 sheet. .

Smoot, C.W., and Fendick, R.B., Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 63, 36 p., 1 pl.

Smoot, C.W., and Martin, A., Jr., 1991b, Generalized potentiometric surfaces of the Red River alluvial aquifer, pool 1, Red River waterway area, central Louisiana: U.S. Geological Survey Water-Resources Investigations Report 91-4109, 7 sheets.

Smoot, C.W., and R.B. Fendick Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development, Water Resources Technical Report, no. 63, 36p. 4

Smoot, C.W., and Seanor, R.C., 1991a, Louisiana ground-water map no. 3: Potentiometric surface, 1989, and water-level changes, 1980-89, of the Sparta aquifer in north-central Louisiana: U.S. Geological Survey Water-Resources Investigations Report 90-4183, 2 sheets.

Smoot, C.W., and Seanor, R.C., 1992, Louisiana ground-water map no. 4: Potentiometric surface, 1989, and water-level changes, 1984-89, of the Jasper aquifer system in west-central Louisiana: U.S. Geological Survey Water-Resources Investigations Report 91-4137, 2 sheets.

Snead, J.I. and McCulloh, R.P., 1984, Geologic Map of Louisiana: Louisiana Geological Survey Geologic Map #5 scale 1:500,000.

Snider, J.L., 1983, Ground-water resources of the Fillmore-Haughton-Red Chute area, Bossier and Webster Parishes, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 32, 21 p.

Snider, J.L., A.J. Calandro, and W.J. Shampine, 1972, Water Resources of Union Parish, Louisiana: Department of Conservation Louisiana Geological Survey and Louisiana Department of Public Works, Water Resources Bulletin, no. 17. 68p

Snider, J.L., and Forbes, M.J., Jr., 1961, Pumpage of water in Louisiana, 1960: Louisiana Department of Public Works, Department of Conservation, and Louisiana Geological Survey, 6 p.

Snider, J.L., and Ryals, G.N., 1988, Radiochemical analyses of ground water in Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 44, 52 p.

Snider, J.L., Calandro, A.J. , and Shampine, W.J., 1972, Water Resources of Union Parish, Louisiana: Department of Conservation Louisiana Geological Survey and Louisiana Department of Public Works, Water Resources Bulletin, no. 17. 68p.

Snider, J.L., Winner, M.D., Jr., and Epstein, J.B., 1962, Ground water for Louisiana's public supplies: Louisiana Department of Public Works, 267 p.

Stanley, T.B., Jr., and Maher, J.C., 1944, Ground-water resources of Jefferson Davis and Acadia Parishes, Louisiana: Louisiana Department of Public Works, 93 p.

Stephens, J.W., 1976, Records of wells, water-level measurements, and drillers' logs, Red River Valley, Louisiana: U.S. Geological Survey Open-File Report 76-759, 335 p.

Stoessell, R.K. and Prochaska, L., 2005, Chemical evidence for migration of deep formation fluids into shallow aquifers in south Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 55, p. 794-808.

Stuart, C.G., and Demas, C.R., 1990, Organic chemical analyses of ground water in Louisiana, water years 1984-88: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 18, 80 p.

Stuart, C.G., and Lurry, D.L., 1988, Public water supplies in Louisiana, volume 2: Southern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 16, 206 p.

Stuart, C.G., Knochenmus, D., and McGee, B.D., 1994, Guide to Louisiana's ground-water resources: U.S. Geological Survey Water-Resources Investigations Report 94-4085, 55 p.

Sumner, D. M. and Wasson, Billie E., 1990, Geohydrology and simulated effects of large ground-water withdrawals on the Mississippi River alluvial aquifer in northwestern Mississippi: U.S. Geological Survey Water Supply Paper No. 2291, 60 p.

Swarzenski, C.M., 2003, Resurvey of quality of surface water and bottom material of the Barataria Preserve, Jean Lafitte National Historical Park and Preserve, Louisiana, 1999-2000: U.S. Geological Survey Water-Resources Investigations Report 03-4038, 28 p.

Taylor, J.C., Jr., 1945, Water, in Washington Parish Resources and Facilities: Louisiana Department of Public Works and Washington Parish Planning Board, p. 31-32, app., p. g, III-IV.

Texas A&M University, S. G. C. P., College Station, TX, United States, performer, 1996. Sabine Lake conference; Where Texas and Louisiana come together. United States.

Tollett, R.W., and Fendick, R.B., Jr., 2004, Quality of water from shallow wells in the rice-growing area in southwestern Louisiana, 1999 through 2001: U.S. Geological Survey Water-Resources Investigations Report 03-4050, 44 p.

Tollett, R.W., Fendick, R.B., Jr., and Lane B. Simmons, 2003, Quality of water in domestic wells in the Chicot and Chicot equivalent aquifer systems in southern Louisiana and southwestern Mississippi, 2000-2001: U.S. Geological Survey Water-Resources Investigations Report 03-4122, 85 p.

Tomaszewski, D., 2009, Ground-water resources in Rapides Parish, Louisiana, 2005: Louisiana Department of Transportation and Development Water Resources Technical Report no. 78, 54 p.

Tomaszewski, D.J., 1988, Ground-water hydrology of Livingston, St. Helena, and parts of Ascension and Tangipahoa Parishes, southeastern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 43, 54 p.

Tomaszewski, D.J., 1992, Louisiana hydrologic atlas map no. 5: Quality of freshwater in aquifers of Louisiana, 1988: U.S. Geological Survey Water-Resources Investigations Report 90-4119, 7 sheets.

Tomaszewski, D.J., 1996, Distribution and movement of saltwater in aquifers in the Baton Rouge area, Louisiana, 1990-92: Louisiana Department of Transportation and Development Water Resources Technical Report no. 59, 44 p.

Tomaszewski, D.J., 1998, Hydrogeology and the effects of pumpage on the "1,500-foot" sand south of the Baton Rouge fault, near Brusly, Louisiana, 1996: Louisiana Department of Transportation and Development Water Resources Technical Report no. 65, 22 p.

Tomaszewski, D.J., and Anderson, M.L., 1995, Data from wells in a chloride monitoring network, Baton Rouge area, Louisiana, 1965-94: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 19, 40 p.

Tomaszewski, D.J., Lovelace, J.K., and Ensminger, P.A., 2002, Water withdrawals and trends in ground-water levels and stream discharge in Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 68, 30 p.

Torak, L.J., and Whiteman, C.D., Jr., 1982, Applications of digital modeling for evaluating the ground-water resources of the "2,000-foot" sand of the Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 27, 87 p.

Trahan, D.B., 1995, Source and plume investigation of chlorinated compounds in groundwater at a chemical plant: Transaction of the Gulf Coast Association of Geological Societies vol. 45, p. 565-571.

Trudeau, D.A., 1994, Geohydrology and the occurrence of selected chemical contaminants at a hazardous-waste disposal site, Calcasieu Parish, Louisiana, 1984-85: Louisiana Department of Transportation and Development Water Resources Technical Report no. 53, 54 p.

Turcan, A.N., Jr., 1949, Water, in Tensas Parish Resources and Facilities: Louisiana Department of Public Works and Tensas Parish Planning Board, p. 25-29.

Turcan, A. N., Jr., 1952, Industrial use of ground water, Louisiana: Louisiana State University Engineering Experimentation Station Bulleting 31, p. 1-16.

Turcan, A.N., Jr., 1953, Water, in Terrebonne Parish Resources and Facilities: Louisiana Department of Public Works and Terrebonne Parish Development Board, p. 42-44.

Turcan, A.N., Jr., 1954, Water, in St. James Parish Resources and Facilities: St. James Parish Planning and Development Board and Louisiana Department of Public Works, p. 27-33.

Updegraff, D. M., 1989, Microbial content of water and bottom material in the lower Calcasieu River, Louisiana: United States, U. S. Geological Survey : [Reston, VA], United States: 19-22.

USACE-VD (U.S. Army Corps of Engineers-Vicksburg District), 2007, Pearl River Watershed Feasibility Report: U.S. Army Corps of Engineers-Vicksburg District preliminary draft feasibility study report, 4 volumes.

U. S. Army Corps of Engineers, 1981, Water resources development in Louisiana, 1981: Report prepared by the U. S. Army Corps Eng. Lower Miss. Valley Div., Vicksburg, MS, 142 p.

U. S. Army Corps of Engineers, W. E. S., 1950, Technical Memorandum - U. S. Army Corps of Engineers. Salt water intrusion, Calcasieu River, Louisiana and connecting waterways; model investigation: Report by the U. S. Army Corps of Engineers, Waterways Experiment Station : Vicksburg, MS, United States.

U. S. Army Engineer Topographic Laboratories, E. A. f. R. I., 1973, Inventory of basic environmental data; South Louisiana; Mermentau River basin to Chandeleur Sound with special emphasis on the Atchafalaya Basin: Report by the U. S. Army Eng. Topogr. Lab.; Eng. Agency Resour. Invent. : Washington, D. C.

U.S. Geological Survey, 1955, Water, in Livingston Parish Resources and Facilities: Louisiana Department of Public Works and Livingston Parish Development Board, p. 29-40.

U.S. Geological Survey, 1961, Surface water records of Louisiana: U.S. Geological Survey, 166 p.

U.S. Geological Survey, 1962, Surface water records of Louisiana: U.S. Geological Survey, 153 p.

U.S. Geological Survey, 1963, Surface water records of Louisiana: U.S. Geological Survey, 153 p.

U.S. Geological Survey, 1964a, Surface water records of Louisiana: U.S. Geological Survey, 176 p.

U.S. Geological Survey, 1964b, Water quality records in Alabama, Louisiana, and Mississippi: U.S. Geological Survey, 90 p.

U.S. Geological Survey, 1965, Water resources data for Louisiana, Part 1. Surface water records: U.S. Geological Survey, 162 p.

U.S. Geological Survey, 1965, Water resources data for Louisiana, Part 2. Water quality records: U.S. Geological Survey, 46 p.

U.S. Geological Survey, 1966, Water resources data for Louisiana, Part 1. Surface water records: U.S. Geological Survey, 157 p.

U.S. Geological Survey, 1966, Water resources data for Louisiana, Part 2. Water quality records: U.S. Geological Survey, 63 p.

U.S. Geological Survey, 1967, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 266 p.

U.S. Geological Survey, 1968, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 245 p.

U.S. Geological Survey, 1969, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 262 p.

U.S. Geological Survey, 1970, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 239 p.

U.S. Geological Survey, 1971, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 218 p.

U.S. Geological Survey, 1972, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 226 p.

U.S. Geological Survey, 1973, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 315 p.

U.S. Geological Survey, 1974, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 473 p.

U.S. Geological Survey, 1975, Ground-water levels in Louisiana for wells measured through 1974: Louisiana Department of Public Works Water Resources Basic Records Report no. 7, 548 p.

U.S. Geological Survey, 1975, Index to water resources data for Louisiana, surface-water records, water-quality records: Louisiana Department of Public Works Water Resources Basic Records Report no. 8, 81 p.

U.S. Geological Survey, 1975, Water resources data for Louisiana, water year 1975: U.S. Geological Survey Water-Data Report LA-75-1, 816 p.

U.S. Geological Survey, 1976, Water resources data for Louisiana, water year 1976, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-76-1, 463 p.

U.S. Geological Survey, 1976, Water resources data for Louisiana, water year 1976, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-76-2, 826 p.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-77-1, 405 p.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-77-2, 393 p.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-77-3, 578 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-78-1, 412 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-78-2, 365 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-78-3, 326 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-79-1, 426 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-79-2, 461 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-79-3, 284 p.

U.S. Geological Survey, 1980, Land use and land cover and associated maps of Lake Charles, Louisiana, Texas: U. S. Geological Survey Open-File Report map.

U.S. Geological Survey, 1980, Water resources data for Louisiana, water year 1980, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-80-1, 526 p.

U.S. Geological Survey, 1980, Water resources data for Louisiana, water year 1980, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-80-2, 371 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-81-1, 424 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-81-2, 327 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-81-3, 218 p.

van Beek, J.L., 1977, Multiuse management; an alternative to channelization of the Atchafalaya Basin, Louisiana: American Association for the Advancement of Science; contributed papers of the 143rd national meeting.

Van Biersel, T., and Carlson, D., 2009, Distribution and Source Analysis of Elevated Chloride Concentration in the Wilcox Aquifer of Northwestern Louisiana: Gulf Coast Association of Geological Societies, Transactions, v. 59, p753-767.

Van Biersel, T. and Milner L.R., 2010, Principal Freshwater Aquifer of Louisiana: Louisiana Geological Survey Educational Poster Series 10-01, 1 sheet.

Van Biersel, T. P., L. R. Milner, and E. Walden, 2008, Development of a chloride standard exceedance map for Louisiana: Gulf Coast Association of Geological Societies Transactions, v. 58, p. 875-881.

Van Biersel, T.V., Milner, L.R., Carlson, D.A. and E.K. Mier, 2009, Long-term Hydrogeologic Characterization of Water Supply Wells Affected by Hurricanes Katrina and Rita along the North Shore of Lake Pontchartrain: Louisiana Geological Survey Report of Investigations Series #09-01, 56 pp.

Varvaro, G. G., 1957, Bulletin - Louisiana Geological Survey. Geology of Evangeline and Saint Landry Parishes. United States, Louisiana Geological Survey : Baton Rouge, LA, United States. 31.

Varvaro, G. G., 1958, Geology of Evangeline and Saint Landry parishes. United States.

Veatch, A. C., 1902. The geography and geology of the Sabine River. United States. Part 6: 101-148.

Walker, N.D., 2001, Tropical storm and hurricane wind effects on water level, salinity, and sediment transport in the river-influenced Atchafalaya-Vermilion Bay system, Louisiana, USA: Estuarine Research Federation vol. 24, p. 498-508.

Walker, N.D. and Hammack, A.B., 2000, Impacts of winter storms on circulation and sediment transport; Atchafalaya-Vermilion Bay region, Louisiana: Coastal Education and Research Foundation vol. 16, p. 996-1010.

Walters, D.J., 1992, Louisiana ground-water map no. 5: Potentiometric surface, 1990, and water-level changes, 1974-90, of the Evangeline equivalent/southeast Louisiana aquifer system: U.S. Geological Survey Water-Resources Investigations Report 92-4112, 2 sheets.

Walters, D.J., 1995, Louisiana ground-water map no. 7: Potentiometric surface, 1991, and water-level changes, 1969-91, of the Chicot equivalent aquifer system in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 94-4202, 2 sheets.

Walters, D.J., 1995, Louisiana ground-water map no. 11: Potentiometric surface, spring 1993, and water-level changes, 1987-93, of the Gonzales-New Orleans aquifer in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4169, 2 sheets.

Walters, D.J., 1996, Louisiana ground-water map no. 10: Potentiometric surface, 1991, and water-level changes, 1985-91, of the Chicot aquifer system in southwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4044, 2 sheets.

Walters, D.J., and Lovelace, W.M., 1998, Ground-water-quality data for East and West Baton Rouge, East and West Feliciana, and Point Coupee Parishes, Louisiana, water years 1944-97: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 21, 54 p., 1 pl.

Walter, W.H., 1982, Pumpage of water in Louisiana, 1980: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 3, 15 p.

Wang, F. and Gambrell, R.P., 1996, Tidally induced subsurface groundwater flow and transport in two salt marsh ecosystems: Louisiana Water Resources Research Institute Report G 2022-05, p. 19-23.

Wang, F.C., 1984, Mississippi River meandering and Atchafalaya Delta building: Proceedings of the Am. Soc. Civ. Eng. Conference Rivers '83; river meandering.

Wang, F.C., 1987, Saltwater intrusion in Louisiana coastal channels: Proceedings of the Gulf of Mexico Information Transfer Meeting, p. 174-177.

Weiss, J.S., 1990, Geohydrologic units of the coastal lowlands aquifer system, south-central United States: U. S. Geological Survey Open-File Report OF 90-0173.Chicot Aquifer System Bibliography

Welch, R. N., 1942, Geology of Vernon Parish.

Wells, F.C., 1980, Hydrology and water quality of the lower Mississippi River: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 21, 83 p.

Whiteman, C.D., Jr., 1972, Ground water in the Plaquemine-White Castle area, Iberville Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 16, 69 p.

Whiteman, C.D., Jr., 1979, Saltwater encroachment in the "600-foot" and "1,500-foot" sands of the Baton Rouge area, Louisiana, 1966-78, including a discussion of saltwater in other sands: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 19, 49 p.

Whiteman, C.D., Jr., Calandro, A.J., and Broussard, W.L., 1970, Water resources of the Slagle-Simpson-Flatwoods area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 24, 23 p.

Whiteman, H.M., 1965, Estimating Water Quality from Electric Logs in Southwestern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #16, 13 pp.

Whiteman, H.M. and C. Kilburn, 1963, Ground-Water Conditions in Southwestern Louisiana, 1961 and 1962, with a Discussion of the Chicot Aquifer in the Coastal Area: Louisiana Geological Survey Water Resources Pamphlets #12, 32 pp.

Whitfield, M.S., Jr., 1973, Availability of ground water in the Winnsboro area, Louisiana: Louisiana Department of Public Works Water Resources Special Report no. 1, 9 p.

Whitfield, M.S., Jr., 1975, Geohydrology and water quality of the Mississippi River alluvial aquifer, northeastern Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 10, 29 p.

Whitfield, M.S., Jr., 1975, Geohydrology of the Evangeline and Jasper aquifers of southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 20, 72 p.

Whitfield, M.S., Jr., 1980, Chemical character of water in the Red River alluvial aquifer, Louisiana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-1018, 95 p.Sparta Aquifer Bibliography

Wicker, K.M., 1975, Recent changes in physiography of the Buffalo Cove, Atchafalaya Basin, Louisiana: unpublished M.S. Thesis, Louisiana State University.

Wilkinson, E., 1885, On the occurrence of native mercury in alluvium in Louisiana. American Journal of Science vol. 29, p. 280-281.

Williams, C.B. and Duex, T.W., 1995, A hydrogeological study of the Chicot Aquifer in Lafayette Parish, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 45, p. 165-172.

Williams, C.B. and Duex, T.W., 1999, Evidence for local groundwater recharge site in Lafayette Parish, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 49 p. 500-504.

Williamson, A.K. and Grubb. H.F., 2001, Ground-water flow in the Gulf Coast aquifer systems, south-central United States: U. S. Geological Survey Professional Paper P1416-F, p. F1-f173.

Wilson, T.A. and Hosman, R.L., 1987, Geophysical well-log database for the Gulf Coast aquifer systems, south-central United States: U. S. Geological Survey Open-File Report OF 87-0677.

Winner, M.D., Forbes, M.J., and Broussard, W.L., 1968, Water Resources of Pointe Coupee Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #11, 110 pp. plus map pack .

Winner, M.D., Jr., 1963, The Florida Parishes—an area of large, undeveloped ground-water potential in southeastern Louisiana: Louisiana Department of Public Works, 50 p.

Winner, M.D., Jr., Forbes, M.J., Jr., and Broussard, W.L., 1968, Water resources of Pointe Coupee Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 11, 110 p.

Winslow, A.G., Hillier, D.E., and Turcan, A.N., Jr., 1968, Saline ground water in Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-310, 4 sheets.

Yan, S.K. and Adrian, D.D., 1988, Spatial and temporal variations of salt water intrusion in the Gonzales-New Orleans Aquifer, New Orleans area, Louisiana: Proceeding of the American Water Resource Association Conference, vol. 24, p. 127.

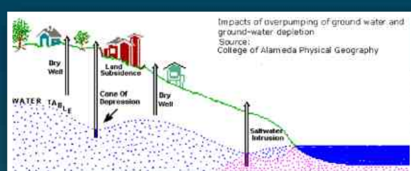
002783.LD14.01

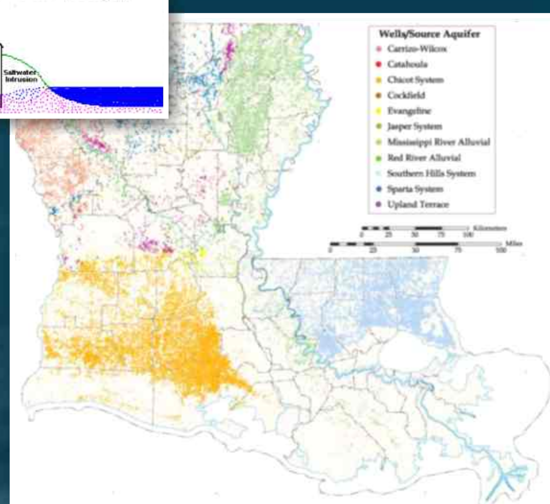
Appendices

Recommendations for a Statewide Ground Water Management Plan

December 7, 2011

DNR Contract No. 2215-10-04





Prepared for

Office of Conservation
Louisiana Department of Natural Resources

Prepared by

ecology and environment, inc.
Global Environmental Specialists

Appendix A
Ground Water Management Plans – Selected States

Georgia

With fourteen major river systems and multiple groundwater aquifer systems, Georgia has abundance water resources. Although their water is abundant, it is not an unlimited resource and must be carefully managed to meet long-term water needs. Sustaining water resources supports the state's economy, protects public health and natural systems, and enhances the quality of life for its citizens. Georgia's State Environmental Protection Division (EPD), under the guidance of Water Council, developed a comprehensive statewide water management plan in 2008. The Water Council is comprised of a basin advisory committee, a statewide advisory committee, and technical advisory committees. EPD and the Water Council included public involvement from agricultural and business interest, local governments, non-profit agencies, trade associations, and others in preparing the plan. The plan is a framework to guide future decisions regarding water management across the state while providing flexibility and adaptability for future water management. The framework consists of:

- Integrated water policies that will govern water management decisions throughout the state;
- Assessment of the water resources capacity;
- Management practices for water quantity and water quality; and
- Regional planning to select management practices that account for resource conditions and uses throughout the state.

Assessment of Water Resources Capacity

To begin the plan, an assessment was needed to determine the consumptive use and assimilative capacity of the State's groundwater and surface waters with consideration to use varying on a regional and local level. The general purposes of the assessment are:

- To conduct consumptive use and assimilative capacity assessment of the State's ground and surface waters.
  - Process to begin with identification of hydrologic boundaries of watershed and aquifers.
  - Selection of appropriate water management strategies
- Support revisions of water quality standards
- Requires the compilation of a significant information base, a comprehensive monitoring program, and a well-coordinated system for information management.

A comprehensive monitoring program is needed to document the surface water flows and groundwater levels in order to scientifically determine the quantity of water available to support current and future growth and to satisfy the requirements for natural systems and in-stream use. This monitoring program will assess water quality conditions and compliance with water quality standards. The consumptive use assessment or Water Quantity Resource Assessment should determine how much water could be removed from rivers, lakes, and aquifers without causing negative impacts, as well as assess the assimilative capacity wastewater and storm water streams.

The hydrologic boundaries of watershed and aquifers were identified and evaluated considering the flow history, natural and altered, and the contributions the source flow has historically made to the hydraulically connected water resources. The water quantity resource assessment includes evaluation of the:

- Time to replenish water withdrawn from a surface water source;
- Impacts of water management practices that may impact return flows, such as on on-site sewage management systems, land application systems, and transfer of withdrawn waters to sources that are not by nature hydraulically connected; and
- Impacts of prior water development and management practices, such as the size and operational characteristics of water storage projects; the extent, location, and timing of discharge waters from interbasin transfers; and other water management practices

The plan calls for the determination of the flow regime requirements based on the consumptive use and in-stream flow conditions for surface water withdraw from the water source. Withdrawal permits will be determined pursuant to the in-stream flow protection strategy adopted by the Board of Natural Resources.

Water Quantity and Water Quality

The EDP will implement and manage the Water Quantity Policy to ensure that sufficient amounts of surface and groundwater remain within a water source to allow current and future users to benefit from the values provided by that resource. The Water Quantity Policy is based upon the Water Quantity Resources Assessment. Consumptive use and water withdrawals indicate how water uses in one area affect the water availability in another area within a water source and at points hydraulically connected. A consumptive use assessment compares the consumption from a water source, which is intended to reflect a dry year, and quantifies it with water available. The consumptive use assessment is developed by EPD with the assistance of a technical advisory group that consists of hydrologists, biologists, engineers, and other disciplines.

Water use above the quantity defined by the consumptive use assessment will be addressed in preparing the regional water development and conservation plans and in permits issued with regards to those plans. The Water Quantity Policy requires regional forecast of water supply and assimilative capacity demands. Planning regions are defined by jurisdictional boundaries and economic interdependencies, as well as hydrologic boundaries.

The water quality policy ensures that the state is in compliance with the federal Clean Water Act standards. The policy manages point and non-point source pollution on a watershed bases to provide protection of water quality, the restoration of impaired waters, and the management of assimilative capacity for present and future needs. Activities on land, and the ways in which land is developed, affect water quality and assimilative capacity. Gaps between forecasted needs for assimilative capacity and the assimilative capacity available will be addressed by selecting the appropriate management practices.

Water Quantity and Water Quality plans provide a framework for the statewide water conservation implementation plan. DNR will lead the development of the water conservation and implementation plan that will establish goals, benchmarks, and best management guidelines. The statewide conservation and implementation plan will provide guidance and flexibility in implementation and reporting by permittees to demonstrate progress toward water conservation goals.

Regional water development and conservation plans prescribe basic water conservation practices that tailor to the conditions of the water resources and the mix of water sectors and users. Regional water development and conservation plans set alternative water consumption goals that refine or supplement the statewide goals. Water withdrawal permitting will be regulated by the Board of Natural Resources as necessary to attain the water conservation goals. Principal elements in the regional plans include:

- Local governments within a planning region;
- Planning for areas at the periphery of the water planning region;
- Major water users;
- Surface water and groundwater sources and their conditions;
- Population estimates for 10 to 40 years, water demands, wastewater returns, land surface types and distributions, and employment characteristics
- Forecasted uses of water bodies for water supply, wastewater discharge, and storm flows for each period;
- Comparisons of forecast with consumptive use assessments and assimilative capacities as determined by the water quantity and water quality assessments;
- Water quantity and water quality management objectives from 10-40 years;
- Recommendations for appropriate management practices for stormwater, wastewater treatment, water supply, water conservation, and water quality protection;
- Intersection with present and future state plans that impact water resources
- Data and information needs;
- Benchmarks for assessing plan effectiveness and identification of required revisions; and
- Provide a 5-year review of each plan to establish progress in meeting objectives, update and assess future needs, and plan change recommendations.

Management Practices for Water Supply

Water supply management practices as identified by the regional water plans will ensure water resource infrastructure are identified early and properly addressed or mitigated. Additional surface water storage is a critical component of the natural capabilities of streams to meet water supply needs. Water users may withdraw for a source within a particular sub-basin to service areas that span multiple sub-basins. Intrabasin transfers are not always returned to the original sub-basin. Consumptive use assessments should be performed prior to permitting intrabasin transfers that service more than four counties. New water supply reservoirs should be designed, sited, and operated in a sustainable manner to maximize offstream water uses and mitigate harm to the environment. A water supply technical assistance program will provide assistance to those developing multi-jurisdictional projects to supplement water supply. The program will:

- Forecast demands over a 50-year planning period;
- Investigate all reasonable water supply resource alternatives;
- Assist site selection to minimize environmental impacts;
- Provide water supply watershed protection provisions;
- Ensure that design and operation provide flows necessary to meet in-stream flow criteria and support flow regimes identified in the water quantity resource assessment; and
- Provide water quality protection.

The adopted plan will identify state resources and funding mechanisms to help achieve water conservation goals.

All water management concepts are consistent and support the state laws. Provisions in state law remain that address emergencies such as water shortage with the priorities for human consumption and farm use.

Arkansas

Groundwater is an important natural resource in the state of Arkansas. Arkansas ranks fourth in the U.S. for the groundwater usage despite the state's relatively small population. Nearly 55 percent of the public-supply systems and 25 percent of the population rely on the state's groundwater resources. Three principal aquifers serve as the main supply system for the state. They contain readily accessible high quality water and are the basis for heavily populated areas. Despite the abundance of groundwater resources, continuous withdrawal and lack of conservation are contributing to serious declines in some areas.

The task of managing groundwater resources, including conservation and protection, is primarily handled by three agencies. The Arkansas Natural Resources Commission (Commission) is currently responsible for the management and planning of the state's water resources. The Commission's strategy for water resource protection is to encourage conservation, education, and the conjunctive use of ground and surface water instead of water resource allocation measures. This is accomplished through monitoring of the aquifer water levels and water quality, encouraging implementation of best management practices, and enforcement of the proper construction of water wells. The Commission's planning responsibilities include:

- Maintaining of an inventory of the State's water resources, including areas of groundwater concern;

- Establishment of watershed management policies and practices;
- Establishment of minimum stream flows to maintain fish and wildlife habitat;
- Determination of a safe yield of surface and groundwater to assure sustainability of water resources;
- Establishment of critical surface and groundwater areas that do not meet the safe yield criterion;
- Determination of favored mitigation practices to augment surface water supply with any surface water excess; and
- Provide the State with a comprehensive groundwater protection document in accordance with the State's Water Plan to serve as a guide for water resources and conservation programs.

The Arkansas State Plant Board (ASPB) and the Arkansas Department of Environmental Quality (ADEQ) also have groundwater monitoring programs designed to protect the state's groundwater from pollution and over use. The ASPB monitoring program was created to prevent agricultural pollution in the state's groundwater. The mission of this program is to provide protection for the public health and welfare, the propagation and protection of terrestrial and aquatic life, the protection of the environment, the operation of existing industries and agriculture, and the maintenance and enhancement of the long-term economic health of the state. Groundwater is monitored in areas vulnerable to agricultural pesticide contamination under an EPA approved Pesticide Management Plan. ASPB works in conjunction with the Arkansas Department of Health to determine actions to be taken in the event pesticide contamination is confirmed. The program is voluntary and includes point and non-point source contamination.

The ADEQ groundwater protection program responsibilities include groundwater quality planning and water-quality monitoring, addressing gaps in groundwater protection through the development of guidelines and regulations, and budgeting and grant administration. Water-quality monitoring is the primary function of this program. Example monitoring programs include:

- Investigation of pesticides in groundwater in eastern Arkansas,
- Nutrient and bacteria transport in shallow aquifer systems in northwest Arkansas, and
- Salt-water intrusion into shallow aquifers in south-eastern Arkansas.

Groundwater quality is sampled every three years through the ambient groundwater monitoring program. This data is used to document trends and changes in water quality over time. The monitoring program currently consists of 195 well and spring sites in 9 different monitoring areas within the State. A full suite of inorganic parameters is analyzed for the samples, including major cations, anions, and trace metals. ADEQ publishing reports following the sampling events. Although the state does not have a formal set of groundwater standards, the Water Division uses federal standards and health advisory limits to establish cleanup levels at contaminated sites.

Alabama

Alabama is unique and fortunate to have an abundance of valuable water resources throughout the state. Over 33 trillion gallons of freshwater flow every year into 77,000 miles of stream channels coursing throughout 14 river basins. Additionally, over 550 trillion gallons of water is stored in underground aquifers. These high quality and functioning aquifers serve as a source of potable water for half of the state's population and for the majority of the public water systems. Despite the size and magnitude of these resources, overuse and exploitation, poorly planned development, and climate variation threaten to overwhelm the state's groundwater supply.

The Alabama Water Resources Act tasks the Office of Water Resources (OWR) and the Water Resources Commission (WRC) with the power and responsibility to develop plans and strategies for the management of the waters of the state. The OWR coordinates with several state agencies in protection and conservation of groundwater resources. The Alabama Department of Environmental Management (ADEM), the Alabama Department of Public Health, the Geological Survey of Alabama, and the Alabama Surface Mining Commission also provide various groundwater management programs.

Groundwater protection programs in Alabama are primarily focused on prevention of contamination from point sources such as underground storage tanks, facilities regulated under the Hazardous Waste Program, and onsite domestic waste disposal. These programs are largely funded by grants from EPA or state under any established federal program. These include releases from point sources such as pipelines, bulk storage tanks, spills of commonly used organic solvents, and septic tanks.

The Groundwater Branch of ADEM administers and provides technical support for regulatory programs related to groundwater protection or cleanup. The Underground Storage Tank (UST) Program and the Underground Injection Control (UIC) Program are administered by this department. Incidents of contamination of groundwater that do not fall within one of the programs above are dealt with under the authority of the Alabama Water Pollution Control Act. This statute provides the legal basis to require investigation and cleanup where groundwater has been contaminated.

The Water Investigations Program of the Geological Survey of Alabama conducts basic water resource investigations of surface and groundwater quantity and quality. The Water Investigations Program conducts a wide array of investigations concerning the state's groundwater resources such as aquifer recharge, water availability, groundwater quality, and regional stratigraphy as related to aquifers. The group also collects a variety of information including water-well drilling data, aquifer data, and general hydrologic data. This group also maintains a statewide network of monitoring sites to assess the yearly status of groundwater levels.

Alabama has a registration and reporting system in place for surface and groundwater withdrawals. This system involves the OWR and a division of the Alabama Department of

Economic and Community Affairs with oversight by the WRC. The registration program requires any person withdrawing waters of the state to file a Declaration of Beneficial Use with the Office of Water Resources. The Declaration of Beneficial Use application must include the:

- Water source;
- Primary uses of the water;
- Geographic location of the points of diversion and points of return of water;
- Estimated or actual quantity of water, in gallons, diverted and estimated or actual quantity of water, in gallons, to be returned;
- Estimated maximum potential quantity of water, in gallons, which could be diverted and estimated potential quantity of water, in gallons, which would be returned;
- Method or means of measuring, estimating, or controlling the water diverted;
- Statement regarding the navigability of the water source; and
- Basis of legal right to use the water to be diverted.

In addition, the OWR administers the Water Use Reporting Program which requires all major water users in the State to report annual water withdrawals by all public water systems. Major water users are classified as:

- Non-public users withdrawing 100,000 gallons of water or more per day; and
- Irrigation users with the capacity to use 100,000 gallons of water or more per day.

Texas

Texas law distinguishes between surface water and groundwater. All surface water, including streams, rivers, and lakes, belongs to the state. The only exception is diffused water, such as storm water runoff, which belongs to the landowner. Surface waters are appropriated through permits and are issued by the Water Uses and Availability Section, Water Quality Division of the Texas Commission on Environmental Quality (TCEQ) in Austin. In contrast to surface water, groundwater law is based on the "right of capture." This doctrine, and its interpretation through case law, allows the landowner to withdraw groundwater without limitation and without being held liable to neighboring landowners for any harmful effects resulting from the withdrawal. The right of landowners to capture groundwater has been upheld by Texas with the following exceptions:

- Drilling a well on someone else's property;
- Drilling a "slant" well on adjoining property that crosses the property line, which is regarded as a trespass;
- Pumping water for the sole purpose of injuring an adjoining landowner, which is regarded as malicious or wanton conduct; and
- Causing land subsidence on adjoining landform, which is regarded as negligent over-pumping.

Texas is the last remaining state to utilize the rule of capture, a doctrine based on English Common Law, as a means of regulating groundwater resources.

In 1949, the Texas Legislature first provided for the voluntary creation of groundwater conservation districts. These conservation districts could be created over any groundwater reservoir designated byte state, following approval by county commissioners 'courts for single-county districts or by the appropriate state agency for districts encompassing multiple counties. A confirmation election was required. The Texas Legislature, while continuing to acknowledge the "right of capture" of groundwater by landowners, passed additional legislation in1985 and 1997 to encourage the establishment of groundwater conservation districts and, in limited cases, to allow for the creation of districts by state initiative.

This legislation confirmed that locally controlled groundwater conservation districts are the state's preferred method of managing groundwater resources. The legislation also stressed the importance and responsibility of groundwater conservation districts in developing and implementing comprehensive management plans to conserve and protect groundwater sources. Groundwater conservation districts can be created by the TCEQ only in designated groundwater management areas. The term "groundwater management area" refers to groundwater reservoirs, or subdivisions thereof, that were:

- Delineated by the state from the1950s to 1970s;
- Groundwater management areas that were delineated by the state in the 1980s;
- Groundwater management areas delineated by the state following a petition from owners within the area; and
- Priority groundwater management areas that were designated by the state in the 1990s.

Groundwater conservation districts are charged to manage groundwater by providing for the conservation, preservation, protection, recharge, and prevention of waste of groundwater resources within their jurisdictions. Groundwater conservation districts have required duties that must be performed, as well as a number of authorized powers that may be invoked. The required duties of groundwater conservation districts are:

- To own, develop, and adopt a comprehensive management plan. The plan should provide for the most efficient use of groundwater, for controlling and preventing waste of groundwater, and for controlling and preventing land subsidence. The plan should specify the acts, procedures, performance, and avoidance measures necessary for implementation. The plan may be amended as necessary and must be readopted at least every 5 years. Management plans and amendments must be submitted and certified by the TWDB and filed with other districts in a common management areas;
- Adopt necessary rules to implement the management plan;
- Require permits for drilling, equipping, or completing wells that produce more than 25,000 gallons per day or for alterations to size or well pumps. Districts must promptly review and approve or deny permit applications. All wells producing at least 25,000

gallons per day in existence prior to the district's creation must automatically be granted a permit.

- Require records to be kept of the drilling, equipping, and completion of water wells, as well as on the production and use of groundwater. Water well drillers' logs and electric use logs must be kept and filed with the district. Information must be made available to the TCEQ and the TWDB upon request.

Authorized powers and optional duties of groundwater conservation districts include:

- Adopt rules to conserve, preserve, protect, recharge, and prevent waste of groundwater and to control land subsidence;
- Provide for the spacing of water wells and regulate the production of wells;
- Enforce rules by injunction, mandatory injunction, or other appropriate remedy in a court of competent jurisdiction;
- Acquire land to erect dams or to drain lakes, draws, and depressions; construct dams; drain lakes, depressions, draws, and creeks; install pumps and other equipment necessary to recharge the groundwater reservoir; and provide facilities for the purchase, sale, transportation, and distribution of water.
- Make surveys of the groundwater reservoir or subdivision and facilities for development, production, transportation, distribution, and use of groundwater. Purchase, sell, transport, and distribute surface water or groundwater for any purpose. Exercise the power of eminent domain to acquire by condemnation a fee simple (property of which the district has unqualified ownership and power of disposition) or other interest in property located inside the district.

Appendix B
Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana (LGS Report)

Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana

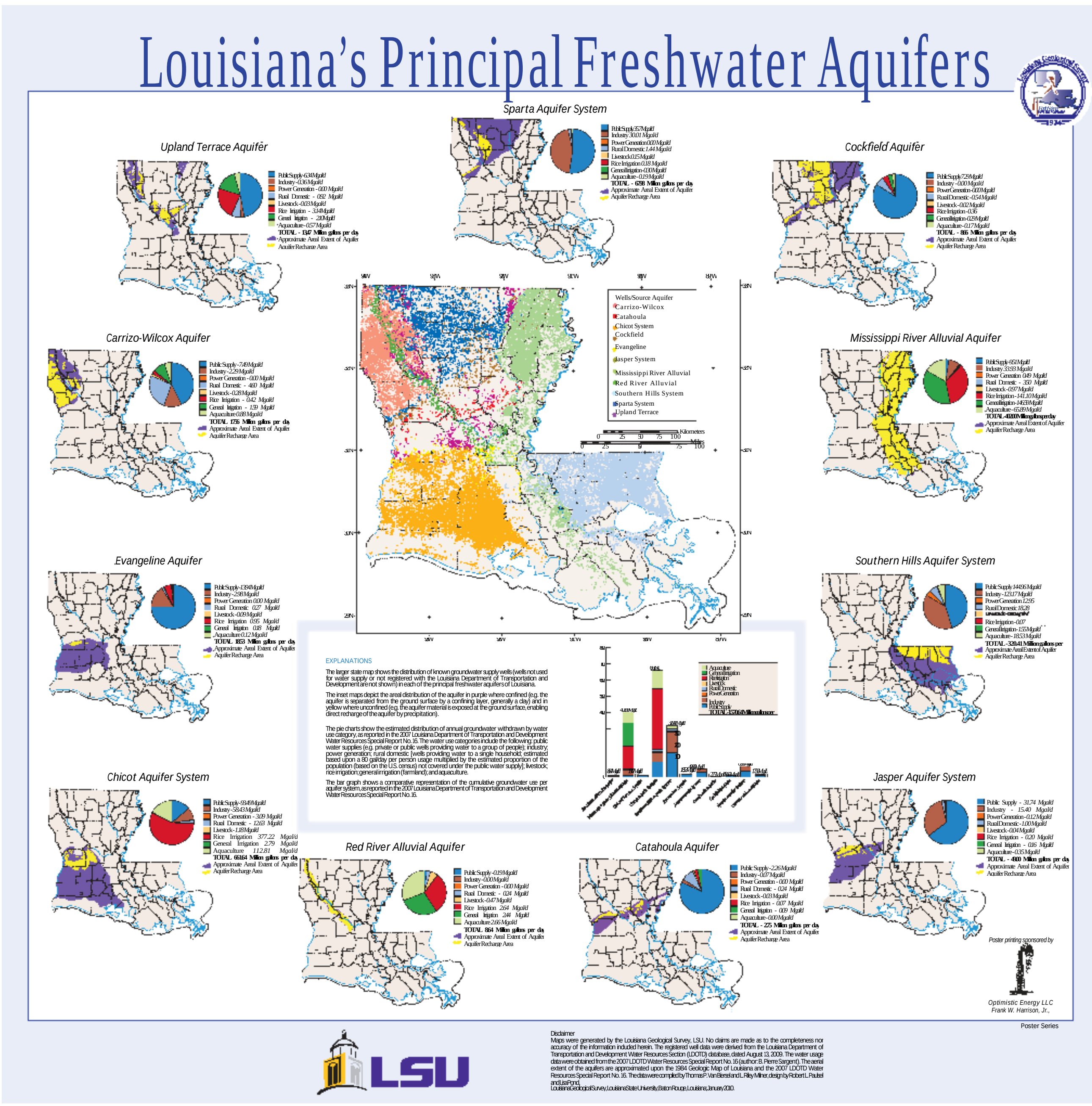
Presented to:

Ecology & Environment, Inc. – Baton Rouge, LA
November 11, 2010

Presented by:

Thomas P. Van Biersel[1], Douglas A. Carlson and L. Riley Milner

Louisiana Geological Survey - Louisiana State University
[1] Now at the Louisiana Department of Natural Resources



Report of Investigation 10-01

State of Louisiana

Bobby J. Jindal, Governor

Louisiana State University, Baton Rouge

Michael Martin, Chancellor

Louisiana Geological Survey

Chacko J. John, Director and State Geologist

This public information document is part of a series published periodically by the Louisiana Geological Survey, whose offices are located at Louisiana State University, Room 3079 Energy, Coast & Environment Building, Baton Rouge, LA 70803-4101. This information is distributed free of charge. The publisher does not guarantee the accuracy or correctness of any information. Contact the LGS business office at (225) 578-5320 for extra copies or for more information, or visit the web site at http://www.lgs.lsu.edu.

Report of Investigation 10-01

Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana

by:

Thomas P. Van Biersel[1], Douglas A. Carlson and L. Riley Milner
Louisiana Geological Survey - Louisiana State University
[1] Now at the Louisiana Department of Natural Resources

Executive Summary

Groundwater Resources

There are approximately 11 aquifers/aquifer systems that are commonly used in Louisiana. The Carrizo-Wilcox and Red River Alluvial aquifers dominate northwest Louisiana. The Sparta Aquifer dominates north central Louisiana, and the Mississippi River Alluvial Aquifer dominates northeast Louisiana. In addition to those four dominant aquifers, the Upland Terrace, Catahoula and Cockfield aquifers are localized secondary groundwater sources. In Southwestern Louisiana, the Chicot Aquifer System is dominant, with the Evangeline Aquifer, Jasper Aquifer System and Catahoula Aquifer as secondary sources. In southeastern Louisiana, the Southern Hills Aquifer System (SHAS) is dominant, with the Mississippi River Alluvial Aquifer as a secondary source. The Catahoula Aquifer is found below the Southern Hills Aquifer System, and can also be used as a secondary source of groundwater. The Southern Hills and Chicot aquifer systems were designated “Sole Source Aquifers” by the U.S. Environmental Protection Agency in 1988.

Surface Water Resources

There are ten watersheds in the State of Louisiana, as follows: Atchafalaya/Teche/Vermilion Rivers; Calcasieu/Mermentau Rivers; Lake Pontchartrain/Lake Maurepas; Mississippi River; Mississippi River Delta; Ouachita River; Pearl River; Red River; Sabine River; and Tensas River. In addition, with the exception of West Feliciana Parish, the Lower Mississippi River in Louisiana is confined by levees, and has a very small basin area. With the exception of the Red River and smaller bayous in West Feliciana and northwestern East Baton Rouge Parishes, no other Louisiana tributaries flow into the Mississippi River.

Data Availability

Louisiana aquifers have been studied by the Louisiana Geological Survey (LGS), U.S. Geological Survey (USGS), and others for more than 80 years. State watersheds have been studied by the U.S. Army Corps of Engineers, the USGS, and others for more than 100 years.

The geohydrologic properties of the 11 aquifers have been characterized by researchers since 1940. The data available contains information on hydraulic properties (e.g. transmissivity, hydraulic conductivity and storage coefficient). In addition, depictions of the aquifer surface and profile have been drafted for most aquifers. Similarly, piezometric surface maps are available for some parts of most of the aquifers. A substantial portion of this work was done by the USGS, in collaboration with the LGS, during the 1960s. Some recent work, which updates this information, has also been done by the LGS and the USGS, in collaboration with the DOTD.

Several data sets exist that combine large amounts of hydrologic, hydrogeologic and water chemistry. The USGS maintains the National Water Information System. The Louisiana Department of Environmental Quality (DEQ) maintains the ambient groundwater and the ambient surface water databases. The Louisiana Department of Health and Hospitals (DHH) maintains the safe water program database.

Groundwater flow models have been developed since the 1980s, addressing water issues throughout the state. However, most of the models were used for a specific project. With the exception of a few, none have been updated or kept up-to-date. Few models holistically studied a regional aquifer system, and none were designed to telescope from the regional to a smaller (e.g. sub-parish) scale.

Water Usage

Statewide surface and ground water usage data has been collected in Louisiana since 1960 by the USGS, in collaboration with state agencies and water user/providers. In addition, several major metropolitan water systems have maintained records of this type of information for longer periods of time. The most detailed water usage information for any given area of Louisiana has been collected by the Capital Area Ground Water Conservation Commission since 1975. In 1960, an estimated 1,030 million gallons per day (MGD) of groundwater, and 4,387 MGD of surface water was consumed in Louisiana for domestic, public, agricultural, industrial and other uses. The most recent estimate (2005) shows that 1,600 MGD of groundwater and 8,700 MGD of surface water were consumed. This represents a 55% and 98% increase, respectively.

Climate

Most of Louisiana lies in a hot humid, subtropical climate. Louisiana averages 57 inches of precipitation per year, with the precipitation relatively evenly spread throughout the year (monthly average). Based upon the review of existing data, it can be observed that the distribution of precipitation is changing within the state. Precipitation amounts and frequency of severe storms are increasing. Temperatures are increasing, primarily the daily minimum and winter values, resulting in a decreased differential between daily and yearly highs and lows. Northern Louisiana is exhibiting a shift of precipitation toward the winter and spring, and a decrease in severe drought frequency. However, there has been an increase in runoff and possible flooding events. Southern Louisiana is exhibiting a shift of precipitation toward the summer and fall, and an increase in severe drought frequency. In addition, the compounding effect of sea-level rise and coastal subsidence may result in increased coastal flooding during storm events.

Table of Contents

Table of Figures

Table of Tables

Table of Appendices

List of Acronyms

ADSWMP	Assistance in Developing the Statewide Water Management Plan
CAS	Chicot Aquifer System
CWA	Carrizo-Wilcox Aquifer
DOTD	Department of Transportation and Development
DNR	Department of Natural Resources
DEQ	Department of Environmental Quality
G/D/P	Gallons per day per person
JAS	Jasper Aquifer System
LGWRC	Louisiana Ground Water Management Commission
MRAA	Mississippi River Alluvial Aquifer
MGD	Million gallons per day
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation Service
RRAA	Red River Alluvial Aquifer
SHAS	Southern Hills Aquifer System
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UTA	Upland Terrace Aquifer

Introduction

In 2002 the "Assistance in Developing the Statewide Water Management Plan" (ADSWMP) report was submitted to the Louisiana Ground Water Management Commission (LGWMC, 2002). This document made the first attempt at compiling the information available for the aquifers and basins which provide Louisiana with its water supplies. This report maintains the three regions (Figure 1) and ten basins identified in the ADSWMP (Figure 2).

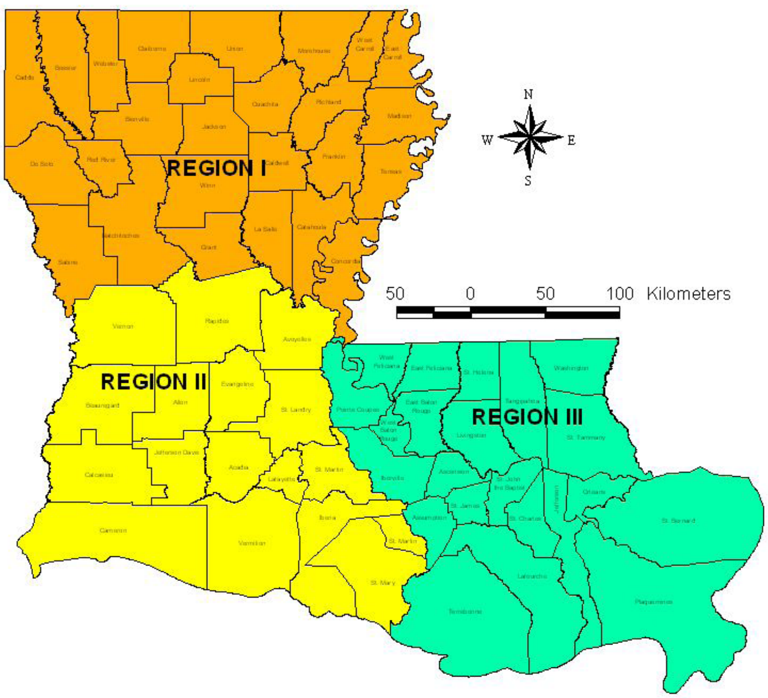


Figure 1. Groundwater Regions

There are approximately 11 aquifers/aquifer systems that are commonly used for public, domestic, industrial and irrigation water supplies (Figure 3). In general, these aquifers can be grouped regionally (Figure 1 and 3). Within Region I the Carrizo-Wilcox Aquifer (CWA) and Red RiverAlluvial Aquifer (RRAA) dominate the west, the Sparta Aquifer the center and the Mississippi River Alluvial Aquifer (MRAA) the east, with the Upland Terrace Aquifer (UTA), Catahoula Aquifer and Cockfield Aquifer as secondary groundwater sources. Within Region II the Chicot Aquifer System is dominant, with the Evangeline Aquifer, Jasper Aquifer System (JAS) and Catahoula Aquifer as secondary sources. Within Region III the Southern Hills Aquifer System (SHAS) is dominant, with the Mississippi River Alluvial Aquifer as a secondary source. However, in Region III the Catahoula Aquifer, below the Southern Hills Aquifer System, is also available in some places. For the purpose of this report, the discussion of the Catahoula Aquifer will be limited to Region I.

The Drainage basins are grouped into 10 watersheds (Figure 2). The ADSWMP refers to nine basins, because the report combines the Lower Mississippi River and Mississippi River Delta basins. With the exception of West Feliciana Parish, the Lower Mississippi River in Louisiana is confined by levees, and has a very small basin area. With the exception of the Red River and smaller bayous in West Feliciana and northwestern East Baton Rouge Parishes, no other Louisiana tributaries flow into the Mississippi River.

This report includes a discussion of existing data on the principal freshwater aquifers and surface water basins of Louisiana. Sources of groundwater are discussed by regions, as follows:

- Region I encompasses the Carrizo-Wilcox Aquifer (CWA), the Catahoula Aquifer, the Cockfield Aquifer, the northern portion of the Mississippi River Alluvial Aquifer (MRAA), the Red River Alluvial Aquifer (RRAA) and the Upland Terrace Aquifer (UTA);

- Region II encompasses the Chicot Aquifer System (CAS), the Evangeline Aquifer and the Jasper Aquifer System (JAS); and

- Region III encompasses the southern portion of the MRAA, and the Southern Hills Aquifer System (SHAS).

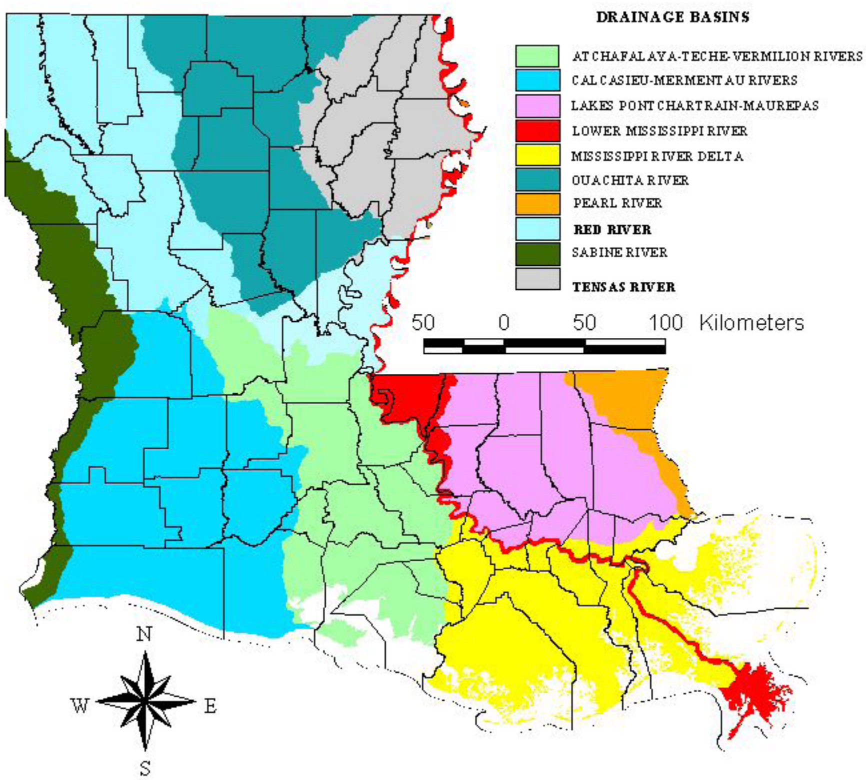


Figure 2. Principal drainage basins of Louisiana.

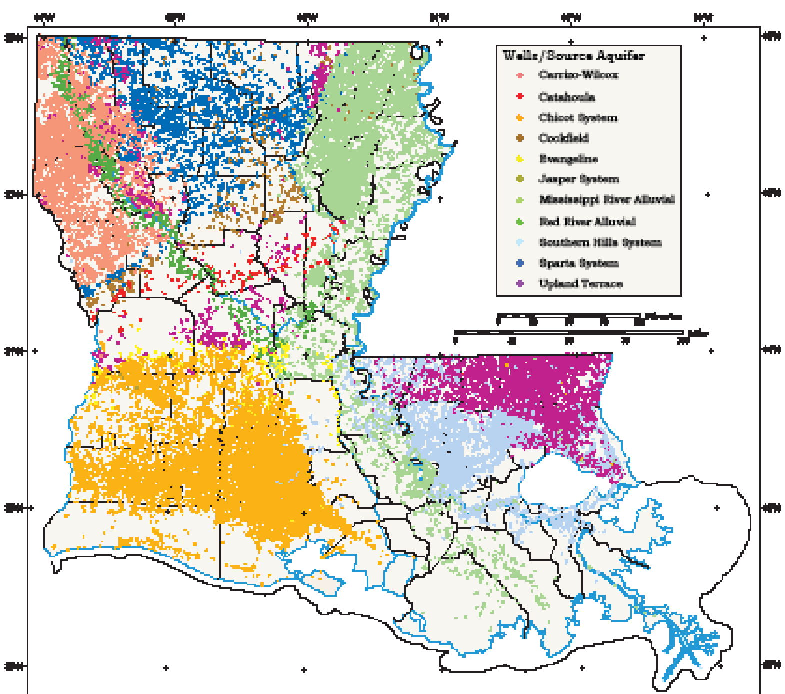


Figure 3. Distribution of groundwater supply wells (domestic, public water supply, industrial, irrigation and other wells as identified in the August 2009 DOTD database) in Louisiana by aquifer (from Van Biersel and Milner, 2010).

Figure 3 depicts the distribution of water supply wells in each of the aquifers. The wells depicted were registered in the Louisiana Department of Transportation and Development (DOTD) water well database as of August 2009.

Groundwater

Introduction

As indicated earlier, the 11 principal aquifers of Louisiana (Figure 3 and Table 1) will be discussed in this document by regions. Because the MRAA is present in two regions, its northern and southern reaches will be discussed separately (Regions I and III). Table 1 summarizes and updates the designation and age of the aquifers. Table 1 also attempts to correlate the aquifers stratigraphically within Louisiana, and with the adjacent States of Texas, Arkansas and Mississippi. It should be noted that old U.S. Geological Survey (USGS) and DOTD nomenclature included Upland Terrace Aquifer for shallow wells in south-eastern Louisiana. This nomenclature is inconsistent with the geologic age of those deposits. Those wells are incorporated in the SHAS in this report. Similarly, the CAS of southwest Louisiana is classified as Pleistocene in age, which correlates with surficial deposits in southeast Louisiana, generally these are not used for aquifer purposes [e.g. there are no Chicot equivalent aquifers in southeastern Louisiana, with the exception of the relatively unused shallow sands (Table 1)].

Because of the dynamic/tectonic nature of geological deposits in Louisiana, it should be noted that faults are present throughout much of the state (Figure 4). Faults, including some with surface expressions, cut through the SHAS, the MRAA, the CAS, the CWA and the Sparta Aquifer. These faults (e.g. the Baton Rouge-Tepetate Fault System) in most cases represent leaky barriers to groundwater flow.

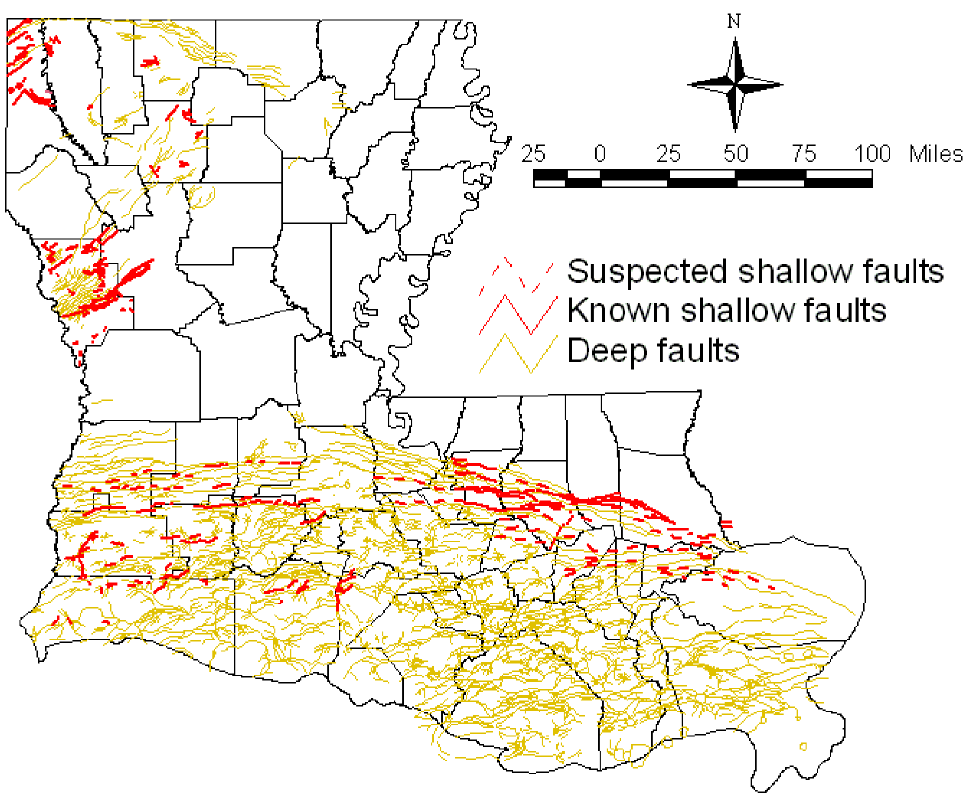


Figure 4. Location of subsurface faults. Shallow faults are known to cause offset of aquifers. Deeper faults may or may not impact aquifers

The recharge areas for the eleven principal aquifers were studied and mapped in detail by Boniol and Hanson (Boniol, 1988; and Boniol and Hanson, 1988). A copy of the map is shown in Figure 5. It should be noted that significant portions of the recharge zones of the SHAS, CWA, UTA and Cockfield Aquifer are located in adjacent states.

Table 1: Generalized Aquifer Designation in Louisiana

System	Series	Stratigraphy		REGION I/North Louisiana			REGION II/Southwest Louisiana				
				Northwest	North Central	Northeast	West	Central	East	Atchafalaya	Mississipp Vall
Quaternary	Holocene	Recent Alluvium		Red River Alluvial	Alluvium	Mississippi River Alluvial	Alluvium	Alluvium	Alluvium	Atchafalaya Alluvial	Mississipp Alluv
	Pleistocene	Prairie and Intermediate allogroups		Upland Terrace	Upland Terrace		200-Foot Sand	Upper Chicot	Chicot		
							500-Foot Sand	Lower Chicot			
							700-Foot Sand				
Neogene	Pliocene	Upland allogroup		Not Present	Not Present						
		Fleming Group	Blounts Creek			Evangeline	Evangeline	Evangeline	Evangeline		1,000-Foo
											1,200-Foo
	Miocene		Castor Creek			Jasper	Jasper	Jasper			1,500-Foo
			Williamson Creek								1,700-Foo
			Dough Hills								2,000-Foo
			Carnahan Bayou								2,400-Foo
			Lena								
		Catahoula Group	Anahuac	Catahoula	Catahoula	Catahoula	Catahoula				
Paleogene	Oligocene		Frio								
	Eocene	Vicksburg Group									No Freshw
		Jackson Group									
		Claiborne Group	Cockfield	Cockfield	Cockfield	Cockfield					
			Cook Mountain								
			Sparta	Sparta	Sparta	Sparta					
			Cane River								
			Carrizo	Carrizo-Wilcox							
	Paleocene	Wilcox Group									
		Midway.									

Modified from: Johnston et al, 2000 and Van Biersel et al, 2009.

Note: Eastern Feliciana Parishes include St. Tammany, Tangipahoa, and Washington parishes; and the Western Florida Parishes include East Baton Rouge, East Feliciana, West Feliciana, Livingston, and St. Helena parishes.

pi River ey	REGION II/Southeast Louisiana				Texas		Arkansas	Mississippi	Series	System
	New Orleans Area	Baton Rouge Area	Western Florida Parishes	Eastern Florida Parishes						
pi River vial	Shallow Sand	Shallow Sand	Shallow Sand	Shallow Sand	Alluvium		Alluvium	Post-Graham Ferry	Holocene	Quaternary
	Gramercy				Gulf Coast Aquifer System	Chicot	Terrace/ Sand & Gravel		Pleistocene	
	Norco									
	Gonzales- New Orleans									
	1,200-Foot Sand	400-foot Sand	Upland Terrace	Upper Ponchatoula		Evangeline	Not Present	Citronelle	Pliocene	Neogene
		600-Foot Sand	Upper Ponchatoula					Upper Graham Ferry		
		800-Foot Sand	Lower Ponchatoula	Lower Ponchatoula				Lower Graham Ferry		
ot Sand		1,000-Foot Sand								
ot Sand		1,200-Foot Sand		Big Branch						
ot Sand		1,500-Foot Sand	Kentwood	Abita		Jasper		Upper Pascagoula	Miocene	
ot Sand		1,700-Foot Sand		Covington				Lower Pascagoula		
			Slidell	Slidell						
ot Sand		2,000-Foot Sand	Hammond	Tchefuncte/ Hammond				Upper Hattiesburg		
ot Sand		2,400-Foot Sand	Amite	Amite						
		2,800-Foot Sand	Ramsay	Ramsay				Lower Hattiesburg		
								Upper Catahoula		
			Catahoula	Franklinton		Catahoula		Lower Catahoula	Oligocene	Paleogene
p water									Eocene	
					Yegua		Cockfield	Cockfield		
					Sparta		Sparta	Sparta		
					Queen City					
					Carrizo-Wilcox		Carrizo	Meridian		
							Wilcox	Wilcox	Paleocene	

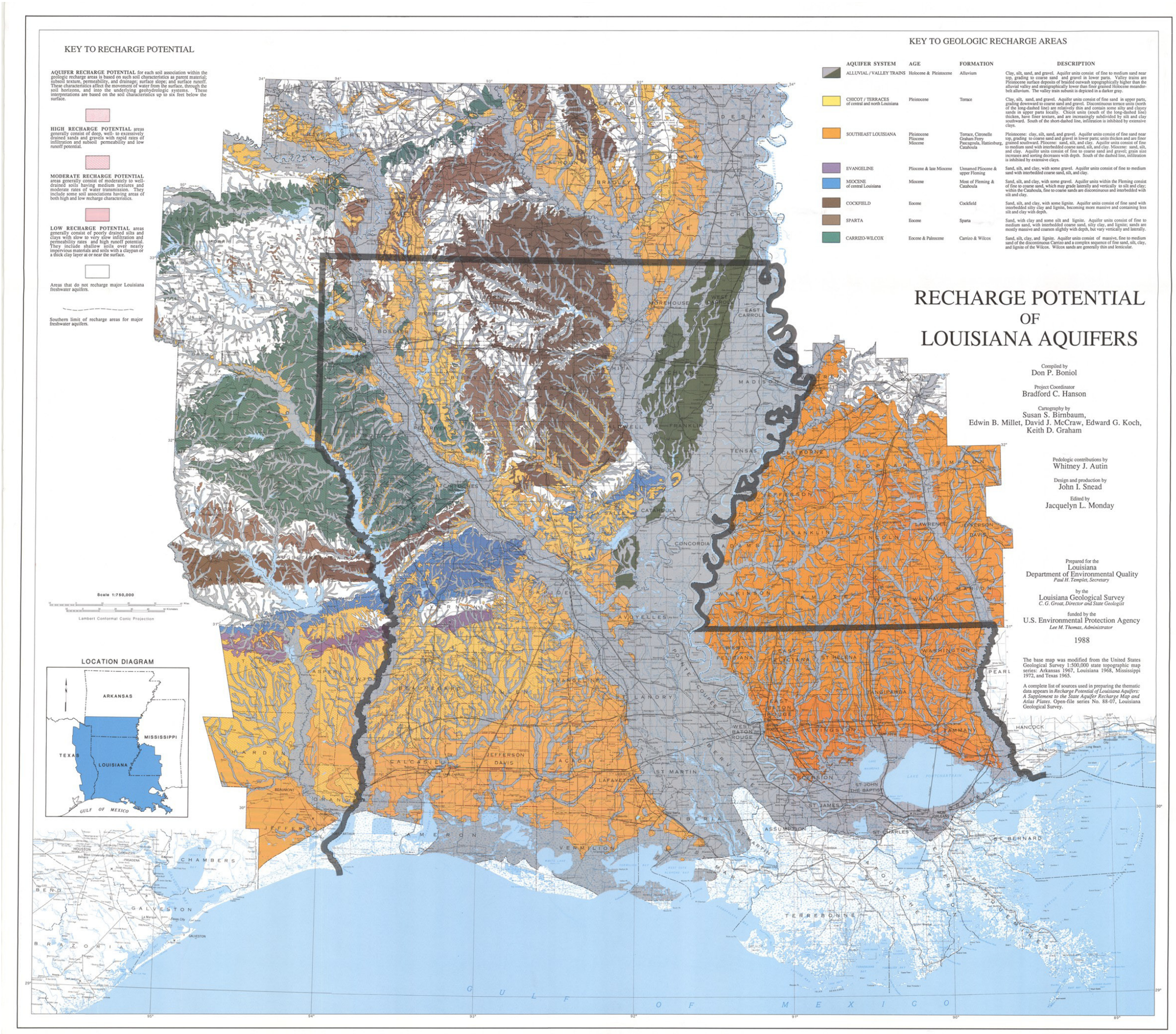


Figure 5. Recharge potential map (from Boniol and Hanson, 1988).

The discussion of each aquifer is broken into five subheadings as follows: existing/published aquifer property data, existing/published groundwater usage data, existing/published water level data, existing/published water quality data and other types of relevant existing/published data. The following discussion presents some of the statewide data which is not directly applicable to a specific aquifer. Statewide databases are discussed in the last section of this report.

Properties

The properties section traditionally includes reports that contain information on hydraulic properties, transmissivity, hydraulic conductivity and storage coefficient. Because transmissivity is simply a multiple of hydraulic conductivity and unit thickness, and storage coefficient is only a concern for transient modeling studies, only counts of hydraulic conductivity values are noted. In general, hydraulic conductivity values reported by various authors from the USGS were derived from a small number of full-scale aquifer tests. There have been other studies which report transmissivity or hydraulic conductivity results from analysis of specific capacity tests. Information on specific capacity tests, pump tests and/or grain size analysis results are occasionally reported by water well drillers on the forms submitted formerly to the DOTD and, currently, to the Louisiana Department of Natural Resources (DNR).

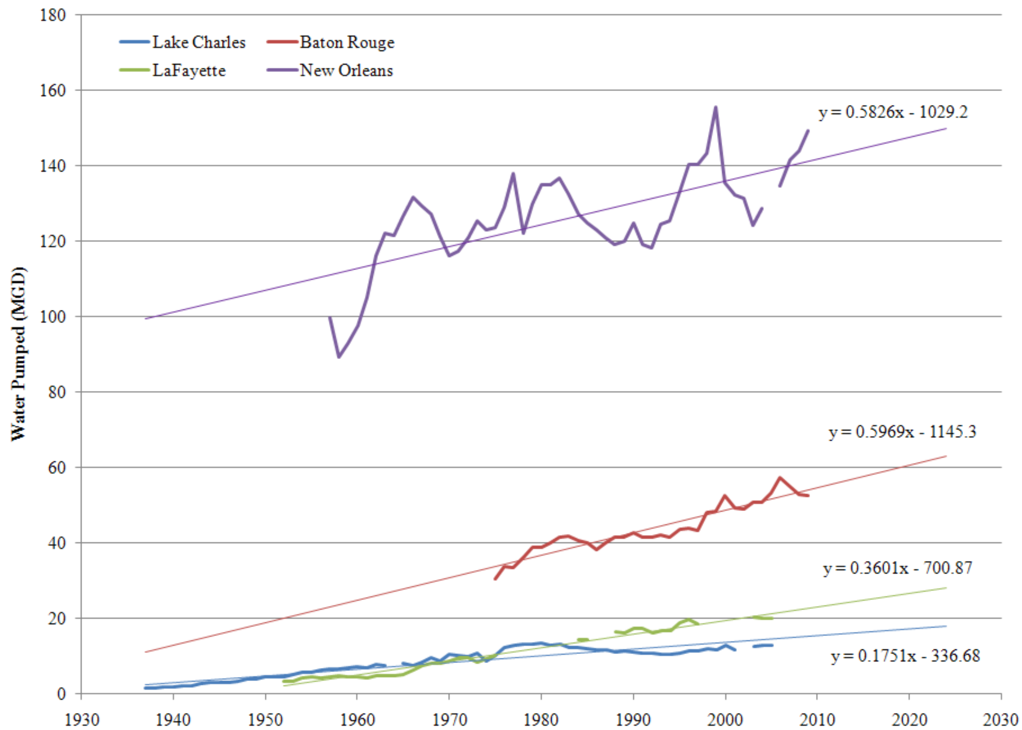


Figure 6. Long term pumping records of major water utilities in southern Louisiana.

Usage

Statewide water usage data has been collected in Louisiana since 1960 by the USGS and state agencies. Locally, several water systems (e.g. New Orleans water utilities) have been collecting this type of information for longer periods of time (Figure 6).

Water Levels

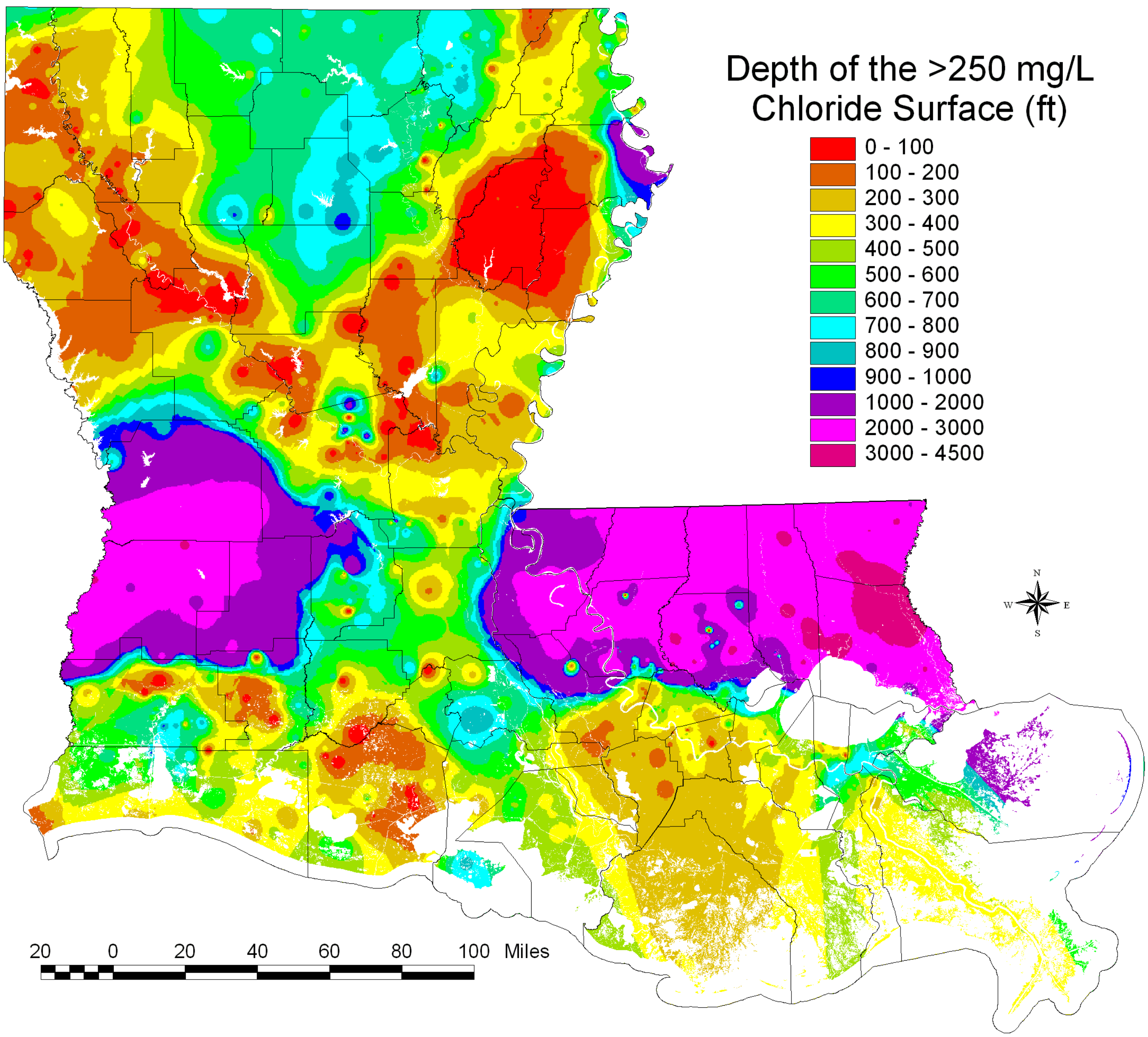
Water levels are generally reported on the state's water well registration form. The USGS has been monitoring water levels regularly in only a select few wells across the state. However, many more are monitored on a specific study basis. Similarly, private facilities and public water suppliers may monitor water levels. Water levels in this case refer to the measurement of the depth to water in a well casing for which a surveyed elevation is available for the measuring point.

Water Quality

There are few water quality maps for aquifers of Louisiana: Winslow et al. (1968) determined where the base of freshwater is throughout Louisiana, as defined by where TDS exceeds 1,000 milligram/Liter (mg/L). Twenty years later, Smoot (1988) determined the base of freshwater in Louisiana aquifers. A new version of the map was prepared by Van Biersel et al in 2008 (Figure 7). Tomaszewski (1992) created a series of statewide water quality maps for dissolved iron, manganese, sodium, hardness, and total dissolved solids.

Other Studies

There are a few large scale studies, such as regional groundwater flow models, that will be described.



Statewide Bibliography

Boniol, D., 1988, Recharge Potential of Louisiana Aquifers: A Supplement to the State Aquifer Recharge Map and Atlas Plates: Louisiana Geological Survey Open File Series #88-07, 50 pp. plus appendix.

Boniol, D.P. and B.C. Hanson, 1985, Potential Risk to Ground Water: Louisiana Geological Survey Water Resources Plate #5, scale 1:250,000.

Carlson, 2005, Louisiana's Groundwater Resources: Louisiana Geological Survey, Educational Series, no. 4, 27 p.

Dial, D.C., and Huff, G.F., 1989, Occurrence of minor elements in ground water in Louisiana including a discussion of three selected sites having elevated concentrations of barium: Louisiana Department of Transportation and Development Water Resources Technical Report # 47, 88 p.

Dial, D.C., 1970a, Public water supplies in Louisiana: Louisiana Department of Public Works Basic Records Report no. 3, 460 p.

Griffith, J.M., 2007, Fluoride concentrations in freshwater aquifers in Louisiana, 1931-2006: Louisiana Department of Transportation and Development Water Resources Technical Report No. 77, 18 p.

Harris, G.D., 1904, Underground waters of southern Louisiana, with discussions of their uses for water supplies and for rice irrigation, by M.L. Fuller: U.S. Geological Survey Water-Supply Paper 101, 98 p.

Huff, G.F., Fendick, R.B., Stuart, C.G., and Cramer, G., 1988, Louisiana ground-water quality in Moody, D.W., Carr, J.E., Chase, E.B., and Aronson, D.A., comps., National water summary 1986--Hydrologic events and ground-water quality: U.S. Geological Survey Water-Supply Paper 2325, p. 273-278.

LGWMC (Louisiana Ground Water Management Commission), 2002, Assistance in developing the statewide water management plan: report prepared by C.H. Fenstermaker & Associates, Inc., LBG-Guyton Associates, Hydro-Environmental Technology, Inc., and Onebane, Bernard, Torian, Diaz, McNamara & Abell, 3 volumes.

Lovelace, J.K., and Lovelace, W.M., 1995, Hydrogeologic unit nomenclature and computer codes for aquifers and confining units in Louisiana: Louisiana Department of Transportation and Development Water Resources Special Report no. 9, 12 p.

Lovelace, W.M., 2002, Water-level measurements and chloride concentrations for selected wells in Louisiana, January 1988-October 1997, Water Resources Basic Records Report no. 23, 168 p.

Marshall, S.L., 1978, Index to water-resources data for Louisiana, ground-water records: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 9, 176 p.

Martin, A., Jr., and Early, D.A., 1987, Statistical analysis of aquifer-test results for nine regional aquifers in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4001, 26 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1989, Geohydrology and regional ground-water flow of the coastal lowlands aquifer system in parts of Louisiana, Mississippi, Alabama, and Florida--A preliminary analysis: U.S. Geological Survey Water-Resources Investigations Report 88-4100, 88 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1990, Calibration and sensitivity analysis of a ground-water flow model of the coastal lowlands aquifer system in parts of Louisiana, Mississippi, Alabama, and Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4189, 54 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1991, Hydrology of the coastal lowlands aquifer system in parts of Alabama, Florida, Louisiana, and Mississippi: U.S. Geological Survey Open-File Report 91-72, 115 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1999, Hydrology of the Coastal Lowlands aquifer system in parts of Alabama, Florida, Louisiana, and Mississippi: U.S. Geological Survey Professional Paper 1416-H, 51 p.

Renken, R.A., 1998, Ground water atlas of the United States; Segment 5; Arkansas, Louisiana, and Mississippi: U. S. Geological Survey Hydrologic Investigations Atlas F1-f28.

Rollo, J.R., 1960, Ground water in Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 1, 84 p.

Smoot, C.W., 1989, Louisiana hydrologic atlas map no. 4: Geohydrologic sections of Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4288, 1 sheet.

Smoot, C.W., 1988, Louisiana hydrologic atlas map no. 3: Altitude of the base of freshwater in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4314, 1 sheet.

Smoot, C.W., 1986, Louisiana hydrologic atlas map no. 2: Areal extent of freshwater in major aquifers of Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4150, 1 sheet.

Snider, J.L., and Ryals, G.N., 1988, Radiochemical analyses of ground water in Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 44, 52 p.

Snider, J.L., Winner, M.D., Jr., and Epstein, J.B., 1962, Ground water for Louisiana's public supplies: Louisiana Department of Public Works, 267 p.

Stuart, C.G., and Demas, C.R., 1990, Organic chemical analyses of ground water in Louisiana, water years 1984-88: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 18, 80 p.

Stuart, C.G., Knochenmus, D., and McGee, B.D., 1994, Guide to Louisiana's ground-water resources: U.S. Geological Survey Water-Resources Investigations Report 94-4085, 55 p.

Tomaszewski, D.J., 1992, Louisiana hydrologic atlas map no. 5: Quality of freshwater in aquifers of Louisiana, 1988: U.S. Geological Survey Water-Resources Investigations Report 90-4119, 7 sheets.

Tomaszewski, D.J., Lovelace, J.K., and Ensminger, P.A., 2002, Water withdrawals and trends in ground-water levels and stream discharge in Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 68, 30 p.

Van Biersel, T. and Milner L.R., 2010, Principal Freshwater Aquifer of Louisiana: Louisiana Geological Survey Educational Poster Series 10-01, 1 sheet.

Van Biersel, T. P., L. R. Milner, and E. Walden, 2008, Development of a chloride standard exceedance map for Louisiana: Gulf Coast Association of Geological Societies Transactions, v. 58, p. 875-881.

Williamson, A.K. and Grubb. H.F., 2001, Ground-water flow in the Gulf Coast aquifer systems, south-central United States: U. S. Geological Survey Professional Paper P1416-F, p. F1-f173.

Wilson, T.A. and Hosman, R.L., 1987, Geophysical well-log database for the Gulf Coast aquifer systems, south-central United States: U. S. Geological Survey Open-File Report OF 87-0677.

Winslow, A.G., Hillier, D.E., and Turcan, A.N., Jr., 1968, Saline ground water in Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-310, 4 sheets.

Region I

Introduction

Northern Louisiana is an area defined as largely north of the 31 parallel. The aquifers that are considered include the CWA, Catahoula, Cockfield, MRAA, UTA, RRAA, and Sparta. These aquifers generally lay within four major surface watersheds: Ouachita, Red River, Sabine and Tensas as defined by four US Geological Survey's studies (Garrison and Covey, 1994; and Garrison, 1997a, 1997b and 1998-see section 3.0).

The vast majority of publications on Louisiana groundwater or surface water have focused on limited portions of Louisiana defined by parish, watershed, local area or aquifer. There are a few publications that consider all of Louisiana's groundwater resources. Rollo (1960) describes all of the aquifers of Louisiana in terms of location, stratigraphy and lithology, and he comments on groundwater flow and quality. A similar study by Stuart et al. (1994) included the same general material as Rollo (1960) with refinements due to additional observations plus a more comprehensive description of how aquifers are used by category of water consumer.

There are three reports that focus on groundwater supplies for public utilities. Two of these are for the whole state of Louisiana and include information on water quality, pumpage, and driller's logs (Snider et al., 1962; and Dial, 1970a). The third study includes only public utilities in northern Louisiana (Lurry, 1985).

A limited number of reports consider groundwater occurence, largely in terms of isopach maps of aquifer thickness. Ryals (1984) included isopach maps of the Cockfield, Sparta and Carrizo-Wilcox aquifers in northwest and north central Louisiana and isopach maps of three aquitards: Cook Mountain, which lies between Cockfield and Sparta Aquifers; Cane River, which lies between Sparta and CWA; and Midway which lies between the CWA and conductive but salty units below, such as the Navarro, Austin Groups or Monroe Gas Rock.

There are two types of groundwater models that were prepared in northern Louisiana, smaller local, sub parish scale, and larger, more regional (e.g. multi-parish scale), models of the Sparta Aquifer. Clark and Hart (2009) developed a regional multiple layer model in the Mississippi Embayment Region that included 13 layers throughout northern Louisiana east of the Red River and west of the freshwater boundary in the Jackson-Vicksburg down to the Wilcox, but only for the Wilcox in Mississippi. This model includes the Mississippi River alluvium. The model included all of the Sparta (3 layers) and Cockfield (1 layer).

Region I Specific Bibliography

Clark, B.R., and R.M. Hart, 2009, The Mississippi Embayment Regional Aquifer Study (MERAS): Documentation of a Groundwater-Flow Model Constructed to Assess Water Availability in the Mississippi Embayment: U.S. Geological Survey Scientific Investigations Report 2009-5172 44p.

Lurry, D.L., 1985, Public water supplies in Louisiana, volume 1: Northern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 13, 119 p.

Ryals, G.N., 1984, Regional geohydrology of the northern Louisiana salt-dome basin, part II, geohydrologic maps of the Tertiary aquifers and related confining layers: U.S. Geological Survey Water-Resources Investigations Report 83-4135, 6 p.

Ryals, G.N., 1982a, Regional geohydrology of the northern Louisiana salt-dome basin, part I, Conceptual model and data needs: U.S. Geological Survey Open-File Report 82-343, 23 p.

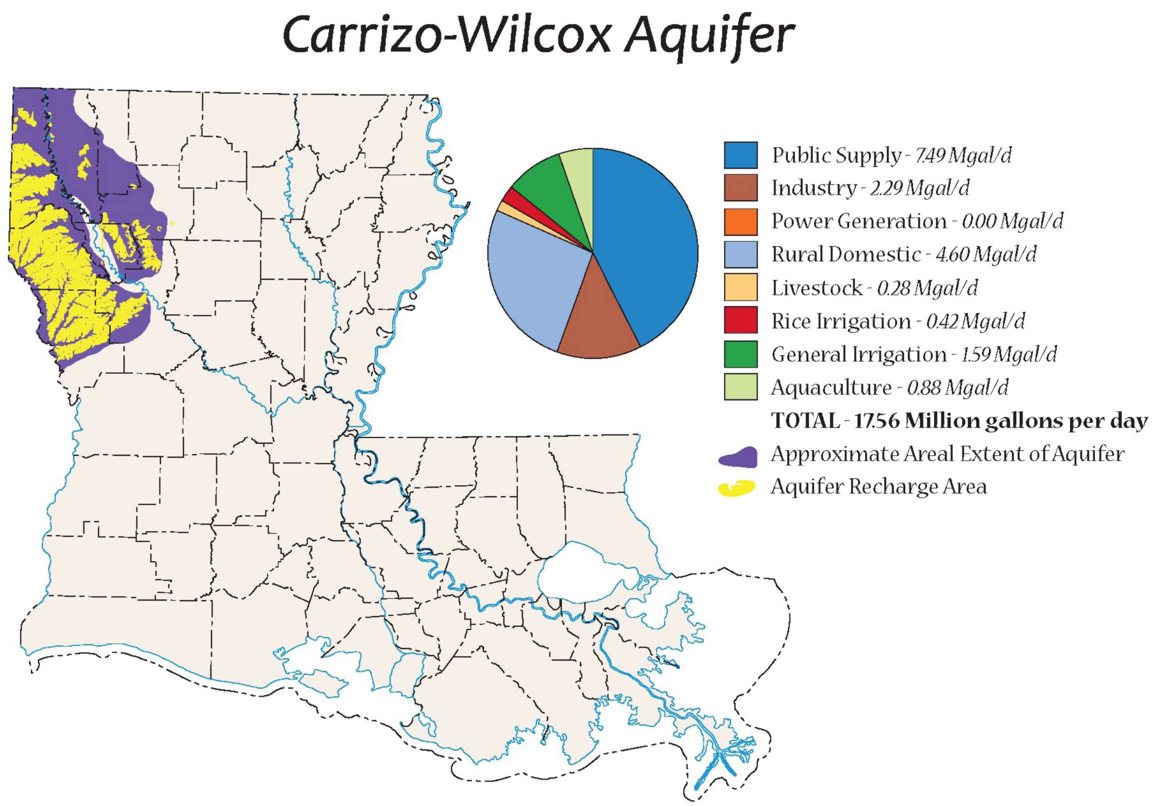


Figure 8. Extent of the CWA in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

- The CWA has a total of 87 hydraulic conductivity values reported (Ryals, 1982b; Ryals, 1983b; Martin and Early, 1987). The three leading studies in terms of number of reported Wilcox hydraulic conductivity values are: Martin and Early (1987) with 64 values; Ryals (1983b) with 18 values; and Ryals (1982b) with 5 values.

- Carlson (2004a) determined the geometric mean of hydraulic conductivity for the CWA using 372 specific capacity tests.

- Carlson (2004b) involved determination of porosity from sonic logs for the Carrizo and Wilcox Formations using 1348 values.

- Carlson (2005) compiled and determined the average porosity from core results for the Wilcox Formation using 550 porosity values.

- Carlson (2010a) prepared a scaling which study included permeability results from cores (small laboratory tests) and well tests (field tests that are approximately the same size as specific capacity tests) from 3,523 permeability values for the Wilcox Formation.

Usage

- Water withdrawal from the CWA has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

- CWA had its potentiometric surface determined in 1980 (Ryals, 1983a), and 1990 (Seanor and Smooth, 1995b).

Water Quality

- Page et al. (1963), Page and May (1964), Calandro et al (1970), Ryals (1982a and 1982b), Snider (1983), Tomaszewski (1992), Rapp (1996), and Carlson and Van Biersel (2009) include water quality values for samples the CWA (Table 2).

Other Studies

A localize groundwater flow mode was prepared for the area surrounding the Dolet Hills lignite mine in De Soto Parish (Breyer, 2001). The model was prepared by a graduate student at Texas Christian University to evaluate the effect of overburden dewatering at the mine.

There is one groundwater model covering the Carrizo-Wilcox Aquifer in Texas which extends into northwestern Louisiana (Fryar et al., 2003). The model was prepared for the Texas Water Development Board.

Table 2. Large studies of the Carrizo-Wilcox Aquifer in terms of the number of water quality samples.

Parameter	Newcome et al. (1963)	Snider (1983)	Rapp (1996)	Tomaszewski (1992)	Carlson and Van Biersel (2009)
Temperature	0	11	65	0	0
pH	19	24	57	269	136
Specific Cond.	9	24	52	287	0
TDS	19	24	48	280	136
Hardness	27	25	214	359	0
bicarbonate	26	24	0	0	0
calcium	16	24	54	296	0
chloride	27	25	217	359	135
fluoride	20	24	125	298	130
iron	20	21	42	280	136
magnesium	16	24	54	296	0
nitrate	13	0	0	0	54
potassium	10	16	51	292	0
silica	14	23	50	285	0
sodium	14	17	53	292	136
sulfate	20	24	128	291	0

Note: The table lists the number of sample results by parameter for each study.

Carrizo-Wilcox Bibliography

Anderson, H.V., 1960, Geology of Sabine Parish: Louisiana Geological Survey, Bulletin, 164p.

Breyer, R.H., 2001, A Groundwater model to facilitate dewatering of overburden at the Dolet Hills lignite mine, De Soto Parish, Louisiana: Fort Worth, Texas, Texas Christian University, Master Thesis, 37p.

Calandro, A.J., Broussard, W.L., and Hosman, R.L., 1970, Water resources of the Belmont-Marthaville-Robeline area, Louisiana: Louisiana Department of Public Works Water Resources Pamphlet no. 25, 21 p.

Carlson, D., 2010a, Influence of Lithology on Scaling Effects for Louisiana Stratigraphic Units' Permeability: Gulf Coast Association of Geological Societies, Transactions, v. 60, p. 87-101.

Fryar, D., Senger, R., Deeds, N., Pickens, J., and T. Jones, 2003, Groundwater Availability Model for the Northern Carrizo-Wilcox Aquifer: Report for Texas Water Development Board, unnumbered pages.

Newcome, Roy, Jr., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Page, L.V., and May, H.G., 1964, Water resources of Bossier and Caddo Parishes, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 5, 105 p.

Page, L.V., Newcome, Roy, Jr., and Graeff, G.D., Jr., 1963, Water resources of Sabine Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 3, 146 p.

Rapp, T.R., 1996, Ground-water resources of Caddo Parish, Louisiana, 1992: Louisiana Department of Transportation and Development Water Resources Technical Report no. 58, 89 p.

Ryals, G.N., 1983a, Regional geohydrology of the northern Louisiana salt-dome basin, part III, potentiometric levels of the Wilcox-Carrizo and Sparta aquifers: U.S. Geological Survey Water-Resources Investigations Report 83-4131, 14 p.

Ryals, G.N., 1982b, Ground-water resources of the Arcadia-Minden area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 28, 35 p.

Seanor, R.C., and Smoot, C.W., 1995b, Louisiana ground-water map no. 8: Potentiometric surface, 1991, of the Carrizo-Wilcox aquifer in northwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4176, 1 sheet.

Snider, J.L., 1983, Ground-water resources of the Fillmore-Haughton-Red Chute area, Bossier and Webster Parishes, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 32, 21 p.

Van Biersel, T., and Carlson, D., 2009, Distribution and Source Analysis of Elevated Chloride Concentration in the Wilcox Aquifer of Northwestern Louisiana: Gulf Coast Association of Geological Societies, Transactions, v. 59, p753-767.

Catahoula Aquifer

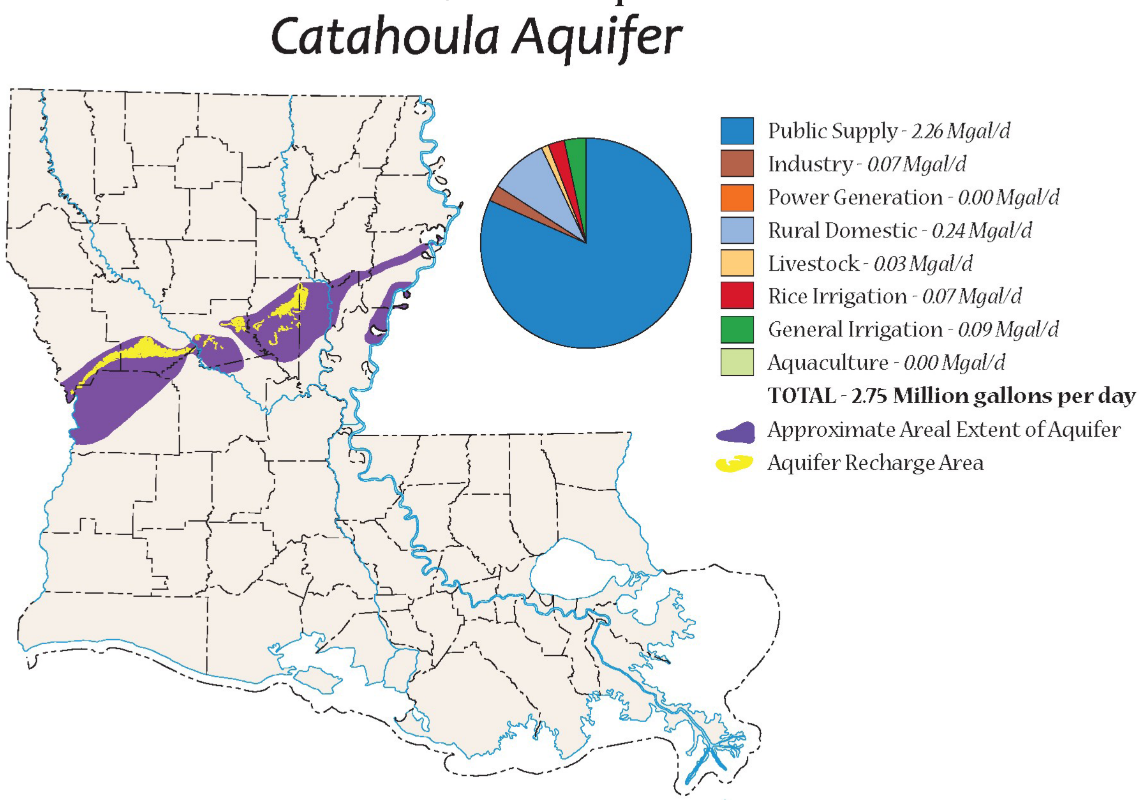


Figure 9. Extent of the Catahoula Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

- Martin and Early (1987) determined an average hydraulic conductivity for the Catahoula Aquifer from 54 well tests.

- Carlson (2005) determined the average porosity from core results using 4,619 porosity values for Catahoula Formation.

- Carlson (2010a) prepared a scaling study which included permeability results from cores (small laboratory tests) and well tests (field tests that are approximately the same size as specific capacity tests) from 5,105 permeability values for Catahoula Formation.

Usage

- Water withdrawal from the Catahoula Aquifer has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

- The Catahoula Aquifer had its potentiometric surface determined in 1980 (Martin and Whiteman, 1986).

Water Quality

- Whiteman et al. (1970) includes water quality values for samples from within the Catahoula Aquifer.

- Tomaszewski (1992) in his statewide atlas of groundwater quality provided an average water chemistry for the Catahoula Aquifer (Table 3)

Table 3. Studies of the Catahoula Aquifer in terms of the number of water quality samples.

Parameter	Tomaszewski (1992)
Temperature	0
pH	119
Specific Cond.	135
TDS	126
Hardness	171
bicarbonate	0
calcium	129
chloride	172
fluoride	149
iron	122
magnesium	129
nitrate	0
potassium	127
silica	128
sodium	128
sulfate	129

Note: The table lists the number of sample results by parameter for each study.

Catahoula Aquifer Bibliography

Carlson, D., 2010a, Influence of Lithology on Scaling Effects for Louisiana Stratigraphic Units' Permeability: Gulf Coast Association of Geological Societies, Transactions, v. 60, p.87-102.

Martin, A., Jr., and Whiteman, C.D., Jr., 1986, Generalized potentiometric surface of the Catahoula aquifer in central Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 86-4059, 1 sheet.

Newcome, R., Jr., and Sloss, R., 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Newcome, R., Jr., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Page, L.V., Newcome, R., Jr., and Graeff, G.D., Jr., 1963, Water resources of Sabine Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 3, 146 p.

Rogers, J.E., and Calandro, A.J., 1965, Water resources of Vernon Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 6, 104 p.

Smoot, C.W., and R.B. Fendick Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development, Water Resources Technical Report, no. 63, 36p.

Whiteman, C.D., Jr., Calandro, A.J., and Broussard, W.L., 1970, Water resources of the Slagle-Simpson-Flatwoods area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 24, 23 p.

Cockfield Aquifer

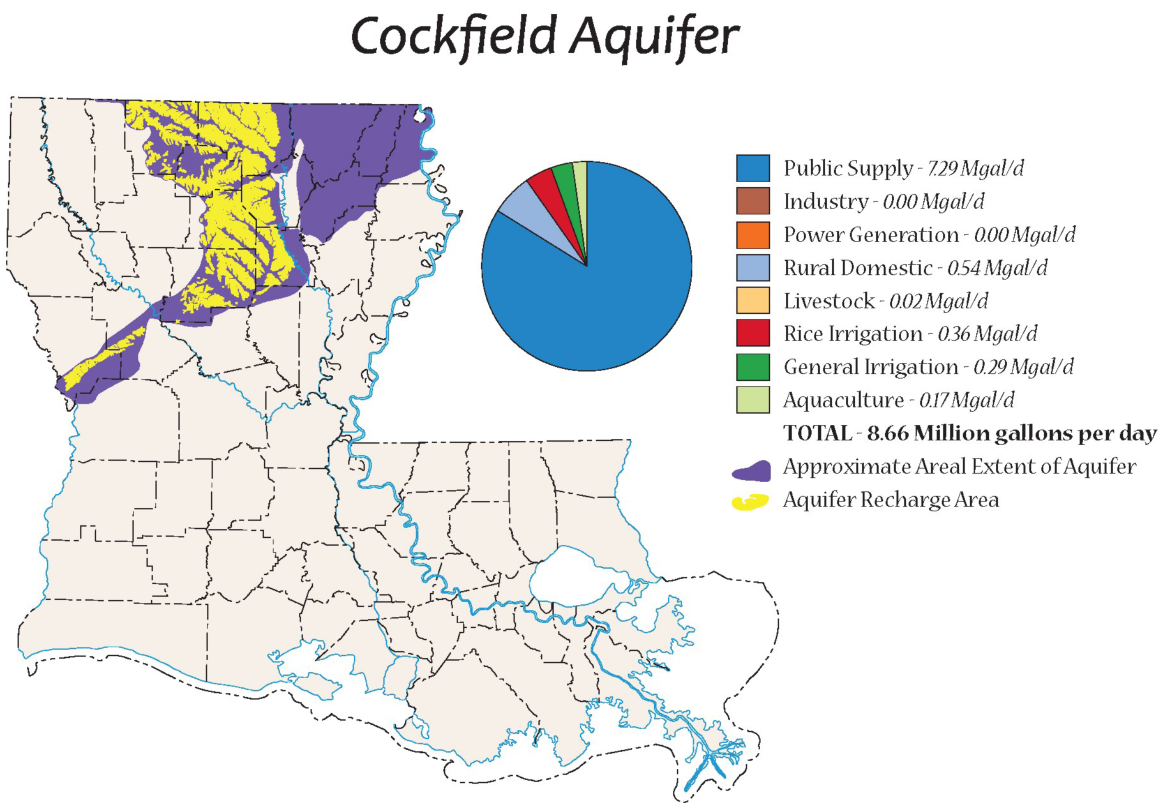


Figure 10. Extent of the Cockfield Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

• Martin and Early (1987) determined an average hydraulic conductivity the Cockfield Aquifer from 43 well tests.

• Carlson (2004a) determined the geometric mean of hydraulic conductivity for the Cockfield Aquifer from 139 specific capacity tests.

• Carlson (2005) compiled and determined the average porosity from core results from 550 porosity values for the Cockfield Formation.

• Carlson’s (2010a) scaling study included permeability results from cores (small laboratory tests) and well tests (field tests that are approximately the same size as specific capacity tests) using 692 permeability values for the Cockfield Formation.

Usage

• Water withdrawal from the Cockfield Aquifer has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

• A potentiometric surface of the Cockfield Aquifer was plotted in 1993 by Brantly and Seanor (1996).

• The 1968-1993 Cockfield Aquifer drawdown map was prepared by Brantly and Seanor (1996).

Water Quality

• Sanford (1973b) includes water quality values for samples from within the Cockfield Aquifer.

• Tomaszewski (1992) in his state atlas of groundwater quality provided an average water chemistry for the Catahoula Aquifer (Table 4)

Table 4. Studies of the Cockfield Aquifer in terms of the number of water quality samples.

Parameter	Tomaszewski (1992)
Temperature	0
pH	170
Specific Cond.	185
TDS	174
Hardness	235
bicarbonate	0
Calcium	186
chloride	235
Fluoride	187
Iron	174
magnesium	186
Nitrate	0
potassium	185
Silica	185
Sodium	186
Sulfate	187

Note: The table lists the number of sample results by parameter for each study

Cockfield Bibliography

Anderson, H.V., 1960, Geology of Sabine Parish: Louisiana Geological Survey, Bulletin, 164p.

Brantly, J.A., and Seanor, R.C., 1996, Louisiana ground-water map no. 9: Potentiometric surface, 1993, and water-level changes, 1968-93, of the Cockfield aquifer in northern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4241, 2 sheets.

Carlson, D., 2010a, Influence of Lithology on Scaling Effects for Louisiana Stratigraphic Units' Permeability: Gulf Coast Association of Geological Societies, Transactions, v. 60, p.87-102.

Covay, K.J., 1985, Ground-water resources of the Rayville-Delhi area, northeastern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 37, 22 p.

Martin, A. and Early, D., 1987, Statistical analysis of aquifer-test results for nine regional aquifers in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4001, 26 p.

Newcome, Roy, Jr., Page, L.V., and Sloss, Raymond, 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Page, L.V., Newcome, Roy, Jr., and Graeff, G.D., Jr., 1963, Water resources of Sabine Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 3, 146 p.

Sanford, T.H., Jr., 1973b, Ground-water resources of Morehouse Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 19, 90 p.

Smoot, C.W., and R.B. Fendick Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development, Water Resources Technical Report, no. 63, 36p.

Snider, J.L., A.J. Calandro, and W.J. Shampine, 1972, Water Resources of Union Parish, Louisiana: Department of Conservation Louisiana Geological Survey and Louisiana Department of Public Works, Water Resources Bulletin, no. 17. 68p.

Mississippi River Alluvial Aquifer (northern portion)

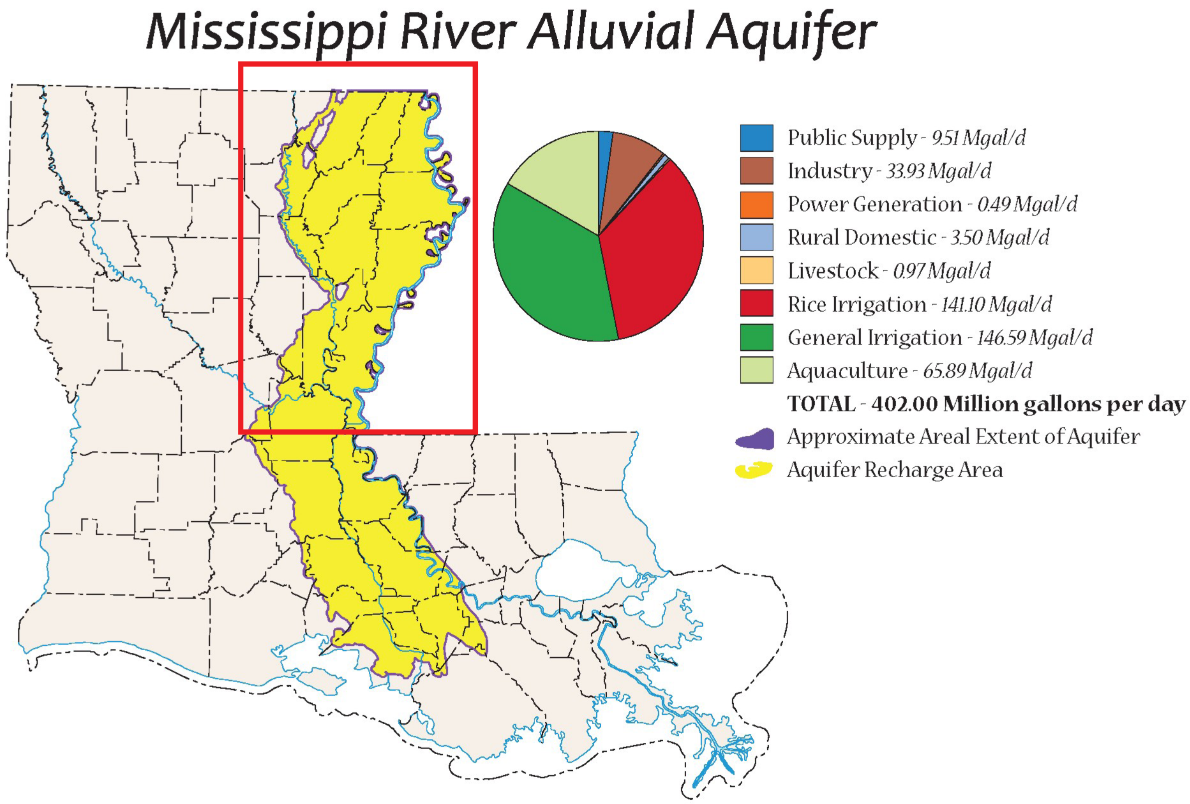


Figure 11. Extent of the Mississippi River Alluvial Aquifer in Louisiana. The 2005 estimated water usage for the whole MRAA (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

• Ballard (1994) is the first study determining transmissivity for the MRAA in northeastern Louisiana.

• Carlson (2006) reports 1,196 specific capacity tests within the MRAA were analyzed to determine a distribution of geometric mean of hydraulic conductivities across 10 northeastern parishes. A total of 260 specific capacity tests were analyzed to determine the distribution of hydraulic conductivity vertically within the MRAA in Franklin Parish.

• Carlson (2004a) determined the geometric mean of hydraulic conductivity for the Mississippi River Alluvial Aquifer from 443 specific capacity tests.

Usage

• Water withdrawal from the MRAA has been estimated by the USGS in collaboration with state agencies since 1960 (Figure 11).

Water Levels

• The MRAA has had its potentiometric surface determined in 1974 (Whitfield, 1975); 1990 (Seanor and Smoot, 1995a); and 2000-2002 for Franklin Parish only (Seanor and Kress, 2004).

• For the MRAA change of potentiometric level maps is for 1974 to 1990 (Seanor and Smoot, 1995a).

Water Quality

- Sanford (1973b), Whitfield (1973 and 1975), Covay (1985), and McGee (1997) include water quality values for samples from within the MRAA (Table 5). The values presented are for the whole MRAA. Table 5 shows the number of samples values presented in some of the reports.

Other Studies

- Sumner and Wasson (1990) of the USGS prepared a model of the MRAA for Mississippi only.

- Mahon and Poynter (1993) of the USGS prepared a model of the MRAA for Arkansas only.

- Ackerman (1996) of the USGS prepared a model of the MRAA for Arkansas, Louisiana, Missouri and Mississippi.

- Arthur (2001) of the USGS prepared a revised model of the MRAA for Mississippi only.

- Reed (2003) of the USGS prepared a model of the MRAA for Arkansas only.

- Gillip and Czarnecki (2009) of the USGS prepared a model of the MRAA for Arkansas only.

Table 5. Studies of the MRAA in terms of the number of water quality samples.

Parameter	Whitfield (1973)	Whitfield (1975)	Covay (1985)	McGee (1997)
Temperature	3	70	17	133
pH	35	117	26	0
Specific Cond.	19	119	56	133
TDS	14	125	32	0
Hardness	52	128	180	0
bicarbonate	14	127	32	0
calcium	14	114	42	0
chloride	52	128	202	0
fluoride	14	111	33	0
iron	38	125	31	0
magnesium	14	114	42	0
nitrate	12	115	10	137
potassium	14	110	30	0
silica	14	122	33	0
sodium	14	115	32	0
sulfate	14	125	67	0

Note: The table lists the number of sample results by parameter for each study.

Mississippi River Alluvial Aquifer (north) Bibliography

Ackerman, D.J., 1996, Hydrology of the Mississippi River valley alluvial aquifer, south-central United States: U.S. Geological Survey Professional Paper 1416-D, 56 p. and 8 plates.

Ballard, W.J., 1994, The development of methods for calculating transmissivity from specific capacity within the Mississippi River alluvial aquifer in northeastern Louisiana: New Orleans, Louisiana, University of New Orleans, M.S. Thesis, 117p.

Covay, K.J., 1985, Ground-water resources of the Rayville-Delhi area, northeastern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 37, 22 p.

Gillip, J.A.; Czarnecki, J.B., 2009, Validation of a Ground-Water Flow Model of the Mississippi River Valley Alluvial Aquifer Using Water-Level and Water-Use Data for 1998-2005 and Evaluation of Water-Use Scenarios: U.S. Geological Survey Scientific Investigations Report 2009-5040, 23 p.

Mahon, G. L. and Poynter, D. T., 1993, Development, calibration, and testing of ground-water flow models for the Mississippi River Valley alluvial aquifer in eastern Arkansas using one-square-mile cells: U.S. Geological Survey Water-Resources Investigations Report 92-4106, 33 p.

McGee, B.D. 1997, Occurrence of nitrate in the Mississippi River alluvial aquifer in Louisiana, June through December 1993: Louisiana Department of Transportation and Development Water Resources Technical Report no. 61, 21 p.

Reed, T.B., 2003, Recalibration of a ground-water flow model of the Mississippi River Valley alluvial aquifer of northeastern Arkansas, 1918-1998, with simulations of water levels caused by projected ground-water withdrawals through 2049: U.S. Geological Survey Water-Resources Investigations Report 2003-4109, 58 p.

Sanford, T.H., Jr., 1973b, Ground-water resources of Morehouse Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 19, 90 p.

Seanor, R.C., and W.H. Kress, 2004, Water levels and water quality in the Mississippi River alluvial aquifer, Franklin Parish, Louisiana, 2000-2002: Louisiana Department of Transportation and Development.

Seanor, R.C., and Smoot, C.W., 1995a, Louisiana ground-water map no. 6: Potentiometric surface, 1990, and water-level changes, 1974-90, of the Mississippi River alluvial aquifer in northeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4146, 2 sheets.

Sumner, D. M. and Wasson, Billie E., 1990, Geohydrology and simulated effects of large ground-water withdrawals on the Mississippi River alluvial aquifer in northwestern Mississippi: U.S. Geological Survey Water Supply Paper No. 2291, 60 p.

Whitfield, M.S., Jr., 1975, Geohydrology and water quality of the Mississippi River alluvial aquifer, northeastern Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 10, 29 p.

Whitfield, M.S., Jr., 1973, Availability of ground water in the Winnsboro area, Louisiana: Louisiana Department of Public Works Water Resources Special Report no. 1, 9 p.

Red River Alluvial Aquifer

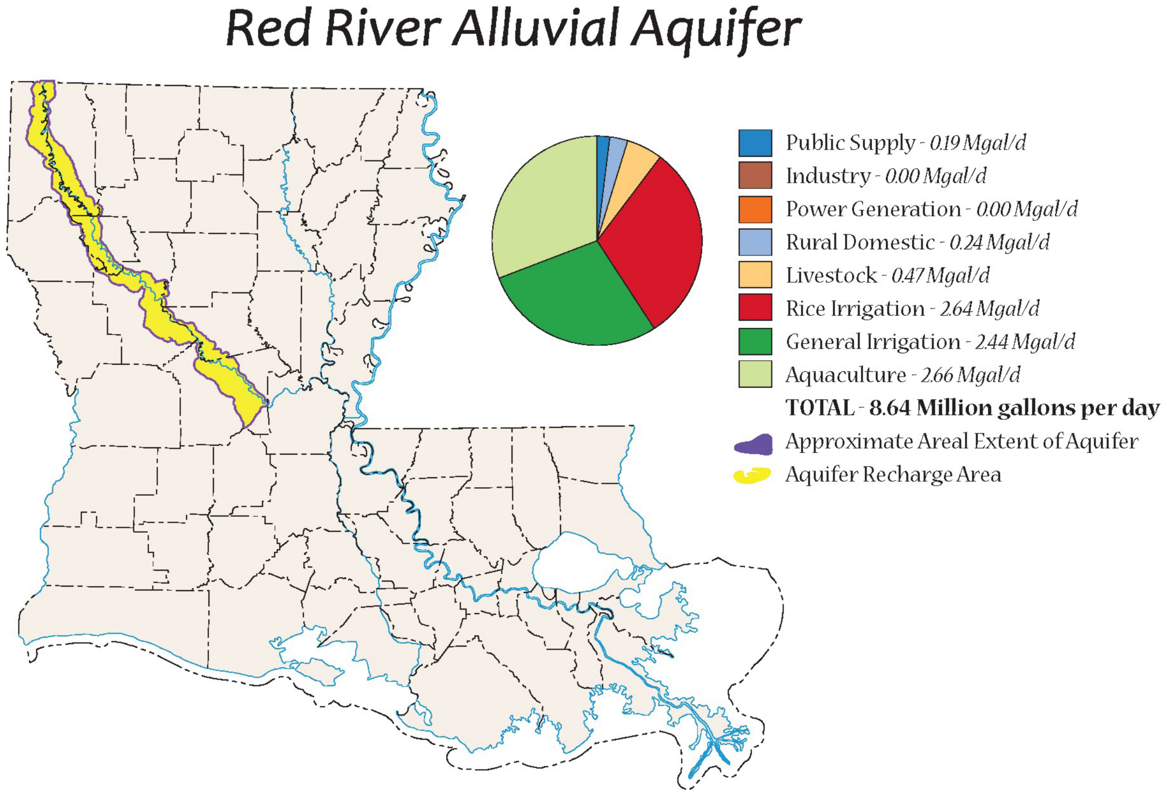


Figure 12. Extent of the Red River Alluvial Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

• Carlson (2004a) determined the geometric mean of hydraulic conductivity for the RRAA from 39 specific capacity tests.

Usage

• Water withdrawal from the RRAA has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

• Parts of the RRAA had their potentiometric surface determined for 1971, 1973, 1985-1987 and 1987 (Smoot and Martin, 1991b).

• For the RRAA there are no system-wide potentiometric maps. However, there are three reports that anyone can use to construct potentiometric maps of parts or all of the RRAA. These reports contain water level data from: approximately 1955 to 1976 (Stephens, 1976), which contains results from approximately 200 wells; 1975 to 1980 (Smoot, 1983), which contains results from approximately 400 wells; and 1986 to 1991 (Seanor, 1994), which contains results from approximately 400 wells.

• Another volume that contains 1000s of water level values is USGS (1975) study of water levels throughout Louisiana prior to 1975.

Water Quality

• Page and May (1964), Whitfield (1980), Snider (1983), Smoot et al. (1994) Smoot and Fendick (1998) include water quality values for samples from within the RRAA. Van Biersel and Carlson (2009) also collected some data as part of their Wilcox study. Table 6 shows the number of samples values presented in some of the reports.

Other Studies

Ludwig and Terry (1980) prepared a groundwater model of the RRAA from north of the Bossier-Shreveport metropolitan area to south of the mouth of the Black River.

Table 6. Large studies of the Red River Alluvial Aquifer in terms of the number of water quality samples.

Parameter	Rapp (1996)	Smoot et al. (1994)	Whitfield (1980)	Van Biersel and Carlson (2009)
Temperature	38	224	861	0
pH	21	362	1,409	0
Specific Cond.	58	221	1,827	0
TDS	39	102	623	87
Hardness	86	468	2,320	0
bicarbonate	0	0	705	0
calcium	39	234	799	94
chloride	90	470	2,390	94
fluoride	43	141	647	0
iron	53	336	1,612	0
magnesium	39	236	793	94
nitrate	0	9	494	0
potassium	39	113	618	0
Silica	39	111	616	76
Sodium	39	115	617	87
Sulfate	70	443	1,777	94

Note: The table List the number of sample results by parameter for each study.

Red River Alluvial Aquifer Bibliography

Ludwig, A.H., and Terry, J.E., 1980, Methods and applications of digital-model simulation of the Red River alluvial aquifer, Shreveport to the mouth of the Black River, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 79-114, 103 p.

Newcome, R., Jr., and Sloss, R., 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Newcome, R., Jr., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Rapp, T.R., 1996, Ground-water resources of Caddo Parish, Louisiana, 1992: Louisiana Department of Transportation and Development Water Resources Technical Report no. 58, 89 p.

Page, L.V., and May, H.G., 1964, Water resources of Bossier and Caddo Parishes, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 5, 105 p.

Seanor, R.C., 1994, Water-level measurements, 1986-91, Red River alluvial aquifer, Red River Valley, Louisiana: U.S. Geological Survey Open-File Report 94-69, 218 p.

Smoot, C.W., and Fendick, R.B. Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development, Water Resources Technical Report, no. 63, 36p.

Smoot, C.W., and Martin, A., Jr., 1991b, Generalized potentiometric surfaces of the Red River alluvial aquifer, pool 1, Red River waterway area, central Louisiana: U.S. Geological Survey Water-Resources Investigations Report 91-4109, 7 sheets.

Smoot, C.W., 1983, Records of water-level measurements and lithologic logs, Red River Valley, Louisiana, 1975-80: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 12, 197 p.

Stephens, J.W., 1976, Records of wells, water-level measurements, and drillers' logs, Red River Valley, Louisiana: U.S. Geological Survey Open-File Report 76-759, 335 p.

Van Biersel, T., and Carlson, D., 2009, Distribution and Source Analysis of Elevated Chloride Concentration in the Wilcox Aquifer of Northwestern Louisiana: Gulf Coast Association of Geological Societies, Transactions, v. 59, p753-767.

Whitfield, M.S., Jr., 1980, Chemical character of water in the Red River alluvial aquifer, Louisiana: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-1018, 95 p.

Sparta Aquifer System

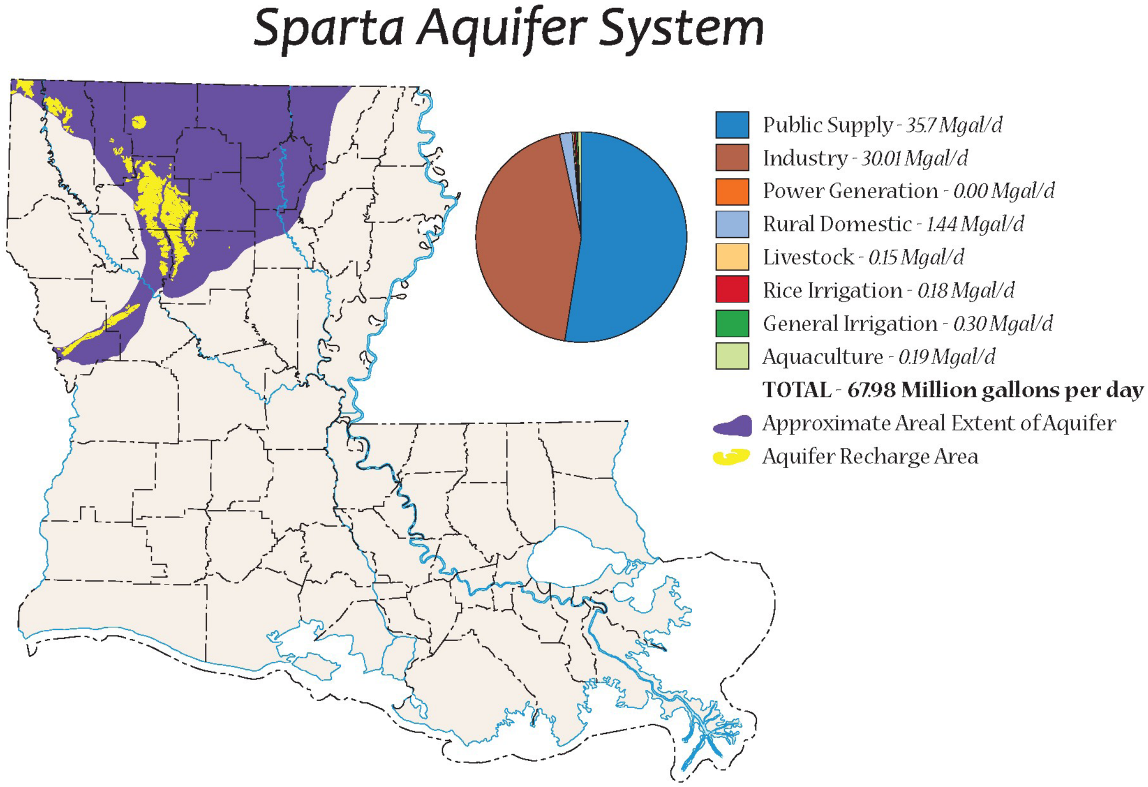


Figure 13. Extent of the Sparta Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

- The Sparta Aquifer has a total of 104 hydraulic conductivity values with 76 values in Martin and Early (1987); 14 values in Sanford (1973b); 11 values in Snider et al. (1972) and three values reported in Ryals (1982b).

- Carlson (2004a) determined the geometric mean of hydraulic conductivity for the Sparta Aquifer from 484 specific capacity tests.

- Carlson (2004b) determined on of porosity from sonic logs for the Sparta Aquifer from 1565 porosity values.

- Carlson (2010a) prepared a scaling study which included permeability results from cores (small laboratory tests) and well tests (field tests that are approximately the same size as specific capacity tests) for 184 permeability values for the Sparta Aquifer.

Usage

- Water withdrawal from the Sparta Aquifer has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

- By far the largest number of potentiometric maps generated for northern Louisiana aquifers are for the Sparta Aquifer. The Sparta Aquifer potentiometric maps are available for the following years: 1900 (Ryals, 1980), 1965 (Sanford, 1973; and Ryals, 1980), 1975 (Ryals, 1980), 1980 (Ryals, 1980; 1982a; and 1983a), 1989 (Smoot and Seanor, 1991a), 1996 (Brantly et al, 2002), 2001 (Schrader, 2004), 2005 (Schrader and Jones, 2007), and 2007 (Schrader, 2008).

- Drawdown maps for the Sparta Aquifer were prepared for following time periods: 1925-1965 (Sanford, 1973), and 1980-1989 (Smoot and Seanor, 1991).

- Tomaszewski et al. (2002) created a map showing the yearly rate of decline of the potentiometric surface within the Sparta Aquifer between 1990 and 2000.

- The USGS maintains six real-time stations for the Sparta Aquifer (L-26, Ja-148, Ou-401A, Bi-166, Un-26 and L-68).

Water Quality

- Page et al. (1963), Page and May (1964), Rogers et al. (1972), Sanford (1973a and b), Ryals (1982a and 1982b), Snider (1972 and 1983), Schrader (2004), and Schrader and Jones (2007) include water quality discussions and/or values for samples from within the Sparta Aquifer (Table 7).

- Tomaszewski (1992) created a series of water quality maps for dissolved iron, manganese, sodium, hardness and total dissolved solids for the Sparta Aquifer.

- Carlson and Van Biersel (2009) collected water quality samples throughout the aquifer and researched the movement of saltwater in the aquifer (Figure 14).

Other Studies

- Regional groundwater flow model of the Sparta Aquifer covering northern Louisiana, southern Arkansas and central Mississippi (Trudeau and Bono, 1985).

- Regional groundwater flow model of the Sparta Aquifer covering northern Louisiana and southern Arkansas (McWreath et al., 1991).

- There have been six updated applications of the McWreath et al. (1991) model: the Kilpatrick (1992), Hayes et al. (1998), Hayes (2001), Meyer, Meyer, LaCroix & Hixson Inc. (2002), McKee and Clark (2003), and McKee, et al.(2004) models.

- There are two local models of the Sparta Aquifer. One is focused on the area around Minden, Louisiana (Kerschbaum, 1995), and a second is focused on the area around Monroe, Louisiana (Gregory, 2001).

Table 7. Studies of the Sparta Aquifer in terms of the number of water quality samples.

Parameter	Sanford (1973a & b)	Ryals (1982a)	Tomaszewski (1992)	Snider et al. (1972)	Rogers et al. (1972)
Temp.	16	55	0	16	0
pH	32	82	415	47	62
Specific Cond.	31	83	430	41	44
TDS	32	83	432	40	56
Hardness	33	83	781	47	60
bicarbonate	32	83	0	47	44
calcium	32	83	453	46	62
chloride	33	83	779	46	63
fluoride	31	83	440	41	39
iron	53	79	417	46	59
magnesium	32	83	449	46	62
nitrate	31	31	0	41	47
potassium	32	83	420	41	31
silica	32	83	446	41	57
sodium	32	83	440	46	57
sulfate	32	83	450	47	64

Note: The table lists the number of sample results by parameter for each study.

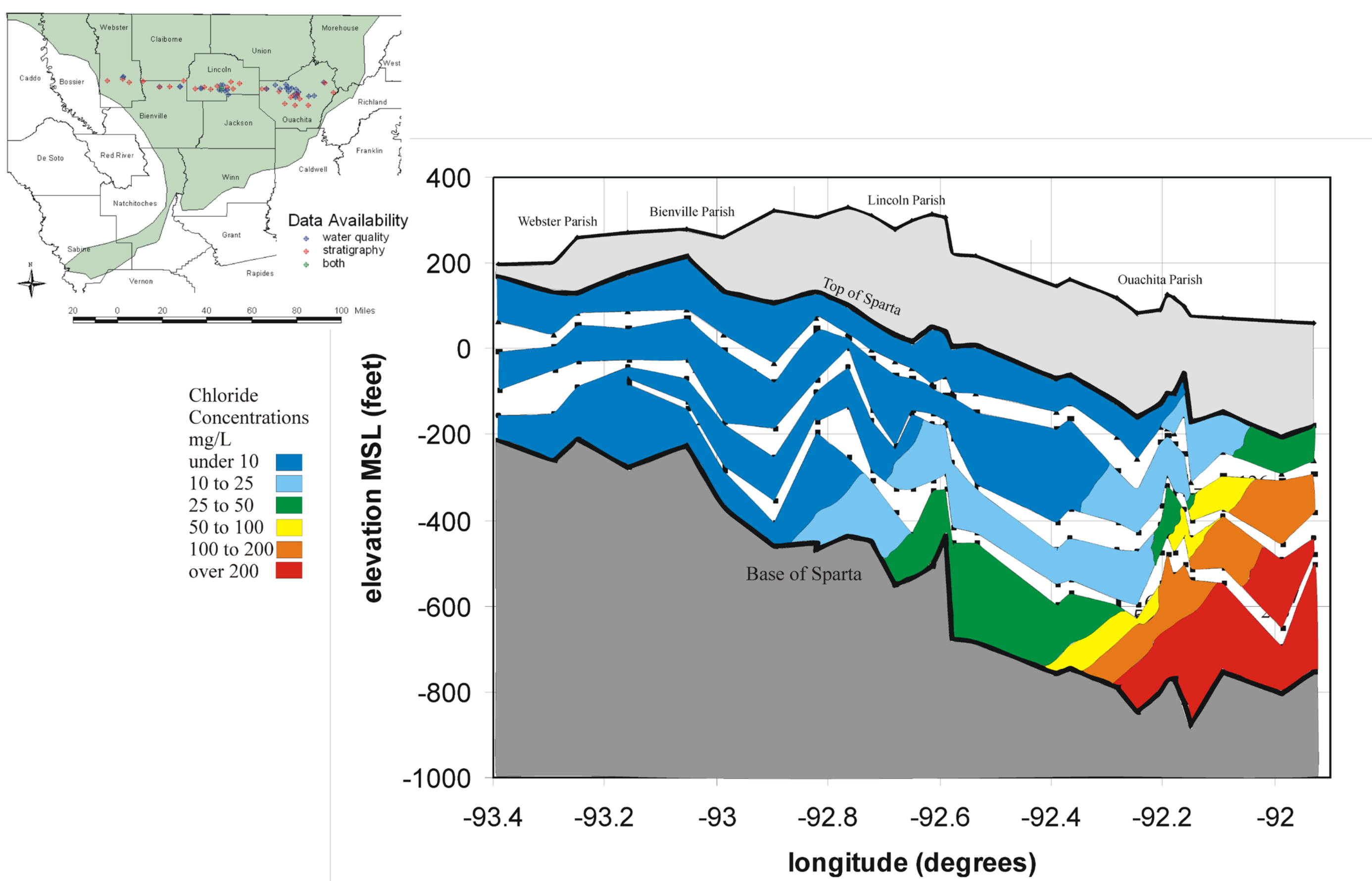


Figure 14: West to East profile of the Sparta Aquifer in Louisiana (from Carlson and Van Biersel, 2009).

Sparta Aquifer Bibliography

Brantly, J.A., Seanor, R.C., and McCoy, K.L., 2002, Louisiana ground-water map no. 13: Hydrogeology and potentiometric surface, October 1996, of the Sparta aquifer in northern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 02-4053, 3 sheets.

Carlson, D., 2010a, Influence of Lithology on Scaling Effects for Louisiana Stratigraphic Units' Permeability: Gulf Coast Association of Geological Societies, Transactions, v. 60, p. 87-102.

Carlson, D. and Van Biersel, T., 2009, Monitoring Saltwater Front Sparta Aquifer in North Central Louisiana: Draft report submitted to the Louisiana Department of Transportation and Development

Carlson, D., 2005, Louisiana Aquifer Characterization Aquifer Properties: Louisiana Geological Survey, NewsInsights, v. 15, no. 2, p. 1-5

Carlson, D., 2004a, Characterization/Conductivities of Louisiana Aquifer Explored Conductivities: Louisiana Geological Survey, NewsInsights, v. 14, no.2, p. 3-6.

Carlson, D., 2004b, Sparta Aquifer: First-Year Study Completed: Louisiana Geological Survey, NewsInsights, v. 14, no. 2, p. 6-9.

Gregory, J.D., 2001, Effects of surface water accumulation from the 1991 flood on the groundwater hydraulics of the Sparta Aquifer in north-central Louisiana: Monroe, Louisiana, University of Louisiana at Monroe, Masters Thesis, 102p.

Hays, P.D., 2001, Simulated Response of the Sparta Aquifer to Outcrop Area Recharge Augmentation, Southeastern Arkansas: U.S. Geological Survey, Water-Resources Investigations, no. 01-4039, 14p.

Hays, P.D., Lovelace, J.K., and Reed, T.B., 1998, Simulation response to pumping stress in the Sparta Aquifer of southeastern Arkansas and north-central Louisiana, 1998-2007: U.S. Geological Survey, Water-Resources Investigations, no. WRI 98-4121, 25p.

Kerschbaum, S.J., 1995, Simulation of pumping scenarios using numerical flow modeling with particle tracking to optimize water quality at Minden, Louisiana: New Orleans, Louisiana, University of New Orleans, Master Theses, 212p.

Kilpatrick, J.M., 1992, Simulated Reponse to Future Pumping in the Sparta Aquifer, Union County, Arkansas: U.S. Geological Survey Water-Resources Investigations, no. 91-4161, 25p.

McKee, P.W., Clark, B.R., and Czarnecki, J.B., 2004, Conjunctive-use optimization model and sustainable-yield estimation for the Sparta Aquifer of southeastern Arkansas and north-central Louisiana: U.S. Geological Survey Water-Resources Investigations, no. WRI 03-4231, 30p.

McKee, P.W., and Clark, B.R., 2003, Development and calibration of a ground-water flow model for the Sparta Aquifer of southeastern Arkansas and north-central Louisiana and simulated response to withdrawals; 1998-2027: U.S. Geological Survey Water-Resources Investigations, no. WRI 03-4132, 71p.

McWreath, H.C., III, Nelson, J.D., and Fitzpatrick, D.J., 1991, Simulated response to pumping stresses in the Sparta aquifer, northern Louisiana and southern Arkansas: Louisiana Department of Transportation and Development Water Resources Technical Report no. 51, 51 p.

Meyer, Meyer, LaCroix & Hixson, Inc., Lazenby and Associates, Louisiana Tech University, URS Corporation, C.W. Smoot, and Frye-Magee, 2002, Sparta Groundwater Study: report for Sparta Groundwater Conservations District, unnumbered pages.

Newcome, Roy, Jr., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Page, L.V., Newcome, R., Jr., and Graeff, G.D., Jr., 1963, Water resources of Sabine Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 3, 146 p.

Page, L.V., and May, H.G., 1964, Water resources of Bossier and Caddo Parishes, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 5, 105 p.

Ryals, G.N., 1983a, Regional geohydrology of the northern Louisiana salt-dome basin, part III, potentiometric levels of the Wilcox-Carrizo and Sparta aquifers: U.S. Geological Survey Water-Resources Investigations Report 83-4131, 14 p.

Ryals, G.N., 1982b, Ground-water resources of the Arcadia-Minden area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 28, 35 p.

Ryals, G.N., 1980, Potentiometric surface maps of the Sparta Sand; northern Louisiana and southern Arkansas, 1900, 1965, 1975, and 1980: U.S. Geological Survey Open-File Report 80-1180, 1 sheet.

Sanford, T.H., Jr., 1973a, Water resources of the Ruston area, Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 8, 32 p.

Sanford, T.H., Jr., 1973b, Ground-water resources of Morehouse Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 19, 90 p.

Schrader, T.P., 2008, Potentiometric Surface in the Sparta-Memphis Aquifer of the Mississippi Embayment, Spring 2007: U.S. Geological Survey Scientific Investigations Map 3014, 1 sheet.

Schrader, T.P., and Jones, J.S., 2007, Status of Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer in Arkansas and the Status of Water Levels in the Sparta Aquifer in Louisiana, Spring 2005: U.S. Geological Survey Scientific Investigations Report 2007-5029, 35p.

Schrader, T.P., 2004, Status of Water Levels and Selected Water-Quality Conditions in the Sparta-Memphis Aquifer in Arkansas and the Sparta Aquifer in Louisiana, Spring-Summer 2001: U.S. Geological Survey Scientific Investigations Report 2004-5055, 35p.

Smoot, C.W., and Seanor, R.C., 1991a, Louisiana ground-water map no. 3: Potentiometric surface, 1989, and water-level changes, 1980-89, of the Sparta aquifer in north-central Louisiana: U.S. Geological Survey Water-Resources Investigations Report 90-4183, 2 sheets.

Snider, J.L., Calandro, A.J. , and Shampine, W.J., 1972, Water Resources of Union Parish, Louisiana: Department of Conservation Louisiana Geological Survey and Louisiana Department of Public Works, Water Resources Bulletin, no. 17. 68p.

Snider, J.L., 1983, Ground-water resources of the Fillmore-Haughton-Red Chute area, Bossier and Webster Parishes, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 32, 21 p.

Upland Terrace Aquifer

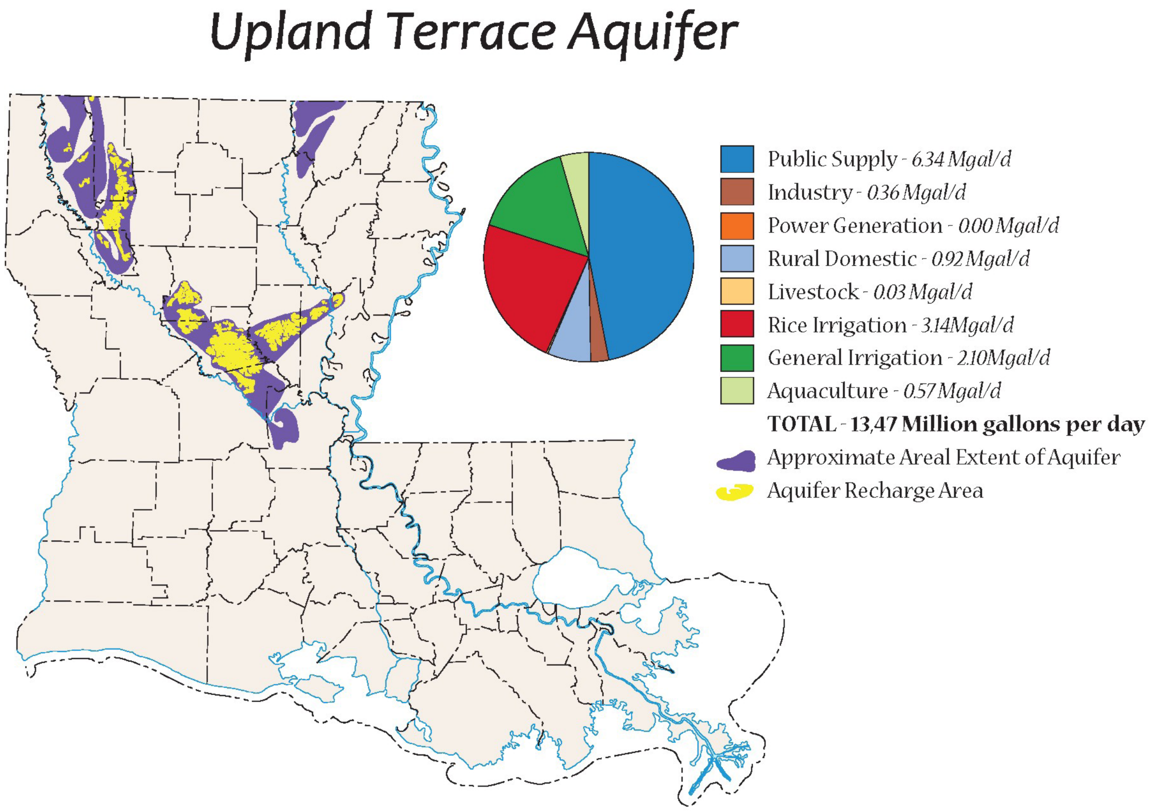


Figure 15: Extent of the Upland Terrace Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

- Carlson (2004a) determined the geometric mean of hydraulic conductivity for the UTA from 68 specific capacity tests.

Usage

- Water withdrawal from the UTA has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

- There is no formal map of the UTA's potentiometric surface. However, there are water level measurements for the aquifer in the DOTD and USGS databases.

Water Quality

• The following studies include water quality values for samples from within the UTA, as follows: Page and May (1964), Snider (1983), Smoot and Fendick (1998), and Tomaszewski (2009).

Upland Terrace Aquifer Bibliography

Ryals, G.N., 1982b, Ground-water resources of the Arcadia-Minden area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 28, 35 p.

Sanford, T.H., Jr., 1973b, Ground-water resources of Morehouse Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 19, 90 p.

Snider, J.L., 1983, Ground-water resources of the Fillmore-Haughton-Red Chute area, Bossier and Webster Parishes, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 32, 21 p.

Tomaszewski, D., 2009, Ground-water resources in Rapides Parish, Louisiana, 2005: Louisiana Department of Transportation and Development Water Resources Technical Report no. 78, 54 p.

2.3 Region II

The three principal aquifers of Region II are the CAS, the Evangeline Aquifer and the JAS. Region II is dominated by the CAS, which was designated in 1988 by the U.S. Environmental Protection Agency as a "sole source aquifer."

Region II Specific Bibliography

Fader, S.W., 1954, An Analysis of Contour Maps of Water Levels in Wells in Southwestern Louisiana, 1952 and 1953: Louisiana Geological Survey Water Resources Pamphlets #1, 7 pp.

Fader, S.W., 1955, An Analysis of Contour Maps of Water Levels in Southwestern Louisiana, 1954: Louisiana Geological Survey Water Resources Pamphlets #2, 13 pp.

Fader, S.W., 1957, An Analysis of Contour Maps of 1955 Water Levels, With a Discussion on Salt-Water Problems in Southwestern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #4, 27 pp.

Fader, S.W., 1958, Water Levels and Water-Level Contour Maps for Southwestern Louisiana, 1956 and 1957: Louisiana Geological Survey Water Resources Pamphlets #5, 23 pp.

Fajardo, I., 1969, A study of the connate waters and clay mineralogy in southern Louisiana: unpublished M.S. thesis, University of Tulsa, 68 p.

Pettijohn, R.A., Weiss, J.S. and Williamson, A.K., 1988, Distribution of dissolved-solids concentrations and temperature in ground water of the Gulf Coast aquifer systems, south-central United States: U. S. Geological Survey Water-Resources Investigations WRI 88-4082.

Pettijohn, R.A., Busby, J.F. and Layman, T.B., 1993, Properties and chemical constituents in ground water from permeable zone B (lower Pleistocene-upper Pliocene deposits), coastal lowlands aquifer system, south-central United States: U. S. Geological Survey Water-Resources Investigations WRI 91-4152.

Weiss, J.S., 1990, Geohydrologic units of the coastal lowlands aquifer system, south-central United States: U. S. Geological Survey Open-File Report OF 90-0173.

Chicot Aquifer System

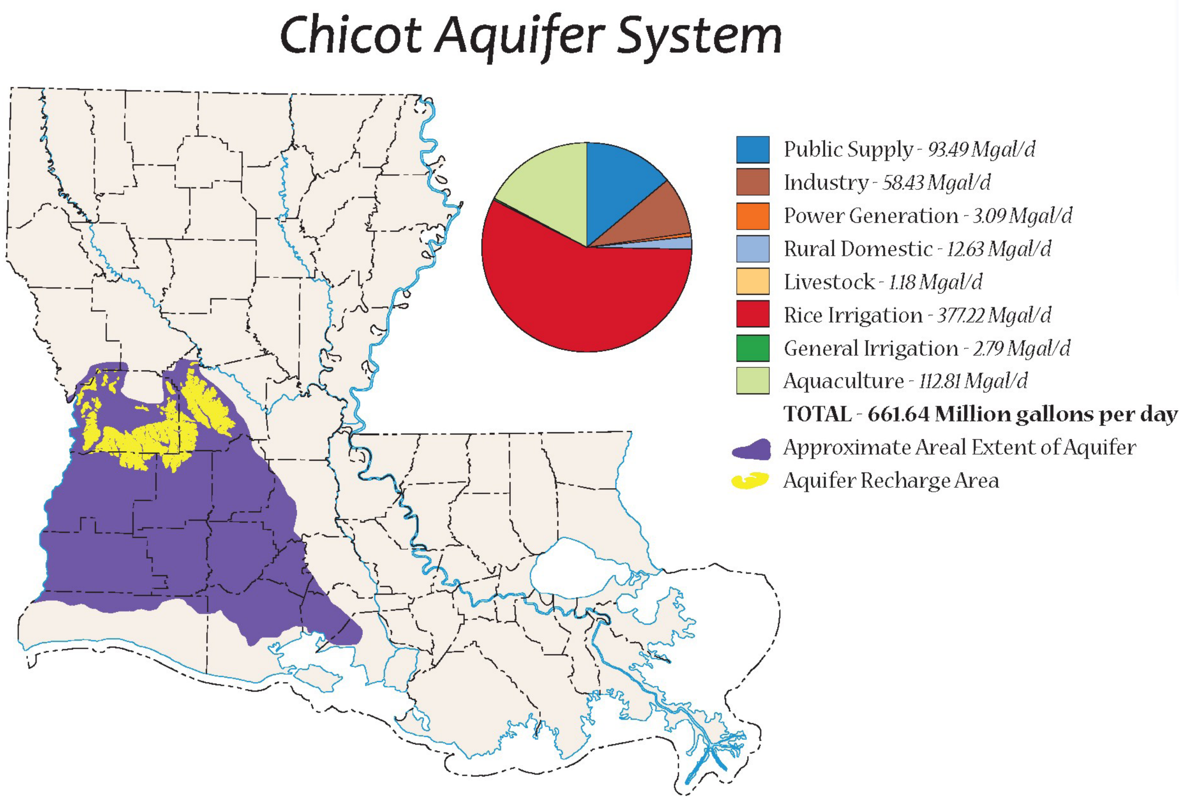


Figure 16: Extent of the Chicot Aquifer System in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

• The geohydrology of the CAS was characterized by Nyman et al (1990).

• Milner and Fisher (2009) revised the hydrostratigraphy of the CAS (Figures 17, 18 and 19).

• Properties of the CAS were determined by Harder (1960), Whitman and Kilburn (1963), Jones et al (1954), and Rao et al (1991).

• Carlson (2007a and 2007b), Carlson et al (2003), Carlson and Milner (2004), and Rahman et al (2006) analyzed the distribution of aquifer parameters within the CAS.

• Hartono (2005) studied the distribution of hydraulic conductivity and recharge within the CAS.

Usage

• Water withdrawal from the CAS has been estimated by the USGS in collaboration with state agencies since 1960.

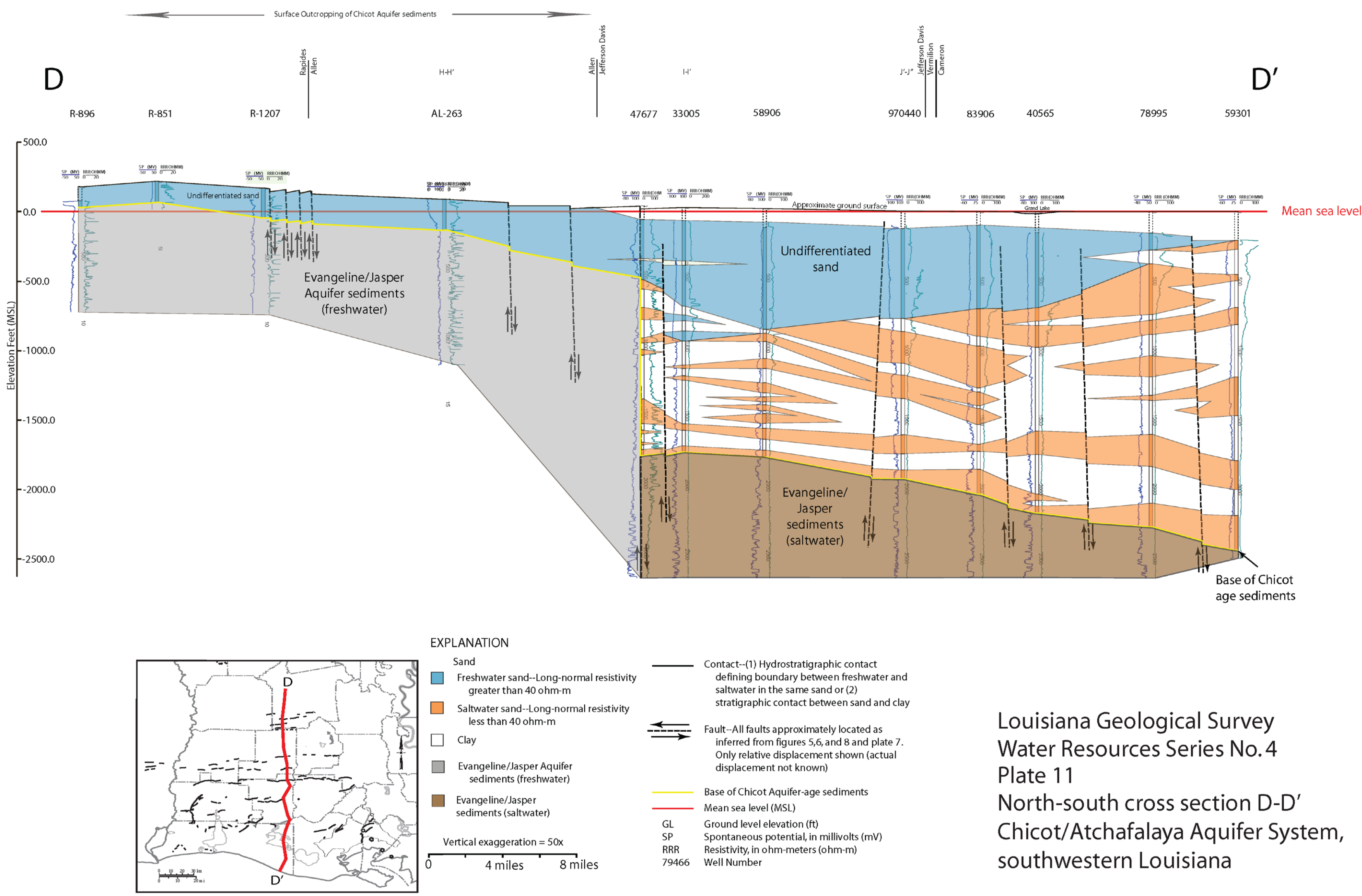


Figure 17: North-South profile across the Chicot Aquifer System (from Milner and Fisher, 2009).

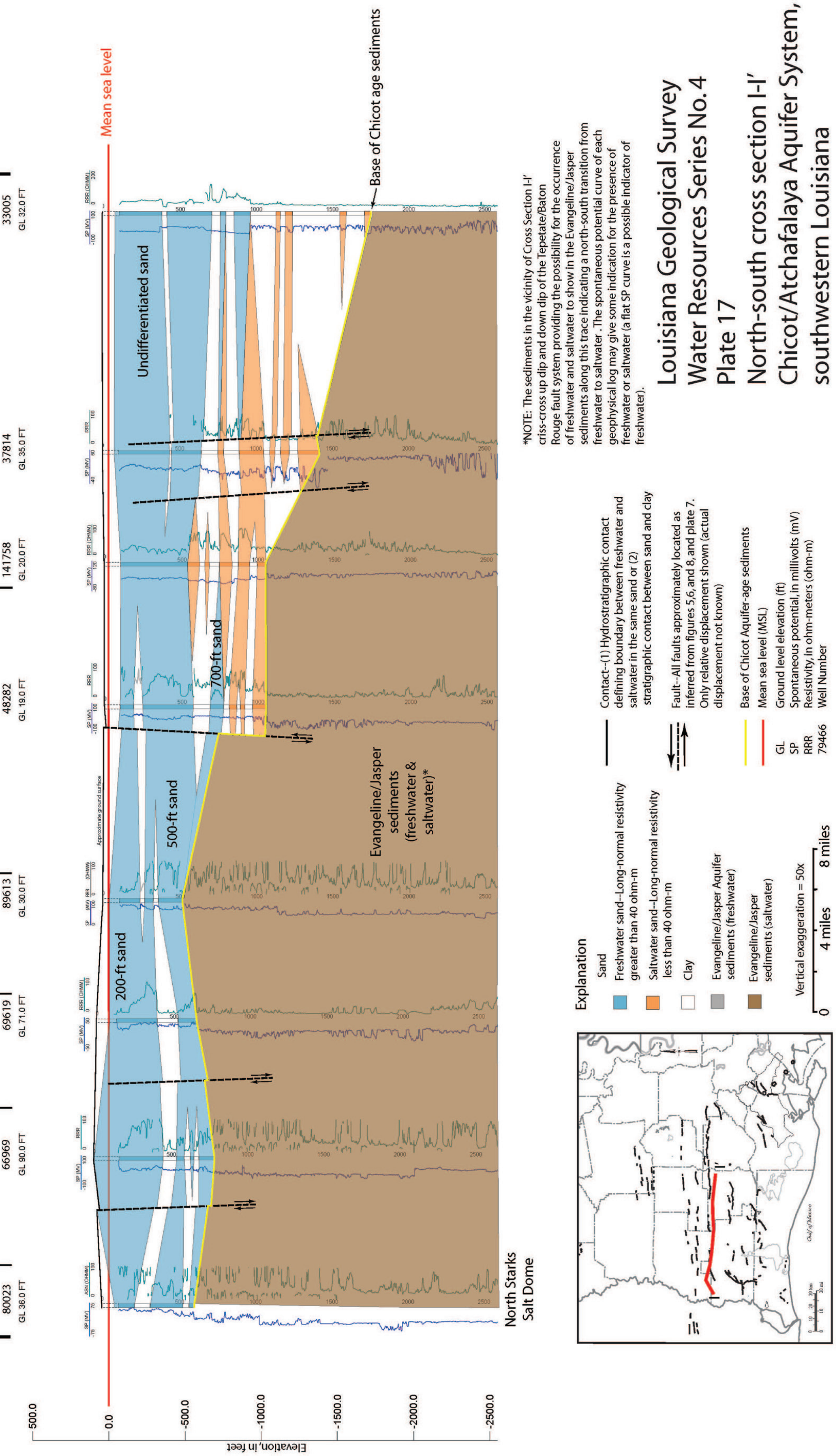


Figure 18: West-East profile across the Chicot Aquifer System (from Milner and Fisher, 2009).

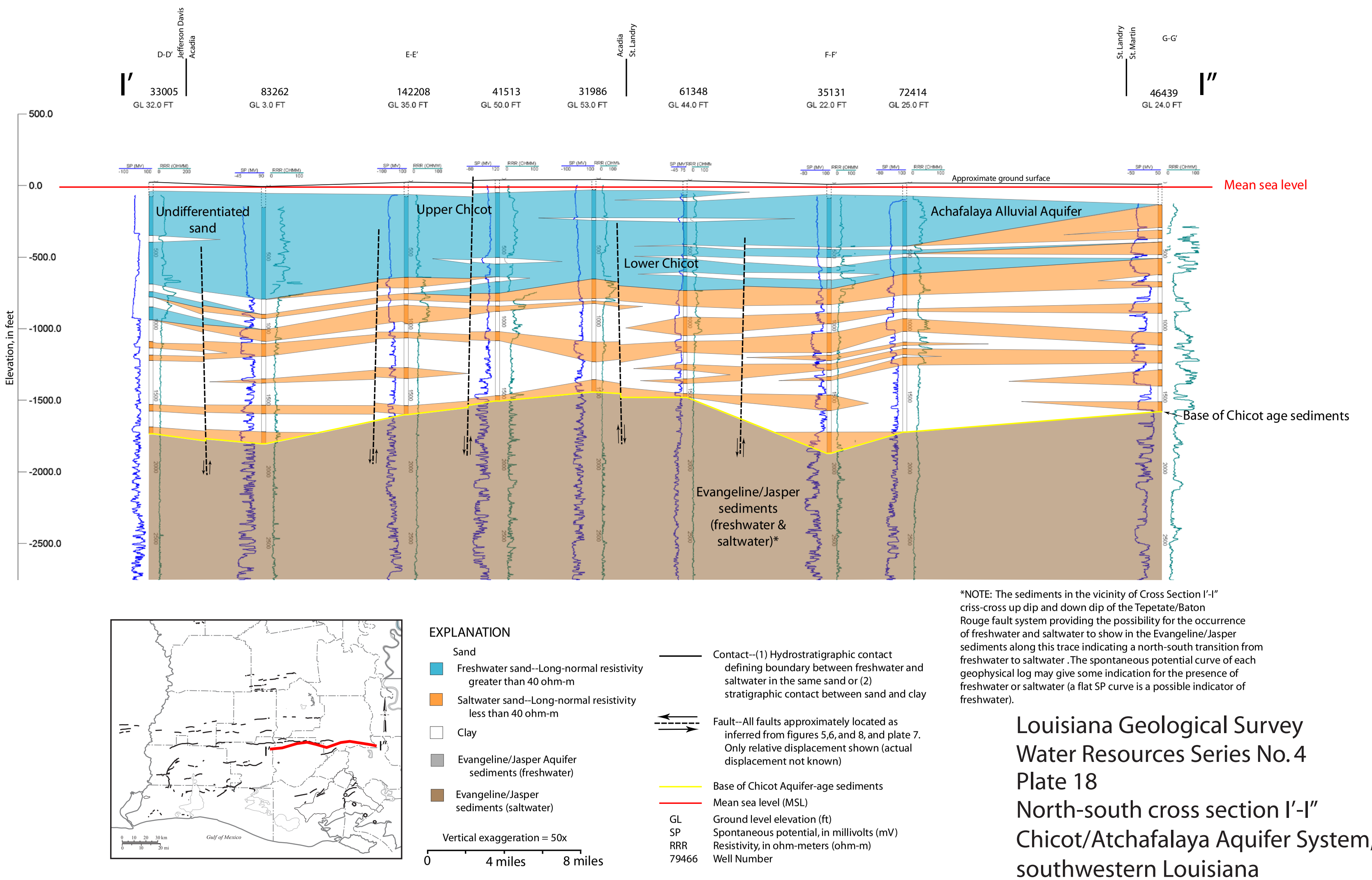


Figure 19: West-East profile across the Chicot Aquifer System (from Milner and Fisher, 2009).

Water Levels

• The USGS maintains two real-time stations for the CAS (JD-485A and Ev-229).

Potentiometric surface maps for the CAS were prepared by the USGS in 1958/59 (Harder, 1960), 1959/60 (Harder, 1961), 1960/61 (Kilburn et al, 1962), 1980 (Martin and Whiteman, 1985), 1985 (Fendick and Nyman, 1987), 1991 (Walters, 1995 and 1996), 2000 (Lovelace et al, 2001), 2001 (Lovelace et al, 2002), and 2000-03 (Lovelace et al, 2004).

Water Quality

• Saltwater intrusion in the CAS was studies by Stanley and Maher (1944), Smoot (1986) Smoot (1988), Birbiglia (1995), Lovelace (1998) and more recently, Milner and Van Biersel (2006).

• Methane has been observed in wells near Lake Charles (Hodge et al, 1963; and Murray and Beck, 1992).

• Meyer (1953), Whiteman (1965), Hosman (1974), Sargent and McGee (1998), Tollet et al (2003), Tollet and Fendick (2004) describe the groundwater quality condition in the CAS.

Other Studies

• A regional groundwater flow model was prepared by Nyman et al (1990).

• A revised and updated groundwater flow model was prepared by Hartono (2005) as part of her Ph.D. dissertation.

Chicot Aquifer System Bibliography

Bengtson, R L., Carter C.E. and Fouss, J.L., 1991, Water management research in Louisiana: Transaction of the American Society of Agricultural Engineers 1991 Summer Meeting.

Birbiglia, G.V., 1995, A geophysical investigation of the fresh-water/salt-water interface beneath Grand Isle, Louisiana: unpublished M.S. thesis, University of New Orleans.

Bookman, M., 1968. Legal and economic aspects of salt-water encroachment into coastal aquifers: Louisiana State University Coastal Studies Institute Vol. 3: 169-186.

Carlson, D., 2007a, Estimate of Vertical Anisotropy of Hydraulic Conductivity for Western Louisiana Aquifers from Grain-Size Data: Gulf Coast Association of Geological Societies, Transactions, v. 57, no. 115-124.

Carlson, D., 2007b, Estimate of Vertical Anisotropy of Hydraulic Conductivity for Northern Louisiana Aquifers from Grain-Size data: Proceedings of Baton Rouge Geological Society's 1 st Annual Louisiana Groundwater Symposium, March 8, 2007, Baton Rouge, Louisiana, v. 1, p. 32-42.

Carlson, D., Milner, R. and Hanson, B.C., 2003, Evaluation of Aquifer Capacity to Sustain Short-, Long-Term Ground Water Withdrawal from Point Sources in the Chicot Aquifer for Southwest Louisiana: Part I: Louisiana Geological Survey, Report of Investigations Series, no. 03-01, 90 p.

Carlson, D. and Milner, R., 2004, Hydrologic Differences Arising from Source Material Differences Between Southwestern Louisiana Aquifers and their Age Equivalents in Southeastern Louisiana: Gulf Coast Association of Geological Societies, Transactions, v. 54, p 101-111.

Duex, T.W., 2003, Water supply in Lafayette, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 53, p. 205-209.

Duex, T.W., 2005, A brief summary of water supply in Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 55: 147-147.

Duex, T.W., 2006, A brief summary of water supply in the State of Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 56: 163-170.

Fayard, L.D., 1971, Relation between oxidation potential and the occurrence of iron in ground water from the Chicot aquifer, Lafayette, Louisiana, in Geological Survey Research 1971: U.S. Geological Survey Professional Paper 750-D, p. D182-D186.

Fendick, R.B., Jr., and Nyman, D.J., 1987, Louisiana ground-water map no. 1: Potentiometric surface, 1985, and water-level changes, 1983-85, of the Chicot aquifer in southwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4348, 2 sheets.

Gresham, D.M., 2007, Potential arsenic sources for groundwater of the Cow Island area, Vermilion Parish, Louisiana: unpublished M.S. thesis, University of Southwest Louisiana, 108 p.

Haque, S.M. , 1984, Ground-Water Quality in the Lake Charles Area, Louisiana: Louisiana Geological Survey Water Resources Series #2, 57 pp.

Hansen, F.N., Irelan, B. and Aertker, D.R., 1954, Supplemental surface-water supplies report for the Vermillion River basin, Louisiana: U.S. Geological Survey Open-File Report 54-115, 50 p.

Harder, A.H., 1960, The geology and ground-water resources of Calcasieu Parish, Louisiana: U.S. Geological Survey Water-Supply Paper 1488, 102 p.

Harder, A.H., 1960, Water levels and water-level contour maps for southwestern Louisiana, 1958 and 1959: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 8, 27 p.

Harder, A.H., 1961, Water levels and water-level contour maps for southwestern Louisiana, 1959 and spring 1960, with a discussion of ground-water withdrawals: Department of Conservation and Louisiana Department of Public Works Water Resources Pamphlet no. 10, 25 p.

Harder, A.H., Kilburn, C., Whitman, H.M., and Rogers, S.M., 1967, Effects of ground-water withdrawals on water levels and saltwater encroachment in southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 10, 56 p.

Harris, G.D., 1904, Underground waters of southern Louisiana, with discussions of their uses for water supplies and for rice irrigation, by M.L. Fuller: U.S. Geological Survey Water-Supply Paper 101, 98 p.

Hartono, S., 2005, Spatial and temporal estimation of pumping recharge in groundwater system analysis: unpublished PhD dissertation, Louisiana State university, 91 p.

Heinrich, P.V., 2005, Distribution and origin of fault-line scarps of southwest Louisiana, USA: Transaction of the Gulf Coast Association of Geological Societies vol. 55, p. 284-293.

Hill, J.M., 1982, Source determination of rice irrigation water in southwestern Louisiana using Landsat data: Transaction of the International symposium on rainfall-runoff modeling, Mississippi State, MS, p. 545-554.

Hodges, A.L., Jr., Rogers, S.M., and Harder, A.H., 1963, Gas and brackish water in fresh-water aquifers, Lake Charles area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 13, 35 p.

Holland, W.C., Hough, L.W. and Murray, G.E., 1952, Geology of Beauregard and Allen Parishes: Louisiana Geological Survey Geology Bulletin #27, 224 pp. plus map pack.

Hosman, R.L., Broussard, W.L. and Calandro, A.J., 1970, Water Resources of Northwestern St. Landry Parish and Vicinity, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #23, 29 pp.

Hosman, R.L., 1974, Soft-water zone in the Chicot aquifer, Bayou Teche area, Louisiana: U.S. Geological Survey Open-File Report 74-65, 20 p.

Howe, H.V. and Moresi, C.K., 1933, Geology of Lafayette and St. Martin Parishes: Louisiana Geological Survey Geology Bulletin #3, 238 pp.

Howe, H.V., Russell, R.J., McGuirt, J.H., Craft, B.C. and Stephenson, M.B., 1935, Reports on the Geology of Cameron and Vermillion Parishes: Louisiana Geological Survey Geology Bulletin #6, 242 pp.

Jones, P.H., Turcan, A.N. and Skibitzke, H.E. 1954, Geology and Ground-Water Resources of Southwestern Louisiana: Louisiana Geological Survey Geology Bulletin #30, 285 pp. plus map pack.

Jones, P.H., Hendricks, E.L., Irelan, B., and others, 1956, Water resources of southwestern Louisiana: U.S. Geological Survey Water-Supply Paper 1364, 460 p.

Kerfoot, H.B., Brady, W., Schramm, B. and Allendorf, M.A., 2007, Geochemical and hydrologic characterization to identify the source of low level benzene in the Chicot Aquifer groundwater Transaction of the Gulf Coast Association of Geological Societies vol. 57, p. 397-407.

Kilburn, C. and Whitman, H.M., 1962, Water levels in southwestern Louisiana, April 1960 to April 1961, with a discussion of water-level trends from 1950 to 1960: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 11, 21 p.

Klug, M.L., 1955, Geology and Ground-Water Resources of the Alexandria Area, Rapides Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #3, 23 pp.

Larson, J.M., 1987, A three-dimensional simulation of the CECOS injection well near Lake Charles, Louisiana: unpublished M.S. thesis, Ohio University, 189 p.

Lock, B.E., 1993, The proposed Cade II landfill site, South Louisiana; threat to the Chicot Aquifer: Transaction of the Gulf Coast Association of Geological Societies vol. 43, p. 211-217.

Lovelace, J.K., 1998, Distribution of saltwater in the Chicot aquifer system in the Calcasieu Parish area, Louisiana, 1995-96: Louisiana Department of Transportation and Development Water Resources Technical Report no. 62, 59 p.

Lovelace, J.K., 1999, Distribution of saltwater in the Chicot aquifer system of southwestern Louisiana, 1995-96: Louisiana Department of Transportation and Development Water Resources Technical Report no. 66, 61 p.

Lovelace, J.K., Frederick, C.P., Fontenot, J.W., and Naanes, M.S., 2001, Louisiana ground-water map no. 12: Potentiometric surface of the Chicot aquifer system in southwestern Louisiana, June 2000: U.S. Geological Survey Water-Resources Investigations Report 01-4128, 1 sheet.

Lovelace, J.K., Fontenot, J.W., and Frederick, C.P., 2002, Louisiana ground-water map no. 14: Potentiometric surface, January 2001, and water-level changes, June 2000 to January 2001, of the Chicot aquifer system in southwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 02-4088, 2 sheets.

Lovelace, J.K., Fontenot, J.W., and Frederick, C.P., 2004: Withdrawals, water levels, and specific conductance in the Chicot aquifer system in southwestern Louisiana, 2000-03: U.S. Geological Survey Scientific Investigations Report 2004-5212, 56 p.

Maloney, J.W., 2005, Geology and hydrogeology of the area within a 2-mile radius of Judice sand mine, Lafayette Parish, Louisiana. Unpublished M.S. thesis, University of Louisiana at Lafayette, 68 p.

Martin, A., and Whiteman, C.D., Jr., 1985, Map showing generalized potentiometric surface of aquifers of Pleistocene Age, southern Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4331, 1 sheet.

McGinnis, L.D., Thompson, M.D., Kuecher, G.J., Wilkey P.L. and Isaacson, H.R., 1995, Salinity and hydrodynamics of the Holocene and upper Pleistocene beneath the Louisiana wetlands from electrical measurements: Proceedings of the symposium on the Application of geophysics to engineering and environmental problems, p. 261-271.

McWreath, H.C. and Smoot, C.W., 1989, Geohydrology and development of ground water at Fort Polk, Louisiana: U. S. Geological Survey Water-Resources Investigations WRI 88-4088.

Meyer, R.R., 1953, Summary of ground-water conditions in southwestern Louisiana: U.S. Geological Survey Open-File Report, 7 p.

Miller, C.Q., Jr., 1954, The subsurface geology of Vermilion Parish, Louisiana: unpublished M.S. thesis, University of Houston.

Milner, R., 2003, Chicot Aquifer in Jefferson Davis Parish, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 53, p. 555-556.

Milner, L.R. and C. Fisher, 2009, Geological Characterization of the Chicot/Atchafalaya Aquifer Region: Southwest Louisiana: Louisiana Geological Survey Water Resources Series #4, 39 pp.

Murikan, A., 2002, Ground water availability and water usage trends in Lafayette Parish from 1960 to 2000, and a comparison with state-wide trends in Louisiana: unpublished M.S. thesis, University of Louisiana at Lafayette.

Murray, H.E. and Beck, J.N., 1992, Methane in well water from Lake Charles, Louisiana: Environmental Contamination and Toxicology Bulletin vol. 48, p. 768-771.

Newcome, R. and Sloss, R., 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Nyman, D. J., Steinkampf, W.C., Hutchinson, C.B. and Zack, A.L., 1983, Saltwater movement in the coastal areas: U. S. Geological Survey Professional Paper 1983, p. 123-124.

Nyman, D.J., 1984, The occurrence of high concentrations of chloride in the Chicot aquifer system of southwestern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 33, 75 p.

Nyman, D.J., 1989, Quality of water in freshwater aquifers in southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 42, 22 p.

Nyman, D.J., Halford, K.J., and Martin, A., Jr., 1990, Geohydrology and simulation of flow in the Chicot aquifer system of southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 50, 58 p.

Nyman, D.J., Beck, J.N., Rao, G.N. and Murray, H.E., 1991, The Sabine River diversion canal and groundwater conservation in Calcasieu Parish, Louisiana: American Water Resources Association Technical Publication Series 91-3, p. 253-259.

Ocamb, R.D., 1961, Growth faults of South Louisiana. United States: Transaction of the Gulf Coast Association of Geological Societies vol. 11, p. 139-175.

Paine, W.R., 1962, Geology of Acadia and Jefferson Davis Parishes: Louisiana Geological Survey Geology Bulletin #36, 277 pp. plus map pack.

Prakken, L.B., 1998, Water-quality data for public-supply wells at Fort Polk, Vernon Parish, Louisiana, March and June 1997: U.S. Geological Survey Open-File Report 98-271, 13 p.

Rahman, A., 2003, Incorporating uncertainty into high-resolution groundwater supply models: Proceeding of the Symposium on Groundwater quality modeling and management under uncertainty, p. 122-130.

Rahman, A., Tsai, F.T.C., White, C.D., Carlson, D.A. and Willson, C.S., 2008, Geophysical data integration, stochastic simulation and significance analysis of groundwater responses using ANOVA in the Chicot aquifer system, Louisiana, USA: Hydrogeology Journal vol. 16, p. 749-764.

Rahman, A., Tsai, F. T. C., White, C. D., Carlson, D. A., and Wilson, C., 2006, Geophysical Data integration and conditional uncertainty analysis on hydraulic conductivity estimation: Proceedings of American Society of Civil Engineers/Environmental Water & Resources Institute, May 21-25, 2006, Omaha, Nebraska, unnumbered pages in CD.

Ranganathan, V. and Hanor, J., 1988, Density-driven groundwater flow near salt domes: Chemical Geology vol. 74, p. 173-188.

Rao, G. N. Beck, J. N., Murray, H. E. and Nyman, D. J., 1991, Estimating transmissivity and hydraulic conductivity of Chicot Aquifer from specific capacity data: Water Resources Bulleting vol. 27, p. 47-58.

Rogers, J. E. and Calandro, A. J., 1965, Water Resources of Vernon Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #6, 104 pp. plus map pack.

Rouly, K. C. (1989). Quaternary and environmental geology of southwestern St. Martin Parish, Louisiana: unpublished M.S. thesis, University of Southwestern Louisiana, 135 p.

Rowland, M. A. and Hannoura, A. A. A., 1988, Regional groundwater modeling and aquifer characterization: Proceedings of the National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods vol. 2, p. 1471-1494.

Sargent, B.P., and McGee, B.D., 1998, Occurrence of nitrate and selected water-quality data, Chicot aquifer system in southwestern Louisiana, July 1994 through January 1996: Louisiana Department of Transportation and Development Water Resources Technical Report no. 64, 53 p.

Sargent, B.P., Frederick C.P. and Roberts, F.C., 2004, Shallow sands and thickness data for the Chicot aquifer system surficial confining unit, southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report #73, 29 p.

Sargent, B.P., 2004, Thickness of the Chicot aquifer system surficial confining unit and location of shallow sands, southwestern Louisiana:Louisiana Department of Transportation and Development Water Resources Technical Report

Sasser, D.C., Sturrock, A.M., Jr., and Covay, K.J., 1988, Meteorological and microlysimeter data for a rice irrigation study in southwestern Louisiana, 1985 and 1986: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 15, 24 p.

Smoot, C.W., 1986, Louisiana hydrologic atlas map no. 2: Areal extent of freshwater in major aquifers of Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4150, 1 sheet.

Smoot, C.W., 1988, Louisiana hydrologic atlas map no. 3: Altitude of the base of freshwater in Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4314, 1 sheet.

Smoot, C.W., 1989, Louisiana hydrologic atlas map no. 4: Geohydrologic sections of Louisiana: U.S. Geological Survey Water-Resources Investigations Report 87-4288, 1 sheet.

Stanley, T.B., Jr., and Maher, J.C., 1944, Ground-water resources of Jefferson Davis and Acadia Parishes, Louisiana: Louisiana Department of Public Works, 93 p.

Stoessell, R.K. and Prochaska, L., 2005, Chemical evidence for migration of deep formation fluids into shallow aquifers in south Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 55, p. 794-808.

Tollett, R.W., and Fendick, R.B., Jr., 2004, Quality of water from shallow wells in the rice-growing area in southwestern Louisiana, 1999 through 2001: U.S. Geological Survey Water-Resources Investigations Report 03-4050, 44 p.

Tollett, R.W., Fendick, R.B., Jr., and Lane B. Simmons, 2003, Quality of water in domestic wells in the Chicot and Chicot equivalent aquifer systems in southern Louisiana and southwestern Mississippi, 2000-2001: U.S. Geological Survey Water-Resources Investigations Report 03-4122, 85 p.

Trahan, D.B., 1995, Source and plume investigation of chlorinated compounds in groundwater at a chemical plant: Transaction of the Gulf Coast Association of Geological Societies vol. 45, p. 565-571.

Trudeau, D.A., 1994, Geohydrology and the occurrence of selected chemical contaminants at a hazardous-waste disposal site, Calcasieu Parish, Louisiana, 1984-85: Louisiana Department of Transportation and Development Water Resources Technical Report no. 53, 54 p.

Turcan, A. N., Jr., 1952, Industrial use of ground water, Louisiana: Louisiana State University Engineering Experimentation Station Bulleting 31, p. 1-16.

U. S. Army Corps of Engineers, 1981, Water resources development in Louisiana, 1981: Report prepared by the U. S. Army Corps Eng. Lower Miss. Valley Div., Vicksburg, MS, 142 p.

Varvaro, G.G., 1957, Geology of Evangeline and St. Landry Parishes: Louisiana Geological Survey Geology Bulletin #31, 295 pp. plus map pack.

Walters, D.J., 1995, Louisiana ground-water map no. 7: Potentiometric surface, 1991, and water-level changes, 1969-91, of the Chicot equivalent aquifer system in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 94-4202, 2 sheets.

Walters, D.J., 1996, Louisiana ground-water map no. 10: Potentiometric surface, 1991, and water-level changes, 1985-91, of the Chicot aquifer system in southwestern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4044, 2 sheets.

Wang, F. and Gambrell, R.P., 1996, Tidally induced subsurface groundwater flow and transport in two salt marsh ecosystems: Louisiana Water Resources Research Institute Report G 2022-05, p. 19-23.

Whiteman, H.M. and C. Kilburn, 1963, Ground-Water Conditions in Southwestern Louisiana, 1961 and 1962, with a Discussion of the Chicot Aquifer in the Coastal Area: Louisiana Geological Survey Water Resources Pamphlets #12, 32 pp.

Whiteman, H.M., 1965, Estimating Water Quality from Electric Logs in Southwestern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #16, 13 pp.

Whiteman, C.D., Jr., Calandro, A.J., and Broussard, W.L., 1970, Water resources of the Slagle-Simpson-Flatwoods area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 24, 23 p.

Williams, C.B. and Duex, T.W., 1995, A hydrogeological study of the Chicot Aquifer in Lafayette Parish, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 45, p. 165-172.

Williams, C.B. and Duex, T.W., 1999, Evidence for local groundwater recharge site in Lafayette Parish, Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 49 p. 500-504.

Evangeline Aquifer

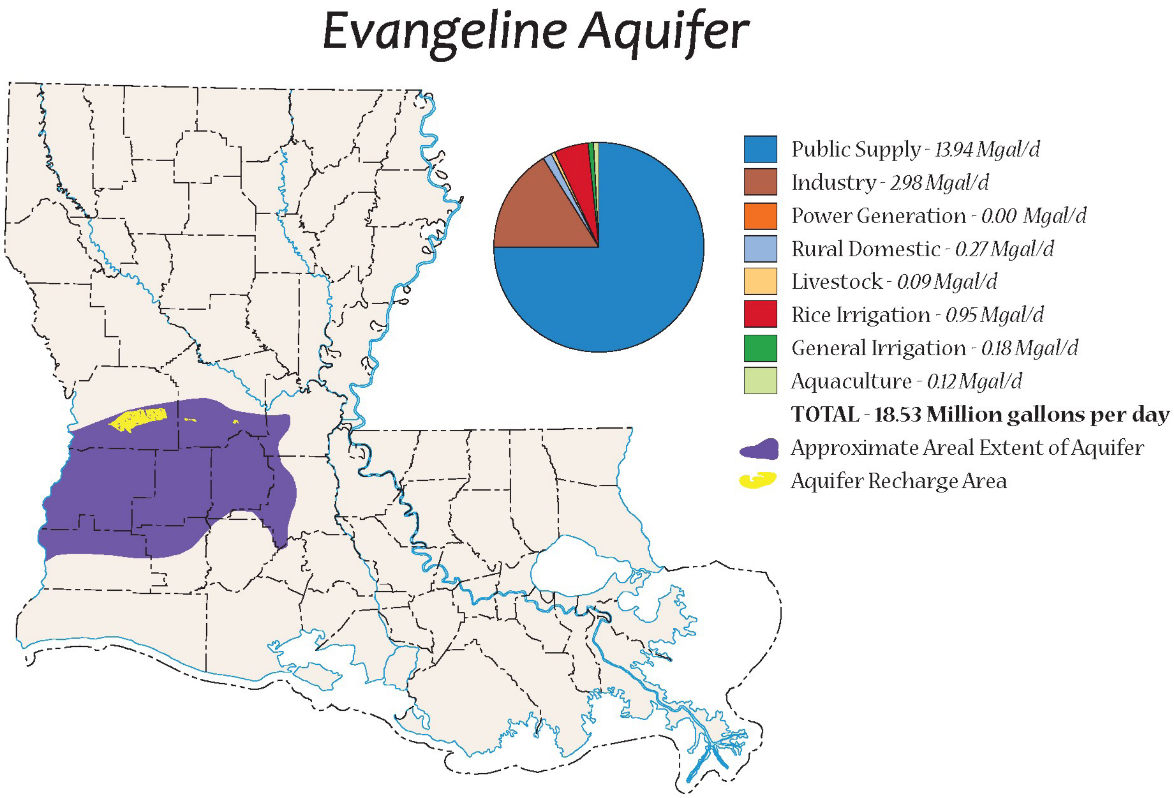


Figure 20: Extent of the Evangeline Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

• Properties of the Evangeline Aquifer are presented by Jones et al (1956),

Usage

• Water withdrawal from the Evangeline Aquifer has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

• Published potentiometric surface maps and/or water levels are available for 1960 (Harder, 1960), 1980 (Martin and Whiteman, 1985) and 1990 (Walters, 1992).

Water Quality

• Nyman (1989) discussed the water quality in the Evangeline Aquifer.

• Groundwater quality for the U.S. Army Fort Polk Military Reservation in Vernon Parish and the vicinity of the City of Alexandria in Rapides Parish have been well studied by Klug (1955), McWreath and Smoot (1989), Prakken (1998), and Tomaszewski (2009).

Evangeline Aquifer Bibliography

Fendick, R.B., 2005, Louisiana ground-water map no. 21; generalized potentiometric surface of the Evangeline Aquifer in south-central Louisiana, January-March 2004: U. S. Geological Survey Scientific Investigations Map.

Harder, A.H., 1960, Water levels and water-level contour maps for southwestern Louisiana, 1958 and 1959: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 8, 27 p.

Harris, G.D., 1904, Underground waters of southern Louisiana, with discussions of their uses for water supplies and for rice irrigation, by M.L. Fuller: U.S. Geological Survey Water-Supply Paper 101, 98 p.

Jones, P.H., Hendricks, E.L., Irelan, B., and others, 1956, Water resources of southwestern Louisiana: U.S. Geological Survey Water-Supply Paper 1364, 460 p.

Klug, M.L., 1955, Geology and Ground-Water Resources of the Alexandria Area, Rapides Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #3, 23 pp.

Martin, A., Jr., and Whiteman, C. D., Jr., 1985, Map showing generalized potentiometric surface of the Evangeline and equivalent aquifers in Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4359, 1 sheet.

McWreath, H.C. and Smoot, C.W., 1989, Geohydrology and development of ground water at Fort Polk, Louisiana: U. S. Geological Survey Water-Resources Investigations WRI 88-4088.

Newcome, Roy, Jr., 1961, Sources of emergency water supply in the Alexandria area, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works, 7 p.

Newcome, R., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Newcome, R., and Sloss, R., 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Nyman, D.J., 1989, Quality of water in freshwater aquifers in southwestern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 42, 22 p.

Prakken, L.B., 1998, Water-quality data for public-supply wells at Fort Polk, Vernon Parish, Louisiana, March and June 1997: U.S. Geological Survey Open-File Report 98-271, 13 p.

Rogers, J.E. and Calandro, A.J. 1965, Water Resources of Vernon Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #6, 104 pp. plus map pack.

Tomaszewski, D., 2009, Ground-water resources in Rapides Parish, Louisiana, 2005: Louisiana Department of Transportation and Development Water Resources Technical Report no. 78, 54 p.

Walters, D.J., 1992, Louisiana ground-water map no. 5: Potentiometric surface, 1990, and water-level changes, 1974-90, of the Evangeline equivalent/southeast Louisiana aquifer system: U.S. Geological Survey Water-Resources Investigations Report 92-4112, 2 sheets.

Whitfield, M.S., Jr., 1975, Geohydrology of the Evangeline and Jasper aquifers of southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 20, 72 p.

Jasper Aquifer System

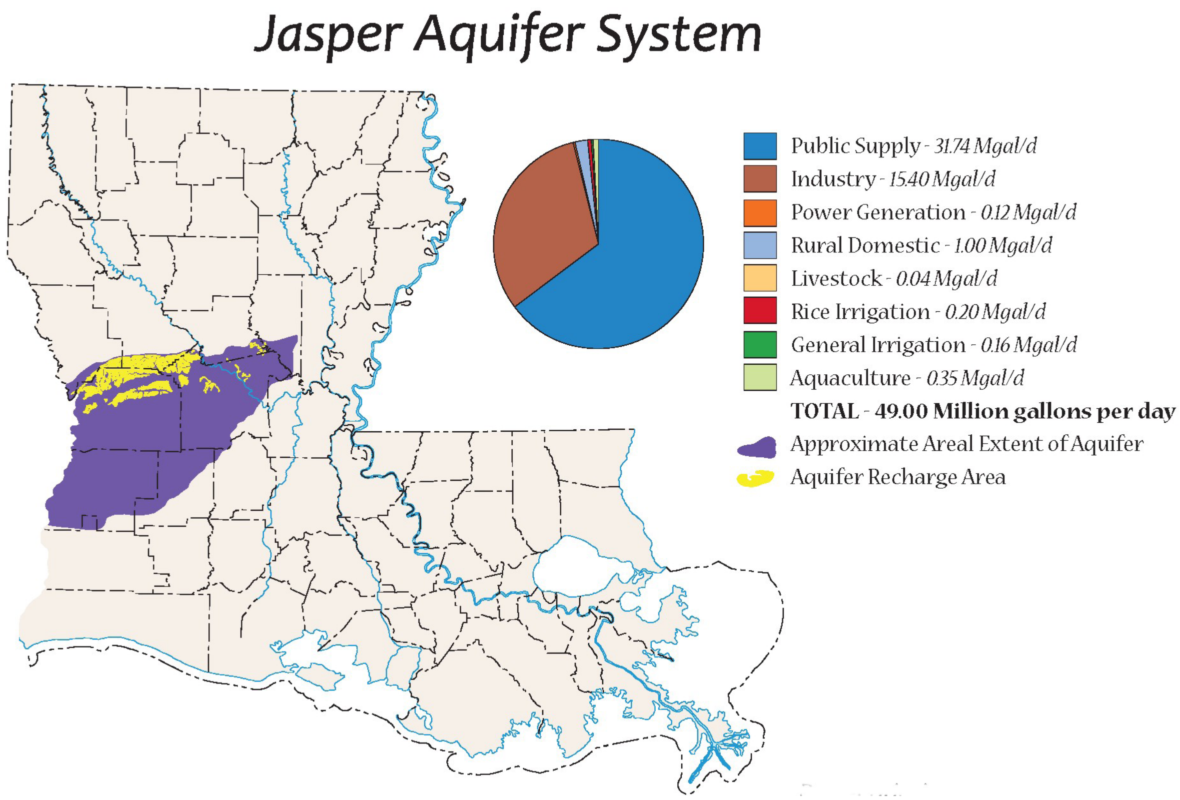


Figure 21: Extent of the Jasper Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

• Jones et al (1954 and 1956) and Whitfield (1975) discuss the properties of the JAS.

Usage

• Water withdrawal from the JAS has been estimated by the USGS in collaboration with state agencies since 1960.

Water Levels

- Potentiometric maps were prepared for the JAS in 1958/59 (Harder, 1960), 1959/60 (Harder, 1961), 1960/61 (Kilburn et al, 1962), 1984 (Martin et al, 1988), 1989 (Smoot & Seanor, 1992), and 2003 (Brantly and Seanor, 2005).

Water Quality

- Groundwater quality for the U.S. Army Fort Polk Military Reservation in Vernon Parish and the vicinity of the City of Alexandria in Rapides Parish have been well studied by Klug (1955), McWreath and Smoot (1989), Prakken (1998), and Tomaszewski (2009).

- Meyer (1953) and Whitfield (1975) discuss the water quality of the JAS.

Jasper Aquifer System Bibliography

Brantly, J.A., and Seanor, R.C., 2005, Louisiana ground-water map no. 18, potentiometric surface, 2003, Jasper aquifer system in west-central Louisiana: U. S. Geological Survey Scientific Investigations Map.

Barton, D.C., 1925, Pine Prairie salt dome [Evangeline Parish, Louisiana]: American Association of Petroleum Geologists Bulletin #9, p. 738-755.

Bengtson, R L., Carter C.E. and Fouss, J.L., 1991, Water management research in Louisiana: Transaction of the American Society of Agricultural Engineers 1991 Summer Meeting.

Conger, R.M., 1986, The environmental safety of underground injection of oilfield brines in Louisiana. United States, Gulf Coast Association of Geological Societies: New Orleans, LA, United States. 36: 65-69.

Fader, S.W., 1957, An Analysis of Contour Maps of 1955 Water Levels, With a Discussion on Salt-Water Problems in Southwestern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #4, 27 pp.

Harder, A.H., 1960, Water levels and water-level contour maps for southwestern Louisiana, 1958 and 1959: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 8, 27 p.

Harder, A.H., 1961, Water levels and water-level contour maps for southwestern Louisiana, 1959 and spring 1960, with a discussion of ground-water withdrawals: Department of Conservation and Louisiana Department of Public Works Water Resources Pamphlet no. 10, 25 p.

Harder, A.H., Kilburn, C., Whitman, H.M., and Rogers, S.M., 1967, Effects of ground-water withdrawals on water levels and saltwater encroachment in southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 10, 56 p.

Harris, G.D., 1904, Underground waters of southern Louisiana:U. S. Geological Survey Water-Supply Paper W0101.

Jones, P.H., Turcan, A.N. and Skibitzke, H.E., 1954, Geology and Ground-Water Resources of Southwestern Louisiana: Louisiana Geological Survey Geology Bulletin #30, 285 pp. plus map pack.

Jones, P.H., Hendricks, E.L., Irelan, B., and others, 1956, Water resources of southwestern Louisiana: U.S. Geological Survey Water-Supply Paper 1364, 460 p.

Kilburn, C., and Whitman, H.M., 1962, Water levels in southwestern Louisiana, April 1960 to April 1961, with a discussion of water-level trends from 1950 to 1960: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 11, 21 p.

Klug, M.L., 1955, Geology and Ground-Water Resources of the Alexandria Area, Rapides Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #3, 23 pp.

Martin, A., Whiteman, C.D. and Becnel, M.J., 1988, Generalized potentiometric surfaces of the upper and lower Jasper and equivalent aquifers in Louisiana, 1984: U. S. Geological Survey Water-Resources Investigations WRI 87-4139.

McWreath, H.C., III, and Smoot, C.W., 1989, Geohydrology and development of ground water at Fort Polk, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4088, 53 p.

Meyer, R.R., 1953, Summary of ground-water conditions in southwestern Louisiana: U.S. Geological Survey Open-File Report, 7 p.

Prakken, L.B., 1998, Water-quality data for public-supply wells at Fort Polk, Vernon Parish, Louisiana, March and June 1997: U.S. Geological Survey Open-File Report 98-271, 13 p.

Smoot, C.W., and Seanor, R.C., 1992, Louisiana ground-water map no. 4: Potentiometric surface, 1989, and water-level changes, 1984-89, of the Jasper aquifer system in west-central Louisiana: U.S. Geological Survey Water-Resources Investigations Report 91-4137, 2 sheets.

Tomaszewski, D., 2009, Ground-water resources in Rapides Parish, Louisiana, 2005: Louisiana Department of Transportation and Development Water Resources Technical Report no. 78, 54 p.

Whitfield, M.S., Jr., 1975, Geohydrology of the Evangeline and Jasper aquifers of southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 20, 72 p.

Region III

Region III is dominated by the Southern Hills Aquifer System, which was designated in 1988 by the U.S. Environmental Protection Agency as a "sole source aquifer." Within Region III, it should be noted that the Catahoula Aquifer is also present in the northern portion of the Florida Parishes, however the aquifer is found beneath the sands of the Southern Hills Aquifer System and is generally not used due to the depth.

Southern Hills Aquifer System

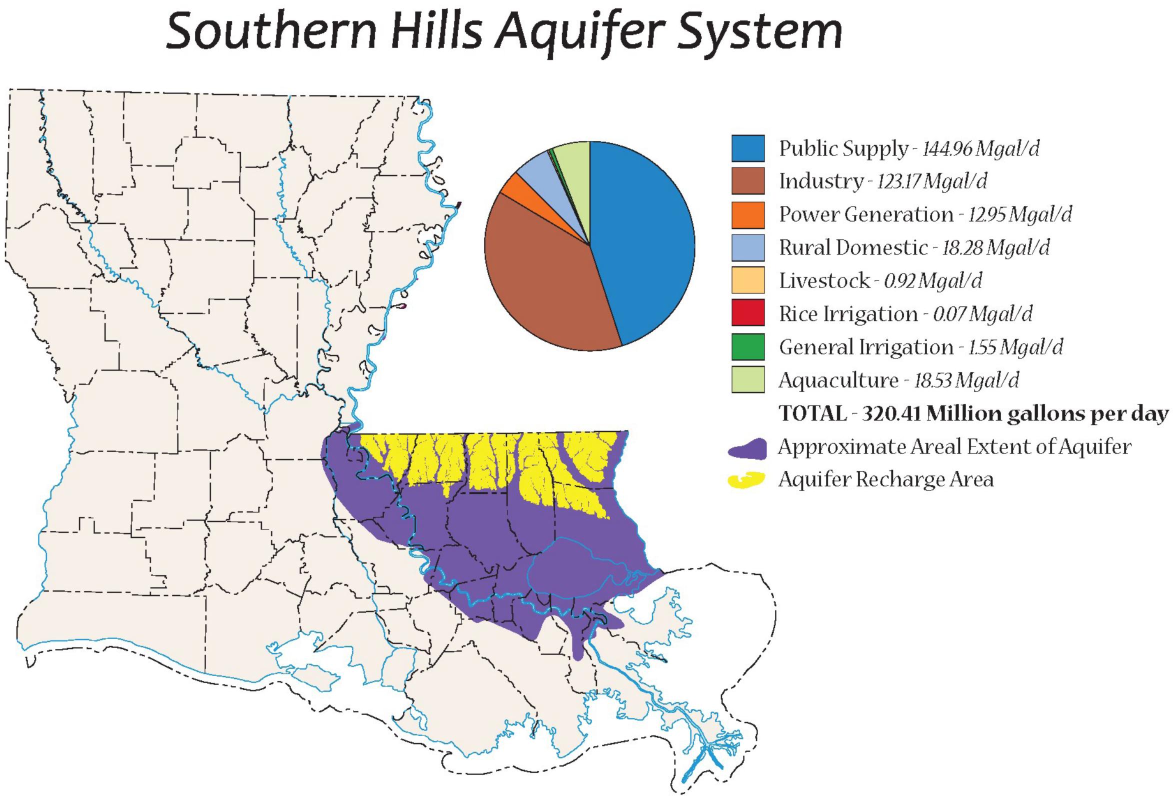


Figure 22: Extent of the Southern Hills Aquifer System in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

Properties

Properties of the thirteen sands of the Southern Hills Aquifer System are relatively well known in the Baton Rouge metropolitan area, and poorly characterized elsewhere. Griffith (2003) updated the hydrogeologic characterization of the sands, however, a detailed analysis of the continuity (or discontinuity) and interconnection of the sands and clays has not been completed (Figures 23, 24, and 25). In addition, values for the hydraulic properties of the sands exist, but not the clays which separated them. Similarly, the Baton Rouge-Tepetate Fault Zone is recognized as a leaky barrier to the flow of saltwater south of the faults, however the hydraulic characteristic of the geologic feature are not quantified (Anonymous, 2001 and Autin and McCulloh, 1991).

• The following information is available on the aquifer:

• Hydraulic conductivity from of available pump tests (>445)

• Hydraulic conductivity from specific yield tests (>1328)

• Hydraulic conductivity from grain size analyses (>4637)

• Buono (1983), and Meyer and Turcan (1953 and 1955) contain detailed descriptions of the aquifers.

Usage

• The Capital Area Ground Water Conservation Commission (CAGWCC) maintains a database of groundwater usage by large users since 1975.

• The USGS in collaboration with the DOTD has been reporting every five years the parish water usage since 1960.

• Several reports address pumpage in the Baton Rouge area, including: Morgan et al (1962), Tomaszewski (1998), and Carlson (2006).

Water Levels

• Water levels in the Southern Hills Aquifer System have generally declined in populated areas, including metropolitan Baton Rouge, the north shore of Lake Pontchartrain area and eastern Washington Parish.

• The USGS has three real-time stations in the Southern Hills Aquifer System (EB-917, EB-1293 and EB-1274).

• Discussions of water level changes were prepared by Dial (1968), Haque (1982) and Lovelace (2002).

• Potentiometric maps for the Gonzales-New Orleans sand were prepared by Fendick (1989) and Walter (1985).

• Potentiometric maps for the shallow sands were prepared by Martin and Whiteman (1989) and Walter (1995).

• A potentiometric map for the 400 and 600-foot sand of Baton Rouge was prepared by Kuniansky et al (1989).

• Potentiometric maps for the 1,200-foot sand of Baton Rouge were prepared by Walter (1992), Halford and Lovelace (1994) and Griffith and Lovelace (2003a)

• Potentiometric maps for the 1,500-foot sand of Baton Rouge were prepared by Griffith and Lovelace (2003b) and Prakken (2004).

• A potentiometric map for the 1,700-foot sand of Baton Rouge was prepared by Prakken (2004).

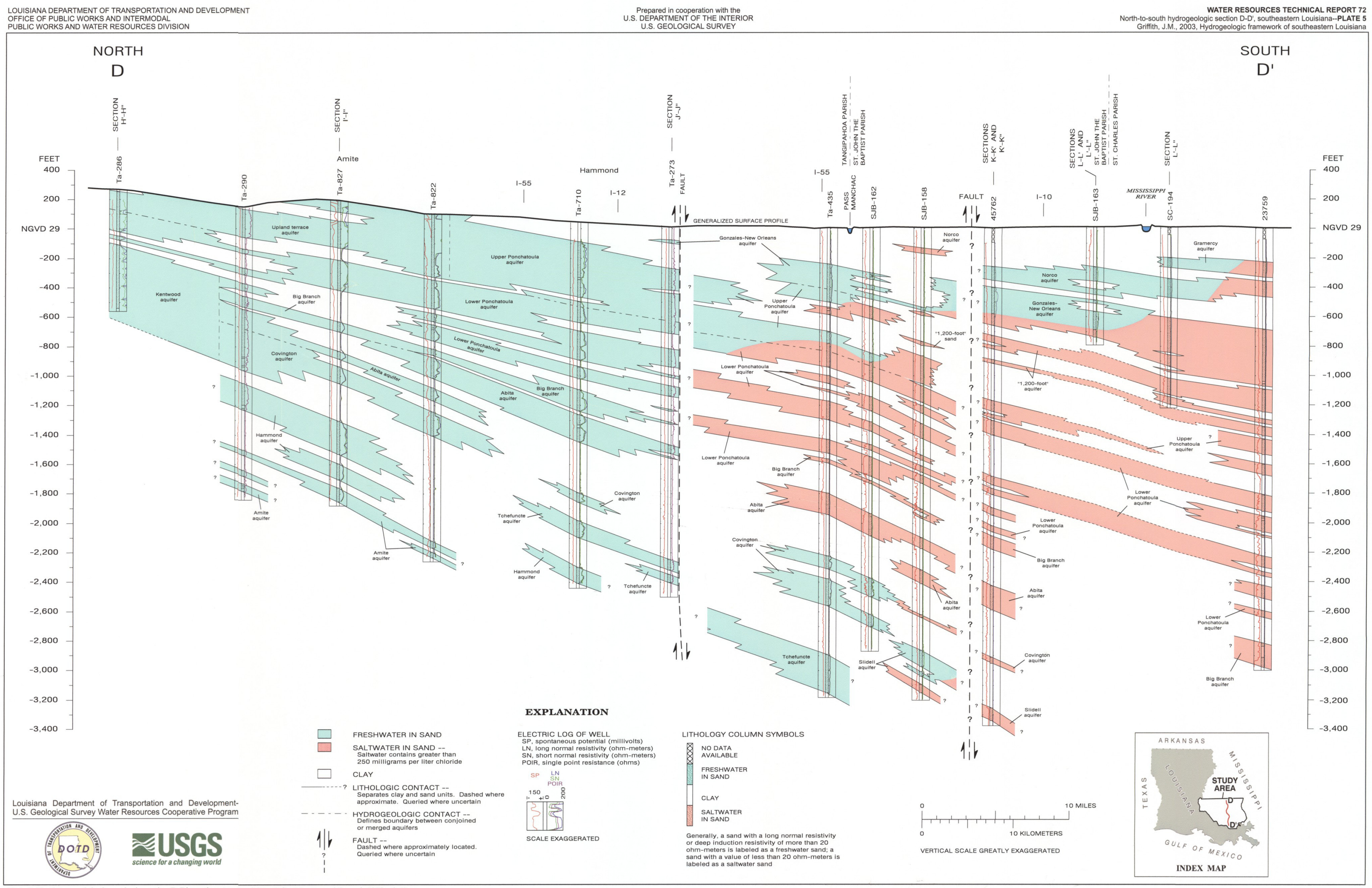


Plate 5. North-to-south hydrogeologic section D-D', southeastern Louisiana (after Nyman and Fayard, 1978, pl. 1).

Figure 23: North-south profile across the Southern Hills Aquifer System (taken from: Griffith, 2003)

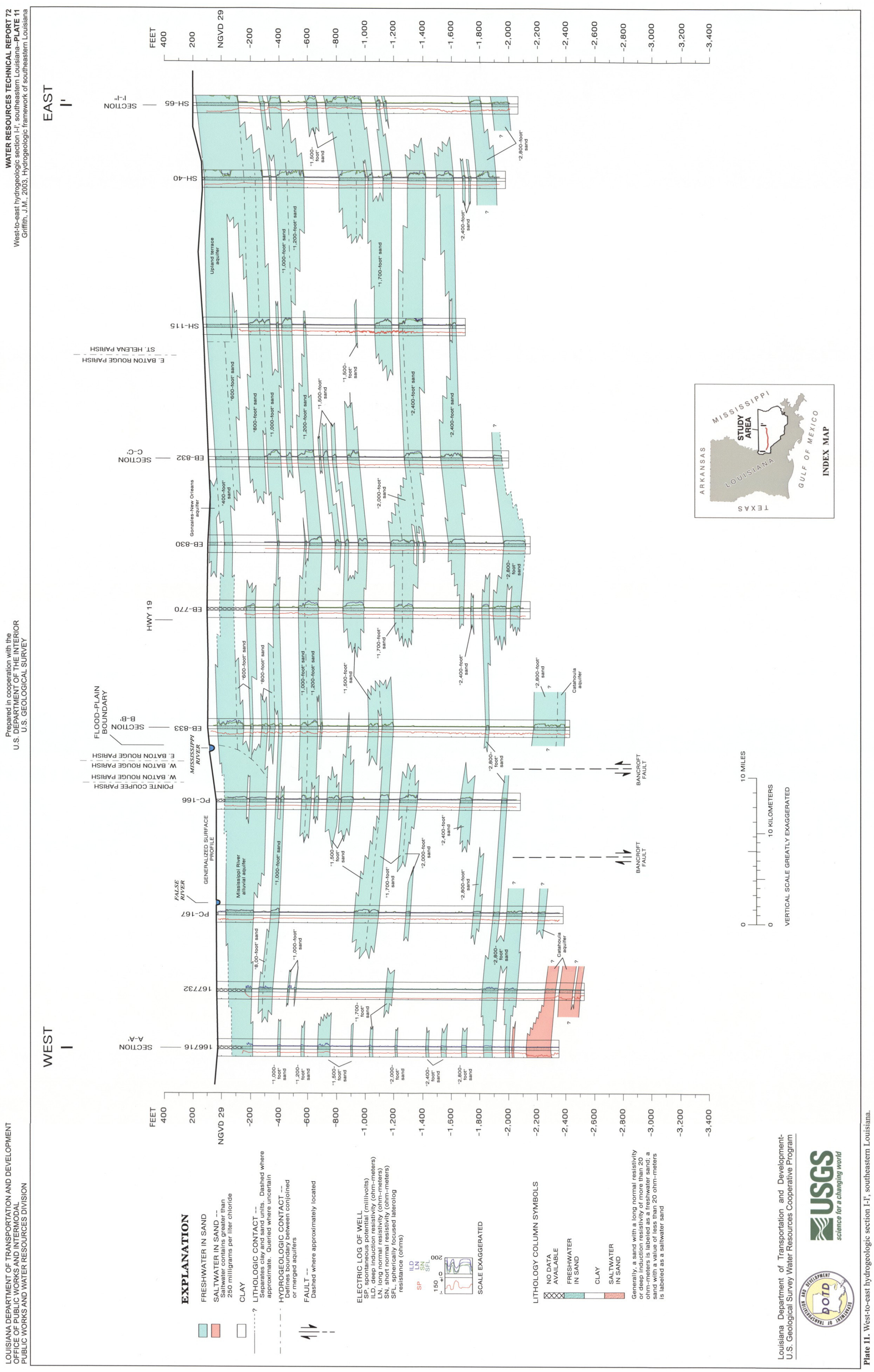


Figure 24: West-east profile across the western Florida Parishes of the Southern Hills Aquifer System (taken from: Griffith, 2003)

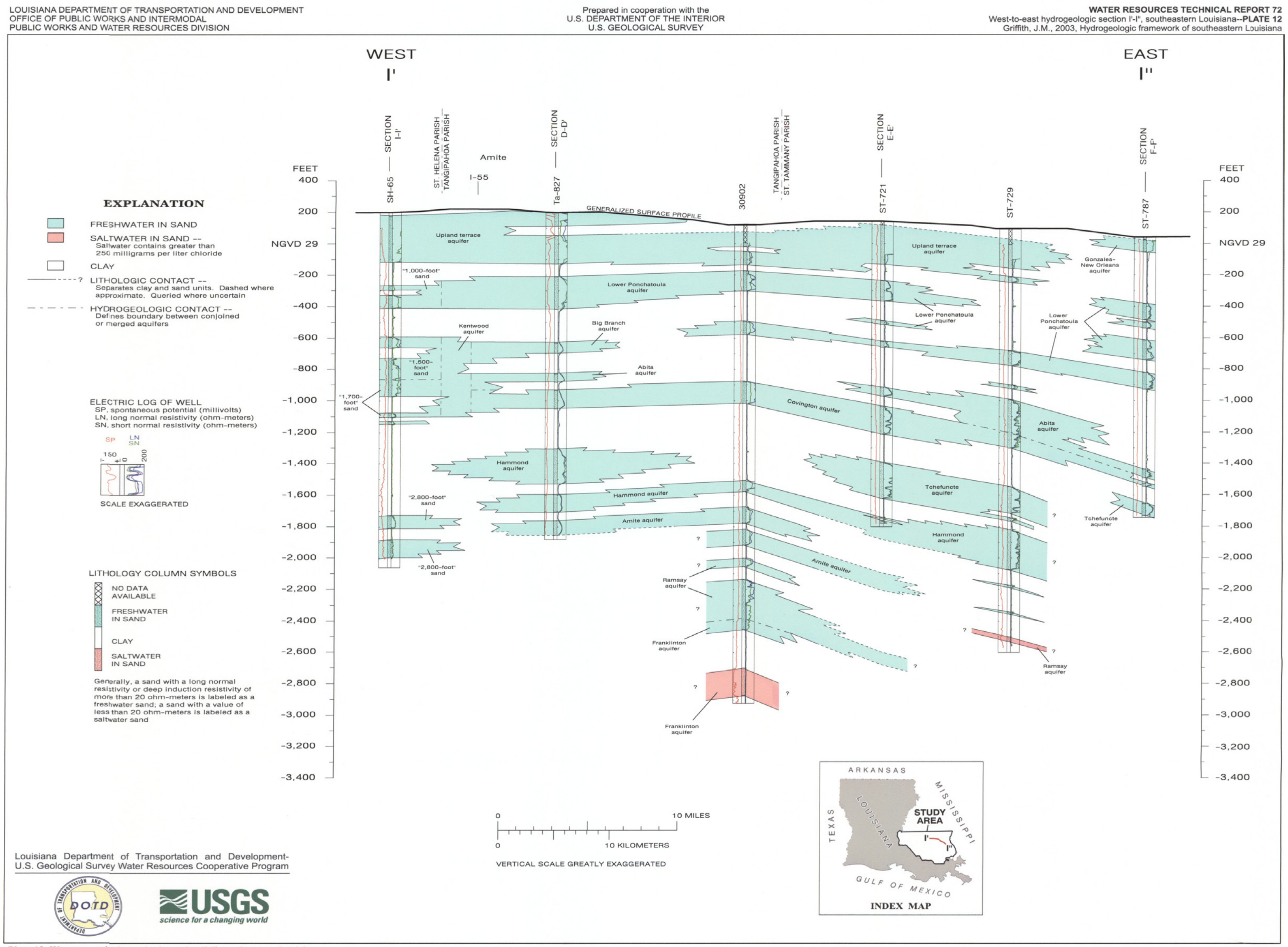


Plate 12. West-to-east hydrogeologic section I'-I", southeastern Louisiana.

Figure 25: West-east profile across the eastern Florida Parishes of the Southern Hills Aquifer System (taken from: Griffith, 2003)

Water Quality

Water quality in the Southern Hills Aquifer System is generally good with the following exceptions:

- Saltwater is encroaching in several of the sands in the Baton Rouge area (Rollo, 1969; Whiteman, 1979; Tomaszewski and Anderson, 1995; and Tomaszewski, 1996)

- Saltwater is encroaching into several of the sand north of the Baton Rouge-Tepetate Fault Zone.

- Other groundwater quality report includes Walter and Lovelace (1998).

- Only the shallower sands south of the Baton Rouge-Tepetate Fault Zone contain freshwater.

Other Studies

Several groundwater flow models have been prepared the researchers on portion of the Southern Hills Aquifer System. To date no comprehensive detail regional has been prepared to address groundwater resource management. Existing digital groundwater flow models include the following:

- Torak and Whiteman (1982) prepared a 2-D and 3-D steady state groundwater flow model of the 2,000-foot in East Baton Rouge Parish.

- Huntzinger, Whiteman and Knochemus (1985) prepared a 3-D steady state ground water flow model of the 1,500 and 1,700-foot in East Baton Rouge Parish.

- Yan and Adrian (1988) prepared a 2-D model of Orleans Parish only to address saltwater intrusion issues.

- Dial and Tomaszewski (1988) prepared a 3-D model of Northern Jefferson and Orleans Parishes only to address increase pumping in the shallow sands.

- Kuniansky (1989) prepared a groundwater flow model of the 400 and 600-foot for East Baton Rouge Parish.

- Martin and Whiteman (1990) prepared a groundwater flow model of the coastal lowland aquifer (LA, MS, AL and FL).

- Halford and Lovelace (1994) prepared a groundwater flow model of the 1,200-foot Sand for the CAG-WCC only.

- Williamson and Grubb (2001) prepared a regional groundwater flow model of the Gulf Coast Plain (LA, MS, AR, TN, MO, AL and FL).

- Recently, Nyman (2010) prepared a groundwater flow model of West Feliciana Parish.

- Ongoing, USGS saltwater transport model of the 1,500 and 2,000 foot CAGWCC only.

- Other localized models have been prepared for industrial facilities.

Southern Hill Aquifer System Bibliography

Anonymous, 2001, Active Faults in East Baton Rouge Parish, Louisiana: Louisiana Geological Survey Public Information Series #8, 8 pp.

Autin, W. J., 1987, Soil Geomorphology of the Amite River: Louisiana Geological Survey Open File Series #87-01, 20 pp.

Autin W. J. and McCulloh, R.P., 1991, Geologic and Derivative Engineering Geology Hazard Maps of East Baton Rouge Parish, Louisiana: Louisiana Geological Survey Open File Series #91-01.

Autin, W. J., Boniol, D.P. and Hanson, B.C., 1985, Soils Recharge Potential: Louisiana Geological Survey Water Resources Plate #4, scale 1:250,000.

Buono, A., 1983, The Southern Hills regional aquifer system of southeastern Louisiana and southwestern Mississippi: U.S. Geological Survey Water-Resources Investigations Report 83-4189, 38 p.

Calandro, A. J., Broussard, W.L., and Hosman, R.L., 1970, Water resources of the Belmont-Marthaville-Robeline area, Louisiana: Louisiana Department of Public Works Water Resources Pamphlet no. 25, 21 p.

Calandro, A. J., Whiteman, C.D., and Gaydos, M.W., 1966, Water, in East Feliciana Parish Resources and Facilities: Louisiana Department of Public Works and East Feliciana Parish Development Board, p. 32-37.

Cardwell, G.T., Forbes M.J., and Gaydos, M.W., 1967, Water Resources of the Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #12, 105 pp.

Cardwell, G.T. and Rollo, J.R., 1960, Interim Report on Ground-Water Conditions Between Baton Rouge and New Orleans, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #9, 44 pp.

Cardwell, G.T., Forbes, M.J., and Gaydos, M.W., 1966, Progress Report on the Availability of Fresh Water, Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #18, 24 pp.

Case, H.L., III, 1979, Ground-water resources of Washington Parish, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 18, 33 p.

Cushing, E.M., and Jones, P.H., 1945, Ground-water conditions of the Baton Rouge area, Louisiana, with special reference to the shallow artesian sands of the industrial district--A progress report: Louisiana Department of Public Works, 33 p.

Dial, D.C., 1983, Ground-water data for the Mississippi River parishes in the greater New Orleans area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 11, 47 p.

Dial, D.C., 1970, Public water supplies in Louisiana: Louisiana Department of Public Works Basic Records Report no. 3, 460 p.

Dial, D.C., 1968, Water-Level Trends in Southeastern Louisiana: Louisiana Geological Survey Water Resources Pamphlets #22, 11 pp.

Dial, D.C., and Huff, G.F., 1989, Occurrence of minor elements in ground water in Louisiana including a discussion of three selected sites having elevated concentrations of barium: Louisiana Department of Transportation and Development Water Resources Technical Report no. 47, 88 p.

Dial, D.C., and Sumner, D.M., 1989, Geohydrology and simulated effects of pumpage on the New Orleans aquifer system at New Orleans, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 46, 54 p.

Dial, D.C., and Tomaszewski, D.J., 1988, Geohydrology, water quality, and effects of pumpage on the New Orleans aquifer system, northern Jefferson Parish, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4097, 34 p.

Dial, D.C., and Kilburn, C., 1980, Ground-water resources of the Gramercy area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 24, 39 p.

Eddards, M.L., Kister, L.R., and Scarcia, G., 1956, Water resources of the New Orleans area, Louisiana: U.S. Geological Survey Circular 374, 41 p.

Fendick, R.B., Jr., 1989, Louisiana ground-water map no. 2: Potentiometric surface, 1987, of the Gonzales-New Orleans aquifer in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 89-4016, 1 sheet.

Frederick, C.P., 2003, Water quality characteristics of urban storm runoff at selected sites in East Baton Rouge Parish, Louisiana, February 1998 through April 2002: U.S. Geological Survey Water-Resources Investigations Report 03-4212, 24 p.

Fisk, H.N., Richards, H.G., Brown, C.A. and Steere, W.C., 1938, Contributions to the Pleistocene History of the Florida Parishes of Louisiana: Louisiana Geological Survey Geology Bulletin #12, 137 pp.

Griffith, J.M., 2009, Water resources of St. Tammany Parish: U.S. Geological Survey Fact Sheet 2009-3064, 6 p.

Griffith, J., 2003, Hydrogeologic Framework of Southeastern Louisiana: Louisiana Dept. of Transportation and Development Water Resources Technical Report No. 72, 21 p. and map folio, 18 plates.

Griffith, J.M., and Fendick, R.B., 2009, Water resources of Ascension Parish: U.S. Geological Survey Fact Sheet 2009-3063, 4 p.

Griffith, J.M., and Lovelace, J.K., 2003a, Louisiana ground-water map no. 15: Potentiometric surface of the “1,200-foot” sand of the Baton Rouge area, Louisiana, spring 2001: U.S. Geological Survey Water-Resources Investigations Report 03-4020, 2 sheets.

Griffith, J.M., and Lovelace, J.K., 2003b, Louisiana ground-water map no. 16: Potentiometric surface of the “1,500-foot” sand of the Baton Rouge area, Louisiana, spring 2001: U.S. Geological Survey Water-Resources Investigations Report 03-4021, 2 sheets.

Halford, K.J., and Lovelace, J.K., 1994, Analysis of ground-water flow in the “1,200-foot” aquifer, Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 54, 68 p.

Hanson, B.C. and Boniol, D.P., 1985, Capital Area Recharge Region Study Based on Geologic and Hydrologic Studies in Southeastern Louisiana and Southwestern Mississippi: Louisiana Geological Survey Water Resources Series #3, 64 pp.

Haque, S.M. , 1982, Water Level Trends in the Florida Parishes, Louisiana: Louisiana Geological Survey Water Resources Series #1, 34 pp.

Harder, A.H., V.B. Sauer and W.L. Broussard, 1968, Water Resources of the Lettsworth-Innis-Batchelor Area, Pointe Coupee Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #21, 28 pp.

Heinrich, P.V., 2008, Loess Map of Louisiana: Louisiana Geological Survey Public Information Series #12, 4 pp.

Heinrich, P.V. and McCulloh, R.P., 2007, Port Hudson, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2007-01, scale = 1:24,000.

Heinrich, P.V., McCulloh, R.P. and Snead, J.I., 2007, The Bogalusa Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #10, scale = 1:100,000.

Heinrich, P.V., McCulloh, R.P. and Snead, J.I., 2004, The Gulfport Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #7, scale = 1:100,000.

Heinrich, P.V. and McCulloh, R.P., 2003, Industrial, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2003-04, scale = 1:24,000.

Heinrich, P.V., McCulloh, R.P. and Snead, J.I., 2003, The Ponchatoula Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #5, scale = 1:100,000.

Heinrich, P.V. and McCulloh, R.P., 2002, Haaswood, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2002-05, scale = 1:24,000.

Heinrich, P.V. and McCulloh, R.P., 2001, Lacombe, LA 7.5-minute geologic quadrangle:Louisiana Geological Survey Open-File Map 2001-05, scale = 1:24,000.

Heinrich, P.V. and Autin, W.J., 2000, The Baton Rouge Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #2, scale = 1:100,000.

Heinrich, P.V. and McCulloh, R.P., 2000, Baton Rouge West, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2000-02, scale = 1:24,000.

Hosman, R.L., 1972, Ground Water Resources of the Norco Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #18, 61 pp.

Howe, H.H., 1962, Subsurface Geology of St. Helena, Tangipahoa, Washington and St. Tammany Parishes, Louisiana: Gulf Coast Association of Geological Societies Transactions Vol. 12, p. 121-125.

Howe, H.V., Russell, R.J., Kniffen, F.B., McGuirt, J.H. and. McDonald, S.M., 1938, Reports on the Geology of Iberville and Ascension Parishes: Louisiana Geological Survey Geology Bulletin #13, 223 pp.

Huntzinger, T.L., Whiteman, C.D., Jr., and Knochenmus, D.D., 1985, Simulation of ground-water movement in the "1,500- and 1,700-foot" aquifer of the Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 34, 52 p.

Jones, P. H., 1947, Water, in Ascension Parish Resources and Facilities: Louisiana Department of Public Works and Ascension Parish Planning Board.

Kuniansky, E.L., 1989, Geohydrology and simulation of ground-water flow in the "400-foot," "600-foot," and adjacent aquifers, Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 49, 90 p.

Kuniansky, E.L., Dial, D.C., and Trudeau, D.A., 1989, Maps of the "400-foot," "600-foot," and adjacent aquifers and confining beds, Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 48, 16 p.

Long, R.A., 1965, Feasibility of a Scavenger-Well System as a Solution to the Problem of Vertical Salt-Water Encroachment: Louisiana Geological Survey Water Resources Pamphlets #15, 27 pp.

Long, R.A., 1965, Ground Water in the Geismar-Gonzales Area, Ascension Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #7, 67 pp.

Lovelace, W.M., 2002, Water-level measurements and chloride concentrations for selected wells in Louisiana, January 1988-October 1997, Water Resources Basic Records Report no. 23, 168 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1985, Map showing generalized potentiometric surface of aquifers of Pleistocene Age, southern Louisiana, 1980: U.S. Geological Survey Water-Resources Investigations Report 84-4331, 1 sheet.

Martin, A., Jr., and Whiteman, C.D., Jr., 1989, Geohydrology and regional ground-water flow of the coastal lowlands aquifer system in parts of Louisiana, Mississippi, Alabama, and Florida—A preliminary analysis: U.S. Geological Survey Water-Resources Investigations Report 88-4100, 88 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1990, Calibration and sensitivity analysis of a ground-water flow model of the coastal lowlands aquifer system in parts of Louisiana, Mississippi, Alabama, and Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4189, 54 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1991, Hydrology of the coastal lowlands aquifer system in parts of Alabama, Florida, Louisiana, and Mississippi: U.S. Geological Survey Open-File Report 91-72, 115 p.

Martin, A., Jr., and Whiteman, C.D., Jr., 1999, Hydrology of the Coastal Lowlands aquifer system in parts of Alabama, Florida, Louisiana, and Mississippi: U.S. Geological Survey Professional Paper 1416-H, 51 p.

McCulloh, R.P., 2008, The Scotlandville, Denham Springs, and Baton Rouge Faults: A Map Guide for Real Estate Buyers, Sellers and Developers in the Greater Baton Rouge Area: Louisiana Geological Survey Public Information Series #13, 38 pp.

McCulloh, R.P., 1996, Topographic Criteria Bearing on the Interpreted Placement of the Traces of Faults of the Baton Rouge System in Relation to Their Fault-line Scarps: Louisiana Geological Survey Open File Series #96-01, 23 pp.

McCulloh, R.P., 1992, Surface Geologic Mapping in Louisiana: History, Present Status, and Future Prospects: Louisiana Geological Survey Open File Series #92-01, 20 pp.

McCulloh, R.P., 1991, Surface Faults in East Baton Rouge Parish: Louisiana Geological Survey Open File Series #91-02, 25 pp., plus five plates.

McCulloh, R.P., Heinrich, P.V. and J.I. Snead, 2009, The Amite Geologic Quadrangle: Louisiana Geological Survey Geologic Quadrangle #12, scale = 1:100,000.

McCulloh, R.P. and Heinrich, P.V., 2007, Zachary, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2007-02, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2007, Fred, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2007-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2003, Bush, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2003-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2002, Slidell, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2002-06, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2002, Mandeville, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2002-04, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2001, Comite, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2001-01, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2001, Denham Springs, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2001-02, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2001, St. Tammany, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2001-03, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2000, Scotlandville, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2000-01, scale = 1:24,000.

McCulloh, R.P. and Heinrich, P.V., 2000, Baton Rouge East, LA 7.5-minute geologic quadrangle: Louisiana Geological Survey Open-File Map 2000-03, scale = 1:24,000.

Meyer, R.R. and Rollo, J.R., 1965, Salt-Water Encroachment, Baton Rouge Area, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #17, 9 pp.

Meyer, R.R., and Turcan, A.N., Jr., 1955, Geology and ground-water resources of the Baton Rouge area, Louisiana: U.S. Geological Survey Water-Supply Paper 1296, 138 p.

Meyer, R.R., and Turcan, A.N., Jr., 1953, Summary report on the geology and ground-water resources of the Baton Rouge area, Louisiana: U.S. Geological Survey Open-File Report, 23 p.

Morgan, C.O., 1961, Ground-Water Conditions in the Baton Rouge Area, 1954-59, with Special Reference to Increased Pumpage: Louisiana Geological Survey Water Resources Bulletins #2, 78 pp. plus map pack.

Morgan, C.O., and Winner, M.D., Jr., 1962, Hydrochemical facies in the “400-foot” and “600-foot” sands of the Baton Rouge area, Louisiana, in Geological Survey research 1962; short papers in geology, hydrology, and topography, articles 1-59: U.S. Geological Survey Professional Paper 450-B, article 50, p. B120-B123.

Nyman, D.J., and Fayard, L.D., 1978, Ground-water resources of Tangipahoa and St. Tammany Parishes, southeastern Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 15, 76 p.

Prakken, L.B., 2004, Louisiana ground-water map no. 17: Generalized potentiometric surface of the Kentwood aquifer system and the “1,500-foot” and “1,700-foot” sands of the Baton Rouge area in southeastern Louisiana, March-April 2003: U.S. Geological Survey Scientific Investigations Map 2862, 2 sheets.

Rapp, T.R., 1994, Ground-water resources of southern Tangipahoa Parish and adjacent areas, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 92-4182, 47 p.

Rollo, J.R., 1969, Salt-Water Encroachment in Aquifers of the Baton Rouge Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #13, 45 pp. plus map pack.

Rollo, J.R., 1966, Ground-Water Resources of the Greater New Orleans Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #9, 69 pp. plus map pack.

Rollo, J.R., 1960, Ground Water in Louisiana: Louisiana Geological Survey Water Resources Bulletins #1, 84 pp. plus map pack.

Russell, R.J., Howe, H.V., McGuirt, J.H., Dohm, C.F., Hadley, W., Kniffen, F.B. and Brown, C.A., 1936, Lower Mississippi River Delta: Reports on the Geology of Plaquemines and St. Bernard Parishes: Louisiana Geological Survey Geology Bulletin #8, 454 pp.

Saucier, R.T., and Snead, J.I., 1989, Quaternary Geology of the Lower Mississippi Valley: Louisiana Geological Survey Geologic Map #7, scale 1:1,000,000.

Scarcia, Glenn, 1954, Water, in St. Tammany Parish Resources and Facilities: Louisiana Department of Public Works and St. Tammany Parish Planning Board, p. 37-46.

Snead, J.I. and McCulloh, R.P., 1984, Geologic Map of Louisiana: Louisiana Geological Survey Geologic Map #5 scale 1:500,000.

Taylor, J.C., Jr., 1945, Water, in Washington Parish Resources and Facilities: Louisiana Department of Public Works and Washington Parish Planning Board, p. 31-32, app., p. g, III-IV.

Tomaszewski, D.J., 1998, Hydrogeology and the effects of pumpage on the “1,500-foot” sand south of the Baton Rouge fault, near Brusly, Louisiana, 1996: Louisiana Department of Transportation and Development Water Resources Technical Report no. 65, 22 p.

Tomaszewski, D.J., 1996, Distribution and movement of saltwater in aquifers in the Baton Rouge area, Louisiana, 1990-92: Louisiana Department of Transportation and Development Water Resources Technical Report no. 59, 44 p.

Tomaszewski, D.J., 1988, Ground-water hydrology of Livingston, St. Helena, and parts of Ascension and Tangipahoa Parishes, southeastern Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 43, 54 p.

Tomaszewski, D.J., and Anderson, M.L., 1995, Data from wells in a chloride monitoring network, Baton Rouge area, Louisiana, 1965-94: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 19, 40 p.

Torak, L.J., and Whiteman, C.D., Jr., 1982, Applications of digital modeling for evaluating the ground-water resources of the "2,000-foot" sand of the Baton Rouge area, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 27, 87 p.

Turcan, A.N., Jr., 1954, Water, in St. James Parish Resources and Facilities: St. James Parish Planning and Development Board and Louisiana Department of Public Works, p. 27-33.

U.S. Geological Survey, 1955, Water, in Livingston Parish Resources and Facilities: Louisiana Department of Public Works and Livingston Parish Development Board, p. 29-40.

Van Biersel, T.V., Milner, L.R., Carlson, D.A. and E.K. Mier, 2009, Long-term Hydrogeologic Characterization of Water Supply Wells Affected by Hurricanes Katrina and Rita along the North Shore of Lake Pontchartrain: Louisiana Geological Survey Report of Investigations Series #09-01, 56 pp.

Walters, D.J., 1995, Louisiana ground-water map no. 7: Potentiometric surface, 1991, and water-level changes, 1969-91, of the Chicot equivalent aquifer system in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 94-4202, 2 sheets.

Walters, D.J., 1995, Louisiana ground-water map no. 11: Potentiometric surface, spring 1993, and water-level changes, 1987-93, of the Gonzales-New Orleans aquifer in southeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95-4169, 2 sheets.

Walters, D.J., 1992, Louisiana ground-water map no. 5: Potentiometric surface, 1990, and water-level changes, 1974-90, of the Evangeline equivalent/southeast Louisiana aquifer system: U.S. Geological Survey Water-Resources Investigations Report 92-4112, 2 sheets.

Walters, D.J., and Lovelace, W.M., 1998, Ground-water-quality data for East and West Baton Rouge, East and West Feliciana, and Point Coupee Parishes, Louisiana, water years 1944-97: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 21, 54 p., 1 pl.

Whiteman, C.D., Jr., 1979, Saltwater encroachment in the "600-foot" and "1,500-foot" sands of the Baton Rouge area, Louisiana, 1966-78, including a discussion of saltwater in other sands: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 19, 49 p.

Whiteman, C.D., 1972, Ground Water in the Plaquemine-White Castle Area, Iberville Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #16, 69 pp.

Winner, M.D., Jr., 1963, The Florida Parishes—an area of large, undeveloped ground-water potential in southeastern Louisiana: Louisiana Department of Public Works, 50 p.

Winner, M.D., Forbes, M.J., and Broussard, W.L., 1968, Water Resources of Pointe Coupee Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #11, 110 pp. plus map pack .

Yan, S.K. and Adrian, D.D., 1988, Spatial and temporal variations of salt water intrusion in the Gonzales-New Orleans Aquifer, New Orleans area, Louisiana: Proceeding of the American Water Resource Association Conference, vol. 24, p. 127.

Mississippi River Alluvial Aquifer (southern half)

The southern half of the Mississippi River Alluvial Aquifer is located within the New Orleans District of the U.S. Army Corps of Engineers. This portion of the aquifer, which lies south of the Old River Structures, can be considered to be within the delta of the Mississippi River.

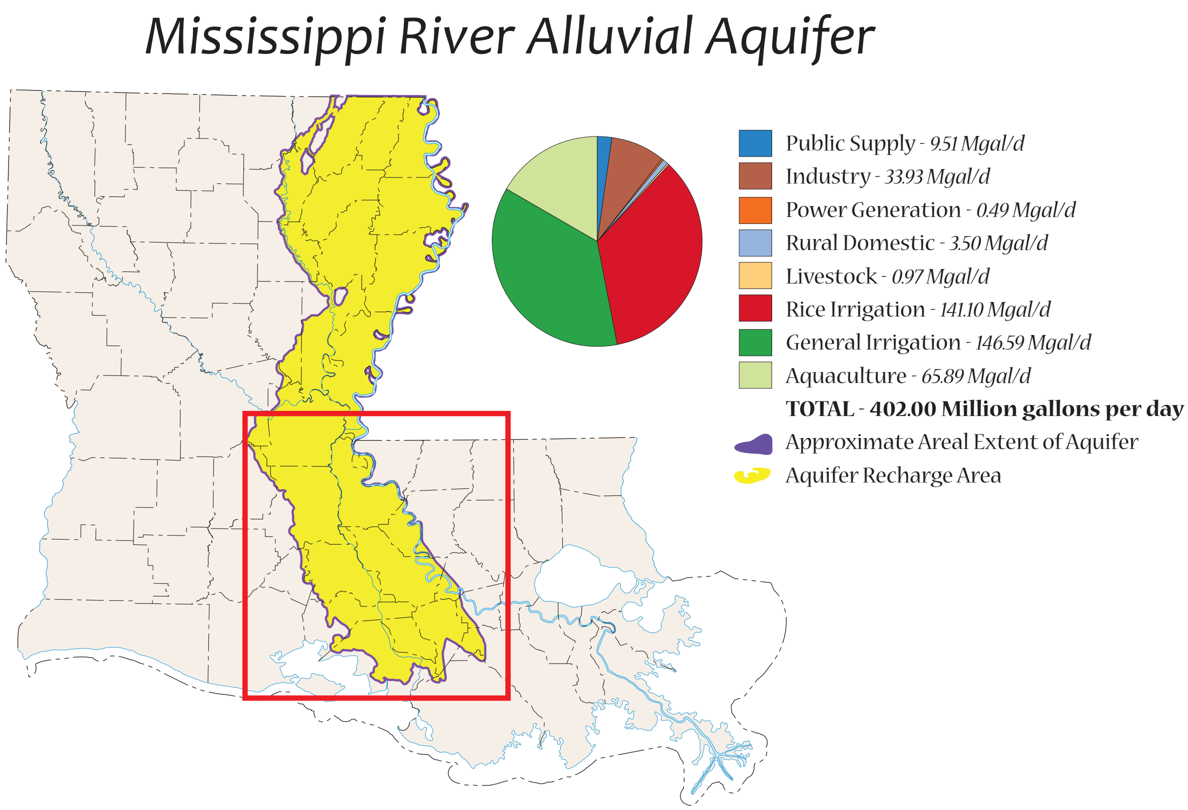


Figure 26. Extent of the MRAA in Louisiana.

Properties

• Properties for the southern half of the MRAA are presented by Cardwell et al (1963).

Usage

• The CAGWCC has maintained a database of groundwater usage by large users since 1975.

• The USGS in collaboration with the DOTD has been reporting every five years the parish water usage since 1960.

Water Levels

- A regional potentiometric map for the southern half of the MRAA has not been prepared yet.

Water Quality

- Reports including groundwater quality of the southern half of the MRAA were prepared in the 1950's for several of the subject parishes.

Mississippi River Alluvial Aquifer (south) Bibliography

Cardwell, G.T., Rollo, J.R., and Long, R.A., 1963, Basic ground-water data for the Mississippi River parishes south of Baton Rouge, Louisiana: Louisiana Department of Public Works, 5 p.

Cardwell, G.T., Sloss, Raymond, and Duncan, A.C., 1965, Water, in Assumption Parish Resources and Facilities: Louisiana Department of Public Works and Assumption Parish Development Board, p. 25-38.

Chawner, W.D. , 1936, Geology of Catahoula and Concordia Parishes: Louisiana Geological Survey Geology Bulletin #9, 232 pp.

Harder, A.H., Sauer, V.B. and W.L. Broussard, 1968, Water Resources of the Lettsworth-Innis-Batchelor Area, Pointe Coupee Parish, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #21, 28 pp.

Jones, P. H., 1947, Water, in West Baton Rouge Parish Resources and Facilities: Louisiana Department of Public Works and West Baton Rouge Parish Development Board, p. 29-33.

Jones, P. H., 1947, Water, in Ascension Parish Resources and Facilities: Louisiana Department of Public Works and Ascension Parish Planning Board.

Jones, P. H., 1946, Water, in Pointe Coupee Parish Resources and Facilities: Louisiana Department of Public Works and Pointe Coupee Parish Planning Board, p. 30-34.

Jones, P. H., 1945, Water, in Iberville Parish Resources and Facilities: Louisiana Department of Public Works and Iberville Parish Planning Board, p. 21-25.

Marie, J.A., 1971, Ground Water Resources of Avoyelles Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #15, 70 pp.

McGee, B.D. 1997, Occurrence of nitrate in the Mississippi River alluvial aquifer in Louisiana, June through December 1993: Louisiana Department of Transportation and Development Water Resources Technical Report no. 61, 21 p.

Page, L.V. and Poole, J.L., 1958, Water, in West Baton Rouge Parish Resources and Facilities: Louisiana Department of Public Works and West Baton Rouge Parish Development Board, p. 26-35.

Russell, R.J., Howe, H.V., McGuirt, J.H., Dohm, C.F., Hadley, W., Kniffen, F.B. and Brown, C.A., 1936, Lower Mississippi River Delta: Reports on the Geology of Plaquemines and St. Bernard Parishes: Louisiana Geological Survey Geology Bulletin #8, 454 pp.

Rollo, J.R., 1962, Ground water in Plaquemines Parish, Louisiana: U.S. Geological Survey Open-File Report, 8 p.

Turcan, A.N., Jr., 1953, Water, in Terrebonne Parish Resources and Facilities: Louisiana Department of Public Works and Terrebonne Parish Development Board, p. 42-44.

Whiteman, C.D., Jr., 1972, Ground water in the Plaquemine-White Castle area, Iberville Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 16, 69 p.

Winner, M.D., Jr., Forbes, M.J., Jr., and Broussard, W.L., 1968, Water resources of Pointe Coupee Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 11, 110 p.

Surface Water

Introduction

Use of surface water in Louisiana has been determined by parish, category of use and basin in a series of ten reports by the USGS. These reports summarize surface water use every five years 1960 to 2005 (Snider and Forbers, 1961; Bieber and Forbes, 1966; Dial, 1970; Cardwell and Walter, 1979; Walter, 1982; Lurry, 1987; Lovelace, 1991; Lovelace and Johnson, 1996; and Sargent 2002 and 2007). In general, these documents reported values of surface water use by parish, category of use and major basins. From the very first report, surface water use was reported by parish (Snider and Forbes, 1961). The first report included six categories of use: public supplies, industrial, rural domestic, livestock, rice irrigation and general irrigation (other crops) (Snider and Forbes, 1961). Dial (1970) added a thermoelectric (power generation) use for the 1970 report. An eighth and last surface water use category, aquaculture, was added for the 1980 report (Walter, 1982). The first report of surface water use by major basin appears in the 1985 report, but only for the whole basin (Lurry, 1987). The Lovelace (1991) report on 1990 groundwater use is the first of the last four reports which includes the amount of water withdrawn from each of the major basins considered by individual parish. There are 10 major basins included in the Lovelace (1991) report as follows: Atchafalaya/Teche/Vermilion Rivers; Calcasieu/Mermentau Rivers; Lake Pontchartrain/Lake Maurepas; Mississippi River; Mississippi River Delta; Ouachita River; Pearl River; Red River; Sabine River; and Tensas River. In addition, Lovelace (1991) started the practice of noting for each parish withdrawals from individual public suppliers and by major industrial groups.

Water use data for public-supply, industrial and power-generation categories were obtained directly from the facilities (Sargent, 2007). The irrigation use data was a combination of acreage data and application rate data. Application rate data was obtained from U.S. Consolidated Farm Service Agency collected from farmers during the spring, when most of the application of water occurs and the acreage data was determined from irrigation surveys within the National Agricultural Statistics Service reports (Sargent, 2007). Determination of aquaculture use was determined from application rate and acreage data estimated by the Louisiana Cooperative Extension Service (Sargent, 2007). Livestock use was determined from livestock population and rate of use data provide by county agents (Cardwell and Walter, 1979).

The surface water flow has been measured for over 100 streams and rivers each year in a series of USGS Data reports since the 1960s (U.S. Geological Survey, 1961 to 1981; Carlson et al., 1982 to 1986 and 1988; Arcement et al., 1989 to 1993; Dantin et al., 1994; Garrison et al., 1995 to 1999; Goree 2000 to 2003). These reports include average daily discharge for streams in cubic feet/second. These reports cover the whole state of Louisiana. However, the data is divided by major watershed. In these reports the watersheds that cover northern Louisiana are: Red River Basin and Sabine Basin. The Red River Basin in these reports is defined to include the Tensas River, and Ouachita River. Generally a gaging station reports include the location data, the period the record, the discharge and/or stage, depending on the type of water body. In addition, collected water quality data for water bodies is also noted. There is a limited amount of average monthly stream gaging discharge data for stations that lie in Natchitoches Parish (Newcome et al., 1963).

McWreath and Lowe (1986) determined the mean annual runoff throughout Louisiana, which ranges from nearly 8 to about 24 inches. Louisiana's mean annual rainfall ranges from approximately 48 to 64 inches. An earlier study by Sauer (1970) determined the relationship between rainfall and runoff for streams and rivers in northern Louisiana. A set of three studies considered low-flow characteristics of Louisiana streams for water supply consideration (Page, 1963; Lee, 1985; and Ensminger and Wright, 2003). Page (1963) and Ensminger and Wright (2003) considered annual average flow for lowest 7 days, 30 days, 60 days, 120 days and 183 days in 2 year, 5 year 10 year and 20 year intervals of time. Ensminger and Wright (2003) determined annual average flow for lowest 1 and 3 days in 2, 5, 10 and 20 year recurrence intervals. The Lee (1985) study was more limited in terms of number of streams and focused on average flow for lowest 7 days in 2 year, 10 year and 20 year recurrence intervals. Lower flow study of streams in Union Parish considered lowest 7, 14, 30 60, 120, 183 and 274 for 2, 5, 10 and 20 year recurrence intervals.

For water quality there is a series of ten U.S. Geological Survey reports that report water quality for ten major watersheds throughout Louisiana. For northern Louisiana there are four watersheds that cover the area: Ouachita River, Red River, Sabine River and Tensas River (Garrison and Covay, 1994; and Garrison 1997a, 1997b and 1998). Each of these reports included statistical result of samples for seven different categories: general properties, common cations, common anions, trace elements, nutrients, organic compounds and biological agents. For each of the species considered, a box and whiskers plot of concentration distribution is displayed for sites with a large number of observations (over 20). The whisker top end is 95th percentile, box top is 75th percentile, box middle is median values (50th percentile), box bottom is 25th percentile, and bottom end of whisker is 5th percentile. In addition, on each plot is the analytical detection limit of measurement (Garrison and Covay, 1994), usually this is an issue for trace elements, organic compounds and biological agents. There are four general properties measured (electrical conductivity, pH, temperature and concentration of dissolved oxygen). Electrical conductivity is plotted on a scatter plot and a linear regression is completed for it against total dissolved solids (TDS) concentration. For common cations: calcium, magnesium, sodium and potassium are measured, and for common anions alkalinity is determined and calcium carbonate. sulfate and chloride concentrations are measured. Four trace elements are measured: copper, iron, lead and zinc. There are three nutrients measured: ammonia plus organic nitrogen, nitrite plus nitrate and phosphorus. Eleven organic compounds are measured: DDT, PCB, Diazinon, Lindane, Chlordane, Malathion, Endrin, Parathion, Dieldrin, Endosulfan and 2, 4-D. There are two biological agents measured: fecal coliform and fecal streptococcus (Garrison and Covay, 1994). Later reports (Garrison, 1997a, 1997b, and 1998) included one additional biological agent for some of the sites: phytoplankton.

Surface Water State-Wide Bibliography

Benton, O.L., and Higgins, P.C., 1981, Index to water-resources data for Louisiana--surface-water records, water-quality records: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 10, 138 p.

Calandro, A.J., 1978, Time of travel of solutes in Louisiana streams: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 17, 32 p.

Cardwell, G.T. and Walter, W.H., 1979, Pumpage of Water in Louisiana, 1975: Louisiana Department of Transportation and Development Water Resources Special Report no. 2, 15 p.

Demas, C.R., 1976, Analyses of native water, bed material, and elutriate samples of major Louisiana waterways, 1975: U.S. Geological Survey Open-File Report 76-853, 304 p.

Duncan, A.C., 1967, Chemical quality of surface waters of Louisiana 1959-63: Louisiana Department of Public Works Basic Records Report no. 2, 137 p.

Ensminger, P.A., and Wright, L.S., 2003, Low-flow characteristics of Louisiana streams: Louisiana Department of Transportation and Development Water Resources Technical Report no. 70, 160 p.

Lee, F.N., 1985, Analysis of the low-flow characteristics of streams in Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 35, 41 p.

Page, L.V., 1963, Water-supply characteristics of Louisiana streams: Louisiana Department of Public Works Technical Report no. 1, 109 p.

Sauer, V.B., 1970, Rainfall-runoff-hydrograph relations for northern Louisiana: Louisiana Department of Public Works Technical Report no. 3, 33 p.

Shampine, W.J., 1970, Gazetteer of Louisiana lakes and reservoirs: Louisiana Department of Public Works Basic Records Report no. 4, 31 p.

Shampine, W.J., 1971, Chemical, biological, and physical data for the major lakes and reservoirs in Louisiana: Louisiana Department of Public Works Basic Records Report no. 5, 98 p.

Skrobialowski, S.C., 2002, Trace elements and organic compounds in bed sediment from selected streams in southern Louisiana, 1998: U.S. Geological Survey Water-Resources Investigations Report 02-4089, 39 p.

Sloss, Raymond, 1971, Drainage area of Louisiana streams: Louisiana Department of Public Works Basic Records Report no. 6, 117 p.

U.S. Geological Survey, 1961, Surface water records of Louisiana: U.S. Geological Survey, 166 p.

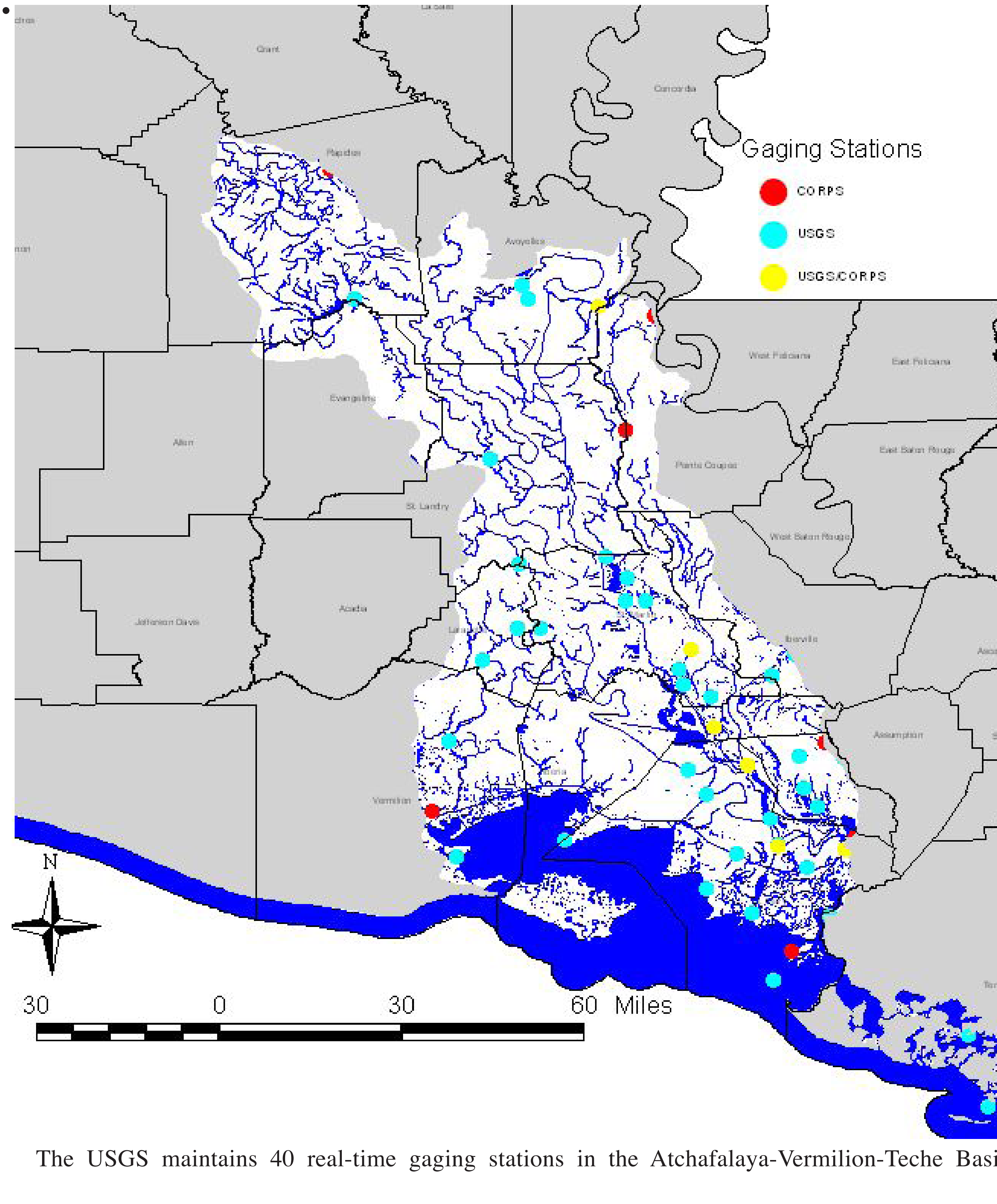
U.S. Geological Survey, 1962, Surface water records of Louisiana: U.S. Geological Survey, 153 p.

U.S. Geological Survey, 1963, Surface water records of Louisiana: U.S. Geological Survey, 153 p.

U.S. Geological Survey, 1964a, Surface water records of Louisiana: U.S. Geological Survey, 176 p.

U.S. Geological Survey, 1964b, Water quality records in Alabama, Louisiana, and Mississippi: U.S. Geological Survey, 90 p.

Figure 27: Extent of the Atchafalaya-Vermilion-Teche Rivers Basin.



The USGS maintains 40 real-time gaging stations in the Atchafalaya-Vermilion-Teche Basin

(Figure 27).

• The USACE maintains 11 continuous gaging stations within the basin (Figure 27).

Atchafalaya-Vermilion-Teche Rivers Bibliography

Allen, Y.C., Constant, G.C. and Couvillion, B.R., 2008, Preliminary classification of water areas within the Atchafalaya Basin Floodway System by using Landsat imagery" U. S. Geological Survey Open-File Report OF 2008-1320, 12 p.

Baker, N.T., 1988, Hydrologic features and processes of the Vermilion River, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4019, 49 p.

Calandro, A.J., 1981, Time of travel of solutes in the Vermilion River, Louisiana: U.S. Geological Survey Open-File Report 81-1065, 19 p.

Callihan, J. B., 1988, Quaternary and environmental geology of northwestern Iberia Parish, Louisiana: unpublished M.S. thesis, Southwestern Louisiana university, 116 p.

Demas, C.R., 1977, Analyses of native water, core material, and elutriate samples collected from the Atchafalaya River and Atchafalaya Bay: U.S. Geological Survey Open-File Report 77-769, 17 p.

Demas, C.R., Brazelton, S.R., and Powell, N.J., 2002, The Atchafalaya Basin--river of trees: U.S. Geological Survey Fact Sheet FS-021-02, 2 p.

Demcheck, D.K., and Leone, H.L., Jr., 1983, Water quality of the upper Vermilion River, Louisiana, April-August 1980: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 30, 37 p.

Hern, S.C., Lambou, V.W. and Butch, J.R., 1980, Descriptive water quality for the Atchafalaya Basin, Louisiana: U.S. Environmental Protection Agency Report EPA-600/4-80-014, 168 p.

Howe, H.V. and Moresi, C.K., 1931, Geology of Iberia Parish: Louisiana Geological Survey Geology Bulletin #1, 187 pp.

Howe, H.V. and Moresi, C.K., 1933, Geology of Lafayette and St. Martin Parishes: Louisiana Geological Survey Geology Bulletin #3, 238 pp.

Jennings, M.E. and O'Neil, C.P., 1976, Simulation of forest changes related to hydrologic variables in the Atchafalaya River basin, Louisiana: Journal of Research of the U. S. Geological Survey vol. 4, p. 481-489.

Jennings, M.E. and Land, L.F., 1977, Simulation studies of flow and sediment transport using a mathematical model, Atchafalaya River basin, Louisiana: U. S. Geological Survey Water-Resources Investigations WRI 77-0014, 55 p.

Jones, P.H., 1951, An investigation of the relation between stream flow and ground-water conditions in Beauregard Parish, Louisiana: U.S. Geological Survey Open-File Report, 22 p.

Kinsland, G.L., 1998, Vermilion River flood gates; to mitigate Lafayette, Louisiana flooding: Transaction of the Gulf Coast Association of Geological Societies vol. 48: 159-163.

Kinsland, G.L. and Wildgen, J., 2006, Evolution of the morphology of the Vermilion River near Lafayette, Louisiana, USA; consequent flooding problems and a mitigation plan; some features on the surface of the Prairie Complex; all illustrated with lidar imagery: Transaction of the Gulf Coast Association of Geological Societies vol. 56: 353-365.

Maher, J.C. and Jones P.H., 1945, Ground-water exploration at Alexandria, Louisiana: Economic Geology vol. 40, p. 164-182.

Marie, J.A., 1971, Ground Water Resources of Avoyelles Parish, Louisiana: Louisiana Geological Survey Water Resources Bulletins #15, 70 pp.

Martinez, J.D. and Haag, W.G., 1986, Engineering geology and cultural history of the Atchafalaya River basin: Transaction of the Gulf Coast Association of Geological Societies vol. 36: 1-11.

Martinez, J.D. and Haag, W.G., 1987, The Atchafalaya River and its basin; a field trip: Louisiana Geological Survey Guidebook Series #4.

McManus, J., 2002, The history of sediment flux to Atchafalaya Bay, Louisiana: Geological Society of London Special Publication #191, p. 209-226.

McPhee, J., 1987, The control of nature; Atchafalaya: New Yorker Magazine vol. 63, p. 39-100.

Moresi, C. K., 1932, Geology of Lafayette and St. Martin parishes, Louisiana: unpublished M.S. thesis Louisiana State University.

Mossa, J., 1990, Discharge-suspended sediment relationships in the Mississippi-Atchafalaya rivers system, Louisiana: unpublished Ph.D. thesis Louisiana State University, 195 p.

Patterson, L.J., Muhammad, Z., Bentley, S.J., Britsch, L.D. and Dillon, D.L., 2003, (super 210) Pb and (super 137) Cs geochronology of the Lake Fausse Pointe region of the lower Atchafalaya Basin: Transaction of the Gulf Coast Association of Geological Societies vol. 53, p. 668-675.

Poach, M.E., 1999, Soil phosphorus characteristics of natural and created wetlands in the Atchafalaya Delta, Louisiana: unpublished Ph.D. thesis Louisiana State University, 108 p.

Roberts, H.H., Coleman, J.M. and van Heerden, I., 1998, Atchafalaya Basin and deltas field trip: Louisiana State University, Coastal Studies Institute Field trip book, 68 P.

Roberts, H.H., 1998, Delta switching; early responses to the Atchafalaya River diversion. United States, Coastal Education and Research Foundation vol. 14, p. 882-899.

Rogers, J.E., 1981, Water resources of the Kisatchie well-field area near Alexandria, Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 26, 57 p.

Smoot, C.W., and Fendick, R.B., Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development Water Resources Technical Report no. 63, 36 p., 1 pl.

U. S. Army Engineer Topographic Laboratories, E. A. f. R. I., 1973, Inventory of basic environmental data; South Louisiana; Mermentau River basin to Chandeleur Sound with special emphasis on the Atchafalaya Basin: Report by the U. S. Army Eng. Topogr. Lab.; Eng. Agency Resour. Invent. : Washington, D. C.

van Beek, J.L., 1977, Multiuse management; an alternative to channelization of the Atchafalaya Basin, Louisiana: American Association for the Advancement of Science; contributed papers of the 143rd national meeting.

Varvaro, G.G., 1957, Geology of Evangeline and St. Landry Parishes: Louisiana Geological Survey Geology Bulletin #31, 295 pp. plus map pack.

Walker, N.D. and Hammack, A.B., 2000, Impacts of winter storms on circulation and sediment transport; Atchafalaya-Vermilion Bay region, Louisiana: Coastal Education and Research Foundation vol. 16, p. 996-1010.

Walker, N.D., 2001, Tropical storm and hurricane wind effects on water level, salinity, and sediment transport in the river-influenced Atchafalaya-Vermilion Bay system, Louisiana, USA: Estuarine Research Federation vol. 24, p. 498-508.

Wang, F.C., 1984, Mississippi River meandering and Atchafalaya Delta building: Proceedings of the Am. Soc. Civ. Eng. Conference Rivers '83; river meandering.

Wang, F.C., 1987, Saltwater intrusion in Louisiana coastal channels: Proceedings of the Gulf of Mexico Information Transfer Meeting, p. 174-177.

Wicker, K.M., 1975, Recent changes in physiography of the Buffalo Cove, Atchafalaya Basin, Louisiana: unpublished M.S. Thesis, Louisiana State University.

Wilkinson, E., 1885, On the occurrence of native mercury in alluvium in Louisiana. American Journal of Science vol. 29, p. 280-281.

Winner, M.D., Jr., Forbes, M.J., Jr., and Broussard, W.L., 1968, Water resources of Pointe Coupee Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 11, 110 p.

Calcasieu-Mermentau Rivers Basin

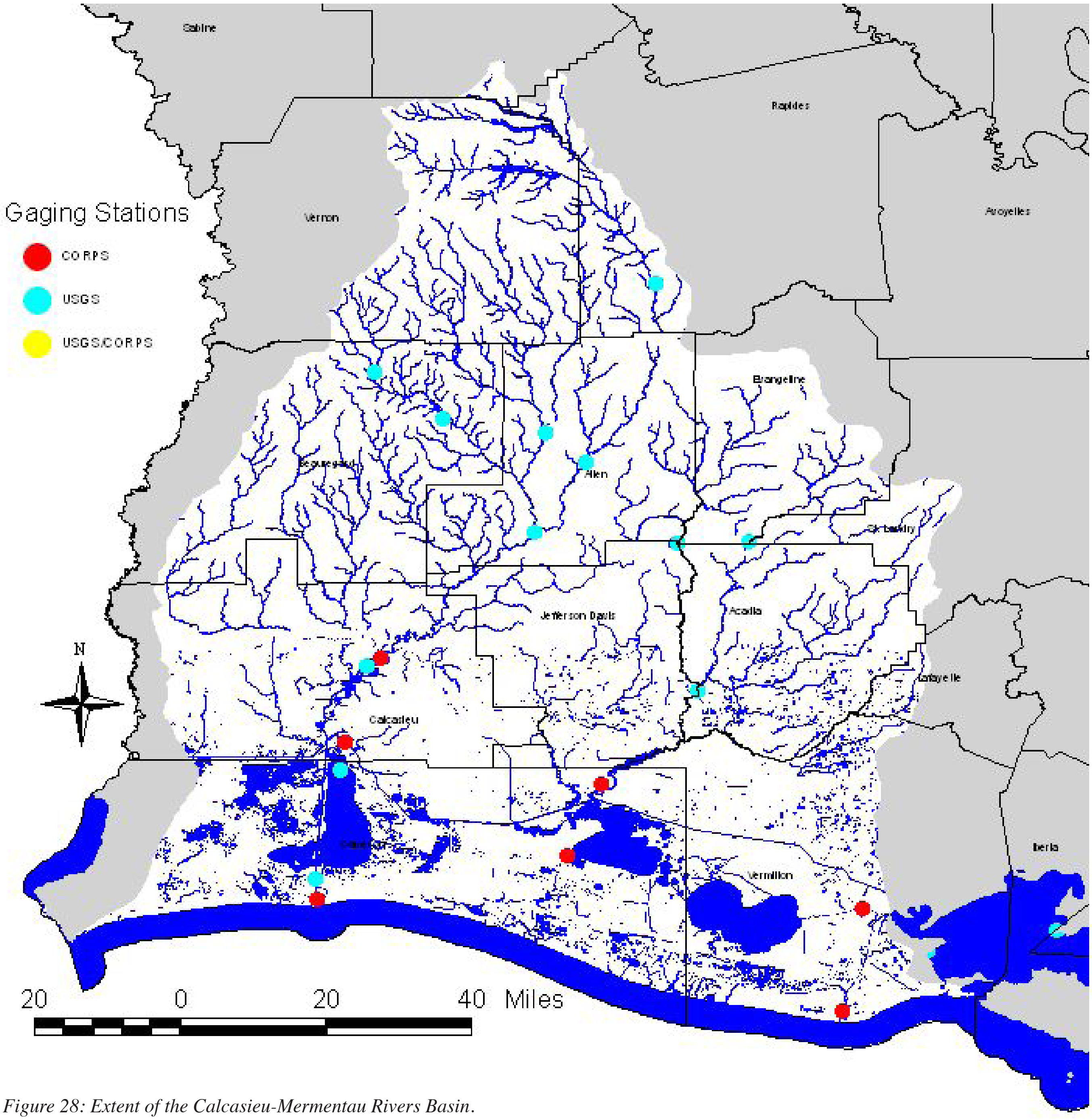


Figure 28: Extent of the Calcasieu-Mermentau Rivers Basin.

- The USGS maintains 12 real-time gaging stations in the Calcasieu-Mermentau Rivers Basin (Figure 28)

•The USACE maintains 14 continuous gaging stations within the basin (Figure 28).

Calcasieu-Mermentau Rivers Bibliography

Barber, L. B., II, 1989, The occurrence and distribution of semi-volatile organic compounds in the lower Calcasieu River, Louisiana, by use of the closed-loop-stripping isolation procedure: U. S. Geological Survey Water-Resources Investigations WRI 88-4089, 11 p.

Barrilleaux, J., 1986, The geomorphology and Quaternary history of the Houston barrier segment of the Ingleside strandplain, Calcasieu Parish, Louisiana: unpublished M.S. thesis, University of Southwestern Louisiana.

Chiou, C. T. and Leenheer, J.A., 1988, Properties of Calcasieu River and Suwannee River humic substances that affect contaminant solubility enhancement. J. A.. United States, U. S. Geological Open-File Report OF 87-0764, p. 81-84.

Curwick, P.B., 1988, Use of dye-tracing techniques to determine mixing and circulation in the loops and lakes of the lower Calcasieu River: U.S. Geological Survey Open-File Report 87-764, p. 67-69.

Demas, C.R., Demcheck, D.K., and Curwick, P.B.,1988, Occurrence and fate of volatile organic compounds under different wind and sampling conditions in the lower Calcasieu River, Louisiana: U.S. Geological Survey Open-File Report 87-764, p. 99-102.

Demas, C.R., 1988, Objectives and preliminary results of reconnaissance sampling for selected hazardous substances in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 61-64.

Demas, C.R., Demcheck, D.K., and Curwick, P.B.,1988, Occurrence and fate of volatile organic compounds under different wind and sampling conditions in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 99-102.

Demcheck, D.K., 1988, Automated instrumentation used for the lower Calcasieu River study, in Mallard, G.E., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 65-66.

Demas, C. R., Demcheck, D.K. and Curwick, P.B., 1989, Occurrence of nutrients, minor elements, and organic compounds in water and bottom material in the lower Calcasieu River, Louisiana: U. S. Geological Survey Water-Resources Investigations WRI 88-4089, p. 1-17.

Demas, C.R., 1989, Reconnaissance study of water and bottom material quality in the lower Calcasieu River, southwestern Louisiana, May 29-30, 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4089, 51 p.

Demas, C.R., and Demcheck, D.K., 1989, Fate and transport of organic compounds and trace elements in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program--proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 271-281.

Demas, C.R., and Demcheck, D.K., 1989, Uptake of manmade organic compounds by Rangia cuneata in the lower Calcasieu River, Louisiana, in Mallard, G.E., ed., U.S. Geological Survey toxic substances hydrology program--proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 309-319.

Demcheck, D.K., 1988, Automated instrumentation used for the lower Calcasieu River study, in Mallard, G.E., U.S. Geological Survey toxic substances hydrology program, surface-water contamination--proceedings of the technical meeting, Denver, Colorado, February 2-4, 1987: U.S. Geological Survey Open-File Report 87-764, p. 65-66.

Demcheck, D. K., Demas, C.R. and Curwick, P.B., 1990, Plan of study for selected toxic substances in the Calcasieu River, Louisiana: U. S. Geological Survey Open-File Report OF 90-0148, 29 p.

Demcheck, D.K., 1994, Louisiana hydrologic atlas map no. 7: Water-quality survey of the Mermentau River basin, 1989-90: U.S. Geological Survey Water-Resources Investigations Report 92-4181, 3 sheets.

Demcheck, D. K., and Skrobialowski, S.C., 2003, Fipronil and degradation products in the rice-producing areas of the Mermentau River basin, Louisiana, February-September 2000: U. S. Geological Survey Fact Sheet FS 0010-03, 6 p.

Forbes, M.J., 1988, Hydrologic investigations of the lower Calcasieu River, Louisiana: United States, U. S. Geological Survey Water-Resources Investigations WRI 87-4173, 61 p.

Garrison, C.R., 1997, Statistical summary of surface-water quality in Louisiana--Calcasieu-Mermentau River basin, 1943-95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55E, 78 p.

Milliken, K. L. T., 2008, Holocene sea-level history and the evolution of Sabine Lake and Calcasieu Lake; East Texas and west Louisiana, USA and the glacial retreat history of Maxwell Bay, South Shetland Islands, Antarctica; implications for ice cap thickness, retreat and Climate Change: unpublished Ph.D. dissertation, Rice University, 164 p.

Milliken, K.T., Anderson, J.B. and Rodriguez, A.B., 2008, Record of dramatic Holocene environmental changes linked to eustasy and climate change in Calcasieu Lake, Louisiana, USA: Geological Society of America Bulletin vol. 443, p. 43-63.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, lower Mermentau River: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC:08080202, 43 p.

Nichol, S.L. Boyd R. and Penland S. 1992, Hydrology of a wave-dominated estuary; Lake Calcasieu, Southwest Louisiana: Gulf Coast Association of Geological Societies : New Orleans, LA. 42: 835-844.

Norriss, D.D. 1991, Distribution and uptake of environmental contaminants in the lower Calcasieu Estuary, Louisiana: unpublished Ph.D. dissertation, Tulane University, 237 p.

Pereira, W.E., Rostad C.E., Keck, R. and Chiou, C.T., 1989, Distribution of organic compounds in the lower Calcasieu River, Louisiana, with special emphasis on haloarenes: U. S. Geological Survey Water Resources Investigation WRI 88-4089, p. 35-51.

Simon, N.S., 1988, The effect of different methods for removal of organic matter on hydrochloric acid extraction of metals from sediment; Calcasieu River, Louisiana: U. S. Geological Survey Open-File Report OF 87-0764, p. 73-80.

Skrobialowski, S.C., Mize, S.V. and Demcheck, D.K., 2004, - U. S. Geological Survey. Environmental setting, water quality, and ecological indicators of surface-water quality in the Mermentau River basin, southwestern Louisiana, 1998-2001: U. S. Geological Survey Water-Resources Investigations WRI 03-4185, 73 p.

U.S. Geological Survey, 1980, Land use and land cover and associated maps of Lake Charles, Louisiana, Texas: U. S. Geological Survey Open-File Report map.

U. S. Army Corps of Engineers, W. E. S., 1950, Technical Memorandum - U. S. Army Corps of Engineers. Salt water intrusion, Calcasieu River, Louisiana and connecting waterways; model investigation: Report by the U. S. Army Corps of Engineers, Waterways Experiment Station : Vicksburg, MS, United States.

U. S. Army Engineer Topographic Laboratories, E. A. f. R. I., 1973, Inventory of basic environmental data; South Louisiana; Mermentau River basin to Chandeleur Sound with special emphasis on the Atchafalaya Basin: Report by the U. S. Army Eng. Topogr. Lab.; Eng. Agency Resour. Invent. : Washington, D. C., United States.

Updegraff, D. M., 1989, Microbial content of water and bottom material in the lower Calcasieu River, Louisiana: United States, U. S. Geological Survey : [Reston, VA], United States: 19-22.

Varvaro, G. G., 1957, Bulletin - Louisiana Geological Survey. Geology of Evangeline and Saint Landry Parishes. United States, Louisiana Geological Survey : Baton Rouge, LA, United States. 31.

Varvaro, G. G., 1958, Geology of Evangeline and Saint Landry parishes. United States.

Wang, F. C., 1987, Saltwater intrusion in Louisiana coastal channels: United States, Texas A & M University, Dept. of Oceanography : College Station, TX, United States: 174-177.

Welch, R. N., 1942, Geology of Vernon Parish.

Lakes Pontchartrain-Lake Maurepas Basin

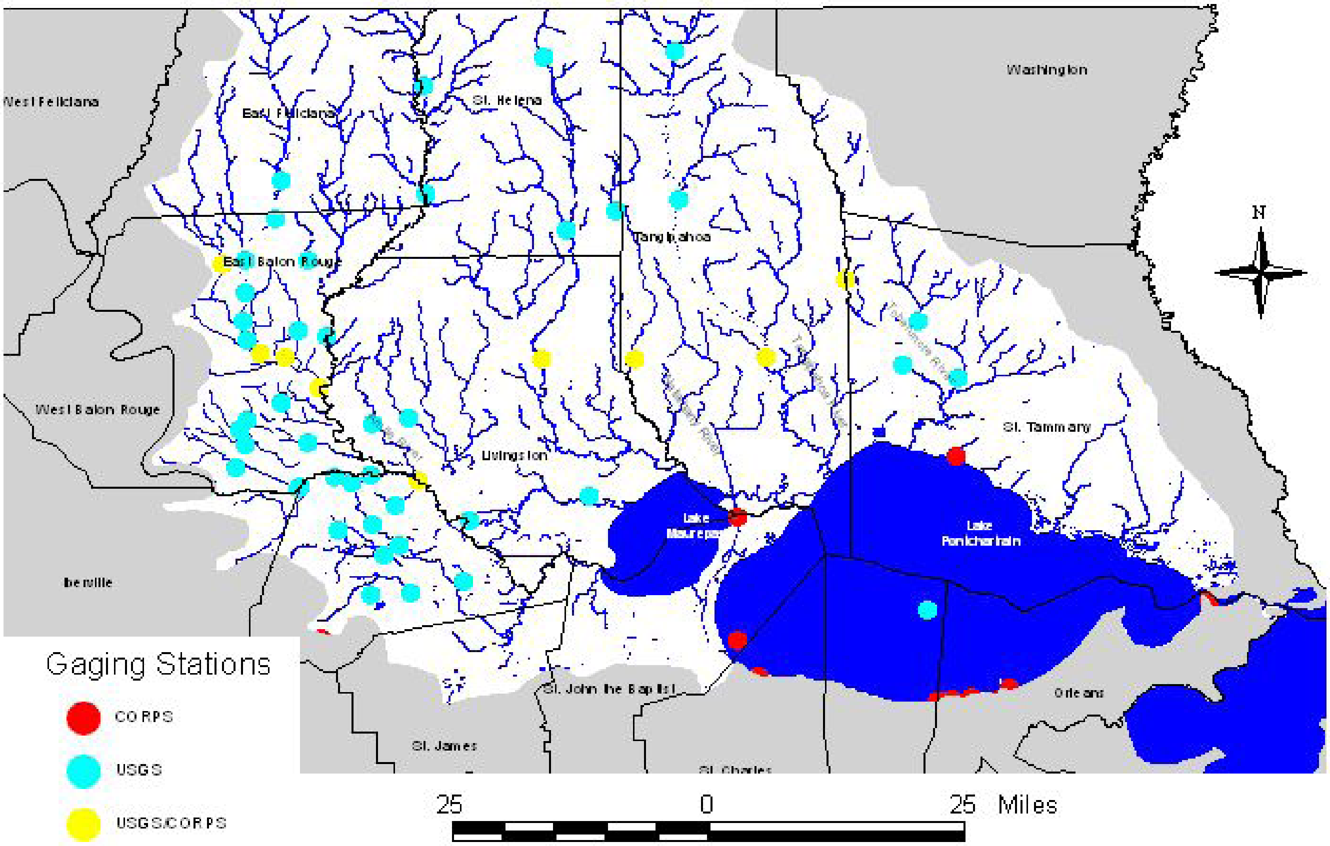


Figure 29: Extent of the Lakes Ponchartrain-Maurepas Basin.

• The USGS maintains 56 real-time gaging stations in the Lakes Pontchartrain-Maurepas Basin (Figure 29).

•The USACE maintains 20 continuous gaging stations within the basin (Figure 29).

Lakes Pontchartrain and Maurepas Bibliography

Arcement, G.J., Colson, B.E., and Ming, C.O., 1979, Backwater at bridges and densely wooded flood plains, Beaver Creek near Kentwood, Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-601, 3 sheets.

Arcement, G.J., Colson, B.E., and Ming, C.O., 1978, Backwater at bridges and densely wooded flood plains, Comite River near Olive Branch, Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-602, 3 sheets.

Cardwell, G., Forbes M. and Gaydos, M., 1967, Water Resources of the Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Bulletins #12, 105 p.

Cardwell, G.T., Forbes, M.J. and Gaydos, M.W., 1966, Progress Report on the Availability of Fresh Water, Lake Pontchartrain Area, Louisiana: Louisiana Geological Survey Water Resources Pamphlets #18, 24 pp.

Demas, C.R., Demcheck, D.K., Anderson, M.L., and Garon, J.D., 1999, National water quality assessment program--Acadian Pontchartrain study unit, 1999, U.S. Geological Survey Fact Sheet FS-185-99, 4 p.

Demcheck, D.K., 1995, The Lake Pontchartrain watershed: A unique resource of the Louisiana coast: U.S. Geological Survey Fact Sheet FS-118-95, 2 p.

Demcheck, D.K., 1996, Analysis of selected water-quality data for surface water in St. Tammany Parish, LA, April-August 1995: U.S. Geological Survey Open-File Report 96-345, 59 p.

Ensminger, P.A., and Wright, L.S., 2003, Low-flow characteristics of Louisiana streams: Louisiana Dept. of Transportation and Development Water Resources Technical Report no. 70, 160 p.

Fayard, L.D., and Nyman, D.J., 1976, Surface-water resources of the Tangipahoa, Tchefuncta, and Natalbany River basins, southeastern Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 11, 49 p.

Forbes, M.J., Jr., 1980, Low-flow characteristics of Louisiana streams: Louisiana Department of Transportation and Development Water Resources Technical Report no. 22, 95 p.

Garrison, C.R., 1999, Statistical summary of surface-water quality in Louisiana-- Lake Pontchartrain-Lake Maurepas basin, 1943-95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55G, 100 p.

Gaydos, M.W., Rogers, J.E., and Smith, R.P., 1973, Water resources of the Little River basin, Louisiana: U.S. Geological Survey Water-Supply Paper 1989, 74 p.

Gilbert, J.J., 1993, Louisiana stream water quality in Paulson, R.W., Chase, E.B., Williams, J.S., and Moody, D.W., comps., National water summary 1990-91--Hydrologic events and stream water quality: U.S. Geological Survey Water-Supply Paper 2400, p. 293-299.

Griffith, J.M., 2009, Water resources of St. Tammany Parish: U.S. Geological Survey Fact Sheet 2009-3064, 6 p.

Grimsley, K.J., and D'Arconte, P.J., 2003, Annotated bibliography of water-related information and studies, Acadian-Pontchartrain Study Unit, Louisiana, 1863-2000: U.S. Geological Survey Open File Report no. 03-9, 249 p.

Kapustka, S.F., 1964, Chemical composition of surface waters of Louisiana, 1943-58: Louisiana Department of Public Works, 212 p.

Kuniansky, E.L., 1984, Hydrology of Fritchie Marsh, coastal Louisiana: U.S. Geological Survey Water-Resources Investigations Report 84-4324, 23 p.

Lee, F.N., 1985, Analysis of the low-flow characteristics of streams in Louisiana: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 35, 41 p.

Leone, H.L., Jr., 1976, Analyses of water, core material, and elutriate samples collected near New Orleans, Louisiana (Lake Pontchartrain, Louisiana, and vicinity hurricane protection project): U.S. Geological Survey Open-File Report 76-758, 22 p.

Leone, H.L., Jr., 1977, Analyses of water, core material, and elutriate samples collected near Buras, Louisiana (New Orleans to Venice, Louisiana, hurricane protection project): U.S. Geological Survey Open-File Report 77-310, 14 p.

Leone, H.L., Jr., 1977, Analyses of water, core material, and elutriate samples collected near Galliano, Louisiana (Larose to Golden Meadow, Louisiana, hurricane protection project): U.S. Geological Survey Open-File Report 77-576, 12 p.

Neely, B.L., Jr., 1968, Tickfaw River at Starns bridge near Magnolia, Louisiana: U.S. Geological Survey Open-File Report, 7 p.

Scarcia, Glenn, 1954, Water, in St. Tammany Parish Resources and Facilities: Louisiana Department of Public Works and St. Tammany Parish Planning Board, p. 37-46.

Mississippi River Valley

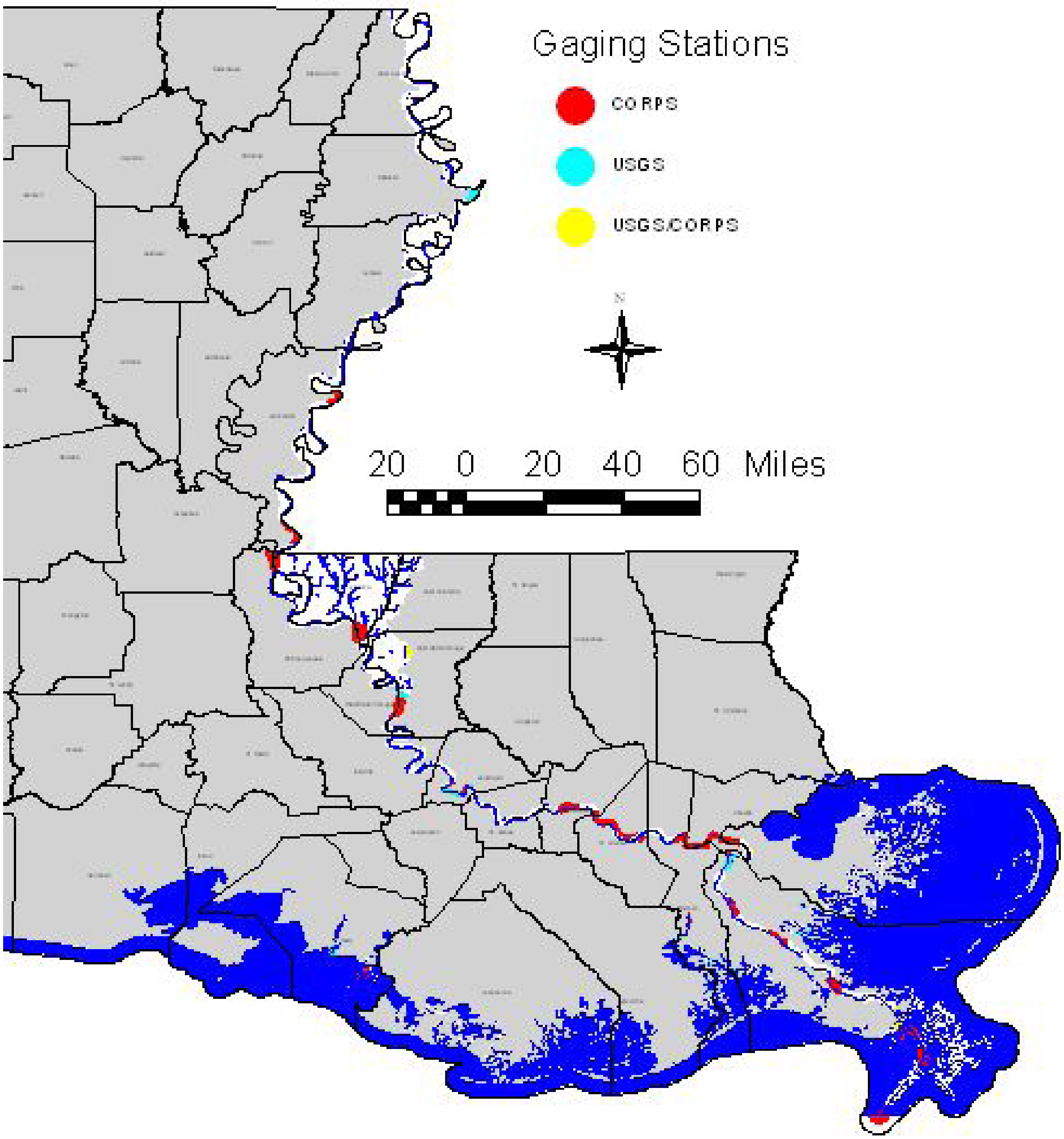


Figure 30: Extent of the Lower Mississippi River Basin.

• The U.S. Army Corps of Engineers maintains 23 continuous gaging stations on the Mississippi River between Vicksburg, MS and the Mississippi River Gulf outlet (Figure 30).

• The USGS maintains six real-time gaging stations along the Mississippi River (Figure 30).

Mississippi River Bibliography

Arcement, G.J., Colson, B.E., and Ming, C.O., 1979, Backwater at bridges and densely wooded flood plains, Alexandria Creek near St. Francisville, Louisiana: U.S. Geological Survey Hydrologic Investigations Atlas HA-600, 3 sheets.

Calandro, A.J., Broussard, W.L., and Hosman, R.L., 1970, Water resources of the Belmont-Marthaville-Robeline area, Louisiana: Louisiana Department of Public Works Water Resources Pamphlet no. 25, 21 p.

Calandro, A.J., Whiteman, C.D., and Gaydos, M.W., 1966, Water, in East Feliciana Parish Resources and Facilities: Louisiana Department of Public Works and East Feliciana Parish Development Board, p. 32-37.

Curwick, P.B., 1988, Simulation of flow and transport in the lower Mississippi River, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 86-4361, 38 p.

Demcheck, D.K., Tollett, R.W., Mize, S.V., Skrobialowski, S.C., Fendick, R.B., Jr., Swarzenski, C.M., and Porter, Stephen, 2004, Water Quality in the Acadian-Pontchartrain Drainages, Louisiana and Mississippi, 1999-2001: U.S. Geological Survey Circular 1232, 41 p.

Demcheck, D.K., Garrison, C.R., and McGee, B.D., 1996, Selected water-quality data for the lower Mississippi River, Bonnet Carré Spillway, and Lake Pontchartrain area, Louisiana, April through June 1994 and 1974-84: U.S. Geological Survey Open-File Report 96-652A, 125 p.

Ensminger, P.A., 1999, Bathymetric survey and physical and chemical-related properties of False River, Louisiana, June and July 1998: U.S. Geological Survey Water-Resources Investigations Report 99-4193, 1 sheet.

Ensminger, P.A., 1999, Bathymetric survey and physical and chemical-related properties of Raccourci Lake, Louisiana, July 1998 and April 1999: U.S. Geological Survey Water-Resources Investigations Report 99-4292, 1 sheet.

Everett, D.E., 1971, Hydrologic and quality characteristics of the lower Mississippi River: Louisiana Department of Public Works Technical Report no. 5, 48 p.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana--Mississippi River mainstem, 1905--95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55I, 91 p.

Jones, P. H., 1947, Water, in West Baton Rouge Parish Resources and Facilities: Louisiana Department of Public Works and West Baton Rouge Parish Development Board, p. 29-33.

Jones, P. H., 1947, Water, in Ascension Parish Resources and Facilities: Louisiana Department of Public Works and Ascension Parish Planning Board.

Jones, P. H., 1946, Water, in Pointe Coupee Parish Resources and Facilities: Louisiana Department of Public Works and Pointe Coupee Parish Planning Board, p. 30-34.

Jones, P. H., 1945, Water, in Iberville Parish Resources and Facilities: Louisiana Department of Public Works and Iberville Parish Planning Board, p. 21-25.

Wells, F.C., 1980, Hydrology and water quality of the lower Mississippi River: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 21, 83 p.

Mississippi River Delta Basin

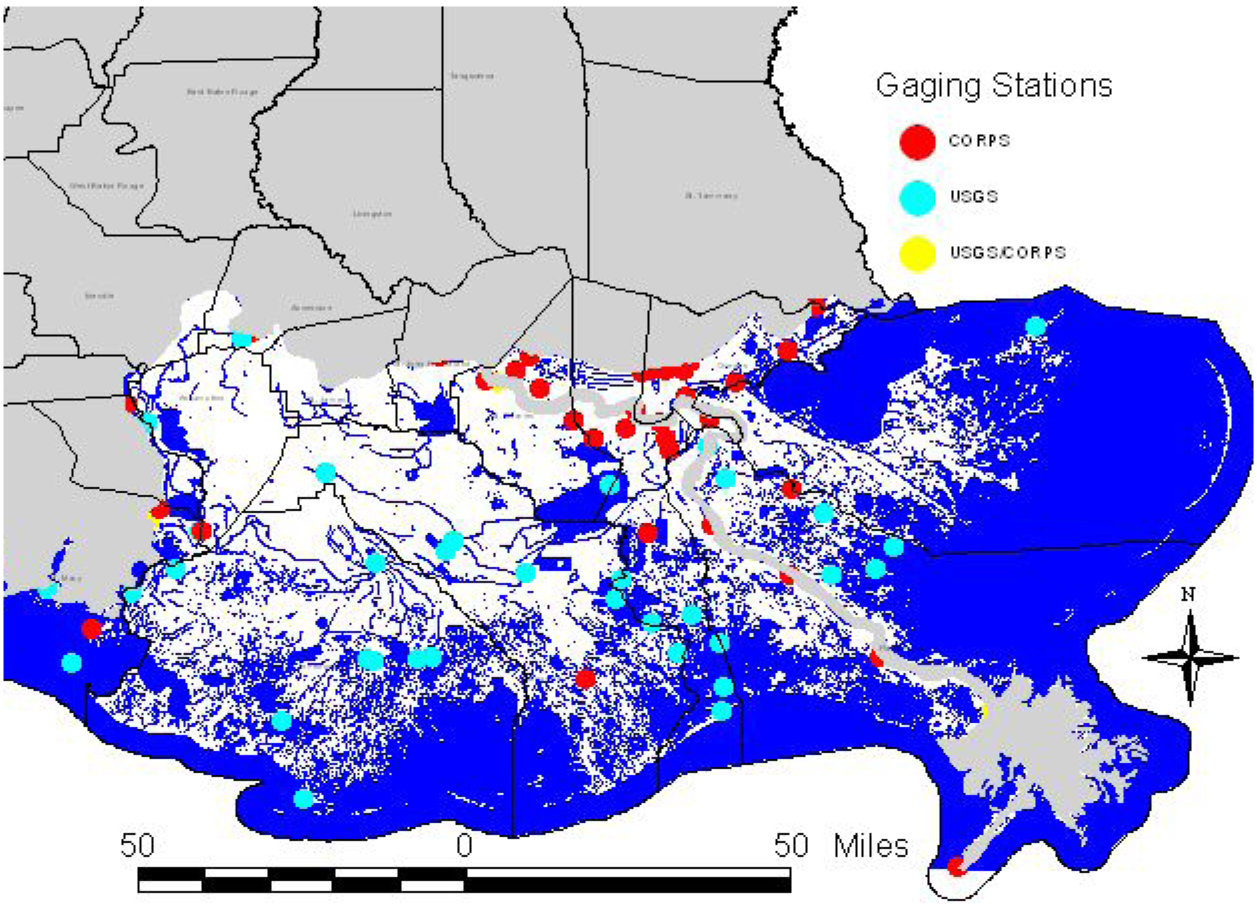


Figure 31: Extent of the Mississippi River Delta Basin.

• The USGS maintain 30 real-time gaging stations in the Mississippi River Delta Basin.

• The USACE maintains eight continuous gaging stations in the basin (Figure 31).

Mississippi River Delta Bibliography

Arcement, G.J., Jr., 1984, Discharge and sediment data for Barataria Pass, Louisiana, 1983: U.S. Geological Survey Open-File Report 84-701, 22 p.

Cardwell, G.T., Sloss, Raymond, and Duncan, A.C., 1965, Water, in Assumption Parish Resources and Facilities: Louisiana Department of Public Works and Assumption Parish Development Board, p. 25-38.

Demcheck, D.K., 1991, Louisiana hydrologic atlas map no. 6: Water-quality survey of the Barataria Basin, 1988: U.S.G.S. Water-Resources Investigations Report 90-4170, 2 sheets.

Eddards, M.L., Kister, L.R., and Scarcia, Glenn, 1956, Water resources of the New Orleans area, Louisiana: U.S. Geological Survey Circular 374, 41 p.

Garrison, C.R., 1982, Water quality of the Barataria Unit, Jean Lafitte National Historical Park, Louisiana (April 1981-March 1982): U.S. Geological Survey Open-File Report 82-691, 34 p.

Johnson-Thibaut, P.M., Demcheck, D.K., Swarzenski, C.M., and Ensminger, P.A., 1998, Water use and quality of fresh surface-water resources in the Barataria-Terrebonne Basins, Louisiana: U.S. Geological Survey Open-File Report 98-632, 47 p., 1 pl.

Sloss, R. and Garber, M.S., 1959, Water, in St. Bernard Parish Resources and Facilities: Louisiana Department of Public Works and St. Bernard Parish Development Board, p. 23-33.

Swarzenski, C.M., 2003, Resurvey of quality of surface water and bottom material of the Barataria Preserve, Jean Lafitte National Historical Park and Preserve, Louisiana, 1999-2000: U.S. Geological Survey Water-Resources Investigations Report 03-4038, 28 p.

Turcan, A.N., Jr., 1953, Water, in Terrebonne Parish Resources and Facilities: Louisiana Department of Public Works and Terrebonne Parish Development Board, p. 42-44.

Ouachita River Basin

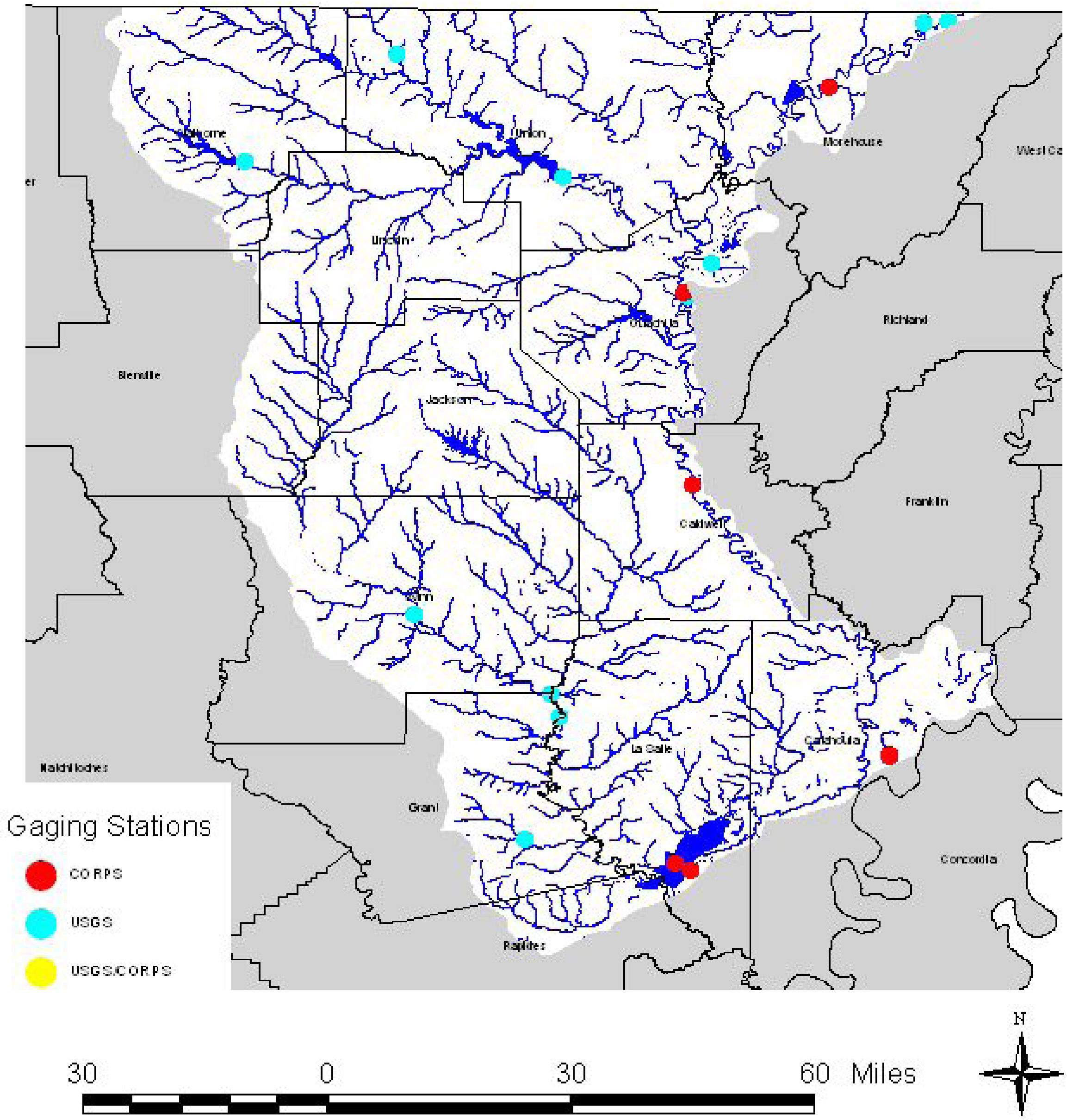


Figure 32: Extent of the Ouachita River Basin.

• Within the basin, the USACE maintains 24 continuous gaging stations (Figure 32).

• The USGS maintains 12 real-time gaging stations in the Ouachita River Basin (Figure 32).

Ouachita River Bibliography

Biedenham, D, N. Raphelt, and C. Montague, 1984, Long term stability of the Ouachita River in River Meandering (editor Elliott, C.M.): American Society of Civil Engineers, New York, New York, p 126-137.

Garrison, C.R., 1997a, Statistical summary of surface-water quality in Louisiana--Ouachita River basin, 1908-94: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55C, 96 p.

Table 8. Number of analytical water quality observations for four major northern Louisiana watersheds, source of data is Garrison and Covay (1994) and Garrison (1997a, 1997b and 1998). These results are for all sites sampled sites for each of the reports.

Parameter	Ouachita River Basin	Red River Basin	Sabine River Basin	Tensas River Basin	Total
General Properties					
Elec. cond.	2,483	4,333	353	1,106	8,275
pH	2,617	4,513	351	1,116	8,597
Temperature	1,660	3,121	319	1.028	6,128
Diss. Oxygen	1,116	2,498	294	773	4,681
Cations					
Calcium	2,251	3,662	342	909	7,164
Magnesium	2,244	3,664	342	907	7,157
Sodium	2,002	2,771	343	865	5,981
Potassium	1,996	2,766	345	859	5,966
Anions					
Alkalinity	2,255	1,873	345	963	5,436
Sulfate	2,473	2,373	350	992	6,188
Chloride	2,581	2,319	349	1,005	6,254
Trace elements					
Copper	228	771	70	202	1,271
Iron	260	1,193	69	210	1,732
Lead	229	1,106	70	205	1,610
Zinc	230	1,105	71	207	1,613
Nutrients					
Ammonia + org. nitrogen	451	1,513	148	467	2,579
Nitrate+Nitrite	560	1,837	183	519	3,099
Phosphorus	674	1,717	187	571	3,149
Organic compounds					
DDT	122	804	60	153	1,139
PCB	114	793	60	137	1,104
Diazinon	114	797	58	143	1,112
Lindane	114	807	60	139	1,120
Chlordane	114	809	61	141	1,125
Malathion	114	798	58	143	1,113
Endrin	117	616	60	143	936
Parathon	114	792	58	143	1,107
Dieldrin	119	808	60	155	1,142
Endosulfan	71	430	44	110	655
2, 4-D	113	778	59	133	1,083
Biological agents					
Fecal Coliform	506	1,503	184	450	2,643
Fecal Streptococcus	486	1,297	181	433	2,397
Phytoplankton	94	223	0	134	451

Pearl River Basin

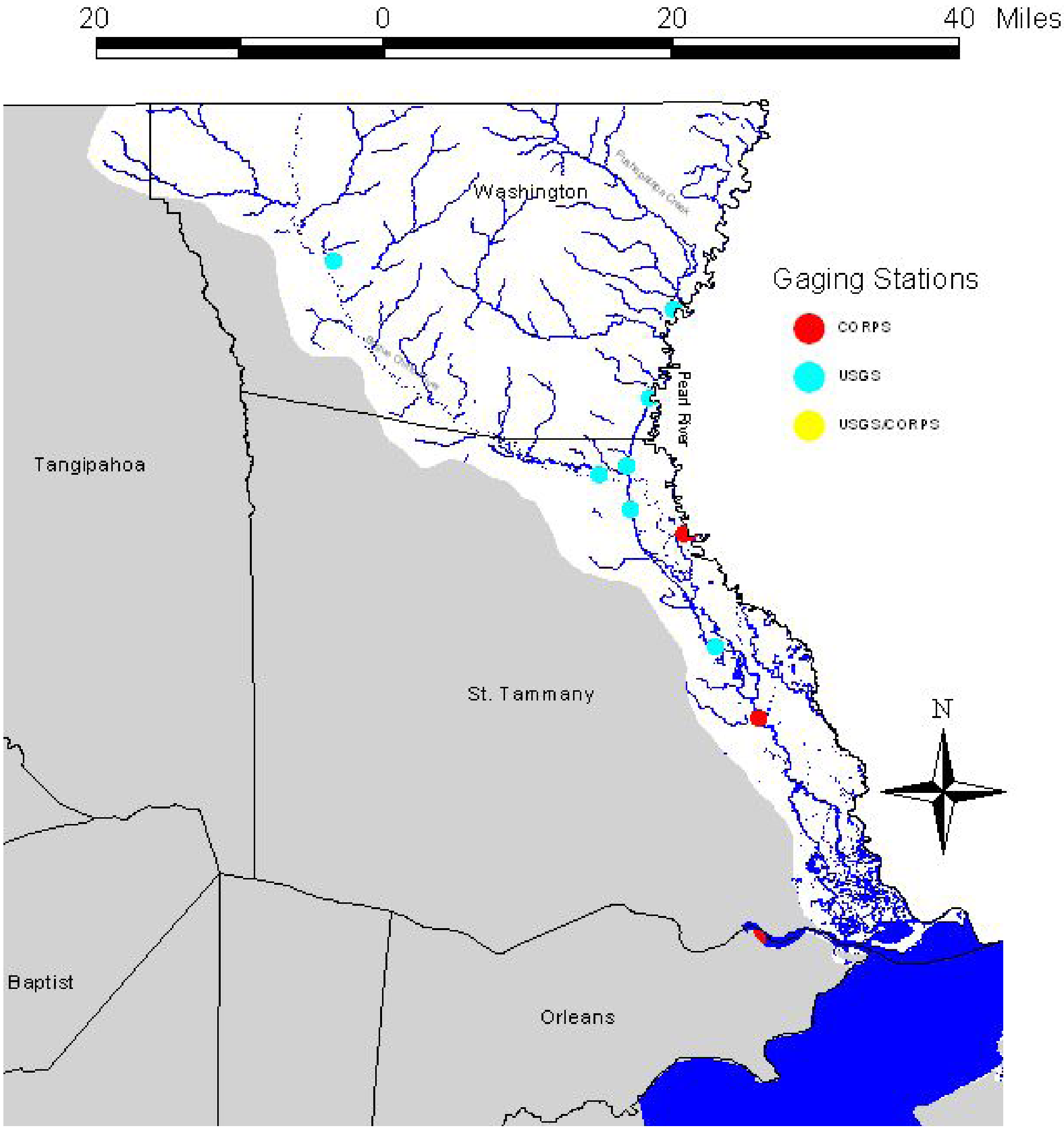


Figure 33: Extent of the Pearl River Basin in Louisiana.

- Within the basin, the U.S. Corps of Engineers-Vicksburg District maintains 3 continuous gaging stations on the Pearl River (Figure 33).

- The USGS maintains 11 real-time gaging stations in the Pearl River Basin (Figure 33).

Pearl River Bibliography

Demcheck, D.K., 1996, Analysis of selected water-quality data for surface water in St. Tammany Parish, LA, April-August 1995: U.S. Geological Survey Open-File Report 96-345, 59 p.

Everett, D.E., Fayard, L.D., and Wells, F.C., 1973, Water quality and waste assimilative capacity of the Pearl River below Bogalusa, Louisiana: Louisiana Department of Public Works Water Resources Technical Report no. 7, 28 p.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana--Pearl River basin, 1943-95: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55J, 50 p.

Lee, F.N., and Arcement, G.J., Jr., 1981, Hydrologic analysis of Pearl River floods, April 1979 and April 1980, in Louisiana and Mississippi: Louisiana Department of Transportation and Development, Office of Highways Research Study no. 81-1-SS, 37 p.

USACE-VD (U.S. Army Corps of Engineers-Vicksburg District), 2007, Pearl River Watershed Feasibility Report: U.S. Army Corps of Engineers-Vicksburg District preliminary draft feasibility study report, 4 volumes.

Red River Basin

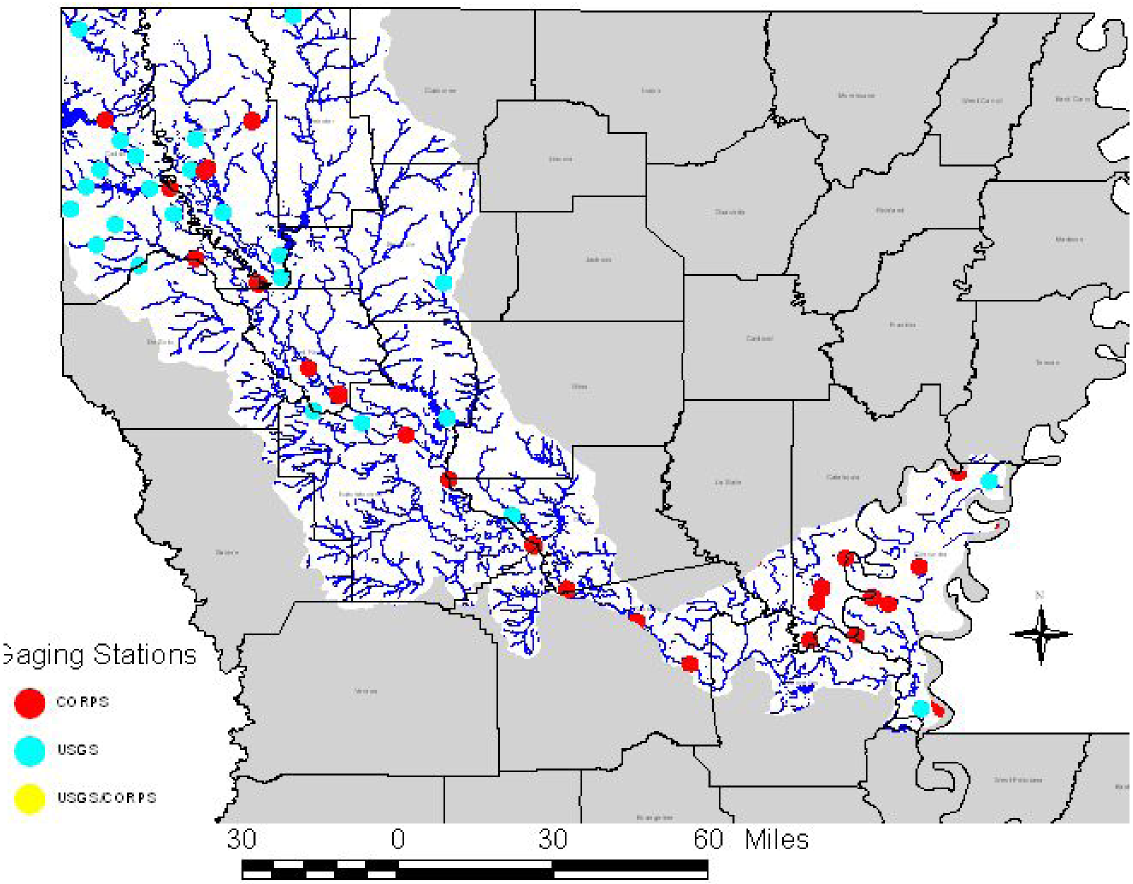


Figure 34: Extent of the Red River Basin.

• Within the basin, the U.S. Corps of Engineers-Vicksburg District maintains 24 continuous gaging stations within the Red River watershed (Figure 34).

• The USGS maintains 26 real-time gaging stations in the Red River Basin (Figure 34).

Red River Bibliography

Garrison, C.R., 1997b, Statistical summary of surface-water quality in Louisiana--Red River basin, 1943-94: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55B, 136 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, upper Saline Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208010, 48 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, lower Saline Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208020, 35 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, Lake Natchez - Bourbeaux Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208030, 34 p.

National Resources Conservation Service (NRCS), 2008, Rapid watershed assessment, Cane Bayou: U.S. Dept. of Agriculture Rapid Watershed Assessment HUC: 11140208040, 34 p.

Newcome, R., Jr., and Sloss, R., 1966, Water resources of Rapides Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 8, 104 p.

Newcome, R., Jr., Page, L.V., and Sloss, R., 1963, Water resources of Natchitoches Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 4, 189 p.

Page, L.V., and May, H.G., 1964, Water resources of Bossier and Caddo Parishes, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 5, 105 p.

Page, L.V. and Pree, H.L., 1964, Water resources of De Soto Parish, Louisiana: U.S. Geological Survey Water Supply Paper #1774, 152 p.

Smoot, C.W., and Fendick, R.B. Jr., 1998, Hydrogeology and water resources of the Alexandria area, Rapides Parish, Louisiana: Louisiana Department of Transportation and Development, Water Resources Technical Report, no. 63, 36 p.

Sabine River Basin

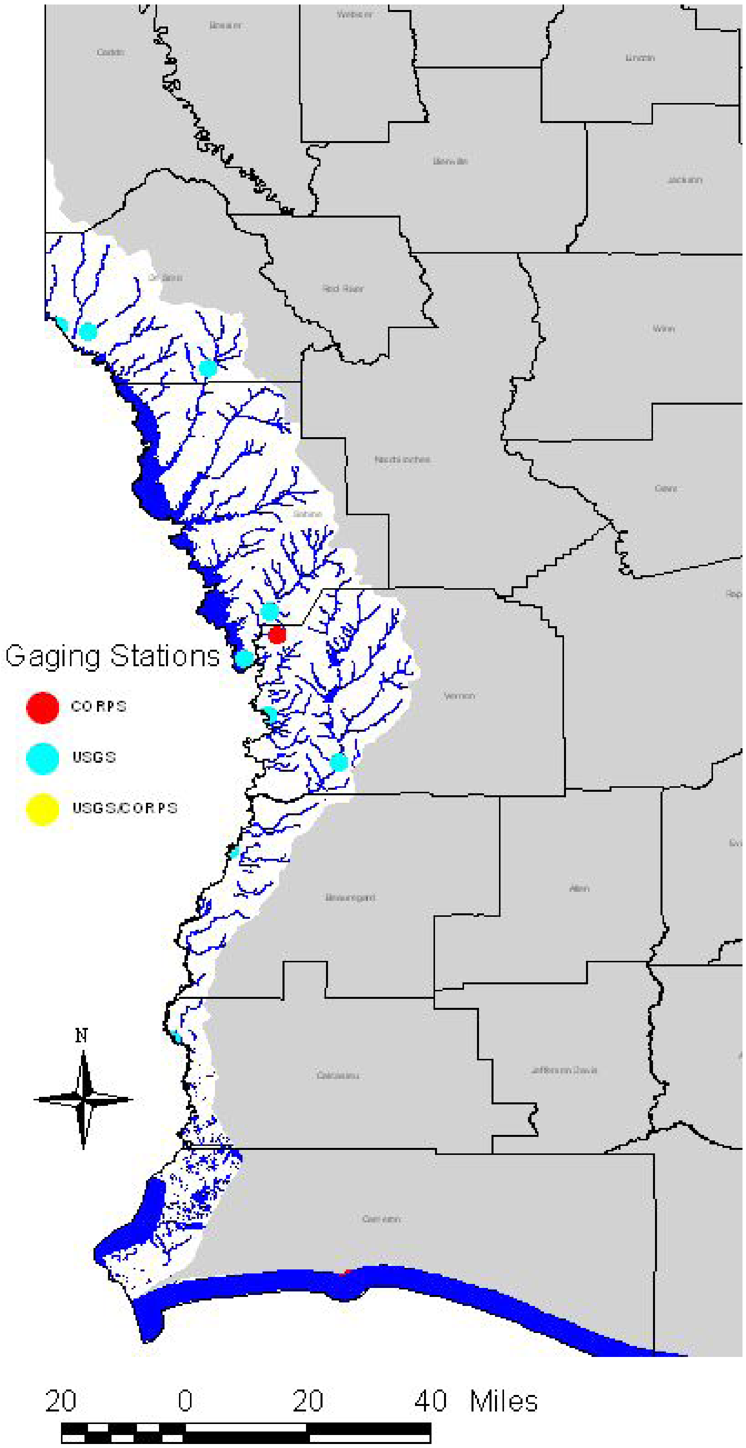


Figure 35: Extent of the Sabine River Basin.

• Within the basin, the U.S. Corps of Engineers-Vicksburg District maintains only one continuous gaging station on the Sabine River (Figure 35), however, they maintain several near Sabine Lake and Port Arthur, TX.

• The USGS maintains nine real-time gaging stations in the Sabine River Basin.

• The South Sabine Water Supply Corporation reports annual water quality reports.

• The Sabine River Authority of Texas reports monthly water quality reports.

Sabine River Bibliography

Andersen, H.V., 1960, Geology of Sabine Parish: Louisiana Geological Survey Geology Bulletin #34, 164 pp. plus map pack.

Anderson, J.B., Taviani, M. and Lawrence, J., 1991, Origin and evolution of Sabine Lake, Texas-Louisiana: Gulf Coast Association of Geological Societies Transaction vol. 41, p. 12-16.

Blakey, J.F. and Skinner, P.W., 1973, A network for continuous monitoring of water quality in the Sabine River basin, Texas and Louisiana: U. S. Geological Survey Open-File Report OF 72-0025.

Falk, L.H. and Stober, W.J., 1970, An economic reappraisal of the Toledo Bend multiple-purpose water project: Louisiana Water Resources Research Institute Bulleting 16, 36 p.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana–Tensas River basin, 1943-93: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55D, 76 p.

Garrison, C.R., and Covay, K.J., 1994, Statistical summary of surface-water quality in Louisiana–Sabine River basin, 1952-85: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55A, 63 p.

Hughes, L.S. and Leifeste, D., 1965, Reconnaissance of the chemical quality of surface waters of the Sabine River basin, Texas and Louisiana: U. S. Geological Survey Water-Supply Paper W 1809-H, 71 p.

Kane, H.E., 1959, Late Quaternary geology of Sabine Lake and vicinity, Texas and Louisiana: Transaction of the Gulf Coast Association of Geological Societies vol. 9, p. 225-235.

Kane, H.E., 1964, Geology of Sabine Lake and vicinity, Louisiana and Texas: Proceeding of the Indiana Academy of Science vol. 73, p. 171-176.

Lee, F.N., 1985, Floods in Louisiana, magnitude and frequency (4th ed.): Louisiana Department of Transportation and Development Water Resources Technical Report no. 36, 30 p.

McCulloh, R.P. and Heinrich, P.V., 2002, Geology of the Fort Polk Region, Sabine, Natchitoches, and Vernon Parishes, Louisiana: Louisiana Geological Survey Report of Investigations Series #02-01, 82 pp. plus appendix and CD.

McWreath, H.C., III, and Smoot, C.W., 1989, Geohydrology and development of ground water at Fort Polk, Louisiana: U.S. Geological Survey Water-Resources Investigations Report 88-4088, 53 p.

Milliken, K. L. T., 2008. Holocene sea-level history and the evolution of Sabine Lake and Calcasieu Lake; East Texas and west Louisiana, USA and the glacial retreat history of Maxwell Bay, South Shetland Islands, Antarctica; implications for ice cap thickness, retreat and Climate Change: unpublished Ph.D. dissertation, Rice University, 164 p.

Neely, B.L., Jr., and Stiltner, G.J., 1979, Elevations and discharges produced by a simulated flood wave on the lower Sabine River, Louisiana and Texas, caused by a theoretical dam failure: U.S. Geological Survey Open-File Report 79-678, 15 p.

Nyman, D.J., Beck, J.N., Rao, G.N. and Murray, H.E., 1991, The Sabine River diversion canal and groundwater conservation in Calcasieu Parish, Louisiana: American Water Resources Association Technical Publication Series 91-3, p. 253-259.

Page, L.V., Newcome, Roy, Jr., and Graeff, G.D., Jr., 1963, Water resources of Sabine Parish, Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 3, 146 p.

Peele, R. H., 2000. GIS data development of the geology of the Fort Polk region of west-central Louisiana. R. P. McCulloh. United States, U. S. Geological Survey : Reston, VA, United States: 119-124.

Phillips, J. D., 2003. Toledo Bend Reservoir and geomorphic response in the lower Sabine River. United Kingdom, Wiley : Chichester, United Kingdom. 19: 137-159.

Phillips, J. D., 2008. Geomorphic controls and transition zones in the lower Sabine River. United States, John Wiley & Sons : New York, NY, United States. 22: 2424-2437.

Prakken, L.B., 1998, Water-quality data for public-supply wells at Fort Polk, Vernon Parish, Louisiana, March and June 1997: U.S. Geological Survey Open-File Report 98-271, 13 p.

Ravichandran, M., 1995. Geochronology of sediments in the Sabine-Neches Estuary, Texas, U.S.A. M. Baskaran, P. H. Santschi and T. S. Bianchi. Netherlands, Elsevier : Amsterdam, Netherlands. 125: 291-306.

Sauer, V. B., 1971. The unit hydrograph; a technique for routing reservoir releases. United States, U. S. Geological Survey : Reston, VA, United States: B259-b264.

Texas A&M University, S. G. C. P., College Station, TX, United States, performer, 1996. Sabine Lake conference; Where Texas and Louisiana come together. United States.

Veatch, A. C., 1902. The geography and geology of the Sabine River. United States. Part 6: 101-148.

Wang, F.C., 1987, Saltwater intrusion in Louisiana coastal channels: Proceedings of the Gulf of Mexico Information Transfer Meeting, p. 174-177.

Wilkinson, E., 1885, On the occurrence of native mercury in alluvium in Louisiana. American Journal of Science vol. 29, p. 280-281.

Tensas River Basin

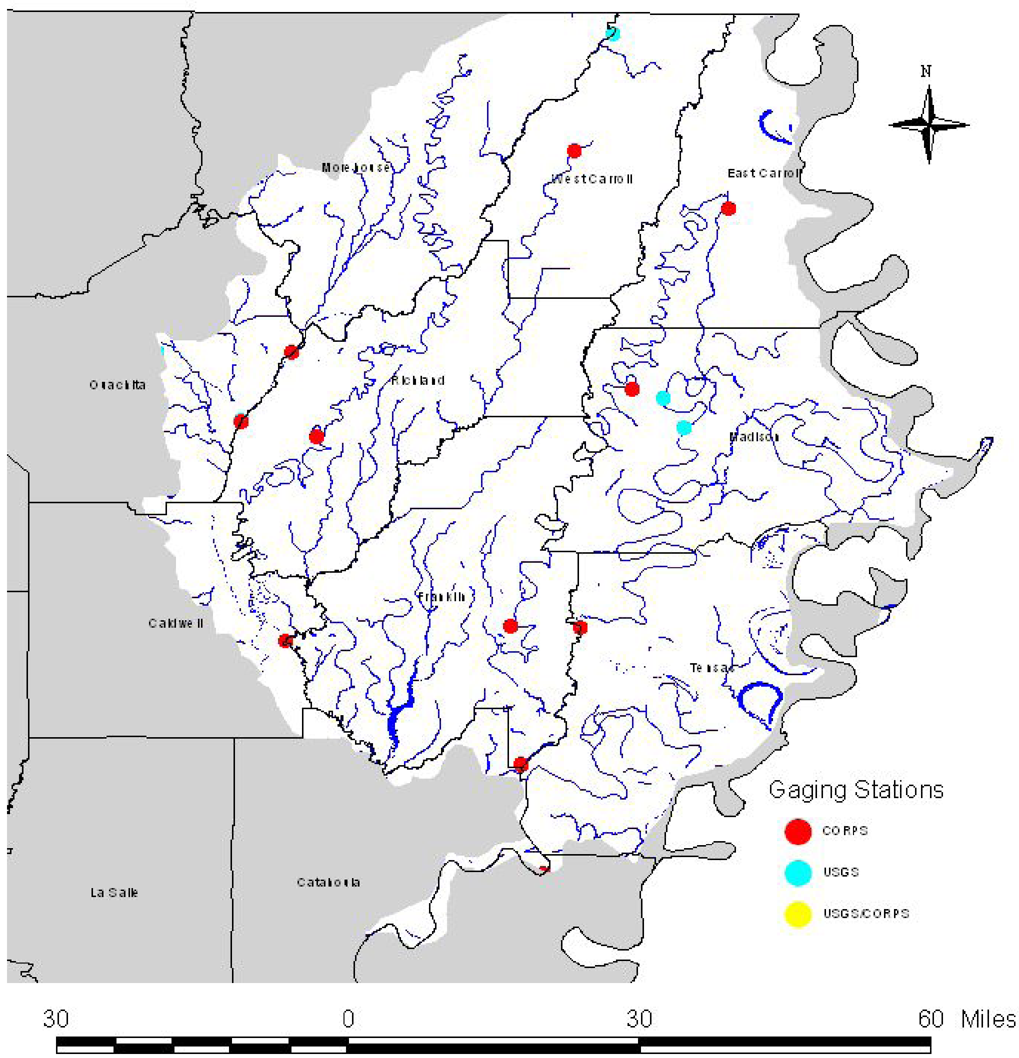


Figure 36: Extent of the Tensas River Basin

• Within the basin, the U.S. Corps of Engineers-Vicksburg District maintains eight continuous gages on the Tensas River (Figure 36).

• The USGS maintains six real-time gaging stations in the Tensas River Basin.

Bibliography

Barks, C.S., Petersen, J.C., and Usrey, F.D., 2002, Water-quality, biological, and habitat assessment of the Boeuf River basin, southeastern Arkansas, 1994-96: U. S. Geological Survey Water-Resources Investigations WRI 02-4187.

Garrison, C.R., 1998, Statistical summary of surface-water quality in Louisiana--Tensas River basin, 1943-93: Louisiana Department of Transportation and Development Water Resources Technical Report no. 55D, 76 p.

Clinton, C. A., 1979, A field test of environmental impact assessment in the Tensas Basin: Proceedings - Mississippi Water Resources Conference Issue 14, pp.27-32.

Heggem, D.T., 2000, A landscape ecology assessment of the Tensas River basin: Environmental Monitoring and Assessment Vol. 64(1), pp.41-54

Turcan, A.N., Jr., 1949, Water, in Tensas Parish Resources and Facilities: Louisiana Department of Public Works and Tensas Parish Planning Board, p. 25-29.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-77-1, 405 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-78-1, 412 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-79-1, 426 p.

U.S. Geological Survey, 1980, Water resources data for Louisiana, water year 1980, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-80-1, 526 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-81-1, 424 p.

Statewide Databases

4.1 Louisiana Registered Water Wells Database

• Maintained by the Louisiana Department of Transportation and Development until March 1, 2010, then by the Louisiana Department of Natural Resources

• Effective since November 1, 1985.

• The April 14, 2010 database contained 181,494 records (Table 10).

• The detailed summaries by aquifer of the database content are included in Appendix A.

• Files include driller's logs, geophysical logs, water quality analyses, bacterial analyses, grain size analyses, water level measurements, and pump tests (Table 11).

Table 9: Number of DOTD Registered Wells

Region	Aquifer	Number of site
Region I	Carrizo-Wilcox	11,792
	Catahoula	619
	Cockfield	1,947
	Mississippi River Alluvial	9,919
	Red River Alluvial	4,521
	Sparta	5,239
	Upland Terrace	4,122
Region II	Chicot	42,360
	Evangeline	1,419
	Jasper	2,608
Region III	Southern Hill*	47,990
	Mississippi River Alluvial	11,507
	Other aquifers	1,794
	Orphan wells	35,657
	Total	181,494

Note: Southern Hills include southeast Louisiana Upland Terrace wells.

Table 10: Number of DOTD Registered Wells

Parameter/Information	Number of well with one or more values
Water levels	147,892
Geophysical logs	5,819
Pump tests	2,202
Water quality tests	11,872
Grain size Analyses	3,613
Drillers log	151,874
Bacteria Analyses	256

4.2 Louisiana Ambient Groundwater Quality

- Maintained by the Louisiana Department of Environmental Quality.
- The network routinely monitors up to 311 wells (Table 11).
- Includes sampling since 1990 on a three-year interval frequency.
- Contains 187,750 individual analyses entries (Table 12), which represents approximately 928 samples and duplicates.

Table 11: Number of DEQ Ambient Groundwater Sampling Sites

Region	Aquifer	Number of site
Region I	Carrizo-Wilcox	20
	Catahoula	13
	Cockfield	22
	Mississippi River Alluvial	32
	Red River Alluvial	16
	Sparta	20
	Upland Terrace	19
Region II	Chicot	45
	Evangeline	16
	Jasper	23
Region III	Southern Hill	75
	Mississippi River Alluvial	10
	Total	311

Table 12: Summary of DEQ Ambient Groundwater Analyses

Metals	Aquifer	Number of site	Time Period		Field Parameters	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	Total
			From	To							
I	Carrizo-Wilcox	20	6/10/1991	11/4/2009	372	979	1,423	2,524	3,917	1,966	11,181
	Catahoula	13	4/6/1992	7/17/2010	132	427	601	1,155	1,873	875	5,063
	Cockfield	22	4/6/1992	5/12/2008	380	1,219	1,935	3,262	4,540	2,368	13,704
	Mississippi River Alluvial	32	4/6/1992	9/17/2007	425	1,509	2,572	4,009	5,424	2,967	16,906
	Red River Alluvial	16	6/10/1991	11/3/2009	179	457	697	1,195	1,712	947	5,187
	Sparta	20	6/10/1991	8/24/2009	471	1,197	1,798	3,558	4,544	2,452	14,020
	Upland Terrace	19	6/11/1991	3/30/2010	376	1,014	1,580	2,716	4,069	2,032	11,787
II	Chicot	45	8/13/1990	6/24/2008	699	2,437	3,732	6,284	10,103	4,722	27,977
	Evangeline	16	6/10/1991	3/17/2010	403	1,109	1,730	3,061	2,958	2,258	11,519
	Jasper	23	6/10/1991	4/14/2010	534	1,491	2,034	3,871	5,876	3,205	17,011
III	Southern Hill	75	8/13/1990	6/1/2009	1,431	4,496	6,809	13,149	13,614	8,781	48,280
	Mississippi River Alluvial	10	4/6/1992	1/7/2008	90	437	795	1,118	1,754	869	5,063
	Orphan Values									51	51
Total		311	8/13/1990	4/14/2010	5,492	16,773	25,706	45,902	60,384	33,493	187,750

Note: Orphan values are values whose results cannot be attributed to a specific aquifer.
The number reported represents the number of individual parameter values available.

4.3 Ambient Surface Water Quality

• Maintained by the Louisiana Department of Environmental Quality.

• The program has collected water samples from 703 sites (Table 13).

• The program monitors 125 sites monthly.

• The database contains 1,576,222 records (individual reported values)

• Lists of the number of samples analyzed for each group of analytes by drainage basins are included in Appendix B.

Table 13: Summary of DEQ Ambient Surface Water Sampling Locations

Basin	Type of Sampling Point									
	Stream	Canal	Lake	Reservoir	Bay/Estuary	Canal/Estuary	Lake/Estuary	Stream/Estuary	Ocean	Total
Atchafalaya-Vermilion-Teche	43	13	7	1	7	3	0	1	0	75
Calcasieu-Mermentau Rivers	51	2	2	0	0	4	5	11	4	79
Lakes Pontchartrain-Maurepas	44	1	2	0	1	0	5	7	0	60
Mississippi River	20	0	2	0	1	0	0	4	0	27
Mississippi River Delta	58	27	21	0	20	11	7	36	3	183
Ouachita River	27	3	0	0	2	0	0	0	0	32
Pearl River	60	0	13	0	0	0	0	0	0	73
Red River	81	4	20	4	0	0	0	0	0	109
Sabine River	11	0	2	1	0	1	1	5	0	21
Tensas River	29	2	13	0	0	0	0	0	0	44
Total	424	52	82	6	31	19		64	7	703

Safe Drinking Water Program Database

- Maintained by the Louisiana Department of Health and Hospitals.

- 4,317 public water supply wells sampled [4,098 known location (3,243 active, 852 inactive and 3 proposed), and 219 location unknown (138 active, 80 inactive and 1 proposed)].

- Of the 4,317 wells, 1,469 have their aquifer identified and 2,848 are in need of confirmation (Table 14).

- Contains 1,226,432 records (each record per analyte per sampling round).

- A list of the number of samples analyzed for each group of analytes is included in Table 15.

Table 14: Summary of DHH Safe Drinking Water Sampling Locations

Region	Aquifer	Number of site
Region I	Carrizo-Wilcox	217
	Catahoula	15
	Cockfield	58
	Mississippi River Alluvial	48
	Red River Alluvial	25
	Sparta	434
	Upland Terrace	42
Region II	Chicot	389
	Evangeline	56
	Jasper	11
Region III	Southern Hill	163
	Mississippi River Alluvial	1
	Other aquifers	10
	Orphan wells	2,848
	Total	4,317

Table 15: Summary of DHH Safe Drinking Water Sample and Analyses

Region	Aquifer	Number of site	Time Period		Number of samples per parameter lists						
			From	To	Conven-tional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Radionuclei
I	Carrizo-Wilcox	217	9/7/1994	2/15/2010	569	544	605	618	670	259	693
	Catahoula	15	2/6/1995	12/2/2009	87	82	91	91	89	0	106
	Cockfield	58	9/6/1994	3/22/2010	133	144	151	163	163	105	167
	Mississippi River Al-luvial	48	9/30/1997	2/20/2009	424	469	467	483	511	217	540
	Red River Alluvial	25	9/14/1994	3/8/2010	22	24	36	38	40	28	37
	Sparta	434	10/11/1994	4/12/2010	1,255	1,285	1,362	1,356	1,420	427	1,551
	Upland Terrace	42	1/12/1996	2/22/2010	104	107	98	95	111	21	128
II	Chicot	389	9/6/1994	4/12/2010	978	1,012	1,091	1,115	1,082	371	1,158
	Evangeline	56	7/31/1995	2/1/2010	135	145	172	168	180	49	186
	Jasper	11	5/1/1995	4/22/2010	128	127	137	139	134	14	139
III	Southern Hill	163	9/14/1994	3/8/2010	425	436	485	473	521	182	548
	Mississippi River Al-luvial	1			0	0	0	0	0	0	0
	Other aquifers	10	5/30/1995	3/22/2010	50	51	49	48	51	0	56
	Orphan Values	2848	9/6/1994	4/22/2010	4,746	4,979	5,278	5,259	5,475	1,981	5,964
Total		4317			9,056	9,405	10,022	10,046	10,447	3,654	11,273

National Water Information System

- Maintained by the U.S. Geological Survey.
- Includes data for 30,879 groundwater sites (Table 16).
- Includes data for 3,553 surface water sites (Table 17).
- Includes data for 271 other related sites (e.g. ditches, excavation, storm surge, etc.).
- Includes 459,699 groundwater level measurements (Table 18).
- Includes 33,545 groundwater quality samples (Table 19).
- Includes 39,880 surface water quality samples.

Table 16: Summary of USGS Groundwater Sampling Locations

Region	Aquifer	Number of site
Region I	Carrizo-Wilcox	2,256
	Catahoula	371
	Cockfield	567
	Mississippi River Alluvial	3,879
	Red River Alluvial	1,794
	Sparta	2,036
	Upland Terrace	
Region II	Chicot	6,819
	Evangeline	710
	Jasper	1,019
Region III	Southern Hill	5,954
	Mississippi River Alluvial	1,239
	Other aquifers	378
	Orphan wells	2,648
	Total	30,879

Table 17: Summary of USGS Surface Water Sampling Locations

Basin	Number of Sampling Sites
Atchafalaya-Vermilion-Teche	698
Calcasieu-Mermentau Rivers	368
Lakes Pontchartrain-Maurepas	867
Mississippi River	273
Mississippi River Delta	464
Ouachita River	221
Pearl River	59
Red River	392
Sabine River	119
Tensas River	92
Total	3,553

Table 18: Summary of USGS Aquifer Water Level Measurements

Region	Aquifer	Number of Measurements
Region I	Carrizo-Wilcox	5,819
	Catahoula	1,839
	Cockfield	3,192
	Mississippi River Alluvial	7,980
	Red River Alluvial	208,304
	Sparta	23,453
	Upland Terrace	16,614
Region II	Chicot	63,868
	Evangeline	2,541
	Jasper	6,970
Region III	Southern Hill	86,448
	Mississippi River Alluvial	8,259
	Other aquifers	1,827
	Orphan wells	22,585
	Total	459,699

Table 19: Summary of USGS Groundwater samples

Region	Aquifer	From	To	Number of Samples Analyzed
Region I	Carrizo-Wilcox	5/12/1905	9/8/2004	1,145
	Catahoula	4/28/1938	2/13/2006	312
	Cockfield	8/10/1926	3/3/2009	430
	Mississippi River Alluvial	9/20/1939	3/10/2010	1,620
	Red River Alluvial	4/21/1905	5/17/2000	4,742
	Sparta	5/5/1905	4/14/2010	2,208
	Upland Terrace	4/21/1905	3/11/2009	853
				0
Region II	Chicot	5/1/1905	4/14/2010	9,424
	Evangeline	6/16/1938	5/6/2009	713
	Jasper	4/21/1905	7/22/2003	915
				0
Region III	Southern Hill	4/23/1905	5/5/2010	9,669
	Mississippi River Alluvial	4/12/1905	4/30/2003	1,189
				0
	Other aquifers	9/3/1937	8/30/1993	292
	Orphan wells	4/2/1942	9/22/2005	33
	Total			33,545

Water Resources Data – Louisiana

• Maintained by the U.S. Geological Survey

Bibliography

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1991, Water resources data—Louisiana, water year 1990: U.S. Geological Survey Water-Data Report LA-90-1, 419 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1992, Water resources data—Louisiana, water year 1991: U.S. Geological Survey Water-Data Report LA-91-1, 435 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1993, Water resources data—Louisiana, water year 1992: U.S. Geological Survey Water-Data Report LA-92-1, 439 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1989, Water resources data—Louisiana, water year 1988: U.S. Geological Survey Water-Data Report LA-88-1, 413 p.

Arcement, G.J., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1990, Water resources data—Louisiana, water year 1989: U.S. Geological Survey Water-Data Report LA-89-1, 395 p.

Baumann, T., Goree, B.B., Lovelace, W.M., Montgomery, P.A., Ross, G.B., Walters, D.J., and Ward, A.N., 2006, Water resources data--Louisiana, water year 2005: U.S. Geological Survey Water-Data Report LA-05-1, 909 p.

Baumann, Todd, Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Ross, Garron B., Sasser, D.C., Jr., and Walters, D.J., 2004, Water resources data—Louisiana, water year 2003: U.S. Geological Survey Water-Data Report LA-03-1, 970 p.

Benton, O.L., and Higgins, P.C., 1981, Index to water-resources data for Louisiana--surface-water records, water-quality records: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Basic Records Report no. 10, 138 p.

Brazelton, S.R., 1994, Water resources abstracts of publications of the Louisiana Department of Transportation and Development and the U.S. Geological Survey, 1954-94: Louisiana Department of Transportation and Development Water Resources Special Report no. 7, 185 p.

Cardwell, G.T., McWreath, H.C., III, and Rogers, J.E., 1985, Louisiana ground-water resources, in U.S. Geological Survey, National water summary 1984--Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, p. 229-235

Carlson, D.D., 1986, Louisiana surface-water resources, in Moody, D.W., Chase, E.B., and Aronson, D.A., comps., National water summary 1985--Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, p. 251-258.

Carlson, D.D., Garrison, C.R., Jordan, M.M., Dantin, L.J., and Montgomery, P.W., 1989, Index to surface-water data in Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 17, 228 p.

Carlson, D.D., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1988, Water resources data—Louisiana, water year 1987: U.S. Geological Survey Water-Data Report LA-87-1, 445 p.

Carlson, D.D., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1986, Water resources data—Louisiana, water year 1986: U.S. Geological Survey Water-Data Report LA-86-1, 547 p.

Carlson, D.D., Dantin, L.J., Garrison, C.R., and Stuart, C.G., 1985, Water resources data—Louisiana, water year 1985: U.S. Geological Survey Water-Data Report LA-85-1, 605 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1984, Water resources data—Louisiana, water year 1984: U.S. Geological Survey Water-Data Report LA-84-1, 608 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1983, Water resources data—Louisiana, water year 1983, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-83-1, 392 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1983, Water resources data—Louisiana, water year 1983, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-83-2, 360 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1982, Water resources data—Louisiana, water year 1982, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-82-1, 422 p.

Carlson, D.D., Stallworth, G.R., Dantin, L.J., and Stuart, C.G., 1982, Water resources data—Louisiana, water year 1982, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-82-2, 404 p.

Collier, D.L., 2002, Ground-water and related publications of the Louisiana District of the U.S. Geological Survey, 1904-2000: Louisiana Department of Transportation and Development Water Resources Special Report no. 14, 182 p.

Collier, D.L., 1999, Water resources publications of the U.S. Geological Survey, 1904-98: Louisiana Department of Transportation and Development Water Resources Special Report no. 13, 155 p.

Dantin, L.J., Garrison, C.R., and Lovelace, W.M., 1994, Water resources data—Louisiana, water year 1993: U.S. Geological Survey Water-Data Report LA-93-1, 458 p.

Demas, C.R., 1983, Hydrology, water quality, and biology of Baptiste Collette Bayou in relation to the lower Mississippi River at Venice, Louisiana: Department of Transportation and Development, Office of Public Works Water Resources Technical Report no. 31, 49 p.

Demas, C.R., 1976, Analyses of native water, bed material, and elutriate samples of major Louisiana waterways, 1975: U.S. Geological Survey Open-File Report 76-853, 304 p.

Demas, C.R., and Curwick, P.B., 1987, Suspended-sediment, bottom-material, and associated chemical data from the lower Mississippi River, Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 14, 117 p.

Demas, C.R., and Higgins, P.C., 1977, Analyses of native water and dredged material from southern Louisiana waterways, 1975-76: U.S. Geological Survey Open-File Report 77-503, 180 p.

Duncan, A.C., 1967, Chemical quality of surface waters of Louisiana 1959-63: Louisiana Department of Public Works Basic Records Report no. 2, 137 p.

Dupuy, A.J., and Couvillion, N.P., 1979, Analyses of native water, bottom material, and elutriate samples of southern Louisiana waterways, 1977-78: U.S. Geological Survey Open-File Report 79-1484, 414 p.

Garrison, C.R., Goree, B.B., Lovelace, W.M., Montgomery, P.A., and Resweber, J.C., 1999, Water resources data—Louisiana, water year 1998: U.S. Geological Survey Water-Data Report LA-98-1, 547 p.

Garrison, C.R., Goree, B.B., Lovelace, W.M., Montgomery, P.A., and Resweber, J.C., 1998, Water resources data—Louisiana, water year 1997: U.S. Geological Survey Water-Data Report LA-97-1, 495 p.

Garrison, C.R., Lovelace, W.M., and Montgomery, P.A., 1996, Water resources data—Louisiana, water year 1995: U.S. Geological Survey Water-Data Report LA-95-1, 510 p.

Garrison, C.R., Lovelace, W.M., and Montgomery, P.A., 1996 [1997], Water resources data—Louisiana, water year 1996: U.S. Geological Survey Water-Data Report LA-96-1, 500 p.

Garrison, C.R., Lovelace, W.M., and Montgomery, P.A., 1995, Water resources data—Louisiana, water year 1994: U.S. Geological Survey Water-Data Report LA-94-1, 547 p.

Garrison, C.R., Seanor, R.C., Walters, D.J., and Arcement, G.J., Jr., 1995, Louisiana water-resources conditions, October 1993 through September 1994: Louisiana Department of Transportation and Development Water Resources Special Report no. 10, 24 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Labbe, C.K., and Walters, D.J., 2003, Water resources data—Louisiana, water year 2002: U.S. Geological Survey Water-Data Report LA-02-1, 671 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Sasser, D.C., Jr., and Walters, D.J., 2001, Water resources data—Louisiana, water year 2000: U.S. Geological Survey Water-Data Report LA-00-1, 563 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., Sasser, D.C., Jr., and Walters, D.J., 2002, Water resources data—Louisiana, water year 2001: U.S. Geological Survey Water-Data Report LA-01-1, 638 p.

Goree, B.B., Lovelace, W.M., Montgomery, P.A., Resweber, J.C., and Walters, D.J., 2000, Water resources data—Louisiana, water year 1999: U.S. Geological Survey Water-Data Report LA-99-1, 635 p.

Marsh, R.E., 1939, Reports on the Surface Water Supply of Louisiana to September 30, 1938: Louisiana Geological Survey Geology Bulletin #16, 198 pp.

U.S. Geological Survey, 1965, Water resources data for Louisiana, Part 1. Surface water records: U.S. Geological Survey, 162 p.

U.S. Geological Survey, 1965, Water resources data for Louisiana, Part 2. Water quality records: U.S. Geological Survey, 46 p.

U.S. Geological Survey, 1966, Water resources data for Louisiana, Part 1. Surface water records: U.S. Geological Survey, 157 p.

U.S. Geological Survey, 1966, Water resources data for Louisiana, Part 2. Water quality records: U.S. Geological Survey, 63 p.

U.S. Geological Survey, 1967, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 266 p.

U.S. Geological Survey, 1968, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 245 p.

U.S. Geological Survey, 1969, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 262 p.

U.S. Geological Survey, 1970, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 239 p.

U.S. Geological Survey, 1971, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 218 p.

U.S. Geological Survey, 1972, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 226 p.

U.S. Geological Survey, 1973, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 315 p.

U.S. Geological Survey, 1974, Water resources data for Louisiana, Part 1. Surface water records; Part 2. Water quality records: U.S. Geological Survey, 473 p.

U.S. Geological Survey, 1975, Index to water resources data for Louisiana, surface-water records, water-quality records: Louisiana Department of Public Works Water Resources Basic Records Report no. 8, 81 p.

U.S. Geological Survey, 1975, Water resources data for Louisiana, water year 1975: U.S. Geological Survey Water-Data Report LA-75-1, 816 p.

U.S. Geological Survey, 1975, Ground-water levels in Louisiana for wells measured through 1974: Louisiana Department of Public Works Water Resources Basic Records Report no. 7, 548 p.

U.S. Geological Survey, 1976, Water resources data for Louisiana, water year 1976, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-76-1, 463 p.

U.S. Geological Survey, 1976, Water resources data for Louisiana, water year 1976, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-76-2, 826 p.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-77-1, 405 p.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-77-2, 393 p.

U.S. Geological Survey, 1977, Water resources data for Louisiana, water year 1977, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-77-3, 578 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-78-1, 412 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-78-2, 365 p.

U.S. Geological Survey, 1978, Water resources data for Louisiana, water year 1978, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-78-3, 326 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-79-1, 426 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-79-2, 461 p.

U.S. Geological Survey, 1979, Water resources data for Louisiana, water year 1979, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-79-3, 284 p.

U.S. Geological Survey, 1980, Water resources data for Louisiana, water year 1980, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-80-1, 526 p.

U.S. Geological Survey, 1980, Water resources data for Louisiana, water year 1980, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-80-2, 371 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 1. Central and northern Louisiana: U.S. Geological Survey Water-Data Report LA-81-1, 424 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 2. Southern Louisiana: U.S. Geological Survey Water-Data Report LA-81-2, 327 p.

U.S. Geological Survey, 1981, Water resources data—Louisiana, water year 1981, volume 3. Coastal Louisiana: U.S. Geological Survey Water-Data Report LA-81-3, 218 p.

Pumpage of Water in Louisiana

Use of groundwater in northern parishes of Louisiana has been determined by parish, category of use and aquifer in a series of ten reports by the US Geological Survey. These reports summarize groundwater use every five years 1960 to 2005 (Snider and Forbers, 1961; Bieber and Forbes, 1966; Dial, 1970b; Cardwell and Walter, 1979; Walter, 1982; Lurry, 1987; Lovelace, 1991; Lovelace and Johnson, 1996; and Sargent 2002 and 2007). From the very first report groundwater use was reported by parish (Snider and Forbes, 1961). The first report included six categories of use: public supplies, industrial, rural domestic, livestock, rice irrigation and general irrigation (other crops) (Snider and Forbes, 1961). Dial (1970b) added a seventh category of use Thermoelectric (power generation) for the report of 1970 groundwater use. An eight and last category, aquaculture, of groundwater use was added for the report of use in 1980 (Walter, 1982). The first report of groundwater use by aquifer appears in the report of 1985 water use, but only for the whole aquifer (Lurry, 1987). Lovelace's (1991) report on 1990 groundwater use is the first of the last four reports which included amount of water withdrawn from each of the major aquifer consider by individual parish. There are 13 aquifers included in Lovelace (1991) report they are: Carrizo-Wilcox, Catahoula, Chicot, Chicot Equivalent of southeast Louisiana, Cockfield, Evangeline, Evangeline Equivalent of southeast Louisiana, Jasper, Jasper Equivalent of southeast Louisiana, Mississippi River Alluvial, Northern Louisiana Terrace, Red River Alluvial, and Sparta. In addition, Lovelace (1991) started the practice of noting for each parish withdrawals from individual public suppliers and by major industrial groups.

Water use data for public-supply, industrial and power-generation categories was obtained directly from the facilities. The rural-domestic use was determined by multiplying population as determined from census data by an estimate of 80 gallons per person per day of use (Sargent, 2007). For irrigation use data was a combination of acreage data and application rate data. Application rate data was collected from US consolidated farm service agency collected from farmers during the spring, which is when most of the application of water occurs. Acreage data is determined from irrigation survey within the national agricultural statistics service reports (Sargent, 2007). Determination of aquaculture use was determined from application rate and acreage data determined by the Louisiana Cooperative Extension Service (Sargent, 2007). Livestock use was determined from livestock population and rate of use data provide by county agents (Cardwell and Walter, 1979).

Bibliography

Bieber, P.P., and Forbes, M.J., Jr., 1966, Pumpage of water in Louisiana, 1965: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Pamphlet no. 20, 8 p.

Cardwell, G.T., and Walter, W.H., 1979, Pumpage of water in Louisiana, 1975: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 2, 15 p.

Dial, D.C., 1970, Public water supplies in Louisiana: Louisiana Department of Public Works Basic Records Report no. 3, 460 p.

Dial, D.C., 1970, Pumpage of Water in Louisiana, 1970: Louisiana Geological Survey Water Resources Pamphlets #26, 10 pp.

Lovelace, J.K., 1991, Water use in Louisiana, 1990: Louisiana Department of Transportation and Development Water Resources Special Report no. 6, 131 p.

Lovelace, J.K., and Johnson, P.M., Water use in Louisiana, 1995: Louisiana Department of Transportation and Development Water Resources Special Report no. 11, 127 p.

Lurry, D.L., 1985, Public water supplies in Louisiana, volume 1: Northern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 13, 119 p.

Lurry, D.L., 1987, Pumpage of water in Louisiana, 1985: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 4, 14 p.

Lurry, D.L., 1987, Pumpage of water in Louisiana, 1985: U.S. Geological Survey Water-Resources Investigations Report 87-4059, 1 sheet.

Sargent, B.P., 2007, Water use in Louisiana, 2005: Louisiana Department of Transportation and Development Water Resources Special Report no. 15, 133 p.

Sargent, B.P., 2002, Water use in Louisiana, 2000: Louisiana Department of Transportation and Development Water Resources Special Report no. 15, 133 p.

Snider, J.L., and Forbes, M.J., Jr., 1961, Pumpage of water in Louisiana, 1960: Louisiana Department of Public Works, Department of Conservation, and Louisiana Geological Survey, 6 p.

Stuart, C.G., and Lurry, D.L., 1988, Public water supplies in Louisiana, volume 2: Southern Louisiana: Louisiana Department of Transportation and Development Water Resources Basic Records Report no. 16, 206 p.

Walter, W.H., 1982, Pumpage of water in Louisiana, 1980: Louisiana Department of Transportation and Development, Office of Public Works Water Resources Special Report no. 3, 15 p.

Haynesville Shale Play Water Use Database

The water used for drilling and hydraulic fracture stimulation is reported (form WH-1) to the DNR Office of Conservation by exploration firms drilling and fracturing the Haynesville shale in northwest Louisiana. Data has been collected since September, 2009. As of August 25, 2010, the DNR database had 567 reported volumes of water used for fracturing the Haynesville shale Fig. 37). The data also includes the source of the groundwater used (Fig. 38) and of the surface water used (Fig. 39).

Total Maximum Daily Load (TMDL) Program in Louisiana

The Total Maximum Daily Load (TMDL) Program at the DEQ has been preparing for the USEPA under Section 303d of the Federal Clean Water Act (promulgated in1972) TMDLs for stream subsegments in Louisiana's watershed. The program was initiated in 2002 and the work is targeted to be completed in 2012. The program involves establishing 1711 TMDLs for 349 water bodies. The DEQ has completed the TMDS for the Mississippi River Delta, Atchafalaya-Vermilion-Teche Rivers, Sabine River, Red River, Pearl River, and Mississippi River. It is in the process of completing the Pontchartrain-Maurepas Lakes TMDLs. The reports are store on the DEQ website (http:/www.deq.louisiana.gov/portal/). Based upon this information, the DEQ has identified watershed subsegments which exhibit impairments (Figure 40).

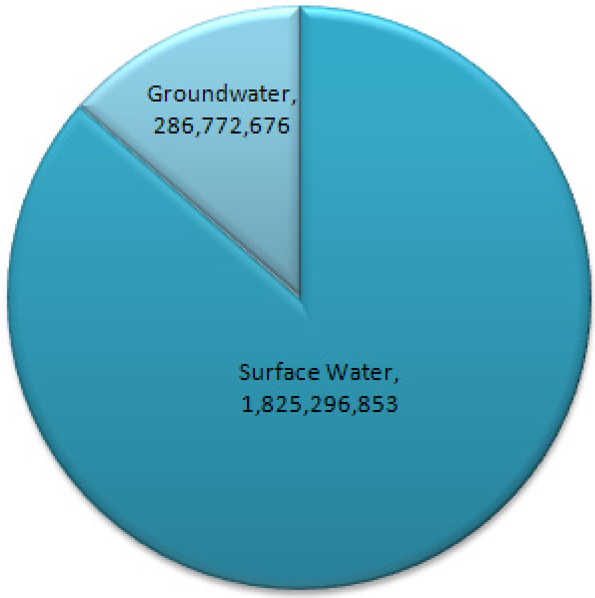


Figure 37: Distribution of source water from WH-1 submittals (source of data: DNR WH-1 forms)

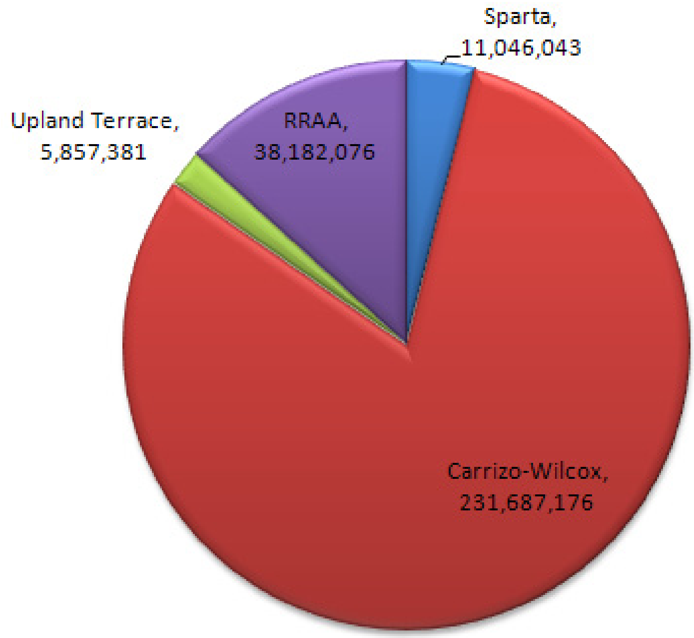


Figure 38: Distribution of source water from WH-1 submittals (source of data: DNR WH-1 forms)

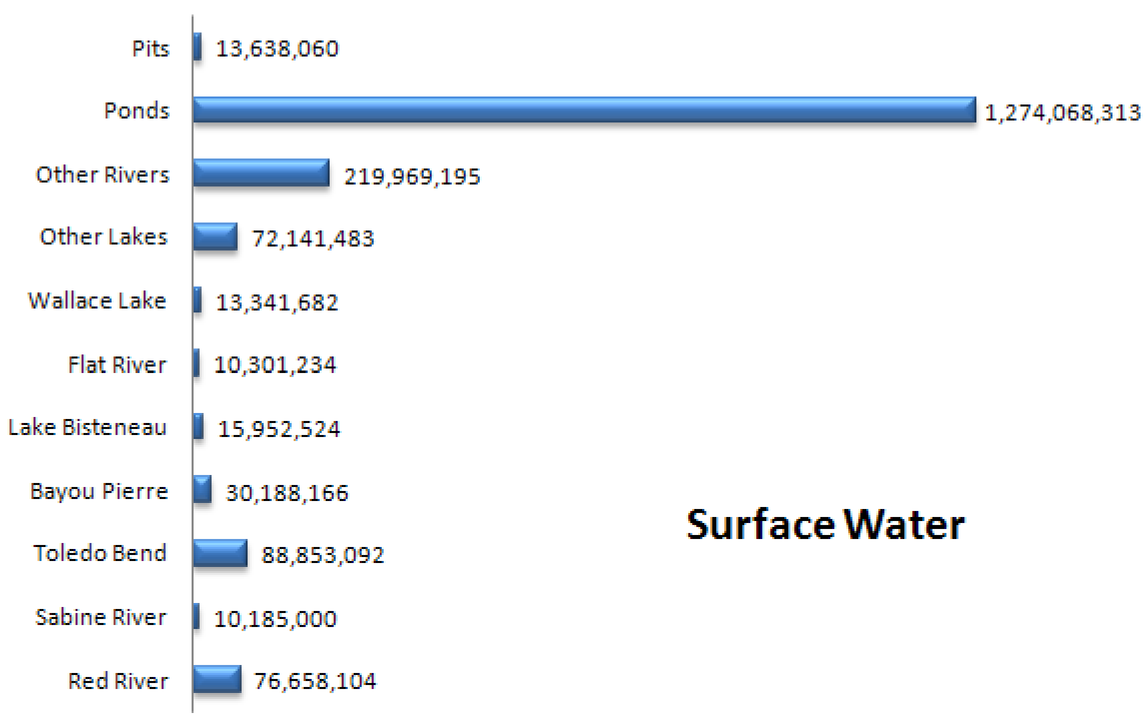


Figure39: Distribution of aquifer source water from WH-1 submittals (source of data: DNR WH-1 forms)

Statewide Water Use

Public water and industrial are two of the main consumers of water in the State of Louisiana (Tables 20 and 21). Although other consumers are locally important (e.g. agriculture/aquaculture in the CAS and MRAA, power generation along the Mississippi River), these will not be discussed in detail as they are either season or highly concentrated. Public water supply usage account for 7% of the total water used in 2005 (22% of the groundwater and 4.2% of the surface water withdrawn). Industrial usage account for 30% of the total water used in 2005 (17% of the groundwater and 33% of the surface water withdrawn)

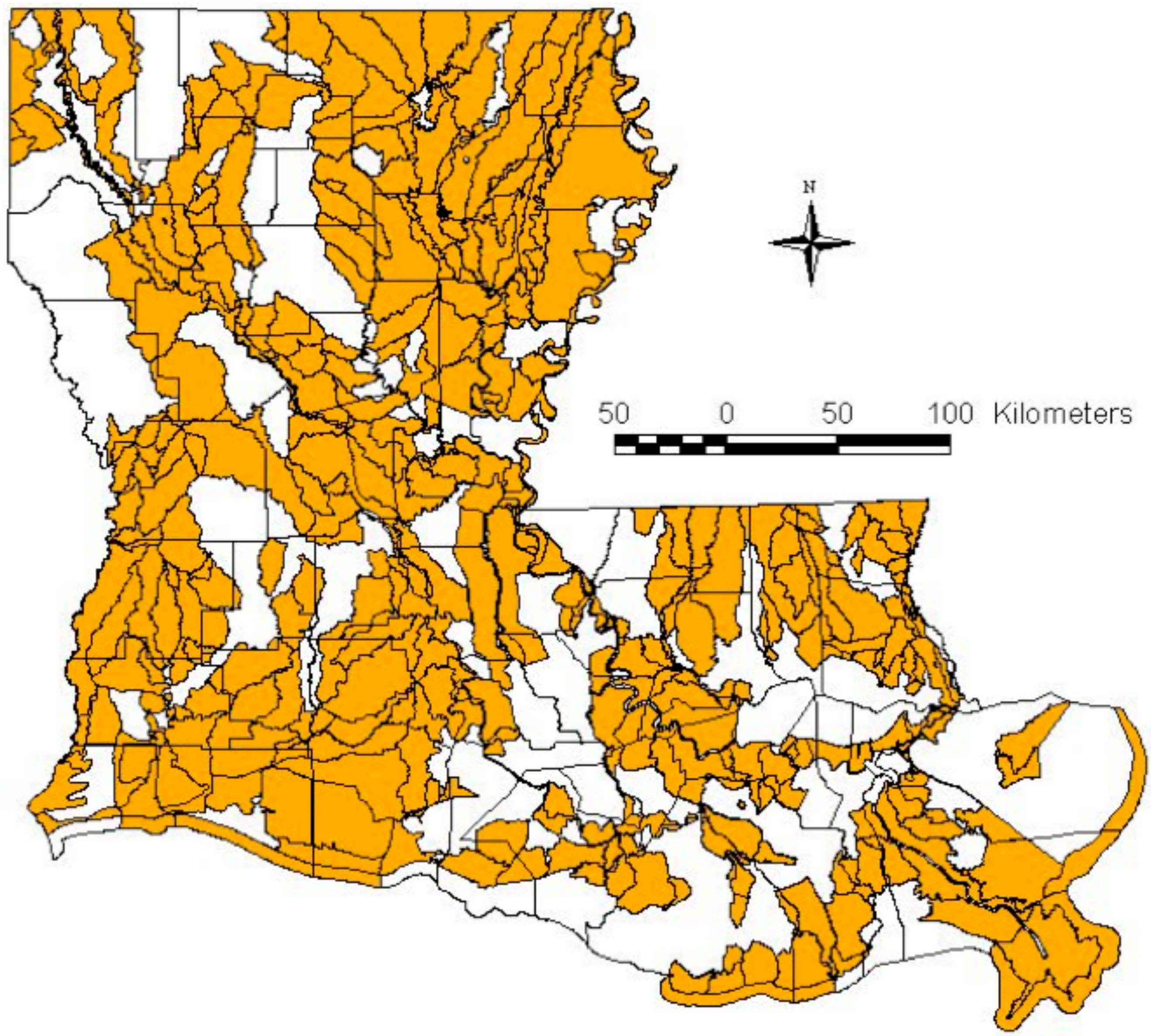


Figure 40: Stream subsegments exhibiting impairments (source of data: DEQ TMDL Program)

Table 20. 2005 Estimated Water Use in Louisiana

User	Groundwater		Surface Water		Total	
	(MGD)	(%)	(MGD)	(%)	(MGD)	(%)
Public Supply	353.65	22%	365.34	4%	718.99	7%
Industry	266.65	17%	2843.45	33%	3110.09	30%
Power Generation	16.66	1%	5138.78	59%	5155.44	50%
Rural Domestic	43.68	3%	0	0%	43.68	<1%
Livestock	4.18	<1%	3.82	<1%	8	<1%
Rice Irrigation	526.42	33%	260.89	3%	787.3	8%
General Irrigation	158.08	10%	46.74	1%	204.83	2%
Aquaculture	202.66	13%	68.39	1%	271.05	3%
Total	1571.98	100%	8727.4	100%	10299.4	100%
	15%		85%		100%	

Source: Sargent, 2007

Statewide Water Use

Public Groundwater Use

In 1960, groundwater resources represented an estimated 19% (1,029 MGD) of the total water consumed in Louisiana (5,415 MGD). By 2005, the groundwater portion had decrease to 15% (1,572 MGD) of the total water consumed in Louisiana (10,299 MGD). The public (non-domestic) groundwater supply use represented 9% of the groundwater withdrawn in 1960 and 22% in 2005 (7% of the total water used). Of the 477 public groundwater suppliers who reported water usage in 1990 (the first time the USGS reported the name of water utilities) and, again, in 2005, 296 exhibited an increase, 126 exhibited a decrease and 55 exhibited no change (Appendix D). The increases range between 2 and 95%, and the decreases range between -4,400 and -1%. Using the per capita usage for utilities reporting people served in 2005 (Appendix E), the average water used per person supplied by a public utility was 0.57 MGD, or 114 gallons per day per person (G/D/P).

Table 21. 2010 Preliminary/Incomplete Estimates of Water Use in Louisiana

User	Groundwater		Surface Water		Total	
	(MGD)	(%)	(MGD)	(%)	(MGD)	(%)
Public Supply	607.57	29%	1453.74	71%	2061.31	6%
Industry	563.89	7%	7570.12	93%	8134.01	25%
Power Generation	75.06	<1%	22788.84	>99%	22863.90	69%
Rural Domestic						
Livestock						
Rice Irrigation						
General Irrigation						
Aquaculture						
Total	1246.52	100%	31812.70	100%	33,059.22	100%
	4%		96%		100%	

Source: USGS

Non-Public Groundwater Use

The industrial groundwater use represented 37% of the groundwater withdrawn in 1960 (7% of the total water used) and 17% in 2005 (30% of the total water used). The industrial water use reported by parish in 1960 and in 2005 was compared to evaluate overall trend. There was an average increase of 248% in water consumed over the 45-year time period (Appendix F).

Public Surface Water Use

In 1960, surface water resources represented an estimated 81% (4,387 MGD) of the total water consumed in Louisiana (5,417 MGD). By 2005, the surface water portion had increased to 84% (8,700 MGD) of the total water consumed in Louisiana (10,300 MGD). The public (non-domestic) surface water supply use represented 4% of the surface water withdrawn in 1960 and remained at 4% in 2005 (7% of the total water used). Of the 44 public surface water suppliers who reported water usage both in 1990 (the first time the USGS reported the name of water utilities) and, again, in 2005, 14 exhibited an increase, 29 exhibited a decrease and one exhibited no change (Appendix G). The increases range between 1 and 310%, and the decreases range between -60 and -2%. Using the per capita usage for utilities reporting people served in 2005 (Appendix H), the average water used by a person supplied per public utility was 6.95 MGD, or 156 gallons per day per person (G/D/P).

Non-Public Surface Water Use

The industrial surface water use represented 84% of the surface water withdrawn in 1960 (68% of the total water used) and 33% in 2005 (30% of the total water used). The industrial water use reported by parish in 1960 and in 2005 was compared to evaluate overall trend. There was an average increase of 596% in water consumed over the 45-year time period (Appendix I).

CLIMATIC DATA

Most of the State of Louisiana lies under a hot, humid subtropical climate (Ning and Abdollahi, 2001). The precipitation, temperature and Palmer Drought Severity Index data is plotted for six regions (northwest, north central, northeast, west central, central, east central, southwest, south central and southeast). The data presented in this report represents a monthly average. The data is time-bias corrected, indicating that this data is an average (equal weight) of all the weather stations within each region reporting both temperature and precipitation. This data was corrected to standardize the observation times (e.g. time of data collection).

Precipitation

The average monthly precipitation data presented covers the period of January 1895 to January 2010 (Figure 41). The data shows that for all six regions precipitation is increasing at a small, but quantifiable rate. The observed monthly increase ranges from 0.43 in. (north central) to 0.72 in. (northeast). Rainfall (~57 in.) through Louisiana is relatively evenly distributed during the year. However, Faiers et al, 1996 indicate that the most storm of with the greatest precipitation occur during the spring, and the least during the winter. This is with the exception of New Orleans, where the fewest storms occurred during the summer.

Temperature

The average monthly temperature data presented covers the period of January 1895 to January 2010 (Figure 42). The data shows that for the southern half of the state (east central, southwest, south central and southeast) the temperature is increasing at a small, but quantifiable rate. In the northern portion of the state, the trend shows no change, or a very slight decrease. Crowe and Quayle (2000) report over the past ten years a 1.5°F increase for the daily minimum temperature, and 0.7°F for the daily maximum temperature.

Values between -1.9 and +1.9 are near normal, -4 or less represent extreme drought and +4 or more extremely moist conditions.

Drought

The average monthly Palmer Drought Severity Index data presented covers the period of January 1895 to January 2010 (Figure 43). The PDSI is based upon temperature and precipitation. It is considered to be a good index for long duration drought. Values between -1.9 and +1.9 are near normal, values of -4 or less represent extreme drought and values of +4 or more represents extremely moist conditions. The data shows that for the northern half of the state severe droughts were more common in the first half of last century. In the southern half of the state droughts were more common in the second half of last century.

Climatic Change

Based upon Figures 41, 42 and 43, as well as other authors (Faiers et al, 1997; Ning and Abdolllahi, 2001) it can be stated that quantifiable climatic changes have occurred during the period of record (approximately the last 115 years). Ning and Abdolllahi (2001), in their section of the "Potential Consequences of Climate Variability and Change," prepared by the National Assessment Synthesis Team of the U.S. Global Change Research Program mandated by the U.S. Congress in 2990, report that for the Gulf Coast region of the U.S., the following can be stated:

- Temperatures are rising. Daily minimum temperatures are rising faster than daily maximum temperatures, and winter temperatures faster than summer temperatures.

- Precipitation is increasing and storm events have greater intensity.

- Extra-tropical storms are stronger.

- Sea-level is rising.

Similarly, Faiers et al (1997) indicates that there is an increasing frequency of heavy rainfall events in Louisiana, resulting in record stream peak stages and floods. Keim et al (2007) reports that the northern half in the state will most likely see an increase precipitation during the winter and spring, while the southern half during the summer-fall. Both increases are reported to result in increasing runoff in the northern half of the state, which has less surface storage capacity.

Bibliography

Crow, M. and Quayle, R., 2000, Observed climate trends for the globe and the southeastern United States. In Current Stress and Potential Vulnerability-Implications of Global Climate Change for the Gulf Coast Region, Ning, Z. and Abdollahi, K. eds: GCRCC and Franklin Press, Baton Rouge, LA.

Faiers, G., Keim, B. and Muller, R., 1997, Rainfall frequency/magnitude atlas for the south-central United States: Southern Regional Climate Center Technical Report 97-1.

Keim, B. D., Faiers, G. E., Muller, R. A., Grymes, J. M. and Rohli, R. V., 1995, Long-term trends of precipitation and runoff in Louisiana, USA. International Journal of Climatology, 15: 531–541.

Keim, B. and Muller, R., 1992, Temporal fluctuations of heavy rainfall magnitudes in New Orleans, Louisiana: 1871-1991: American Water Resources Association Water Resources Bulletin vol. 28(4), p. 721-730.

NCDC (National Climatic Data Center), 2010, Online Climate Data Directory, http://www.ncdc.noaa.gov/oa/climate/climatedata.html, http://www.ncdc.noaa.gov/oa/climate/climatedata.html, accessed 7/21/2010.

Ning, Z. and Abdollahi, K., 2001, Chapter 5: Gulf coast regional climate, in Climate Change Impacts on the United States. The Potential Consequences of Climate Variability and Change, by the National Assessment Synthesis Team, US Global Change Research Program: US Global Change Research Program, Washington, DC, p. 79-82.

Poore, R., Dowsett, H. and Verardo, S., 2003, Millennial- to century-scale variability in Gulf of Mexico Holocene climate records: Paleoceanography vol. 18(2), 13 p.

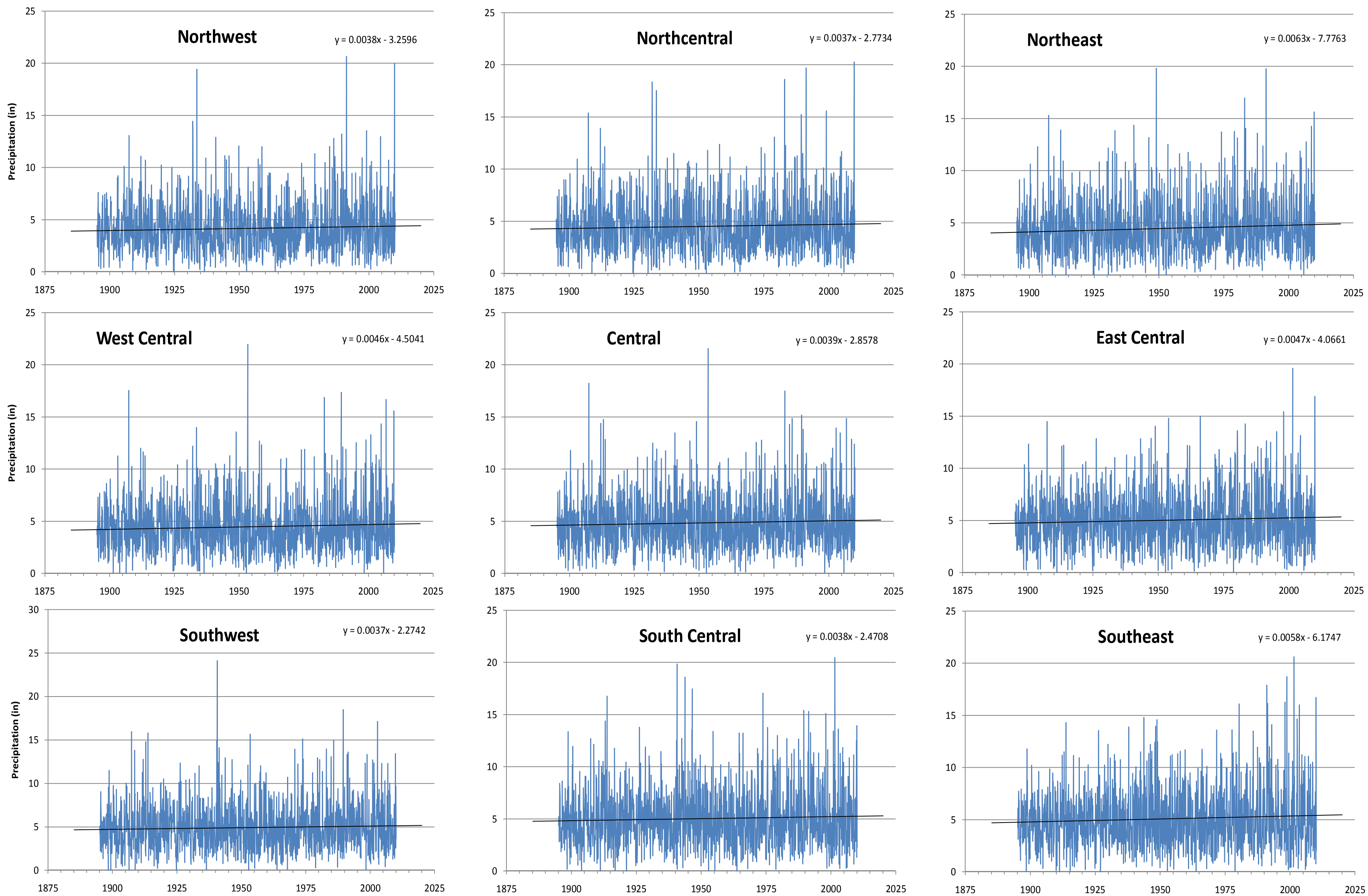


Figure 41. Time-biased corrected precipitation data in inches (source of the data: NOAA-NCDC, accessed 7/21/2010)

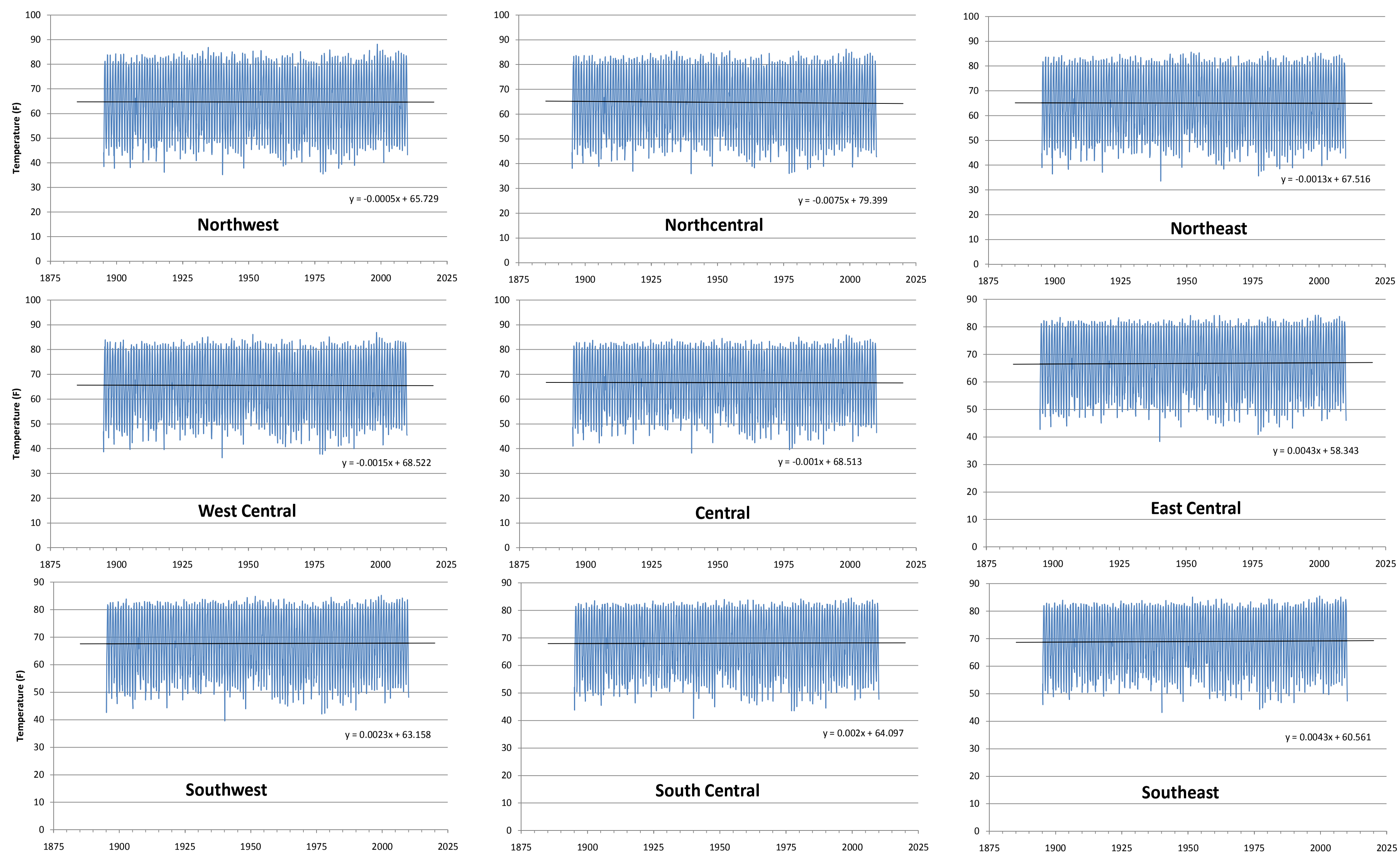


Figure 42. Time-biased corrected precipitation data in degree Fahrenheit (source of the data: NOAA-NCDC, accessed 7/21/2010)

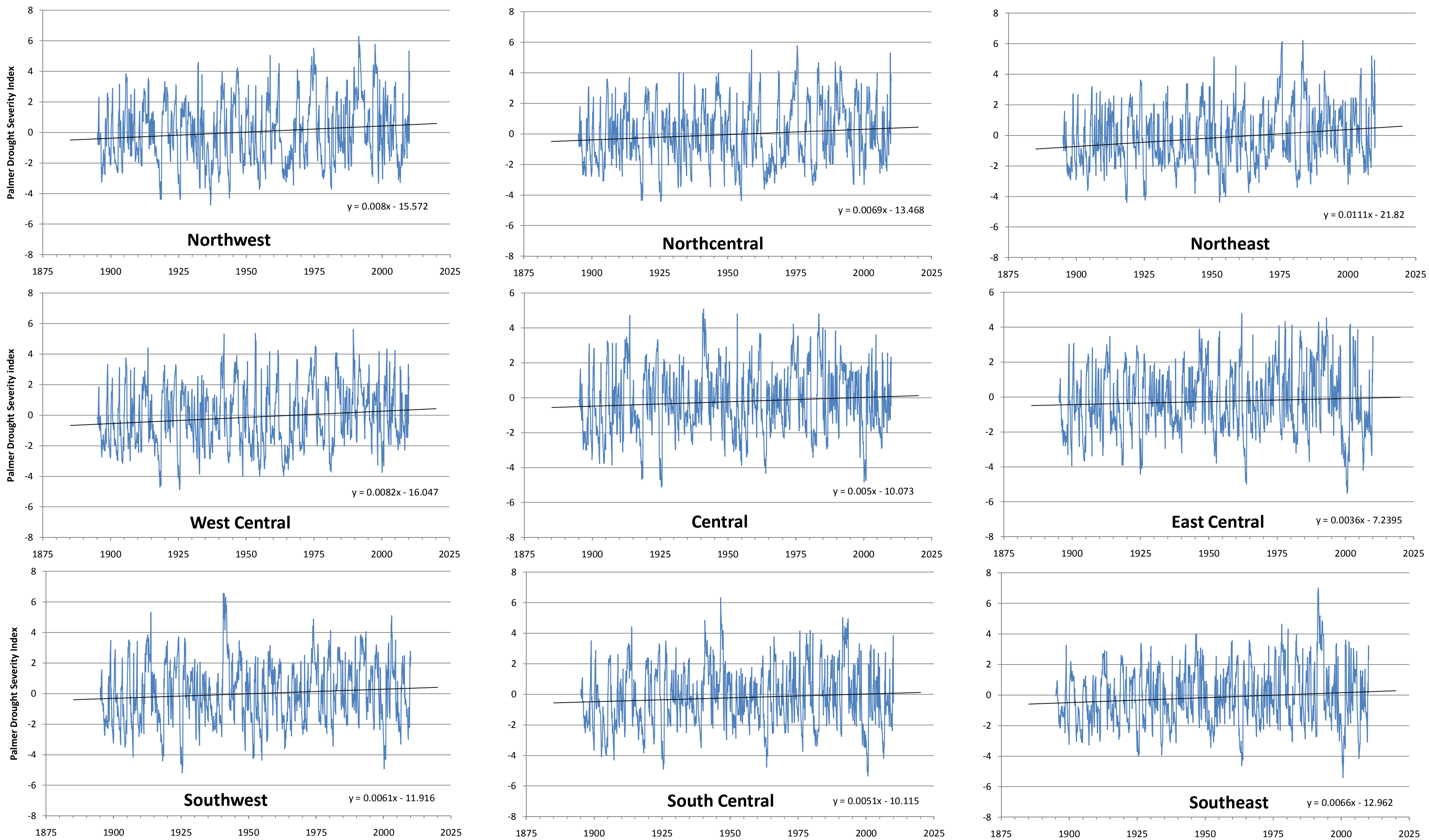


Figure 43. Time-biased corrected Palmer Drought Severity Index (source of the data: NOAA-NCDC, accessed 7/21/2010)

Appendix A:

Glossary of Technical Terms

Term	Definition
Alluvial	Material deposited by flowing water (e.g. stream, rivers, etc.).
Aquifer	A geological deposit capable of producing a sufficient/significant amount of usable water.
Aquifer System	Aggregate of individual sands/aquifer under one name regardless to Stratigraphic position.
Drainage basin	Geographic area which collects the water drained by a stream or river.
equivalent	Used to correlate geologic deposits of different provenance but of similar age.
freshwater	Water containing less than 1000 mg/L of total dissolved solids.
gaging	The measurement of surface water elevation and/or discharge.
Hydraulic Conductivity	The property of a material which defines the ability of a liquid to flow through an aquifer under an hydraulic gradient (ft/sec).
Mean	Arithmetic average of a set of number.
Permeability	The capacity of a rock or sediment to transmit a fluid.
Porosity	The volume of empty space in a rock or sediment.
Potentiometric surface	The surface which represents the total hydraulic head values (e.g. water level measured in a well) in an aquifer.
Recharge	The process of replenishing an aquifer with water (e.g. precipitation infiltrating the ground)
Saline water	Water which has a chloride concentration in excess of the USEPA Secondary Standard of 250 mg/L.
Specific capacity test	The rate of water discharged (at a certain pumping rate) per feet of drawdown (gpm/ft)
Stratigraphy	The arrangement (e.g. succession), distribution, lithology, composition, fossil content, and properties of geological material.
Surface water	Water resources of good quality found at the ground surface.
Transmissivity	The capacity of an aquifer to transmit a fluid.
Watershed	The area which is drained by a stream, river, lake or other water body.

Source: AGI Glossary of Geology, Fourth Edition (1997)

Appendix B: Water Well Registration Database

CARRIZO-WILCOX AQUIFER

Code	Well Use	124WLCX	124WLCXU	124DLHL	124NBRN	124CRRZ	124CRWL	124CRWLC		Total per Use
--	Unknown	-	-	-	-	-	-	-		**-**
B--	Borehole/Pilot Hole	-	-	-	-	-	-	-		**-**
B-A	Borehole/Pilot Hole - Abandoned	-	-	-	-	-	-	-		**-**
B-D	Borehole/Pilot Hole - Destroyed	-	-	-	-	-	-	-		**-**
BEX	Borehole/Pilot Hole - Excavated out	-	-	-	-	-	-	-		**-**
BPA	Borehole/Pilot Hole - Plugged	-	-	-	-	-	-	-		**-**
C--	Cathodic	-	-	-	-	-	-	-		**-**
C-D	Cathodic - Destroyed	-	-	-	-	-	-	-		**-**
CPA	Cathodic - Plugged	1	-	-	-	-	-	-		**1**
D--	Dewatering	9	-	-	-	-	-	-		**9**
D-A	Dewatering - Abandoned	-	-	-	-	-	-	-		**-**
D-D	Dewatering - Destroyed	-	-	-	-	-	-	-		**-**
DEX	Dewatering - Excavated	448	-	-	-	-	-	-		**448**
D-I	Dewatering - Inactive/Standby	-	-	-	-	-	-	-		**-**
DPA	Dewatering - Plugged	73	-	-	-	-	-	-		**73**
E--	Power Generation	-	-	-	-	-	-	-		**-**
E-A	Power Generation - Abandoned	-	-	-	-	-	-	-		**-**
EPA	Power Generation - Plugged	-	-	-	-	-	-	-		**-**
H--	Domestic	6,916	3	16	20	16	3	1		**6,975**
H-A	Domestic - Abandoned	19	-	1	-	-	-	-		**20**
H-D	Domestic - Destroyed	9	-	-	-	1	-	-		**10**
HEX	Domestic - Excavated	-	-	-	-	-	-	-		**-**
H-I	Domestic - Inactive/Standby	12	-	-	-	-	-	-		**12**
HPA	Domestic - Plugged	291	-	-	-	-	-	7		**298**
I--	Irrigation	168	-	-	-	-	-	-		**168**
I-A	Irrigation - Abandoned	1	-	-	-	-	-	-		**1**
I-D	Irrigation - Destroyed	1	-	-	-	-	-	-		**1**
I-I	Irrigation - Inactive/Standby	3	-	-	-	-	-	-		**3**
IPA	Irrigation - Plugged	2	-	-	-	-	-	-		**2**
I-Q	Irrigation - Aquaculture	1	-	-	-	-	-	-		**1**
I-S	Irrigation - Stock	93	-	-	2	2	-	-		**97**
LHH	Heat Pump - Hole	-	-	-	-	-	-	-		**-**
LHS	Heat Pump - Supply Well	6	-	-	-	-	-	-		**6**
LPA	Heat Pump - Plugged	-	-	-	-	-	-	-		**-**
M--	Monitor	125	-	-	-	-	4	373		**502**
M-A	Monitor - Abandoned	-	-	-	-	-	-	-		**-**
M-D	Monitor - Destroyed	1	-	-	-	-	-	5		**6**
MEX	Monitor - Excavated	2	-	-	-	-	-	22		**24**
M-I	Monitor - Inactive/Standby	-	-	-	-	-	-	-		**-**
MPA	Monitor - Plugged	109	-	-	-	-	3	453		**565**
N20	Industrial - Food and Kindred Products	2	-	-	-	-	-	-		**2**
N22	Industrial - Textile Mill Products	1	-	-	-	-	-	-		**1**
N24	Industrial - Lumber & Wood Products	11	-	1	-	-	-	-		**12**
N26	Industrial - Paper & Allied Products	2	-	-	-	-	-	-		**2**
N28	Industrial - Chemical & Allied Products	3	-	-	-	-	-	-		**3**
N29	Industrial - Petroleum Refining & Related Products	10	-	-	-	-	-	-		**10**
N33	Industrial - Primary Metal Industry	2	-	-	-	-	-	-		**2**
N99	Industrial - Other	115	-	2	1	4	3	-		**125**
N-A	Industrial - Abandoned	13	-	-	-	-	1	-		**14**
N-D	Industrial - Destroyed	13	-	-	-	-	-	-		**13**
N-I	Industrial - Inactive/Standby	4	-	-	-	-	-	-		**4**
NPA	Industrial - Plugged	32	-	-	-	1	-	-		**33**
O-A	Observation - Abandoned	7	-	-	-	-	-	-		**7**
O-D	Observation - Destroyed	1	-	-	-	-	-	-		**1**
OEX	Observation - Excavated	3	-	-	-	-	-	-		**3**

O-O	Observation - Multiple Purpose	29	-	-	-	1	-	-		**30**
OPA	Observation - Plugged	20	-	-	-	-	-	-		**20**
O-Q	Observation - Water Quality	-	-	-	-	-	-	-		**-**
O-W	Observation - Water Level	24	-	-	-	-	-	-		**24**
P-A	Public Supply - Abandoned	33	-	-	6	-	-	-		**39**
P-C	Public Supply - Commercial	113	-	-	-	1	-	-		**114**
P-D	Public Supply - Destroyed	10	-	-	1	2	-	-		**13**
PEX	Public Supply - Excavated	-	-	-	-	-	-	-		**-**
P-I	Public Supply - Inactive/Standby	8	-	-	-	1	-	-		**9**
P-M	Public Supply - Therapeutic	-	-	-	-	-	-	-		**-**
P-P	Public Supply - Municipal	76	-	-	-	13	-	-		**89**
PPA	Public Supply - Plugged	117	-	-	1	7	-	1		**126**
P-R	Public Supply - Rural	200	1	-	1	6	-	-		**208**
P-T	Public Supply - Institutional/Government	105	-	-	2	3	-	-		**110**
P-Z	Public Supply - Other	1	-	-	-	-	-	-		**1**
R--	Recovery	2	-	-	-	-	-	41		**43**
R-D	Recovery - Destroyed	-	-	-	-	-	-	-		**-**
REX	Recovery - Excavated	-	-	-	-	-	-	-		**-**
RPA	Recovery - Plugged	4	-	-	-	-	-	64		**68**
S--	Rig Supply	208	-	-	1	1	-	1		**211**
S-A	Rig Supply - Abandoned	3	-	-	-	-	-	-		**3**
S-D	Rig Supply - Destroyed	-	-	-	-	-	-	-		**-**
S-I	Rig Supply - Inactive/Standby	3	-	-	-	-	-	-		**3**
SPA	Rig Supply - Plugged	502	-	-	1	-	1	2		**506**
T--	Test Hole	7	-	-	-	-	-	-		**7**
T-A	Test Hole - Abandoned	2	-	-	-	-	-	-		**2**
T-D	Test Hole - Destroyed	-	-	-	-	-	-	-		**-**
TPA	Test Hole - Plugged	252	-	-	1	25	-	-		**278**
W--	Piezometers	41	-	-	-	-	5	16		**62**
W-D	Piezometers - Destroyed	1	-	-	-	-	-	-		**1**
WEX	Piezometers - Excavated	6	-	-	-	-	-	-		**6**
WPA	Piezometers - Plugged	86	-	-	-	-	2	69		**157**
Z-A	Other - Abandoned	22	-	-	2	-	-	-		**24**
Z-D	Other - Destroyed	2	-	1	-	2	1	-		**6**
Z-F	Other - Fire Protection	2	-	-	-	-	-	-		**2**
Z-I	Other - Inactive/Standby	15	-	-	-	-	-	-		**15**
ZPA	Other - Plugged	42	-	-	-	1	-	36		**79**
Z-R	Other - Reworked	-	-	-	-	-	-	-		**-**
Z-U	Other - Unknown	71	-	1	2	-	-	-		**74**
Z-Z	Other - Other	8	-	-	-	-	-	-		**8**
	Left Blank	-	-	-	-	-	-	-		**-**
	Total per Geounits	**10,524**	**4**	**22**	**41**	**87**	**23**	**1,091**		**11,792**

	CATAHOULA AQUIFER	
Code	Well Use	122CTHL
--	Unknown	-
B--	Borehole/Pilot Hole	-
B-A	Borehole/Pilot Hole - Abandoned	-
B-D	Borehole/Pilot Hole - Destroyed	-
BEX	Borehole/Pilot Hole - Excavated out	-
BPA	Borehole/Pilot Hole - Plugged	-
C--	Cathodic	-
C-D	Cathodic - Destroyed	-
CPA	Cathodic - Plugged	-
D--	Dewatering	-
D-A	Dewatering - Abandoned	-
D-D	Dewatering - Destroyed	-
DEX	Dewatering - Excavated	-
D-I	Dewatering - Inactive/Standby	-
DPA	Dewatering - Plugged	-
E--	Power Generation	-
E-A	Power Generation - Abandoned	-
EPA	Power Generation - Plugged	-
H--	Domestic	193
H-A	Domestic - Abandoned	5
H-D	Domestic - Destroyed	1
HEX	Domestic - Excavated	-
H-I	Domestic - Inactive/Standby	-
HPA	Domestic - Plugged	14
I--	Irrigation	1
I-A	Irrigation - Abandoned	1
I-D	Irrigation - Destroyed	-
I-I	Irrigation - Inactive/Standby	-
IPA	Irrigation - Plugged	-
I-Q	Irrigation - Aquaculture	-
I-S	Irrigation - Stock	9
LHH	Heat Pump - Hole	-
LHS	Heat Pump - Supply Well	-
LPA	Heat Pump - Plugged	-
M--	Monitor	6
M-A	Monitor - Abandoned	-
M-D	Monitor - Destroyed	-
MEX	Monitor - Excavated	-
M-I	Monitor - Inactive/Standby	-
MPA	Monitor - Plugged	5
N20	Industrial - Food and Kindred Products	-
N22	Industrial - Textile Mill Products	-
N24	Industrial - Lumber & Wood Products	-
N26	Industrial - Paper & Allied Products	-
N28	Industrial - Chemical & Allied Products	-
N29	Industrial - Petroleum Refining & Related Products	-
N33	Industrial - Primary Metal Industry	-
N99	Industrial - Other	7
N-A	Industrial - Abandoned	1
N-D	Industrial - Destroyed	-
N-I	Industrial - Inactive/Standby	-
NPA	Industrial - Plugged	1
O-A	Observation - Abandoned	1
O-D	Observation - Destroyed	-
OEX	Observation - Excavated	-
O-O	Observation - Multiple Purpose	8
OPA	Observation - Plugged	2
O-Q	Observation - Water Quality	-
O-W	Observation - Water Level	-

P-A	Public Supply - Abandoned	5
P-C	Public Supply - Commercial	4
P-D	Public Supply - Destroyed	2
PEX	Public Supply - Excavated	-
P-I	Public Supply - Inactive/Standby	1
P-M	Public Supply - Therapeutic	-
P-P	Public Supply - Municipal	19
PPA	Public Supply - Plugged	22
P-R	Public Supply - Rural	42
P-T	Public Supply - Institutional/Government	15
P-Z	Public Supply - Other	-
R--	Recovery	-
R-D	Recovery - Destroyed	-
REX	Recovery - Excavated	-
RPA	Recovery - Plugged	-
S--	Rig Supply	5
S-A	Rig Supply - Abandoned	-
S-D	Rig Supply - Destroyed	-
S-I	Rig Supply - Inactive/Standby	-
SPA	Rig Supply - Plugged	82
T--	Test Hole	2
T-A	Test Hole - Abandoned	3
T-D	Test Hole - Destroyed	12
TPA	Test Hole - Plugged	134
W--	Piezometers	-
W-D	Piezometers - Destroyed	-
WEX	Piezometers - Excavated	-
WPA	Piezometers - Plugged	8
Z-A	Other - Abandoned	1
Z-D	Other - Destroyed	-
Z-F	Other - Fire Protection	1
Z-I	Other - Inactive/Standby	-
ZPA	Other - Plugged	2
Z-R	Other - Reworked	1
Z-U	Other - Unknown	3
Z-Z	Other - Other	-
	Left Blank	-
	Total per Geounits	**619**

	Cockfield Aquifer				
Code	**Well Use**	**124CCKF**	**124CCKFC**		**Total per Use**
--	Unknown	-	-		**-**
B--	Borehole/Pilot Hole	-	-		**-**
B-A	Borehole/Pilot Hole - Abandoned	-	-		**-**
B-D	Borehole/Pilot Hole - Destroyed	-	-		**-**
BEX	Borehole/Pilot Hole - Excavated out	-	-		**-**
BPA	Borehole/Pilot Hole - Plugged	-	-		**-**
C--	Cathodic	-	-		**-**
C-D	Cathodic - Destroyed	-	-		**-**
CPA	Cathodic - Plugged	-	-		**-**
D--	Dewatering	-	-		**-**
D-A	Dewatering - Abandoned	-	-		**-**
D-D	Dewatering - Destroyed	-	-		**-**
DEX	Dewatering - Excavated	-	-		**-**
D-I	Dewatering - Inactive/Standby	-	-		**-**
DPA	Dewatering - Plugged	-	17		**17**
E--	Power Generation	-	-		**-**
E-A	Power Generation - Abandoned	-	-		**-**
EPA	Power Generation - Plugged	-	-		**-**
H--	Domestic	468	5		**473**
H-A	Domestic - Abandoned	4	-		**4**
H-D	Domestic - Destroyed	12	-		**12**
HEX	Domestic - Excavated	-	-		**-**
H-I	Domestic - Inactive/Standby	2	-		**2**
HPA	Domestic - Plugged	27	3		**30**
I--	Irrigation	39	-		**39**
I-A	Irrigation - Abandoned	-	-		**-**
I-D	Irrigation - Destroyed	-	-		**-**
I-I	Irrigation - Inactive/Standby	-	-		**-**
IPA	Irrigation - Plugged	-	-		**-**
I-Q	Irrigation - Aquaculture	4	-		**4**
I-S	Irrigation - Stock	13	-		**13**
LHH	Heat Pump - Hole	-	-		**-**
LHS	Heat Pump - Supply Well	-	-		**-**
LPA	Heat Pump - Plugged	-	-		**-**
M--	Monitor	53	213		**266**
M-A	Monitor - Abandoned	-	-		**-**
M-D	Monitor - Destroyed	2	-		**2**
MEX	Monitor - Excavated	-	3		**3**
M-I	Monitor - Inactive/Standby	-	-		**-**
MPA	Monitor - Plugged	50	304		**354**
N20	Industrial - Food and Kindred Products	-	-		**-**
N22	Industrial - Textile Mill Products	-	-		**-**
N24	Industrial - Lumber & Wood Products	13	-		**13**
N26	Industrial - Paper & Allied Products	-	-		**-**
N28	Industrial - Chemical & Allied Products	-	-		**-**
N29	Industrial - Petroleum Refining & Related Products	3	-		**3**
N33	Industrial - Primary Metal Industry	-	-		**-**
N99	Industrial - Other	20	-		**20**
N-A	Industrial - Abandoned	2	-		**2**
N-D	Industrial - Destroyed	-	-		**-**
N-I	Industrial - Inactive/Standby	-	-		**-**
NPA	Industrial - Plugged	17	-		**17**
O-A	Observation - Abandoned	-	-		**-**
O-D	Observation - Destroyed	10	-		**10**
OEX	Observation - Excavated	-	-		**-**
O-O	Observation - Multiple Purpose	21	-		**21**
OPA	Observation - Plugged	4	-		**4**
O-Q	Observation - Water Quality	-	-		**-**
O-W	Observation - Water Level	1	-		**1**

P-A	Public Supply - Abandoned	10	-		**10**
P-C	Public Supply - Commercial	7	-		**7**
P-D	Public Supply - Destroyed	6	-		**6**
PEX	Public Supply - Excavated	-	-		**-**
P-I	Public Supply - Inactive/Standby	1	-		**1**
P-M	Public Supply - Therapeutic	-	-		**-**
P-P	Public Supply - Municipal	52	-		**52**
PPA	Public Supply - Plugged	48	1		**49**
P-R	Public Supply - Rural	52	-		**52**
P-T	Public Supply - Institutional/Government	21	-		**21**
P-Z	Public Supply - Other	-	-		**-**
R--	Recovery	39	51		**90**
R-D	Recovery - Destroyed	-	-		**-**
REX	Recovery - Excavated	-	-		**-**
RPA	Recovery - Plugged	2	9		**11**
S--	Rig Supply	21	-		**21**
S-A	Rig Supply - Abandoned	1	-		**1**
S-D	Rig Supply - Destroyed	-	-		**-**
S-I	Rig Supply - Inactive/Standby	-	-		**-**
SPA	Rig Supply - Plugged	87	-		**87**
T--	Test Hole	1	-		**1**
T-A	Test Hole - Abandoned	1	-		**1**
T-D	Test Hole - Destroyed	-	-		**-**
TPA	Test Hole - Plugged	136	-		**136**
W--	Piezometers	12	23		**35**
W-D	Piezometers - Destroyed	-	-		**-**
WEX	Piezometers - Excavated	-	-		**-**
WPA	Piezometers - Plugged	3	19		**22**
Z-A	Other - Abandoned	-	-		**-**
Z-D	Other - Destroyed	-	-		**-**
Z-F	Other - Fire Protection	3	-		**3**
Z-I	Other - Inactive/Standby	-	-		**-**
ZPA	Other - Plugged	3	1		**4**
Z-R	Other - Reworked	-	-		**-**
Z-U	Other - Unknown	7	-		**7**
Z-Z	Other - Other	1	19		**20**
	Left Blank	-	-		**-**
					-
	Total per Geounits	**1,279**	**668**		**1,947**

MISSISSIPPI RIVER ALLUVIAL AQUIFER

		Southern Portion									Northern Portion				
Code	Well Use	112PLQM	111DLTCY	111NLLV	111PNBR	112ACFL	112DDMRO	112MRVA	112MRVAC	Total per Use	112ACFL	112MRVA	112MRVAC	Total per Use	Total per Use
--	Unknown	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B--	Borehole/Pilot Hole	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B-A	Borehole/Pilot Hole - Abandoned	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B-D	Borehole/Pilot Hole - Destroyed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BEX	Borehole/Pilot Hole - Excavated out	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BPA	Borehole/Pilot Hole - Plugged	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C--	Cathodic	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C-D	Cathodic - Destroyed	0	0	0	0	0	0	0	0	0	0	1	0	1	1
CPA	Cathodic - Plugged	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D--	Dewatering	0	0	1	0	7	0	123	0	131	0	463	0	463	594
D-A	Dewatering - Abandoned	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D-D	Dewatering - Destroyed	0	0	0	0	0	0	0	2	2	0	0	0	0	2
DEX	Dewatering - Excavated	0	0	0	0	0	0	0	0	0	0	3	0	3	3
D-I	Dewatering - Inactive/Standby	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DPA	Dewatering - Plugged	0	0	0	0	1	0	6	0	7	0	142	0	142	149
E--	Power Generation	0	0	0	0	0	0	4	0	4	0	0	0	0	4
E-A	Power Generation - Abandoned	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPA	Power Generation - Plugged	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H--	Domestic	0	0	0	1	1,717	2	359	9	2,088	1	1,301	2	1,304	3,392
H-A	Domestic - Abandoned	0	0	1	6	6	1	38	0	52	0	11	0	11	63
H-D	Domestic - Destroyed	0	0	0	1	2	1	17	2	23	0	14	0	14	37
HEX	Domestic - Excavated	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H-I	Domestic - Inactive/Standby	0	0	0	0	3	0	3	0	6	0	0	0	0	6
HPA	Domestic - Plugged	1	0	0	1	283	0	124	13	422	1	48	1	50	472
I--	Irrigation	0	0	0	0	270	1	203	1	475	0	5,006	1	5,007	5,482
I-A	Irrigation - Abandoned	0	0	1	0	0	0	7	0	8	0	27	0	27	35
I-D	Irrigation - Destroyed	0	0	0	0	0	0	1	0	1	0	21	0	21	22
I-I	Irrigation - Inactive/Standby	0	0	0	0	4	0	0	0	4	0	5	0	5	9
IPA	Irrigation - Plugged	0	0	0	0	21	0	10	0	31	0	171	0	171	202
I-Q	Irrigation - Aquaculture	0	0	0	0	47	0	25	0	72	0	259	0	259	331
I-S	Irrigation - Stock	0	0	1	2	29	0	68	0	100	0	68	0	68	168
LHH	Heat Pump - Hole	0	0	0	0	1	0	0	0	1	0	0	0	0	1
LHS	Heat Pump - Supply Well	0	0	0	0	38	0	13	0	51	0	9	0	9	60
LPA	Heat Pump - Plugged	0	0	0	0	0	0	1	0	1	0	0	0	0	1
M--	Monitor	0	0	0	13	15	0	67	1,401	1,496	4	89	185	278	1,774
M-A	Monitor - Abandoned	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M-D	Monitor - Destroyed	0	0	0	0	0	0	0	9	9	0	0	0	0	9
MEX	Monitor - Excavated	0	0	0	0	0	0	0	38	38	0	0	7	7	45
M-I	Monitor - Inactive/Standby	0	0	0	0	0	0	0	0	0	0	1	0	1	1
MPA	Monitor - Plugged	0	0	6	3	7	0	51	1,952	2,019	3	34	230	267	2,286
N20	Industrial - Food and Kindred Products	0	0	0	0	8	0	18	0	26	0	15	0	15	41
N22	Industrial - Textile Mill Products	0	0	0	0	1	0	0	0	1	0	0	0	0	1
N24	Industrial - Lumber & Wood Products	0	0	0	0	5	0	3	0	8	0	0	0	0	8
N26	Industrial - Paper & Allied Products	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N28	Industrial - Chemical & Allied Products	0	0	0	0	0	0	31	0	31	0	2	0	2	33
N29	Industrial - Petroleum Refining & Related Products	0	0	0	0	2	0	19	0	21	0	3	0	3	24
N33	Industrial - Primary Metal Industry	0	0	0	0	0	0	2	0	2	0	0	0	0	2
N99	Industrial - Other	0	0	0	0	29	2	77	0	108	0	21	0	21	129
N-A	Industrial - Abandoned	0	1	0	2	3	4	31	0	41	0	6	0	6	47

N-D	Industrial - Destroyed	0	0	0	0	2	3	19	0	24	0	8	0	8	32
N-I	Industrial - Inactive/Standby	0	0	0	0	0	0	2	0	2	0	0	0	0	2
NPA	Industrial - Plugged	0	0	0	0	9	0	90	0	99	0	39	0	39	138
O-A	Observation - Abandoned	0	0	0	0	0	0	4	0	4	0	1	0	1	5
O-D	Observation - Destroyed	0	0	0	3	2	0	18	0	23	0	44	0	44	67
OEX	Observation - Excavated	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O-O	Observation - Multiple Purpose	0	0	0	0	7	0	5	0	12	0	28	0	28	40
OPA	Observation - Plugged	0	0	0	2	0	0	9	0	11	0	19	0	19	30
O-Q	Observation - Water Quality	0	0	0	0	0	0	0	0	0	0	4	0	4	4
O-W	Observation - Water Level	0	0	0	0	0	0	1	0	1	0	6	0	6	7
P-A	Public Supply - Abandoned	0	0	0	2	6	2	13	0	23	0	11	0	11	34
P-C	Public Supply - Commercial	0	0	0	0	70	0	42	0	112	0	36	0	36	148
P-D	Public Supply - Destroyed	0	0	0	0	1	0	16	0	17	0	5	0	5	22
PEX	Public Supply - Excavated	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-I	Public Supply - Inactive/Standby	0	0	0	0	0	0	1	0	1	0	4	0	4	5
P-M	Public Supply - Therapeutic	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P-P	Public Supply - Municipal	0	0	0	0	7	0	5	0	12	0	41	0	41	53
PPA	Public Supply - Plugged	0	0	0	4	26	1	28	0	59	0	52	7	59	118
P-R	Public Supply - Rural	0	0	0	0	7	0	16	0	23	0	39	0	39	62
P-T	Public Supply - Institutional/Government	0	0	0	0	17	0	9	0	26	0	29	0	29	55
P-Z	Public Supply - Other	0	0	0	0	5	0	0	0	5	0	0	0	0	5
R--	Recovery	0	0	0	0	0	0	2	126	128	0	3	4	7	135
R-D	Recovery - Destroyed	0	0	0	0	0	0	0	0	0	0	0	0	0	0
REX	Recovery - Excavated	0	0	0	0	0	0	0	2	2	0	0	0	0	2
RPA	Recovery - Plugged	0	0	0	0	0	0	0	401	401	0	1	20	21	422
S--	Rig Supply	0	0	0	0	167	1	228	0	396	1	84	0	85	481
S-A	Rig Supply - Abandoned	0	0	0	0	1	0	2	0	3	0	0	0	0	3
S-D	Rig Supply - Destroyed	0	0	0	0	4	0	10	0	14	0	6	0	6	20
S-I	Rig Supply - Inactive/Standby	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SPA	Rig Supply - Plugged	0	6	0	0	743	2	1,126	5	1,882	0	842	1	843	2,725
T--	Test Hole	0	0	0	0	4	3	2	0	9	0	4	0	4	13
T-A	Test Hole - Abandoned	0	0	0	0	0	0	1	0	1	0	0	0	0	1
T-D	Test Hole - Destroyed	0	0	0	0	1	0	4	0	5	0	17	0	17	22
TPA	Test Hole - Plugged	0	0	0	3	11	1	66	0	81	0	162	1	163	244
W--	Piezometers	0	1	0	0	6	0	89	323	419	0	30	47	77	496
W-D	Piezometers - Destroyed	0	0	0	0	0	0	0	2	2	0	7	0	7	9
WEX	Piezometers - Excavated	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WPA	Piezometers - Plugged	0	11	0	0	3	0	29	227	270	0	41	16	57	327
Z-A	Other - Abandoned	0	0	0	0	0	0	3	0	3	0	4	0	4	7
Z-D	Other - Destroyed	0	0	0	2	0	0	4	0	6	0	3	0	3	9
Z-F	Other - Fire Protection	0	0	0	0	1	0	23	0	24	0	5	0	5	29
Z-I	Other - Inactive/Standby	0	0	0	0	8	0	14	0	22	0	10	0	10	32
ZPA	Other - Plugged	0	0	0	0	13	0	29	1	43	0	19	7	26	69
Z-R	Other - Reworked	0	0	0	0	0	0	0	0	0	0	1	0	1	1
Z-U	Other - Unknown	0	0	0	0	6	0	5	0	11	0	13	0	13	24
Z-Z	Other - Other	0	0	0	0	6	0	16	30	52	0	36	6	42	94
	Left Blank	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total per Geounits	**1**	**19**	**10**	**45**	**3,632**	**24**	**3,232**	**4,544**	**11,507**	**10**	**9,374**	**535**	**9,919**	**21,426**

	RED RIVER ALLUVIAL AQUIFER				
Code	**Well Use**	**112RRVA**	**112RRVAC**		**Total per Us**
--	Unknown	-	-		**-**
B--	Borehole/Pilot Hole	-	-		**-**
B-A	Borehole/Pilot Hole - Abandoned	-	-		**-**
B-D	Borehole/Pilot Hole - Destroyed	-	-		**-**
BEX	Borehole/Pilot Hole - Excavated out	-	-		**-**
BPA	Borehole/Pilot Hole - Plugged	-	-		**-**
C--	Cathodic	-	-		**-**
C-D	Cathodic - Destroyed	-	-		**-**
CPA	Cathodic - Plugged	-	-		**-**
D--	Dewatering	102	-		**102**
D-A	Dewatering - Abandoned	-	-		**-**
D-D	Dewatering - Destroyed	2	-		**2**
DEX	Dewatering - Excavated	-	-		**-**
D-I	Dewatering - Inactive/Standby	2	-		**2**
DPA	Dewatering - Plugged	243	165		**408**
E--	Power Generation	-	-		**-**
E-A	Power Generation - Abandoned	-	-		**-**
EPA	Power Generation - Plugged	-	-		**-**
H--	Domestic	255	4		**259**
H-A	Domestic - Abandoned	5	-		**5**
H-D	Domestic - Destroyed	1	-		**1**
HEX	Domestic - Excavated	-	-		**-**
H-I	Domestic - Inactive/Standby	-	-		**-**
HPA	Domestic - Plugged	13	1		**14**
I--	Irrigation	251	-		**251**
I-A	Irrigation - Abandoned	4	-		**4**
I-D	Irrigation - Destroyed	-	-		**-**
I-I	Irrigation - Inactive/Standby	-	-		**-**
IPA	Irrigation - Plugged	24	-		**24**
I-Q	Irrigation - Aquaculture	12	-		**12**
I-S	Irrigation - Stock	90	-		**90**
LHH	Heat Pump - Hole	-	-		**-**
LHS	Heat Pump - Supply Well	5	-		**5**
LPA	Heat Pump - Plugged	1	-		**1**
M--	Monitor	217	560		**777**
M-A	Monitor - Abandoned	-	-		**-**
M-D	Monitor - Destroyed	-	17		**17**
MEX	Monitor - Excavated	4	26		**30**
M-I	Monitor - Inactive/Standby	-	-		**-**
MPA	Monitor - Plugged	149	833		**982**
N20	Industrial - Food and Kindred Products	-	-		**-**
N22	Industrial - Textile Mill Products	1	-		**1**
N24	Industrial - Lumber & Wood Products	3	-		**3**
N26	Industrial - Paper & Allied Products	-	-		**-**
N28	Industrial - Chemical & Allied Products	1	-		**1**
N29	Industrial - Petroleum Refining & Related Products	-	-		**-**
N33	Industrial - Primary Metal Industry	-	-		**-**
N99	Industrial - Other	23	-		**23**
N-A	Industrial - Abandoned	4	-		**4**
N-D	Industrial - Destroyed	1	-		**1**
N-I	Industrial - Inactive/Standby	-	-		**-**
NPA	Industrial - Plugged	5	-		**5**
O-A	Observation - Abandoned	3	-		**3**
O-D	Observation - Destroyed	118	-		**118**
OEX	Observation - Excavated	1	-		**1**
O-O	Observation - Multiple Purpose	40	4		**44**
OPA	Observation - Plugged	114	2		**116**
O-Q	Observation - Water Quality	-	-		**-**
O-W	Observation - Water Level	229	-		**229**

P-A	Public Supply - Abandoned		4	-		**4**
P-C	Public Supply - Commercial		7	-		**7**
P-D	Public Supply - Destroyed		2	-		**2**
PEX	Public Supply - Excavated		-	-		**-**
P-I	Public Supply - Inactive/Standby		-	-		**-**
P-M	Public Supply - Therapeutic		-	-		**-**
P-P	Public Supply - Municipal		-	-		**-**
PPA	Public Supply - Plugged		24	-		**24**
P-R	Public Supply - Rural		4	-		**4**
P-T	Public Supply - Institutional/Government		13	-		**13**
P-Z	Public Supply - Other		-	-		**-**
R--	Recovery		16	29		**45**
R-D	Recovery - Destroyed		-	1		**1**
REX	Recovery - Excavated		-	2		**2**
RPA	Recovery - Plugged		1	53		**54**
S--	Rig Supply		66	-		**66**
S-A	Rig Supply - Abandoned		1	-		**1**
S-D	Rig Supply - Destroyed		-	-		**-**
S-I	Rig Supply - Inactive/Standby		1	-		**1**
SPA	Rig Supply - Plugged		142	-		**142**
T--	Test Hole		13	-		**13**
T-A	Test Hole - Abandoned		-	-		**-**
T-D	Test Hole - Destroyed		3	-		**3**
TPA	Test Hole - Plugged		28	-		**28**
W--	Piezometers		67	41		**108**
W-D	Piezometers - Destroyed		-	-		**-**
WEX	Piezometers - Excavated		10	-		**10**
WPA	Piezometers - Plugged		131	238		**369**
Z-A	Other - Abandoned		3	-		**3**
Z-D	Other - Destroyed		1	-		**1**
Z-F	Other - Fire Protection		2	-		**2**
Z-I	Other - Inactive/Standby		5	-		**5**
ZPA	Other - Plugged		26	14		**40**
Z-R	Other - Reworked		-	-		**-**
Z-U	Other - Unknown		27	-		**27**
Z-Z	Other - Other		11	-		**11**
	Left Blank		-	-		**-**
	Total per Geounits		**2,531**	**1,990**		**4,521**

SPARTA AQUIFER

Code	Well Use	124SPRT	124SPRTC		Total per Us
--	Unknown	-	-		**-**
B--	Borehole/Pilot Hole	-	-		**-**
B-A	Borehole/Pilot Hole - Abandoned	-	-		**-**
B-D	Borehole/Pilot Hole - Destroyed	-	-		**-**
BEX	Borehole/Pilot Hole - Excavated out	-	-		**-**
BPA	Borehole/Pilot Hole - Plugged	1	-		**1**
C--	Cathodic	1	-		**1**
C-D	Cathodic - Destroyed	-	-		**-**
CPA	Cathodic - Plugged	-	-		**-**
D--	Dewatering	-	-		**-**
D-A	Dewatering - Abandoned	-	-		**-**
D-D	Dewatering - Destroyed	-	-		**-**
DEX	Dewatering - Excavated	-	-		**-**
D-I	Dewatering - Inactive/Standby	-	-		**-**
DPA	Dewatering - Plugged	1	-		**1**
E--	Power Generation	-	-		**-**
E-A	Power Generation - Abandoned	-	-		**-**
EPA	Power Generation - Plugged	-	-		**-**
H--	Domestic	1,258	-		**1,258**
H-A	Domestic - Abandoned	14	-		**14**
H-D	Domestic - Destroyed	10	-		**10**
HEX	Domestic - Excavated	-	-		**-**
H-I	Domestic - Inactive/Standby	5	-		**5**
HPA	Domestic - Plugged	75	1		**76**
I--	Irrigation	103	-		**103**
I-A	Irrigation - Abandoned	2	-		**2**
I-D	Irrigation - Destroyed	1	-		**1**
I-I	Irrigation - Inactive/Standby	2	-		**2**
IPA	Irrigation - Plugged	12	-		**12**
I-Q	Irrigation - Aquaculture	3	-		**3**
I-S	Irrigation - Stock	104	-		**104**
LHH	Heat Pump - Hole	-	-		**-**
LHS	Heat Pump - Supply Well	1	-		**1**
LPA	Heat Pump - Plugged	-	-		**-**
M--	Monitor	11	14		**25**
M-A	Monitor - Abandoned	-	-		**-**
M-D	Monitor - Destroyed	-	-		**-**
MEX	Monitor - Excavated	1	-		**1**
M-I	Monitor - Inactive/Standby	-	-		**-**
MPA	Monitor - Plugged	22	13		**35**
N20	Industrial - Food and Kindred Products	5	-		**5**
N22	Industrial - Textile Mill Products	1	-		**1**
N24	Industrial - Lumber & Wood Products	34	-		**34**
N26	Industrial - Paper & Allied Products	21	-		**21**
N28	Industrial - Chemical & Allied Products	7	-		**7**
N29	Industrial - Petroleum Refining & Related Products	42	-		**42**
N33	Industrial - Primary Metal Industry	4	-		**4**
N99	Industrial - Other	102	-		**102**
N-A	Industrial - Abandoned	29	-		**29**
N-D	Industrial - Destroyed	32	-		**32**
N-I	Industrial - Inactive/Standby	1	-		**1**
NPA	Industrial - Plugged	167	-		**167**
O-A	Observation - Abandoned	5	-		**5**
O-D	Observation - Destroyed	4	-		**4**
OEX	Observation - Excavated	-	-		**-**
O-O	Observation - Multiple Purpose	69	-		**69**
OPA	Observation - Plugged	9	-		**9**
O-Q	Observation - Water Quality	1	-		**1**
O-W	Observation - Water Level	9	-		**9**

P-A	Public Supply - Abandoned	30	-		**30**
P-C	Public Supply - Commercial	45	-		**45**
P-D	Public Supply - Destroyed	22	-		**22**
PEX	Public Supply - Excavated	-	-		**-**
P-I	Public Supply - Inactive/Standby	7	-		**7**
P-M	Public Supply - Therapeutic	-	-		**-**
P-P	Public Supply - Municipal	144	-		**144**
PPA	Public Supply - Plugged	166	-		**166**
P-R	Public Supply - Rural	316	-		**316**
P-T	Public Supply - Institutional/Government	84	-		**84**
P-Z	Public Supply - Other	-	-		**-**
R--	Recovery	-	-		**-**
R-D	Recovery - Destroyed	-	-		**-**
REX	Recovery - Excavated	-	-		**-**
RPA	Recovery - Plugged	-	-		**-**
S--	Rig Supply	408	-		**408**
S-A	Rig Supply - Abandoned	9	-		**9**
S-D	Rig Supply - Destroyed	5	-		**5**
S-I	Rig Supply - Inactive/Standby	2	-		**2**
SPA	Rig Supply - Plugged	1,370	-		**1,370**
T--	Test Hole	2	-		**2**
T-A	Test Hole - Abandoned	3	-		**3**
T-D	Test Hole - Destroyed	20	-		**20**
TPA	Test Hole - Plugged	309	-		**309**
W--	Piezometers	1	-		**1**
W-D	Piezometers - Destroyed	-	-		**-**
WEX	Piezometers - Excavated	-	-		**-**
WPA	Piezometers - Plugged	-	-		**-**
Z-A	Other - Abandoned	9	-		**9**
Z-D	Other - Destroyed	3	-		**3**
Z-F	Other - Fire Protection	5	-		**5**
Z-I	Other - Inactive/Standby	22	-		**22**
ZPA	Other - Plugged	23	-		**23**
Z-R	Other - Reworked	1	-		**1**
Z-U	Other - Unknown	35	-		**35**
Z-Z	Other - Other	1	-		**1**
	Left Blank	-	-		**-**
					-
	Total per Geounits	**5,211**	**28**		**5,239**

UPLAND TERRACE AQUIFER

Code	Well Use	112MGMR	112UPTC	112UPTCC	112PRIR	112WLBN		Total per Use
--	Unknown	-	-	-	-	-		-
B--	Borehole/Pilot Hole	-	-	-	-	-		-
B-A	Borehole/Pilot Hole - Abandoned	-	-	-	-	-		-
B-D	Borehole/Pilot Hole - Destroyed	-	-	-	-	-		-
BEX	Borehole/Pilot Hole - Excavated out	-	-	-	-	-		-
BPA	Borehole/Pilot Hole - Plugged	-	-	-	-	-		-
C--	Cathodic	-	-	-	-	-		-
C-D	Cathodic - Destroyed	-	-	-	-	-		-
CPA	Cathodic - Plugged	-	-	-	-	-		-
D--	Dewatering	-	79	-	1	-		80
D-A	Dewatering - Abandoned	-	-	-	-	-		-
D-D	Dewatering - Destroyed	-	-	-	-	-		-
DEX	Dewatering - Excavated	-	-	-	-	-		-
D-I	Dewatering - Inactive/Standby	-	-	-	-	-		-
DPA	Dewatering - Plugged	-	63	-	-	-		63
E--	Power Generation	-	-	-	-	-		-
E-A	Power Generation - Abandoned	-	-	-	-	-		-
EPA	Power Generation - Plugged	-	-	-	-	-		-
H--	Domestic	12	14,635	4	85	171		14,907
H-A	Domestic - Abandoned	-	57	-	2	1		60
H-D	Domestic - Destroyed	-	2	-	1	-		3
HEX	Domestic - Excavated	-	1	-	-	-		1
H-I	Domestic - Inactive/Standby	-	9	-	-	-		9
HPA	Domestic - Plugged	1	601	8	4	5		619
I--	Irrigation	-	1,004	-	15	2		1,021
I-A	Irrigation - Abandoned	-	3	-	-	-		3
I-D	Irrigation - Destroyed	-	1	-	-	-		1
I-I	Irrigation - Inactive/Standby	-	1	-	-	-		1
IPA	Irrigation - Plugged	-	17	-	4	-		21
I-Q	Irrigation - Aquaculture	-	16	-	4	-		20
I-S	Irrigation - Stock	-	38	-	8	-		46
LHH	Heat Pump - Hole	-	-	-	-	-		-
LHS	Heat Pump - Supply Well	-	33	-	-	-		33
LPA	Heat Pump - Plugged	-	1	-	-	-		1
M--	Monitor	-	457	509	1	1		968
M-A	Monitor - Abandoned	-	-	-	-	-		-
M-D	Monitor - Destroyed	-	2	2	-	1		5
MEX	Monitor - Excavated	-	1	-	-	-		1
M-I	Monitor - Inactive/Standby	-	-	-	-	-		-
MPA	Monitor - Plugged	-	260	270	2	6		538
N20	Industrial - Food and Kindred Products	-	7	-	1	-		8
N22	Industrial - Textile Mill Products	-	-	-	-	-		-
N24	Industrial - Lumber & Wood Products	-	14	-	-	2		16
N26	Industrial - Paper & Allied Products	-	8	-	-	-		8
N28	Industrial - Chemical & Allied Products	-	8	-	-	1		9
N29	Industrial - Petroleum Refining & Related Products	-	10	-	-	-		10
N33	Industrial - Primary Metal Industry	-	-	-	-	-		-
N99	Industrial - Other	2	30	-	1	-		33
N-A	Industrial - Abandoned	-	4	-	-	4		8
N-D	Industrial - Destroyed	-	14	-	-	-		14
N-I	Industrial - Inactive/Standby	-	-	-	2	-		2
NPA	Industrial - Plugged	-	69	-	-	-		69
O-A	Observation - Abandoned	-	6	-	-	2		8
O-D	Observation - Destroyed	-	44	-	8	1		53
OEX	Observation - Excavated	-	-	-	-	-		-

O-O	Observation - Multiple Purpose	-	34	-	1	1		36
OPA	Observation - Plugged	1	39	1	3	1		45
O-Q	Observation - Water Quality	-	3	-	-	-		3
O-W	Observation - Water Level	-	32	-	1	4		37
P-A	Public Supply - Abandoned	5	34	-	-	3		42
P-C	Public Supply - Commercial	-	404	-	1	5		410
P-D	Public Supply - Destroyed	-	5	-	2	2		9
PEX	Public Supply - Excavated	-	-	-	-	1		1
P-I	Public Supply - Inactive/Standby	-	1	-	-	-		1
P-M	Public Supply - Therapeutic	-	-	-	-	-		-
P-P	Public Supply - Municipal	-	38	-	8	13		59
PPA	Public Supply - Plugged	8	91	1	4	17		121
P-R	Public Supply - Rural	3	65	-	7	12		87
P-T	Public Supply - Institutional/Government	-	111	-	10	7		128
P-Z	Public Supply - Other	-	4	-	-	-		4
R--	Recovery	-	76	66	-	-		142
R-D	Recovery - Destroyed	-	-	-	-	-		-
REX	Recovery - Excavated	-	-	-	-	-		-
RPA	Recovery - Plugged	-	3	26	-	-		29
S--	Rig Supply	-	81	-	1	-		82
S-A	Rig Supply - Abandoned	-	-	-	-	-		-
S-D	Rig Supply - Destroyed	-	2	-	-	-		2
S-I	Rig Supply - Inactive/Standby	-	3	-	-	-		3
SPA	Rig Supply - Plugged	-	156	-	7	5		168
T--	Test Hole	-	4	-	-	1		5
T-A	Test Hole - Abandoned	-	-	-	-	2		2
T-D	Test Hole - Destroyed	-	19	-	1	5		25
TPA	Test Hole - Plugged	10	110	13	18	62		213
W--	Piezometers	-	66	51	2	2		121
W-D	Piezometers - Destroyed	-	2	-	-	-		2
WEX	Piezometers - Excavated	-	3	-	-	-		3
WPA	Piezometers - Plugged	-	97	10	3	-		110
Z-A	Other - Abandoned	1	23	-	1	-		25
Z-D	Other - Destroyed	-	2	-	1	-		3
Z-F	Other - Fire Protection	-	2	-	-	-		2
Z-I	Other - Inactive/Standby	-	2	-	-	-		2
ZPA	Other - Plugged	-	28	1	5	-		34
Z-R	Other - Reworked	-	-	-	-	-		-
Z-U	Other - Unknown	-	18	-	5	3		26
Z-Z	Other - Other	-	35	29	-	-		64
	Left Blank	-	-	-	-	-		-
	Total per Geounits	43	19,088	991	220	343		20,685

CHICOT AQUIFER

Code	Well Use	112CHCT	112CHCTC	112CHCTE	112CHCTL	112CHCTS	112CHCTU	11202LC	11205LC	11207LC		Total per Use
--	Unknown	-	-	-	-	-	-	-	-	-		-
B--	Borehole/Pilot Hole	-	-	-	-	-	1	-	-	-		**1**
B-A	Borehole/Pilot Hole - Abandoned	-	-	-	-	-	-	-	-	-		-
B-D	Borehole/Pilot Hole - Destroyed	-	-	-	-	-	-	-	-	-		-
BEX	Borehole/Pilot Hole - Excavated out	-	-	-	-	-	-	-	-	-		-
BPA	Borehole/Pilot Hole - Plugged	-	-	-	-	-	-	1	-	-		**1**
C--	Cathodic	-	-	-	-	-	-	-	-	-		-
C-D	Cathodic - Destroyed	-	-	-	-	-	-	-	-	-		-
CPA	Cathodic - Plugged	-	-	-	-	-	-	-	-	-		-
D--	Dewatering	-	7	-	-	-	-	-	-	-		**7**
D-A	Dewatering - Abandoned	-	-	-	-	-	-	-	-	-		-
D-D	Dewatering - Destroyed	-	-	-	-	-	-	-	-	-		-
DEX	Dewatering - Excavated	-	-	-	-	-	-	-	-	-		-
D-I	Dewatering - Inactive/Standby	-	-	-	-	-	-	-	-	-		-
DPA	Dewatering - Plugged	-	24	-	-	-	1	-	-	-		**25**
E--	Power Generation	8	-	-	3	-	1	-	6	-		**18**
E-A	Power Generation - Abandoned	-	-	-	-	-	-	-	-	-		-
EPA	Power Generation - Plugged	-	-	-	1	-	-	-	4	-		**5**
H--	Domestic	2,595	171	-	2	2,966	9,549	2,808	888	14		**18,993**
H-A	Domestic - Abandoned	49	15	-	-	22	17	19	12	-		**134**
H-D	Domestic - Destroyed	11	7	-	-	6	7	10	4	-		**45**
HEX	Domestic - Excavated	-	-	-	-	-	-	-	-	-		-
H-I	Domestic - Inactive/Standby	7	-	-	1	1	6	1	1	-		**17**
HPA	Domestic - Plugged	243	84	-	-	656	1,521	460	92	2		**3,058**
I--	Irrigation	1,495	6	1	4	99	1,604	94	72	15		**3,390**
I-A	Irrigation - Abandoned	29	-	-	-	4	42	2	6	2		**85**
I-D	Irrigation - Destroyed	4	1	-	-	-	5	4	4	2		**20**
I-I	Irrigation - Inactive/Standby	7	-	-	-	1	11	-	-	-		**19**
IPA	Irrigation - Plugged	78	1	-	-	12	87	15	8	1		**202**
I-Q	Irrigation - Aquaculture	47	2	-	-	48	110	2	3	-		**212**
I-S	Irrigation - Stock	50	6	-	-	59	147	16	4	1		**283**
LHH	Heat Pump - Hole	-	-	-	-	-	1	-	-	-		**1**
LHS	Heat Pump - Supply Well	6	1	-	-	12	25	-	-	-		**44**
LPA	Heat Pump - Plugged	-	1	-	-	-	1	-	-	-		**2**
M--	Monitor	90	1,926	2	-	173	40	69	2	-		**2,302**
M-A	Monitor - Abandoned	-	7	-	-	-	-	-	-	-		**7**
M-D	Monitor - Destroyed	1	11	-	-	-	1	-	-	-		**13**
MEX	Monitor - Excavated	-	56	-	-	7	-	-	-	-		**63**
M-I	Monitor - Inactive/Standby	-	-	-	-	-	-	-	-	-		-
MPA	Monitor - Plugged	56	2,216	-	7	64	53	8	-	1		**2,405**
N20	Industrial - Food and Kindred Products	5	-	-	1	20	50	-	2	-		**78**
N22	Industrial - Textile Mill Products	1	-	-	-	1	3	2	-	-		**7**
N24	Industrial - Lumber & Wood Products	3	-	-	-	2	2	1	2	-		**10**
N26	Industrial - Paper & Allied Products	3	-	-	-	-	-	-	-	-		**3**
N28	Industrial - Chemical & Allied Products	5	-	-	-	8	14	9	46	7		**89**
N29	Industrial - Petroleum Refining & Related Products	5	-	-	-	17	38	7	34	4		**105**
N33	Industrial - Primary Metal Industry	-	-	-	-	-	2	-	-	-		**2**
N99	Industrial - Other	45	2	-	2	34	161	19	44	1		**308**
N-A	Industrial - Abandoned	7	-	-	-	2	13	1	11	3		**37**
N-D	Industrial - Destroyed	1	-	-	-	1	1	4	6	-		**13**
N-I	Industrial - Inactive/Standby	-	-	-	2	-	6	2	1	1		**12**
NPA	Industrial - Plugged	26	3	-	4	39	71	27	39	16		**225**

O-A	Observation - Abandoned	12	-	-	-	2	5	3	10	4		**36**
O-D	Observation - Destroyed	36	4	-	-	2	1	3	7	1		**54**
OEX	Observation - Excavated	-	-	-	-	-	-	-	-	-		**-**
O-O	Observation - Multiple Purpose	65	3	-	8	62	32	24	43	21		**258**
OPA	Observation - Plugged	18	4	-	-	14	3	10	11	4		**64**
O-Q	Observation - Water Quality	-	2	-	-	-	-	1	1	2		**6**
O-W	Observation - Water Level	10	1	-	1	1	4	-	-	-		**17**
P-A	Public Supply - Abandoned	12	-	-	-	2	39	2	3	3		**61**
P-C	Public Supply - Commercial	71	2	1	2	99	489	97	45	3		**809**
P-D	Public Supply - Destroyed	17	-	-	-	1	12	1	14	5		**50**
PEX	Public Supply - Excavated	-	-	-	-	-	-	-	-	-		**-**
P-I	Public Supply - Inactive/Standby	2	-	-	-	-	2	-	-	-		**4**
P-M	Public Supply - Therapeutic	-	-	-	-	-	-	-	-	-		**-**
P-P	Public Supply - Municipal	52	-	-	26	3	60	3	29	2		**175**
PPA	Public Supply - Plugged	48	4	-	6	38	244	38	44	8		**430**
P-R	Public Supply - Rural	35	-	-	13	23	129	19	28	6		**253**
P-T	Public Supply - Institutional/Government	34	1	-	-	26	89	22	26	-		**198**
P-Z	Public Supply - Other	2	-	-	-	1	9	-	-	-		**12**
R--	Recovery	2	251	-	-	25	1	7	1	-		**287**
R-D	Recovery - Destroyed	-	1	-	-	-	-	-	-	-		**1**
REX	Recovery - Excavated	-	6	-	-	4	-	-	-	-		**10**
RPA	Recovery - Plugged	2	434	-	-	3	12	2	-	-		**453**
S--	Rig Supply	284	4	-	1	109	356	78	83	1		**916**
S-A	Rig Supply - Abandoned	2	-	-	-	-	4	-	1	-		**7**
S-D	Rig Supply - Destroyed	4	-	-	-	2	8	1	1	-		**16**
S-I	Rig Supply - Inactive/Standby	3	-	-	-	-	5	-	-	-		**8**
SPA	Rig Supply - Plugged	1,311	4	1	3	372	1,862	385	263	1		**4,202**
T--	Test Hole	1	-	-	2	4	8	-	-	-		**15**
T-A	Test Hole - Abandoned	2	-	-	1	-	2	-	-	-		**5**
T-D	Test Hole - Destroyed	12	-	-	2	1	1	-	-	-		**16**
TPA	Test Hole - Plugged	90	3	-	63	27	67	13	20	13		**296**
W--	Piezometers	7	177	-	-	52	9	2	-	-		**247**
W-D	Piezometers - Destroyed	-	-	-	-	1	-	-	-	-		**1**
WEX	Piezometers - Excavated	-	4	-	-	-	-	-	-	-		**4**
WPA	Piezometers - Plugged	33	387	1	-	21	3	1	-	-		**446**
Z-A	Other - Abandoned	22	11	-	1	3	9	3	9	-		**58**
Z-D	Other - Destroyed	2	1	-	-	1	3	1	3	-		**11**
Z-F	Other - Fire Protection	2	-	-	-	5	6	2	4	-		**19**
Z-I	Other - Inactive/Standby	8	-	-	-	8	32	4	2	-		**54**
ZPA	Other - Plugged	37	21	-	6	93	118	37	5	-		**317**
Z-R	Other - Reworked	1	-	-	-	-	-	-	-	-		**1**
Z-U	Other - Unknown	88	17	-	1	6	40	9	5	1		**167**
Z-Z	Other - Other	11	45	-	-	17	48	12	2	-		**135**
	Left Blank	-	-	-	-	-	-	-	-	-		**-**
	Total per Geounits	**7,215**	**5,934**	**6**	**163**	**5,282**	**17,303**	**4,361**	**1,951**	**145**		**42,360**

EVANGELINE AQUIFER

Code	Well Use	121EVGL	121EVGLC		Total per Use
--	Unknown	-	-		**-**
B--	Borehole/Pilot Hole	-	-		**-**
B-A	Borehole/Pilot Hole - Abandoned	-	-		**-**
B-D	Borehole/Pilot Hole - Destroyed	-	-		**-**
BEX	Borehole/Pilot Hole - Excavated out	-	-		**-**
BPA	Borehole/Pilot Hole - Plugged	-	-		**-**
C--	Cathodic	-	-		**-**
C-D	Cathodic - Destroyed	-	-		**-**
CPA	Cathodic - Plugged	-	-		**-**
D--	Dewatering	1	-		**1**
D-A	Dewatering - Abandoned	-	-		**-**
D-D	Dewatering - Destroyed	-	-		**-**
DEX	Dewatering - Excavated	-	-		**-**
D-I	Dewatering - Inactive/Standby	-	-		**-**
DPA	Dewatering - Plugged	-	-		**-**
E--	Power Generation	-	-		**-**
E-A	Power Generation - Abandoned	-	-		**-**
EPA	Power Generation - Plugged	-	-		**-**
H--	Domestic	311	-		**311**
H-A	Domestic - Abandoned	4	-		**4**
H-D	Domestic - Destroyed	1	-		**1**
HEX	Domestic - Excavated	-	-		**-**
H-I	Domestic - Inactive/Standby	-	-		**-**
HPA	Domestic - Plugged	19	-		**19**
I--	Irrigation	56	-		**56**
I-A	Irrigation - Abandoned	2	-		**2**
I-D	Irrigation - Destroyed	-	-		**-**
I-I	Irrigation - Inactive/Standby	-	-		**-**
IPA	Irrigation - Plugged	3	-		**3**
I-Q	Irrigation - Aquaculture	2	-		**2**
I-S	Irrigation - Stock	10	-		**10**
LHH	Heat Pump - Hole	-	-		**-**
LHS	Heat Pump - Supply Well	-	-		**-**
LPA	Heat Pump - Plugged	-	-		**-**
M--	Monitor	2	16		**18**
M-A	Monitor - Abandoned	-	-		**-**
M-D	Monitor - Destroyed	-	7		**7**
MEX	Monitor - Excavated	-	15		**15**
M-I	Monitor - Inactive/Standby	-	-		**-**
MPA	Monitor - Plugged	25	212		**237**
N20	Industrial - Food and Kindred Products	1	-		**1**
N22	Industrial - Textile Mill Products	-	-		**-**
N24	Industrial - Lumber & Wood Products	5	-		**5**
N26	Industrial - Paper & Allied Products	-	-		**-**
N28	Industrial - Chemical & Allied Products	4	-		**4**
N29	Industrial - Petroleum Refining & Related Products	7	-		**7**
N33	Industrial - Primary Metal Industry	-	-		**-**
N99	Industrial - Other	25	-		**25**
N-A	Industrial - Abandoned	1	-		**1**
N-D	Industrial - Destroyed	3	-		**3**
N-I	Industrial - Inactive/Standby	-	-		**-**
NPA	Industrial - Plugged	9	-		**9**
O-A	Observation - Abandoned	6	-		**6**
O-D	Observation - Destroyed	-	-		**-**
OEX	Observation - Excavated	-	-		**-**
O-O	Observation - Multiple Purpose	10	-		**10**
OPA	Observation - Plugged	1	-		**1**
O-Q	Observation - Water Quality	-	-		**-**
O-W	Observation - Water Level	-	-		**-**

P-A	Public Supply - Abandoned	18	-		**18**
P-C	Public Supply - Commercial	8	-		**8**
P-D	Public Supply - Destroyed	1	-		**1**
PEX	Public Supply - Excavated	-	-		**-**
P-I	Public Supply - Inactive/Standby	1	-		**1**
P-M	Public Supply - Therapeutic	-	-		**-**
P-P	Public Supply - Municipal	68	-		**68**
PPA	Public Supply - Plugged	55	-		**55**
P-R	Public Supply - Rural	72	-		**72**
P-T	Public Supply - Institutional/Government	19	-		**19**
P-Z	Public Supply - Other	-	-		**-**
R--	Recovery	-	-		**-**
R-D	Recovery - Destroyed	-	-		**-**
REX	Recovery - Excavated	-	-		**-**
RPA	Recovery - Plugged	-	-		**-**
S--	Rig Supply	25	-		**25**
S-A	Rig Supply - Abandoned	-	-		**-**
S-D	Rig Supply - Destroyed	44	-		**44**
S-I	Rig Supply - Inactive/Standby	1	-		**1**
SPA	Rig Supply - Plugged	76	-		**76**
T--	Test Hole	2	-		**2**
T-A	Test Hole - Abandoned	9	-		**9**
T-D	Test Hole - Destroyed	2	-		**2**
TPA	Test Hole - Plugged	203	-		**203**
W--	Piezometers	-	6		**6**
W-D	Piezometers - Destroyed	-	-		**-**
WEX	Piezometers - Excavated	-	-		**-**
WPA	Piezometers - Plugged	6	15		**21**
Z-A	Other - Abandoned	-	-		**-**
Z-D	Other - Destroyed	2	-		**2**
Z-F	Other - Fire Protection	3	-		**3**
Z-I	Other - Inactive/Standby	-	-		**-**
ZPA	Other - Plugged	4	-		**4**
Z-R	Other - Reworked	-	-		**-**
Z-U	Other - Unknown	19	-		**19**
Z-Z	Other - Other	2	-		**2**
	Left Blank	-	-		**-**
	Total per Geounits	**1,148**	**271**		**1,419**

JASPER AQUIFER SYSTEM

Code	Well Use	122CRCK	122CRCKC	122CRNB	122DGHL	122DGHLC	122JSPR	122JSPRC	122MOCN	122WMCK		Total per Use
--	Unknown	-	-	-	-	-	-	-	-	-		**-**
B--	Borehole/Pilot Hole	-	-	-	-	-	-	-	-	-		**-**
B-A	Borehole/Pilot Hole - Abandoned	-	-	-	-	-	-	-	-	-		**-**
B-D	Borehole/Pilot Hole - Destroyed	-	-	-	-	-	-	-	-	-		**-**
BEX	Borehole/Pilot Hole - Excavated out	-	-	-	-	-	-	-	-	-		**-**
BPA	Borehole/Pilot Hole - Plugged	-	-	-	-	-	-	-	-	-		**-**
C--	Cathodic	-	-	-	-	-	-	-	-	-		**-**
C-D	Cathodic - Destroyed	-	-	-	-	-	-	-	-	-		**-**
CPA	Cathodic - Plugged	-	-	-	-	-	-	-	-	-		**-**
D--	Dewatering	-	-	1	-	-	-	-	-	-		**1**
D-A	Dewatering - Abandoned	-	-	-	-	-	-	-	-	-		**-**
D-D	Dewatering - Destroyed	-	-	-	-	-	-	-	-	-		**-**
DEX	Dewatering - Excavated	-	-	-	-	-	-	-	-	-		**-**
D-I	Dewatering - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
DPA	Dewatering - Plugged	-	-	-	-	-	-	-	-	-		**-**
E--	Power Generation	-	-	4	-	-	-	-	-	-		**4**
E-A	Power Generation - Abandoned	-	-	-	-	-	-	-	-	-		**-**
EPA	Power Generation - Plugged	-	-	-	-	-	-	-	-	-		**-**
H--	Domestic	66	-	722	144	-	-	-	-	526		**1,458**
H-A	Domestic - Abandoned	-	-	4	-	-	-	-	-	4		**8**
H-D	Domestic - Destroyed	-	-	2	-	-	-	-	-	3		**5**
HEX	Domestic - Excavated	-	-	-	-	-	-	-	-	-		**-**
H-I	Domestic - Inactive/Standby	-	-	1	-	-	-	-	-	-		**1**
HPA	Domestic - Plugged	8	2	63	8	-	-	1	-	42		**124**
I--	Irrigation	2	-	13	1	-	-	-	-	14		**30**
I-A	Irrigation - Abandoned	-	-	1	-	-	-	-	-	1		**2**
I-D	Irrigation - Destroyed	-	-	-	-	-	-	-	-	1		**1**
I-I	Irrigation - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
IPA	Irrigation - Plugged	2	-	1	-	-	-	-	-	2		**5**
I-Q	Irrigation - Aquaculture	3	-	2	-	-	-	-	-	6		**11**
I-S	Irrigation - Stock	1	-	8	-	-	1	-	-	9		**19**
LHH	Heat Pump - Hole	-	-	-	-	-	-	-	-	-		**-**
LHS	Heat Pump - Supply Well	-	-	1	-	-	-	-	-	-		**1**
LPA	Heat Pump - Plugged	-	-	-	-	-	-	-	-	-		**-**
M--	Monitor	-	5	-	-	-	2	6	-	-		**13**
M-A	Monitor - Abandoned	-	-	-	-	-	-	-	-	-		**-**
M-D	Monitor - Destroyed	-	-	-	-	-	-	-	-	-		**-**
MEX	Monitor - Excavated	-	5	-	-	-	-	-	-	-		**5**
M-I	Monitor - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
MPA	Monitor - Plugged	1	72	1	-	-	-	6	-	-		**80**
N20	Industrial - Food and Kindred Products	1	-	-	-	-	-	-	-	1		**2**
N22	Industrial - Textile Mill Products	-	-	-	1	-	-	-	-	-		**1**
N24	Industrial - Lumber & Wood Products	-	-	-	-	-	-	-	-	6		**6**
N26	Industrial - Paper & Allied Products	-	-	-	-	-	-	-	-	2		**2**
N28	Industrial - Chemical & Allied Products	-	-	-	1	-	1	-	-	1		**3**
N29	Industrial - Petroleum Refining & Related Products	-	-	1	-	-	-	-	-	1		**2**
N33	Industrial - Primary Metal Industry	-	-	-	-	-	-	-	-	-		**-**
N99	Industrial - Other	-	-	12	-	-	10	-	-	16		**38**
N-A	Industrial - Abandoned	-	-	8	-	-	-	-	-	1		**9**
N-D	Industrial - Destroyed	-	-	7	-	-	-	-	1	5		**13**
N-I	Industrial - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
NPA	Industrial - Plugged	-	-	5	1	-	-	-	-	3		**9**
O-A	Observation - Abandoned	-	-	-	-	-	-	-	-	-		**-**
O-D	Observation - Destroyed	-	-	2	-	-	-	-	-	1		**3**
OEX	Observation - Excavated	-	-	-	-	-	-	-	-	-		**-**

O-O	Observation - Multiple Purpose	-	-	5	-	-	-	-	-	6		**11**
OPA	Observation - Plugged	-	-	3	-	-	-	-	-	5		**8**
O-Q	Observation - Water Quality	-	-	1	-	-	-	-	-	-		**1**
O-W	Observation - Water Level	-	-	2	-	-	-	-	1	-		**3**
P-A	Public Supply - Abandoned	1	-	17	-	-	-	-	-	6		**24**
P-C	Public Supply - Commercial	5	-	7	2	-	-	-	-	16		**30**
P-D	Public Supply - Destroyed	1	-	37	-	-	-	-	-	9		**47**
PEX	Public Supply - Excavated	-	-	-	-	-	-	-	-	-		**-**
P-I	Public Supply - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
P-M	Public Supply - Therapeutic	-	-	-	-	-	-	-	-	-		**-**
P-P	Public Supply - Municipal	-	-	50	-	-	1	-	-	13		**64**
PPA	Public Supply - Plugged	4	-	76	1	-	1	-	-	40		**122**
P-R	Public Supply - Rural	1	-	39	-	-	5	-	-	13		**58**
P-T	Public Supply - Institutional/Government	-	-	24	1	-	1	-	-	39		**65**
P-Z	Public Supply - Other	-	-	-	-	-	-	-	-	1		**1**
R--	Recovery	-	-	-	-	-	-	-	-	-		**-**
R-D	Recovery - Destroyed	-	-	-	-	-	-	-	-	-		**-**
REX	Recovery - Excavated	-	-	-	-	-	-	-	-	-		**-**
RPA	Recovery - Plugged	-	-	-	-	-	-	-	-	-		**-**
S--	Rig Supply	-	-	1	-	-	-	-	-	3		**4**
S-A	Rig Supply - Abandoned	-	-	-	-	-	-	-	-	-		**-**
S-D	Rig Supply - Destroyed	-	-	-	-	-	-	-	-	-		**-**
S-I	Rig Supply - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
SPA	Rig Supply - Plugged	-	-	11	5	-	-	-	-	26		**42**
T--	Test Hole	-	-	6	-	-	-	-	-	4		**10**
T-A	Test Hole - Abandoned	-	-	4	-	-	-	-	-	-		**4**
T-D	Test Hole - Destroyed	-	-	3	-	-	-	-	-	3		**6**
TPA	Test Hole - Plugged	1	-	113	-	-	20	-	3	46		**183**
W--	Piezometers	-	-	-	1	3	-	-	-	-		**4**
W-D	Piezometers - Destroyed	-	-	-	-	-	-	-	-	-		**-**
WEX	Piezometers - Excavated	-	-	-	-	-	-	-	-	-		**-**
WPA	Piezometers - Plugged	-	-	-	-	-	-	-	-	-		**-**
Z-A	Other - Abandoned	-	-	1	-	-	-	-	-	3		**4**
Z-D	Other - Destroyed	-	-	-	-	-	-	-	-	-		**-**
Z-F	Other - Fire Protection	-	-	-	-	-	-	-	-	-		**-**
Z-I	Other - Inactive/Standby	-	-	-	-	-	-	-	-	-		**-**
ZPA	Other - Plugged	2	-	4	-	1	-	-	-	6		**13**
Z-R	Other - Reworked	-	-	-	-	-	-	-	-	-		**-**
Z-U	Other - Unknown	1	-	20	-	-	1	-	-	6		**28**
Z-Z	Other - Other	-	-	1	3	15	-	-	-	1		**20**
	Left Blank	-	-	-	-	-	-	-	-	-		**-**
	Total per Geounits	**100**	**84**	**1,284**	**169**	**19**	**43**	**13**	**5**	**891**		**2,608**

												SOUTHERN HILLS AQ					
Code	Well Use	111NORLC	111SLNO	112GRMC	112GZNO	112NORC	112NORLC	112PNCLU	112SESC	112SLBR	112PLSC	11204BR	11205BR	11206BR	11212NO	120ABIT	120CVGN	120KNTD
--	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B--	Borehole/Pilot Hole	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-A	Borehole/Pilot Hole - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B-D	Borehole/Pilot Hole - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BEX	Borehole/Pilot Hole - Excavated out	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BPA	Borehole/Pilot Hole - Plugged	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C--	Cathodic	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
C-D	Cathodic - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CPA	Cathodic - Plugged	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D--	Dewatering	35	1	-	-	-	-	-	-	9	-	20	-	-	-	-	-	-
D-A	Dewatering - Abandoned	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
D-D	Dewatering - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DEX	Dewatering - Excavated	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D-I	Dewatering - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DPA	Dewatering - Plugged	39	53	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
E--	Power Generation	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	1
E-A	Power Generation - Abandoned	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
EPA	Power Generation - Plugged	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
H--	Domestic	4	12	53	4,140	574	-	4,298	12	1,015	-	724	11	99	34	74	67	42
H-A	Domestic - Abandoned	3	9	57	13	44	-	19	1	11	-	21	-	3	-	-	1	1
H-D	Domestic - Destroyed	-	6	7	7	15	-	-	-	18	-	35	-	3	-	-	-	-
HEX	Domestic - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-I	Domestic - Inactive/Standby	-	-	-	1	-	-	2	-	1	-	1	-	-	-	-	-	-
HPA	Domestic - Plugged	1	1	5	205	106	-	82	12	41	-	25	1	4	1	5	1	-
I--	Irrigation	-	4	23	89	36	-	285	1	60	-	70	1	8	-	8	5	3
I-A	Irrigation - Abandoned	-	2	8	3	4	-	-	-	-	-	-	-	-	-	-	-	1
I-D	Irrigation - Destroyed	-	-	-	-	2	-	-	-	7	-	1	-	-	-	-	-	-
I-I	Irrigation - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-
IPA	Irrigation - Plugged	-	-	1	3	3	-	8	-	4	-	5	1	1	-	-	-	-
I-Q	Irrigation - Aquaculture	-	-	4	5	6	-	4	-	14	-	4	-	1	-	-	-	-
I-S	Irrigation - Stock	-	10	24	13	27	-	9	1	4	-	4	-	-	-	2	5	3
LHH	Heat Pump - Hole	-	-	2	-	1	-	-	-	-	-	-	-	1	-	-	-	-
LHS	Heat Pump - Supply Well	-	-	2	3	-	-	6	-	12	-	9	-	1	-	-	-	-
LPA	Heat Pump - Plugged	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
M--	Monitor	2,703	15	6	5	10	27	1	1,247	124	3	16	-	5	1	-	-	-
M-A	Monitor - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M-D	Monitor - Destroyed	48	-	-	-	-	-	-	24	-	-	-	-	-	-	-	-	-
MEX	Monitor - Excavated	84	-	-	-	-	-	-	58	4	-	-	-	-	-	-	-	-
M-I	Monitor - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MPA	Monitor - Plugged	3,544	28	1	6	9	8	-	1,675	40	3	15	-	2	2	-	-	-
N20	Industrial - Food and Kindred Products	-	1	4	5	12	-	2	-	1	-	2	-	1	-	-	1	4
N22	Industrial - Textile Mill Products	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N24	Industrial - Lumber & Wood Products	-	-	-	-	-	-	-	-	1	-	3	-	1	-	2	-	-
N26	Industrial - Paper & Allied Products	-	-	-	1	-	-	-	-	-	-	1	6	-	-	-	-	-
N28	Industrial - Chemical & Allied Products	-	-	7	18	5	-	-	-	2	-	1	2	2	-	-	-	-
N29	Industrial - Petroleum Refining & Related Products	-	-	4	8	12	-	1	-	-	-	3	-	2	1	-	-	-

QUIFER SYSTEM

120SLDL	121BGBC	121PNCLL	12101FP	12102FP	12203FP	12108BR	12109BR	12110BR	12111BR	12112BR	12113BR	12115BR	12116BR	12117BR	122AMIT	121EVGLE	12219BR	12220BR	12223BR	12224BR	12226BR	12228BR	122FRKL	122HMND	122RMSY	122TCFC		Total per Use
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		65
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		94
-	-	-	-	-	-	-	-	-	3	3	-	1	-	-	-	-	-	6	-	-	-	3	-	-	-	1		25
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-		2
-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	5	-	-	-	2	-	-	-	-		13
9	22	1,132	4	1	2	106	-	104	-	120	-	53	-	46	9	4	-	37	1	26	-	16	-	18	2	20		12,891
-	1	3	-	-	-	2	-	8	-	8	-	9	-	6	-	-	-	3	-	-	-	-	-	-	-	-		223
-	-	1	-	-	-	3	-	3	-	12	-	4	-	1	-	-	-	-	-	1	-	-	-	-	-	-		116
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		6
1	-	22	-	-	-	-	-	2	-	6	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-		523
2	2	41	2	-	-	8	1	4	-	19	-	4	1	3	3	-	-	2	-	-	-	1	-	2	-	1		689
-	-	1	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		21
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		10
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2
-	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	-	-	1	-	-		31
-	1	3	-	-	-	-	-	1	-	2	-	1	-	-	-	-	-	1	-	1	-	-	-	-	2	3		53
-	1	10	1	-	-	-	-	2	-	9	-	7	-	6	-	-	-	-	-	3	-	2	-	2	-	1		146
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		4
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		34
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		2
-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		4,164
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		72
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		146
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-		5,334
-	-	1	-	-	-	-	-	-	-	-	-	1	-	3	-	-	-	3	-	1	-	-	-	1	-	-		43
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
-	-	-	-	1	-	-	-	-	-	1	-	1	1	1	-	-	-	-	-	1	-	-	-	1	-	-		14
-	-	-	-	-	-	-	-	-	-	2	-	1	3	1	2	-	-	-	-	2	-	9	2	2	2	-		34
-	-	1	-	-	-	-	-	1	-	9	-	5	-	-	-	-	-	8	-	6	-	9	-	-	-	-		76
-	-	-	-	1	-	1	-	-	1	8	-	2	-	-	-	-	-	7	-	1	-	1	-	-	-	1		54

N33	Industrial - Primary Metal Industry	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
N99	Industrial - Other	-	1	22	88	31	-	21	-	7	-	15	1	7	1	2	3	2	-
N-A	Industrial - Abandoned	-	3	23	26	16	-	1	-	3	-	1	1	3	-	2	-	1	-
N-D	Industrial - Destroyed	-	-	5	21	13	-	-	-	1	-	17	18	7	-	1	4	-	-
N-I	Industrial - Inactive/Standby	-	-	-	7	2	-	-	-	1	-	1	1	-	-	-	-	-	-
NPA	Industrial - Plugged	1	1	15	47	40	-	4	4	5	-	26	37	14	-	3	1	1	-
O-A	Observation - Abandoned	-	-	7	6	2	-	2	-	1	-	7	-	1	-	1	-	-	-
O-D	Observation - Destroyed	-	1	2	4	1	-	2	-	4	-	2	-	-	-	-	-	-	-
OEX	Observation - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
O-O	Observation - Multiple Purpose	-	2	4	8	1	-	-	2	3	-	14	3	6	1	1	2	4	-
OPA	Observation - Plugged	3	1	1	4	1	-	-	4	7	-	4	-	3	-	-	1	-	-
O-Q	Observation - Water Quality	-	-	-	1	-	-	-	-	-	-	2	-	2	-	-	-	-	-
O-W	Observation - Water Level	-	-	-	1	3	-	-	-	2	-	7	-	5	-	-	-	1	-
P-A	Public Supply - Abandoned	1	-	11	12	14	-	3	-	2	-	4	-	-	1	5	1	1	-
P-C	Public Supply - Commercial	-	1	13	196	32	-	155	-	40	-	38	1	5	1	5	4	5	3
P-D	Public Supply - Destroyed	-	-	2	10	8	-	-	-	5	-	3	-	4	1	-	1	1	-
PEX	Public Supply - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-I	Public Supply - Inactive/Standby	-	-	-	-	1	-	1	-	4	-	2	-	-	-	-	1	1	-
P-M	Public Supply - Therapeutic	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
P-P	Public Supply - Municipal	-	-	-	6	1	-	7	-	-	-	4	-	5	-	6	12	5	7
PPA	Public Supply - Plugged	12	1	2	80	9	-	24	1	21	-	41	1	9	1	2	2	3	-
P-R	Public Supply - Rural	-	-	-	112	7	-	27	-	8	-	19	-	3	4	7	20	2	12
P-T	Public Supply - Institutional/Government	-	-	-	45	8	-	46	-	13	1	8	1	-	1	2	10	1	2
P-Z	Public Supply - Other	-	-	1	2	-	-	1	-	-	-	-	-	-	-	-	1	-	-
R--	Recovery	177	-	-	-	1	1	-	184	30	-	-	-	1	-	-	-	-	-
R-D	Recovery - Destroyed	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
REX	Recovery - Excavated	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
RPA	Recovery - Plugged	119	-	-	-	-	-	-	337	35	-	-	-	-	-	-	-	-	-
S--	Rig Supply	1	1	24	2	14	-	-	1	19	-	24	-	4	-	-	-	-	-
S-A	Rig Supply - Abandoned	-	-	7	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
S-D	Rig Supply - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S-I	Rig Supply - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SPA	Rig Supply - Plugged	1	2	127	10	67	-	4	1	66	-	129	1	18	-	-	-	-	-
T--	Test Hole	-	1	1	1	2	-	-	-	-	-	-	-	1	-	-	-	-	-
T-A	Test Hole - Abandoned	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T-D	Test Hole - Destroyed	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
TPA	Test Hole - Plugged	-	13	16	33	18	-	11	-	5	-	13	2	12	-	-	3	6	2
W--	Piezometers	403	13	1	5	3	1	-	207	47	28	14	-	7	-	-	-	-	-
W-D	Piezometers - Destroyed	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
WEX	Piezometers - Excavated	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-
WPA	Piezometers - Plugged	303	11	2	1	1	1	-	120	45	1	2	-	-	-	-	-	-	-
Z-A	Other - Abandoned	-	1	1	14	14	-	1	-	4	-	4	1	-	-	-	1	-	-
Z-D	Other - Destroyed	-	-	2	3	-	-	-	-	4	-	11	-	2	-	-	-	-	-
Z-F	Other - Fire Protection	-	2	1	4	2	-	3	-	3	-	1	1	-	-	-	-	-	-
Z-I	Other - Inactive/Standby	-	-	1	1	2	-	1	-	2	-	5	-	-	-	-	-	-	-
ZPA	Other - Plugged	5	-	4	24	13	-	6	7	10	-	14	1	1	-	2	-	-	-
Z-R	Other - Reworked	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-
Z-U	Other - Unknown	-	1	4	23	3	-	9	-	1	-	-	1	1	-	2	1	-	-
Z-Z	Other - Other	30	-	3	7	2	-	2	29	4	-	4	-	-	-	1	-	-	-
	Left Blank	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total per Geounits	**7,529**	**198**	**511**	**5,348**	**1,203**	**38**	**5,050**	**3,946**	**1,774**	**36**	**1,398**	**93**	**256**	**50**	**133**	**148**	**89**	**38**

-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	**6**
-	12	-	-	-	3	-	1	-	6	-	3	-	3	-	-	-	3	-	1	-	3	-	2	-	-	**238**
-	-	-	-	-	-	-	3	-	6	-	2	-	1	-	-	-	4	-	-	-	4	-	-	-	-	**100**
-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**90**
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	**14**
-	5	-	1	-	1	1	2	-	18	-	10	2	6	-	-	1	16	-	7	-	5	1	-	-	1	**276**
-	-	-	-	-	-	-	-	-	3	-	2	-	1	-	-	-	1	-	-	-	-	-	-	-	-	**34**
-	-	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**20**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
-	2	-	-	1	2	-	3	-	4	-	8	1	2	1	-	-	8	-	6	-	2	-	-	-	-	**91**
-	-	1	1	-	-	-	-	-	1	-	3	1	-	-	-	-	3	-	2	-	5	-	-	-	-	**46**
-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**7**
-	-	-	-	-	1	-	-	-	7	-	3	-	1	-	-	-	3	-	3	-	4	-	-	-	-	**41**
-	3	-	-	-	1	-	1	-	10	-	4	-	10	6	-	-	12	-	8	-	3	-	3	-	3	**119**
3	66	-	-	-	4	-	-	-	10	-	4	-	3	3	-	-	3	-	1	-	4	-	1	1	4	**606**
-	2	-	-	-	3	-	1	-	9	-	14	-	-	-	-	-	7	-	4	-	1	-	-	-	-	**76**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
-	2	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	2	-	1	-	2	-	1	-	1	**21**
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**
-	4	-	-	-	4	-	9	1	16	-	21	-	18	24	-	1	18	3	32	-	36	4	8	-	2	**254**
6	8	-	-	2	15	-	4	-	21	-	33	-	9	10	1	-	28	2	21	-	15	2	5	-	3	**394**
2	24	-	1	1	3	-	10	-	5	-	19	-	23	21	-	-	20	-	18	-	35	3	14	-	16	**436**
4	38	-	-	1	2	-	2	-	5	-	11	-	7	-	-	-	16	-	15	-	9	-	4	-	4	**256**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**5**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**394**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**6**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**491**
-	6	-	-	-	2	-	2	-	11	-	4	-	4	-	-	-	-	-	-	-	-	-	1	-	-	**120**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**11**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
-	11	1	-	-	3	-	8	-	15	-	4	-	3	-	-	-	1	-	1	-	-	-	1	-	-	**474**
-	-	-	-	-	-	-	1	-	3	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	-	**13**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	**4**
-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	**3**
-	8	-	-	-	5	-	10	-	14	-	10	-	9	7	-	-	14	-	15	-	25	6	6	5	3	**271**
-	-	-	-	-	3	-	1	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	**736**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**4**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**10**
-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**494**
-	2	-	1	-	-	-	-	-	3	-	1	-	1	-	-	-	1	-	1	-	1	-	-	-	-	**52**
-	1	-	-	-	1	-	-	-	2	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	**28**
-	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	**22**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**12**
-	5	-	-	-	1	-	2	-	2	-	3	-	2	-	-	-	2	-	1	-	-	-	-	-	-	**105**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**3**
1	5	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	**57**
-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**84**
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-**
																										-
43	**1,420**	**9**	**7**	**8**	**185**	**2**	**186**	**6**	**387**	**1**	**258**	**9**	**174**	**86**	**7**	**2**	**241**	**6**	**181**	**1**	**201**	**18**	**75**	**12**	**64**	**31,427**

OTHER AQUIFERS

Code	Well Use	111HLCN	112ALVL	112ALVLC	112ORVA	112ORVAC	123VKBJC	124CKMN	124CKMNC	124CRVR	124CRVRC	210CRCS	121PLCN	125MDWY		Total per use
--	Unknown	-	-	-	-	-	-	-	-	-	-	-	-	-		-
B--	Borehole/Pilot Hole	-	-	-	-	-	-	-	-	-	-	-	-	-		-
B-A	Borehole/Pilot Hole - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-		-
B-D	Borehole/Pilot Hole - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-		-
BEX	Borehole/Pilot Hole - Excavated out	-	-	-	-	-	-	-	-	-	-	-	-	-		-
BPA	Borehole/Pilot Hole - Plugged	-	-	-	-	-	-	-	-	1	-	-	-	-		**1**
C--	Cathodic	-	-	-	-	-	-	-	-	-	-	-	-	-		-
C-D	Cathodic - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-		-
CPA	Cathodic - Plugged	-	-	-	-	-	-	-	-	-	-	-	-	-		-
D--	Dewatering	-	-	-	6	-	-	-	-	-	-	-	-	-		**6**
D-A	Dewatering - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-		-
D-D	Dewatering - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-		-
DEX	Dewatering - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-		-
D-I	Dewatering - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		-
DPA	Dewatering - Plugged	-	-	-	14	6	-	-	-	-	-	-	-	-		**20**
E--	Power Generation	-	-	-	-	-	-	-	-	-	-	-	-	-		-
E-A	Power Generation - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-		-
EPA	Power Generation - Plugged	-	-	-	-	-	-	-	-	-	-	-	-	-		-
H--	Domestic	5	50	-	135	2	2	66	6	34	-	-	-	-		**300**
H-A	Domestic - Abandoned	-	4	-	2	-	-	1	-	-	-	-	-	-		**7**
H-D	Domestic - Destroyed	-	-	-	-	-	-	1	-	-	-	-	-	-		**1**
HEX	Domestic - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-		-
H-I	Domestic - Inactive/Standby	-	-	-	-	-	-	2	-	-	-	-	-	-		**2**
HPA	Domestic - Plugged	3	3	-	13	-	-	5	-	-	1	-	-	-		**25**
I--	Irrigation	-	44	-	54	1	1	4	-	1	-	-	-	-		**105**
I-A	Irrigation - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-		-
I-D	Irrigation - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-		-
I-I	Irrigation - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		-
IPA	Irrigation - Plugged	-	3	-	3	-	-	1	-	-	-	-	-	-		**7**
I-Q	Irrigation - Aquaculture	-	3	-	4	-	-	-	-	-	-	-	-	-		**7**
I-S	Irrigation - Stock	-	5	-	4	-	-	5	-	-	-	-	-	-		**14**
LHH	Heat Pump - Hole	-	-	-	-	-	-	-	-	-	-	-	-	-		-
LHS	Heat Pump - Supply Well	-	1	-	-	-	-	-	-	-	-	-	-	-		**1**
LPA	Heat Pump - Plugged	-	-	-	-	-	-	-	-	-	-	-	-	-		-
M--	Monitor	4	15	6	26	191	2	3	121	-	-	-	-	-		**368**
M-A	Monitor - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-		-
M-D	Monitor - Destroyed	-	-	-	1	4	-	-	1	-	-	-	-	-		**6**
MEX	Monitor - Excavated	-	-	-	1	3	-	-	4	-	-	-	-	-		**8**
M-I	Monitor - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		-
MPA	Monitor - Plugged	-	3	23	41	289	11	6	202	3	3	-	-	-		**581**
N20	Industrial - Food and Kindred Products	-	-	-	-	-	-	-	-	-	-	-	-	-		-
N22	Industrial - Textile Mill Products	-	1	-	-	-	-	-	-	-	-	-	-	-		**1**
N24	Industrial - Lumber & Wood Products	-	-	-	-	-	-	-	-	1	-	-	-	-		**1**
N26	Industrial - Paper & Allied Products	-	-	-	-	-	-	-	-	-	-	-	-	-		-
N28	Industrial - Chemical & Allied Products	-	-	-	-	-	-	-	-	-	-	-	-	-		-
N29	Industrial - Petroleum Refining & Related Products	-	2	-	1	-	-	-	-	-	-	-	1	-		**4**
N33	Industrial - Primary Metal Industry	-	-	-	-	-	-	-	-	-	-	-	-	-		-
N99	Industrial - Other	-	3	-	7	-	-	1	-	3	-	-	-	-		**14**
N-A	Industrial - Abandoned	-	-	-	1	-	-	-	-	-	-	3	1	1		**6**
N-D	Industrial - Destroyed	-	-	-	2	-	-	-	-	-	-	-	-	-		**2**

N-I	Industrial - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
NPA	Industrial - Plugged	-	-	-	5	-	-	2	-	-	-	-	-	-		**7**
O-A	Observation - Abandoned	-	-	-	-	-	-	-	-	-	-	2	-	-		**2**
O-D	Observation - Destroyed	-	2	1	11	-	-	-	-	-	-	-	-	-		**14**
OEX	Observation - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
O-O	Observation - Multiple Purpose	-	1	13	-	-	-	2	-	-	-	-	-	-		**16**
OPA	Observation - Plugged	-	7	10	9	-	-	-	-	-	-	-	-	-		**26**
O-Q	Observation - Water Quality	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
O-W	Observation - Water Level	-	1	-	3	-	-	-	-	-	-	-	-	-		**4**
P-A	Public Supply - Abandoned	-	-	-	-	-	-	-	-	1	-	-	-	-		**1**
P-C	Public Supply - Commercial	-	-	-	8	-	-	3	-	-	-	-	-	-		**11**
P-D	Public Supply - Destroyed	-	2	-	-	-	-	1	-	-	-	-	-	-		**3**
PEX	Public Supply - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
P-I	Public Supply - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
P-M	Public Supply - Therapeutic	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
P-P	Public Supply - Municipal	-	2	-	-	-	-	-	-	1	-	-	-	-		**3**
PPA	Public Supply - Plugged	-	3	-	3	4	-	1	-	-	-	1	-	-		**12**
P-R	Public Supply - Rural	-	1	-	-	-	-	2	-	-	-	-	-	-		**3**
P-T	Public Supply - Institutional/Government	-	1	-	3	-	-	1	-	7	-	-	-	-		**12**
P-Z	Public Supply - Other	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
R--	Recovery	-	-	-	8	22	-	1	1	-	-	-	-	-		**32**
R-D	Recovery - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
REX	Recovery - Excavated	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
RPA	Recovery - Plugged	-	-	-	3	11	-	-	4	-	-	-	-	-		**18**
S--	Rig Supply	-	2	-	1	-	-	3	1	1	-	-	-	-		**8**
S-A	Rig Supply - Abandoned	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
S-D	Rig Supply - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
S-I	Rig Supply - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
SPA	Rig Supply - Plugged	-	4	-	6	-	-	2	-	5	-	-	-	-		**17**
T--	Test Hole	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
T-A	Test Hole - Abandoned	-	-	-	-	-	-	-	-	-	-	1	-	-		**1**
T-D	Test Hole - Destroyed	-	5	-	-	-	-	-	-	-	-	-	-	-		**5**
TPA	Test Hole - Plugged	-	4	-	6	-	-	4	-	5	-	5	-	-		**24**
W--	Piezometers	-	8	-	5	6	-	-	-	-	-	-	-	-		**19**
W-D	Piezometers - Destroyed	-	3	-	-	1	-	-	-	-	-	-	-	-		**4**
WEX	Piezometers - Excavated	-	-	-	-	2	-	-	-	-	-	-	-	-		**2**
WPA	Piezometers - Plugged	-	5	-	2	11	-	-	5	-	-	-	-	-		**23**
Z-A	Other - Abandoned	-	2	-	-	-	-	-	-	1	-	-	-	2		**5**
Z-D	Other - Destroyed	-	-	-	-	-	-	-	-	-	-	-	-	1		**1**
Z-F	Other - Fire Protection	-	1	-	-	-	-	-	-	-	-	-	-	-		**1**
Z-I	Other - Inactive/Standby	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
ZPA	Other - Plugged	-	-	1	3	-	-	5	1	-	1	-	-	2		**13**
Z-R	Other - Reworked	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
Z-U	Other - Unknown	-	6	-	2	-	-	5	-	1	-	-	-	1		**15**
Z-Z	Other - Other	-	-	-	-	-	-	-	2	-	-	2	1	-		**5**
	Left Blank	-	-	-	-	-	-	-	-	-	-	-	-	-		**-**
	Total per Geounits	**12**	**197**	**54**	**393**	**553**	**16**	**127**	**348**	**65**	**5**	**14**	**3**	**7**		**1,794**

ORPHAN WELLS

Code	Well Use	00000000	11111111	11200NWM		Total per Use
--	Unknown	4	-	-		**4**
B--	Borehole/Pilot Hole	2	-	1		**3**
B-A	Borehole/Pilot Hole - Abandoned	-	2	-		**2**
B-D	Borehole/Pilot Hole - Destroyed	-	-	4		**4**
BEX	Borehole/Pilot Hole - Excavated out	-	-	1		**1**
BPA	Borehole/Pilot Hole - Plugged	112	27	658		**797**
C--	Cathodic	-	-	5		**5**
C-D	Cathodic - Destroyed	-	-	-		**-**
CPA	Cathodic - Plugged	-	-	2		**2**
D--	Dewatering	715	-	-		**715**
D-A	Dewatering - Abandoned	-	-	-		**-**
D-D	Dewatering - Destroyed	-	-	-		**-**
DEX	Dewatering - Excavated	265	-	-		**265**
D-I	Dewatering - Inactive/Standby	-	-	-		**-**
DPA	Dewatering - Plugged	29	-	-		**29**
E--	Power Generation	5	-	-		**5**
E-A	Power Generation - Abandoned	-	-	-		**-**
EPA	Power Generation - Plugged	1	-	-		**1**
H--	Domestic	12,615	1,102	1		**13,718**
H-A	Domestic - Abandoned	-	151	1		**152**
H-D	Domestic - Destroyed	-	8	-		**8**
HEX	Domestic - Excavated	-	-	-		**-**
H-I	Domestic - Inactive/Standby	3	80	-		**83**
HPA	Domestic - Plugged	685	428	10		**1,123**
I--	Irrigation	1,753	260	6		**2,019**
I-A	Irrigation - Abandoned	-	30	-		**30**
I-D	Irrigation - Destroyed	-	1	-		**1**
I-I	Irrigation - Inactive/Standby	4	8	1		**13**
IPA	Irrigation - Plugged	142	32	3		**177**
I-Q	Irrigation - Aquaculture	38	8	-		**46**
I-S	Irrigation - Stock	97	39	-		**136**
LHH	Heat Pump - Hole	28	1	2,267		**2,296**
LHS	Heat Pump - Supply Well	11	6	-		**17**
LPA	Heat Pump - Plugged	6	1	73		**80**
M--	Monitor	3,308	1	1		**3,310**
M-A	Monitor - Abandoned	-	-	-		**-**
M-D	Monitor - Destroyed	15	-	-		**15**
MEX	Monitor - Excavated	4	7	-		**11**
M-I	Monitor - Inactive/Standby	-	-	-		**-**
MPA	Monitor - Plugged	1,284	29	-		**1,313**
N20	Industrial - Food and Kindred Products	15	5	1		**21**
N22	Industrial - Textile Mill Products	-	-	-		**-**
N24	Industrial - Lumber & Wood Products	7	1	-		**8**
N26	Industrial - Paper & Allied Products	4	-	-		**4**
N28	Industrial - Chemical & Allied Products	15	1	-		**16**
N29	Industrial - Petroleum Refining & Related Products	39	6	-		**45**
N33	Industrial - Primary Metal Industry	2	2	-		**4**
N99	Industrial - Other	57	40	1		**98**
N-A	Industrial - Abandoned	-	20	-		**20**
N-D	Industrial - Destroyed	-	4	-		**4**
N-I	Industrial - Inactive/Standby	-	2	-		**2**
NPA	Industrial - Plugged	93	19	-		**112**
O-A	Observation - Abandoned	-	6	-		**6**
O-D	Observation - Destroyed	-	1	-		**1**
OEX	Observation - Excavated	4	-	-		**4**
O-O	Observation - Multiple Purpose	5	2	-		**7**
OPA	Observation - Plugged	4	1	-		**5**
O-Q	Observation - Water Quality	1	-	-		**1**
O-W	Observation - Water Level	-	-	-		**-**

P-A	Public Supply - Abandoned	-	6	-		**6**
P-C	Public Supply - Commercial	214	95	-		**309**
P-D	Public Supply - Destroyed	-	4	-		**4**
PEX	Public Supply - Excavated	-	-	-		**-**
P-I	Public Supply - Inactive/Standby	-	12	-		**12**
P-M	Public Supply - Therapeutic	4	-	-		**4**
P-P	Public Supply - Municipal	75	1	-		**76**
PPA	Public Supply - Plugged	240	55	2		**297**
P-R	Public Supply - Rural	119	33	-		**152**
P-T	Public Supply - Institutional/Government	45	18	-		**63**
P-Z	Public Supply - Other	99	-	-		**99**
R--	Recovery	372	1	-		**373**
R-D	Recovery - Destroyed	-	-	-		**-**
REX	Recovery - Excavated	-	-	-		**-**
RPA	Recovery - Plugged	111	3	-		**114**
S--	Rig Supply	3,687	30	-		**3,717**
S-A	Rig Supply - Abandoned	-	3	-		**3**
S-D	Rig Supply - Destroyed	-	3	-		**3**
S-I	Rig Supply - Inactive/Standby	15	-	-		**15**
SPA	Rig Supply - Plugged	1,763	67	1		**1,831**
T--	Test Hole	9	4	6		**19**
T-A	Test Hole - Abandoned	-	1	2		**3**
T-D	Test Hole - Destroyed	-	-	12		**12**
TPA	Test Hole - Plugged	83	15	919		**1,017**
W--	Piezometers	195	-	-		**195**
W-D	Piezometers - Destroyed	2	-	-		**2**
WEX	Piezometers - Excavated	-	-	-		**-**
WPA	Piezometers - Plugged	105	6	-		**111**
Z-A	Other - Abandoned	1	23	-		**24**
Z-D	Other - Destroyed	3	5	1		**9**
Z-F	Other - Fire Protection	10	-	-		**10**
Z-I	Other - Inactive/Standby	-	20	-		**20**
ZPA	Other - Plugged	89	33	13		**135**
Z-R	Other - Reworked	-	-	-		**-**
Z-U	Other - Unknown	-	48	-		**48**
Z-Z	Other - Other	193	28	12		**233**
	Left Blank	2	-	-		**2**
	Total per Geounits	**28808**	**2845**	**4,004**		**35657**

Total Number of Wells Registered (4/2010)

Code	Well Use	Total per use	
--	Unknown	4	0.00%
B--	Borehole/Pilot Hole	4	0.00%
B-A	Borehole/Pilot Hole - Abandoned	2	0.00%
B-D	Borehole/Pilot Hole - Destroyed	4	0.00%
BEX	Borehole/Pilot Hole - Excavated out	1	0.00%
BPA	Borehole/Pilot Hole - Plugged	800	0.44%
C--	Cathodic	8	0.00%
C-D	Cathodic - Destroyed	1	0.00%
CPA	Cathodic - Plugged	3	0.00%
D--	Dewatering	1580	0.87%
D-A	Dewatering - Abandoned	2	0.00%
D-D	Dewatering - Destroyed	4	0.00%
DEX	Dewatering - Excavated	724	0.40%
D-I	Dewatering - Inactive/Standby	2	0.00%
DPA	Dewatering - Plugged	879	0.48%
E--	Power Generation	56	0.03%
E-A	Power Generation - Abandoned	2	0.00%
EPA	Power Generation - Plugged	19	0.01%
H--	Domestic	75128	41.39%
H-A	Domestic - Abandoned	699	0.39%
H-D	Domestic - Destroyed	250	0.14%
HEX	Domestic - Excavated	1	0.00%
H-I	Domestic - Inactive/Standby	143	0.08%
HPA	Domestic - Plugged	6395	3.52%
I--	Irrigation	13354	7.36%
I-A	Irrigation - Abandoned	186	0.10%
I-D	Irrigation - Destroyed	57	0.03%
I-I	Irrigation - Inactive/Standby	49	0.03%
IPA	Irrigation - Plugged	686	0.38%
I-Q	Irrigation - Aquaculture	702	0.39%
I-S	Irrigation - Stock	1135	0.63%
LHH	Heat Pump - Hole	2302	1.27%
LHS	Heat Pump - Supply Well	202	0.11%
LPA	Heat Pump - Plugged	87	0.05%
M--	Monitor	14493	7.99%
M-A	Monitor - Abandoned	7	0.00%
M-D	Monitor - Destroyed	152	0.08%
MEX	Monitor - Excavated	352	0.19%
M-I	Monitor - Inactive/Standby	1	0.00%
MPA	Monitor - Plugged	14715	8.11%
N20	Industrial - Food and Kindred Products	201	0.11%
N22	Industrial - Textile Mill Products	13	0.01%
N24	Industrial - Lumber & Wood Products	130	0.07%
N26	Industrial - Paper & Allied Products	74	0.04%
N28	Industrial - Chemical & Allied Products	241	0.13%
N29	Industrial - Petroleum Refining & Related Products	306	0.17%
N33	Industrial - Primary Metal Industry	20	0.01%
N99	Industrial - Other	1160	0.64%
N-A	Industrial - Abandoned	278	0.15%
N-D	Industrial - Destroyed	217	0.12%

N-I	Industrial - Inactive/Standby	**37**	**0.02%**
NPA	Industrial - Plugged	**1068**	**0.59%**
O-A	Observation - Abandoned	**113**	**0.06%**
O-D	Observation - Destroyed	**345**	**0.19%**
OEX	Observation - Excavated	**8**	**0.00%**
O-O	Observation - Multiple Purpose	**641**	**0.35%**
OPA	Observation - Plugged	**376**	**0.21%**
O-Q	Observation - Water Quality	**23**	**0.01%**
O-W	Observation - Water Level	**372**	**0.20%**
P-A	Public Supply - Abandoned	**393**	**0.22%**
P-C	Public Supply - Commercial	**2508**	**1.38%**
P-D	Public Supply - Destroyed	**257**	**0.14%**
PEX	Public Supply - Excavated	**1**	**0.00%**
P-I	Public Supply - Inactive/Standby	**62**	**0.03%**
P-M	Public Supply - Therapeutic	**6**	**0.00%**
P-P	Public Supply - Municipal	**1056**	**0.58%**
PPA	Public Supply - Plugged	**1936**	**1.07%**
P-R	Public Supply - Rural	**1745**	**0.96%**
P-T	Public Supply - Institutional/Government	**1039**	**0.57%**
P-Z	Public Supply - Other	**127**	**0.07%**
R--	Recovery	**1541**	**0.85%**
R-D	Recovery - Destroyed	**4**	**0.00%**
REX	Recovery - Excavated	**20**	**0.01%**
RPA	Recovery - Plugged	**1660**	**0.91%**
S--	Rig Supply	**6064**	**3.34%**
S-A	Rig Supply - Abandoned	**38**	**0.02%**
S-D	Rig Supply - Destroyed	**90**	**0.05%**
S-I	Rig Supply - Inactive/Standby	**33**	**0.02%**
SPA	Rig Supply - Plugged	**11722**	**6.46%**
T--	Test Hole	**102**	**0.06%**
T-A	Test Hole - Abandoned	**38**	**0.02%**
T-D	Test Hole - Destroyed	**126**	**0.07%**
TPA	Test Hole - Plugged	**3336**	**1.84%**
W--	Piezometers	**2030**	**1.12%**
W-D	Piezometers - Destroyed	**23**	**0.01%**
WEX	Piezometers - Excavated	**35**	**0.02%**
WPA	Piezometers - Plugged	**2088**	**1.15%**
Z-A	Other - Abandoned	**212**	**0.12%**
Z-D	Other - Destroyed	**73**	**0.04%**
Z-F	Other - Fire Protection	**99**	**0.05%**
Z-I	Other - Inactive/Standby	**162**	**0.09%**
ZPA	Other - Plugged	**838**	**0.46%**
Z-R	Other - Reworked	**7**	**0.00%**
Z-U	Other - Unknown	**530**	**0.29%**
Z-Z	Other - Other	**677**	**0.37%**
	Left Blank	**2**	**0.00%**
	Total	**181494**	**100.00%**

Appendix C:

Ambient Surface Water Database

Basin: Atchafalaya-Vermilion-Teche			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	1198	Alabama Bayou west of Maringouin, Louisiana	34	39	13	11	0	0	0	32	129
STREAM	698	Atchafalaya Basin near Crewboat Chute, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	290	Atchafalaya River at Krotz Springs, Louisiana	220	216	89	7	0	0	0	88	620
STREAM	1196	Atchafalaya River at Krotz Springs, Louisiana	32	42	11	10	0	0	0	32	127
STREAM	39	Atchafalaya River at Morgan City, Louisiana	328	343	207	39	0	0	0	301	1218
STREAM	22	Atchafalaya River at Simmesport, Louisiana	396	393	128	10	0	0	0	169	1096
STREAM	933	Bayou Avoca at Sword Bayou, Louisiana	38	47	12	11	0	0	0	37	145
STREAM	1209	Bayou Blue at North Bend Pumping Station, North Bend, Louisiana	37	49	19	13	0	0	0	33	151
CANAL	3905	Bayou Maringouin southwest of Plaquemine, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	1200	Bayou Teche at Patterson, Louisiana	33	40	12	9	0	0	0	34	128
LAKE	3579	Henderson Lake at Butte La Rose pontoon bridge, Butte La Rose, LA	11	18	4	4	0	0	0	11	48
CANAL	984	I-10 Canal, East Atchafalaya Basin, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	1199	ICWW south of Belle River, Louisiana	33	42	11	11	0	0	0	32	129
STREAM	1203	ICWW south of Patterson, Louisiana	33	35	12	6	0	0	0	34	120
STREAM	1201	Lower Atchafalaya River near Bateman Island, Louisiana	33	35	12	10	0	0	0	34	124
STREAM	979	Lower Grand River, Louisiana	22	24	7	4	0	0	0	17	74
LAKE	1202	Wax Lake Outlet southwest of Patterson, Louisiana	34	50	16	12	0	0	0	34	146
STREAM	104	Bayou Boeuf near Milburn, Louisiana	183	179	136	3	0	0	0	185	686
STREAM	668	Bayou Boeuf north of Washington, Louisiana	38	62	18	12	0	0	0	47	177
STREAM	670	Bayou Carron east of Washington, Louisiana	38	49	18	11	0	0	0	47	163
STREAM	103	Bayou Cocodrie at St. Landry, Louisiana	221	233	155	16	0	0	0	229	854
CANAL	664	Bayou Cocodrie Diversion Canal at Highway 29, Louisiana	48	51	21	13	0	0	0	46	179
STREAM	2154	Bayou Cocodrie north of Washington, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	311	Bayou Cocodrie northeast of Oakdale, Louisiana	43	43	41	3	0	0	0	44	174
STREAM	102	Bayou Courtableau at Washington, Louisiana	182	179	137	4	0	0	0	184	686
STREAM	101	Bayou Courtableau east of Port Barre, Louisiana	162	157	98	4	0	0	0	148	569
STREAM	665	Bayou Courtableau in Port Barre, Louisiana	38	51	18	10	0	0	0	47	164
STREAM	1197	Bayou Courtableau near Courtableau, Louisiana	22	24	10	8	0	0	0	20	84
CANAL	667	Bayou des Glaises Diversion Channel east of Washington, Louisiana	40	51	18	12	0	0	0	47	168
CANAL	672	Bayou des Glaises near Long Bridge, Louisiana	42	49	20	12	0	0	0	37	160
STREAM	676	Bayou du Portage south of Coteau Holmes, Louisiana	36	36	14	8	0	0	0	35	129
STREAM	673	Bayou Teche 1.9 miles south of St. Martinville, LA	36	36	14	8	0	0	0	36	130
STREAM	30	Bayou Teche at Adeline, Louisiana	373	389	252	47	0	0	0	358	1419
STREAM	31	Bayou Teche at Breaux Bridge, Louisiana	437	437	168	6	0	0	0	207	1255
STREAM	100	Bayou Teche at Franklin, Louisiana	450	449	153	19	0	0	0	224	1295
CANAL	674	Charenton Canal south of Baldwin, Louisiana	41	54	19	16	0	0	0	41	171
LAKE	663	Cocodrie Lake north of Clearwater, Louisiana	39	36	14	7	0	0	0	35	131
BAY/ESTUARY	692	East Cote Blanche Bay south of Franklin, Louisiana	36	43	13	7	0	0	0	37	136
CANAL	686	Franklin Canal in Franklin, Louisiana	41	41	15	11	0	0	0	41	149
CANAL	2149	Franklin Canal southwest of Franklin, Louisiana	0	0	0	0	0	0	0	0	0
RESERVOIR	666	Indian Creek Reservoir southeast of Woodworth, Louisiana	40	41	14	7	0	0	0	35	137
STREAM	669	Irish Ditch/Big Bayou southeast of Boyce, Louisiana	38	45	16	7	0	0	0	41	147
LAKE	312	Lake Chicot north of Ville Platte, Louisiana	88	104	60	19	0	0	0	85	356
LAKE	313	Lake Fausse Pointe east of New Iberia, Louisiana	80	96	61	16	0	0	0	80	333
STREAM	99	Spring Creek near Glenmora, Louisiana	252	268	198	12	0	0	0	248	978
STREAM	675	Tete Bayou east of New Iberia, Louisiana	41	45	15	10	0	0	0	42	153
CANAL	671	West Atchafalaya Borrow Pit Canal northeast of Breaux Bridge, LA	36	42	14	8	0	0	0	35	135
BAY/ESTUARY	1204	Atchafalaya Bay south of Burns, Louisiana	26	34	11	11	0	0	0	22	104

STREAM	681	Bayou Petite Anse east of Delcambre, Louisiana	40	43	15	11	0	0	0	41	150
STREAM	693	Bayou Petite Anse southeast of Abbeville, Louisiana	47	59	19	17	0	0	0	47	189
STREAM	682	Bayou Tigre south of Delcambre, Louisiana	41	53	18	14	0	0	0	41	167
STREAM/ESTUARY	696	Bird Island Bayou at North end of Marsh Island, Louisiana	42	56	15	18	0	0	0	42	173
BAY/ESTUARY	689	Boston Canal south of Abbeville, Louisiana	11	11	6	0	0	0	0	11	39
STREAM	2148	Boston Canal/ICWW north of ICWW at 2nd oilfield canal	21	24	7	8	0	0	0	24	84
CANAL	315	Delcambre Canal east of Abbeville, Louisiana	86	88	59	13	0	0	0	86	332
BAY/ESTUARY	690	Dugas Canal by Tiger Lagoon Oil and Gas Field southeast of Boston, LA	35	36	12	7	0	0	0	34	124
CANAL/ESTUARY	685	Intracoastal Waterway at Cypremort Point Drawbridge, Louisiana	41	57	21	16	0	0	0	41	176
STREAM	694	Intracoastal Waterway South of Avery Island, Louisiana	11	12	6	0	0	0	0	11	40
CANAL/ESTUARY	679	Intracoastal Waterway southwest of Abbeville, Louisiana	34	35	13	8	0	0	0	35	125
CANAL/ESTUARY	2116	Intracoastal Waterway southwest of Avery Island, Louisiana	24	24	7	8	0	0	0	24	87
LAKE	688	Lake Peigneur west of Jefferson Island, Louisiana	36	37	14	9	0	0	0	36	132
CANAL	684	New Iberia Southern Drainage Canal near Intracoastal Waterway, LA	11	12	6	0	0	0	0	11	40
CANAL	683	*New Iberia Southern Drainage Canal south of New Iberia, Louisiana*	46	58	16	12	0	0	0	46	178
CANAL	680	Ruth Canal south of Breaux Bridge, Louisiana	35	35	13	8	0	0	0	35	126
BAY/ESTUARY	697	Southwest Pass of Vermilion Bay west of Porpoise Point, Louisiana	6	6	2	0	0	0	0	6	20
LAKE	687	Spanish Lake southwest of Delacroix, Louisiana	35	35	13	8	0	0	0	35	126
BAY/ESTUARY	316	Vermilion Bay south of New Iberia, Louisiana	87	89	56	15	0	0	0	88	335
STREAM	1	Vermilion River at Perry, Louisiana	595	605	250	48	0	0	0	354	1852
STREAM	678	Vermilion River Cutoff southwest of Abbeville, Louisiana	35	35	14	8	0	0	0	35	127
STREAM	2	Vermilion River near Breaux Bridge, Louisiana	186	189	156	3	0	0	0	181	715
STREAM	45	Vermilion River near Lafayette, Louisiana	223	216	99	0	0	0	0	146	684
STREAM	677	Vermilion River North of Intracoastal City, Louisiana	33	49	16	8	0	0	0	35	141
STREAM	314	Vermilion River south of Lafayette, Louisiana	89	89	88	6	0	0	0	88	360
STREAM	2117	Vermilion River south of Lafayette, Louisiana	23	32	11	11	0	0	0	24	101
BAY/ESTUARY	691	West Cote Blanche Bay southeast of Cypremort, Louisiana	34	34	13	7	0	0	0	33	121
		Total number of samples tested	6338	6716	3259	747	0	0	0	5161	22221

Basin: Calcasieu- Mermentau Rivers			**Number of Samples per Parameter Lists**								**Total**
Station Type	**Site ID**	**Site Name**	**Field**	**Conventional**	**Metals**	**VOCs**	**Semi-VOCs**	**Pesticides**	**PCBs**	**Bacteria**	
STREAM	653	Bayou Blue south of Soileau, Louisiana	36	36	14	6	0	0	0	36	128
STREAM	647	Bayou des Cannes near Evangeline, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	308	Bayou Des Cannes northeast of Jennings, Louisiana	89	92	62	16	0	0	0	90	349
STREAM	648	Bayou Joe Marcel near Ville Platte, Louisiana	35	48	17	12	0	0	0	43	155
STREAM	649	Bayou Mallet north of Iota, Louisiana	47	53	18	9	0	0	0	47	174
STREAM	651	Bayou Nezpique east of Jennings, Louisiana	36	38	14	7	0	0	0	35	130
STREAM	309	Bayou Nezpique near Jennings, Louisiana	41	45	44	5	0	0	0	45	180
STREAM	5	Bayou Nezpique north of Basile, Louisiana	222	232	201	5	0	0	0	221	881
STREAM	4	Bayou Plaquemine Brule near Estherwood, Louisiana	222	236	199	2	0	0	0	226	885
STREAM	650	Bayou Plaquemine Brule southwest of Egan, Louisiana	46	69	23	16	0	0	0	45	199
STREAM	652	Beaver Creek west of Pine Prairie, Louisiana	35	50	17	9	0	0	0	42	153
STREAM	490	Castor Creek east of Oberlin, Louisiana	36	53	18	10	0	0	0	35	152
STREAM	658	Bayou Chene south of Welsh, Louisiana	37	36	14	7	0	0	0	37	131
STREAM	98	Bayou Lacassine near Lake Arthur, Louisiana	257	264	190	12	0	0	0	260	983
STREAM	46	Bayou Queue de Tortue north of Gueydan, Louisiana	273	278	202	15	0	0	0	272	1040
CANAL	695	Freshwater Bayou Canal south of Kaplan, Louisiana	33	51	16	10	0	0	0	36	146
LAKE/ESTUARY	659	Grand Lake near Talen's Landing, Louisiana	37	49	18	12	0	0	0	37	153
OCEAN	2114	Gulf of Mexico southwest of Grand Chenier, Louisiana	24	24	8	7	0	0	0	24	87
STREAM	660	Intracoastal Waterway at Mile 170, Louisiana	34	36	13	8	0	0	0	36	127
CANAL	657	Intracoastal Waterway SSW of Iowa, Louisiana	36	36	14	7	0	0	0	36	129
STREAM	655	Mermentau River (lower) at Lacassine National Wildlife Refuge, LA	37	36	14	7	0	0	0	37	131
STREAM	654	Mermentau River at Lake Arthur, Louisiana	37	36	15	8	0	0	0	37	133

STREAM	3	Mermentau River at Mermentau, Louisiana	584	617	250	43	0	0	0	357	1851
OCEAN	662	Mermentau River Basin Coastal Bays and Gulf Waters	12	12	6	0	0	0	0	12	42
STREAM/ESTUARY	29	Mermentau River near Grand Cheniere, Louisiana	253	264	207	12	0	0	0	251	987
CANAL/ESTUARY	661	Superior Canal near Hwy. 82	12	12	6	0	0	0	0	12	42
CANAL/ESTUARY	2115	Unnamed Canal near Big Constance Lake	24	45	12	11	0	0	0	24	116
LAKE	310	White Lake southwest of Abbeville, Louisiana	79	79	56	12	0	0	0	79	305
STREAM	837	Barnes Creek north of Longville, Louisiana	35	53	14	11	0	0	0	35	148
STREAM	838	Barnes Creek south of Reeves, Louisiana	35	37	12	9	0	0	0	36	129
STREAM	840	Bayou Serpent southeast of Hecker, Louisiana	35	37	13	8	0	0	0	36	129
STREAM	93	Calcasieu River at Moss Bluff, Louisiana	528	544	228	49	0	0	0	354	1703
STREAM	820	Calcasieu River east of Union Hill, Louisiana	41	49	15	12	0	0	0	34	151
STREAM	95	Calcasieu River near Kinder, Louisiana	474	471	192	13	0	0	0	264	1414
STREAM	97	Calcasieu River near Oakdale, Louisiana	445	436	182	5	0	0	0	230	1298
STREAM	819	Calcasieu River northeast of Slagle, Louisiana	41	36	11	8	0	0	0	31	127
STREAM	96	Calcasieu River northwest of Oberlin, Louisiana	353	345	181	6	0	0	0	227	1112
STREAM	131	English Bayou near Lake Charles, Louisiana	156	169	135	4	0	0	0	167	631
STREAM	841	English Bayou north of Chloe', Louisiana	36	36	12	8	0	0	0	35	127
STREAM	839	Marsh Bayou southeast of Topsy, Louisiana	35	50	12	11	0	0	0	36	144
STREAM	821	Mill Creek Southwest of Elizabeth, Louisiana	33	41	11	8	0	0	0	35	128
STREAM	834	Bundicks Creek northwest of Bundicks Lake	35	35	12	8	0	0	0	35	125
STREAM	836	Bundicks Creek Southeast of Dry Creek, Louisiana	35	35	12	8	0	0	0	35	125
LAKE	835	Bundicks Lake northwest of Dry Creek, Louisiana	34	34	12	9	0	0	0	34	123
STREAM	552	East Fork Six Mile Creek near Fort Polk, Louisiana	2	2	2	0	0	0	0	0	6
STREAM	832	Six Mile Creek north of Mittie, Louisiana	33	37	12	8	0	0	0	35	125
STREAM	831	Six Mile Creek northwest of Pitkin, Louisiana	42	35	11	8	0	0	0	34	130
STREAM	547	Ten Mile Creek near Fort Polk, Louisiana	2	2	2	0	0	0	0	0	6
STREAM	833	Ten Mile Creek northeast of Mittie, Louisiana	33	43	15	12	0	0	0	35	138
STREAM	551	West Fork Six Mile Creek, near Fort Polk, Lousiana	2	2	2	0	0	0	0	0	6
STREAM	829	Whiskey Chitto Creek northwest of Cravens, Louisiana	30	24	8	4	0	0	0	23	89
STREAM	830	Whiskey Chitto Creek northwest of Kinder, Louisiana	33	36	11	8	0	0	0	34	122
STREAM	3593	Whiskey Chitto Creek west of Cravens, Louisiana	11	11	4	4	0	0	0	11	41
STREAM	548	Whisky Chitto Creek near Fort Polk, Louisiana	2	2	2	0	0	0	0	0	6
STREAM	847	Bear Head Creek northeast of Starks, Louisiana	36	43	12	8	0	0	0	36	135
STREAM	843	Beckwith Creek east of DeQuincy, Louisiana	36	41	12	12	0	0	0	36	137
STREAM	92	Calcasieu River (West Fork) near Lake Charles, Louisiana	329	323	191	12	0	0	0	256	1111
STREAM	842	Hickory Branch east southeast of DeQuincy, Louisiana	36	37	12	8	0	0	0	36	129
STREAM	846	Houston River northeast of Sulphur, Louisiana	34	52	15	12	0	0	0	34	147
STREAM	845	Indian Bayou at Moss Bluff, Louisiana	34	35	12	8	0	0	0	35	124
STREAM	844	Little River east of Buhler, Louisiana	34	35	12	8	0	0	0	35	124
STREAM/ESTUARY	849	Bayou Choupique at Carlyss, Louisiana	12	11	4	0	0	0	0	12	39
STREAM/ESTUARY	2752	Bayou Choupique south of Sulphur, Louisiana	24	24	8	8	0	0	0	24	88
STREAM/ESTUARY	94	Bayou D'Inde near Lake Charles, Louisiana	230	220	178	4	0	0	0	217	849
STREAM/ESTUARY	848	Bayou D'Inde south of Sulphur, Louisiana	36	37	11	8	0	0	0	37	129
STREAM/ESTUARY	825	Bayou Verdine west of Westlake, Louisiana	35	37	12	8	0	0	0	37	129
LAKE/ESTUARY	828	Black Lake west of Hackberry, Louisiana	36	37	11	8	0	0	0	35	127
LAKE/ESTUARY	827	Calcasieu Lake west of Hebert's Landing, Louisiana	36	47	12	8	0	0	0	35	138
OCEAN	852	Calcasieu River Coastal Waters Southeast of Cameron Jetties, Louisiana	26	32	9	6	0	0	0	23	96
STREAM/ESTUARY	826	Calcasieu River in Hackberry, Louisiana	36	40	12	12	0	0	0	35	135
STREAM/ESTUARY	26	Calcasieu River near Burton Landing, Louisiana	437	444	242	47	0	0	0	349	1519
STREAM/ESTUARY	27	Calcasieu River near Lake Charles, Louisiana	308	297	199	4	0	0	0	219	1027
STREAM/ESTUARY	631	Contraband Bayou at Lake Charles, Louisiana	23	31	9	10	0	0	0	23	96
STREAM/ESTUARY	824	Contraband Bayou in the City of Lake Charles, Louisiana	12	12	4	0	0	0	0	12	40
OCEAN	1170	Gulf of Mexico south of Louisiana Point, Louisiana	22	30	7	7	0	0	0	24	90
CANAL/ESTUARY	850	Intracoastal Waterway northwest of Hackberry, Louisiana	36	36	12	8	0	0	0	35	127
CANAL/ESTUARY	851	Intracoastal Waterway west of Boones Corner, Louisiana	35	40	11	10	0	0	0	37	133
LAKE/ESTUARY	822	Lake Charles at the City of Lake Charles, Louisiana	35	42	12	10	0	0	0	36	135
LAKE/ESTUARY	823	Prien Lake southwest of the City of Lake Charles, Louisiana	34	36	10	15	0	0	0	34	129

		Total number of samples tested	7107	7448	3820	730	0	0	0	5900	25005
Basin: Lakes Pontchartrain-Maurepas			**Number of Samples per Parameter Lists**								**Total**
Station Type	**Site ID**	**Site Name**	**Field**	**Conventional**	**Metals**	**VOCs**	**Semi-VOCs**	**Pesticides**	**PCBs**	**Bacteria**	
STREAM	119	Amite River at Grangeville, Louisiana	377	360	192	11	0	0	0	237	1177
STREAM	118	Amite River at Magnolia, Louisiana	256	243	96	0	0	0	0	126	721
STREAM	228	Amite River at mile 6.5, at Clio, Louisiana	27	31	9	10	0	0	0	31	108
STREAM	43	Amite River at Port Vincent, Louisiana	266	267	209	17	0	0	0	241	1000
STREAM	44	Amite River west of Darlington, Louisiana	239	238	203	5	0	0	0	212	897
STREAM	142	Bayou Manchac near Prairieville, Louisiana	176	179	153	17	0	0	0	160	685
STREAM	236	Colyell Bay near Port Vincent, Louisiana	28	30	9	10	0	0	0	30	107
STREAM	1109	Comite River at Wilson-Clinton Rd. Bridge	23	30	7	8	0	0	0	24	92
STREAM	297	Comite River east of Baton Rouge, Louisiana	89	89	87	7	0	0	0	85	357
STREAM	1100	Comite River near Comite Drive Bridge	27	31	9	10	0	0	0	30	107
STREAM	1099	Comite River near Stevendale Road train bridge	28	30	9	10	0	0	0	31	108
STREAM	239	Gray's Creek north of Port Vincent, Louisiana	28	31	9	10	0	0	0	29	107
STREAM	298	Natalbany River west of Ponchatoula, Louisiana	75	75	53	16	0	0	0	74	293
STREAM	1112	Ponchatoula Creek at Hwy. 22	37	35	11	12	0	0	0	35	130
STREAM	116	Tickfaw River at Springville, Louisiana	334	353	186	49	0	0	0	301	1223
STREAM	1106	Tickfaw River near Lake Maurepas	24	32	7	8	0	0	0	24	95
STREAM	299	Yellow Water River west of Ponchatoula, Louisiana	73	80	54	17	0	0	0	117	341
STREAM	268	Amite River Diversion Canal north of Gramercy, Louisiana	27	32	9	10	0	0	0	31	109
STREAM	243	Blind River east of Gonzales, Louisiana	23	26	8	9	0	0	0	27	93
STREAM	1102	Blind River near confluence with Lake Maurepas	23	26	8	9	0	0	0	27	93
STREAM	117	Blind River near Gramercy, Louisiana	193	179	140	6	0	0	0	172	690
STREAM	156	Blind River northwest of Gramercy, Louisiana	0	0	1	1	0	0	0	2	4
STREAM	3590	I-55 Borrow Canal, south of Ponchatoula, Louisiana	13	11	4	4	0	0	0	11	43
LAKE	1105	Lake Maurepas	24	24	7	8	0	0	0	24	87
STREAM	155	Mississippi Bayou north of Reserve, Louisiana	45	45	45	4	0	0	0	43	182
STREAM	1103	New River near Hwy. 937 bridge	32	34	9	12	0	0	0	31	118
STREAM	36	Pass Manchac at Manchac, Louisiana	260	260	212	18	0	0	0	246	996
STREAM	1121	Selsers Creek at Weinberger Road, southeast of Ponchatoula, Louisiana	24	31	7	8	0	0	0	24	94
STREAM	1111	South Slough on I-55 Bridge near Ponchatoula	12	13	3	4	0	0	0	12	44
STREAM	1110	Big Creek near Roseland, Louisiana	24	24	7	7	0	0	0	24	86
STREAM	1101	Chappepeela Creek at Chappepeela Rd. Bridge	25	24	7	7	0	0	0	24	87
STREAM	108	Tangipahoa River at Arcola, Louisiana	197	182	141	6	0	0	0	176	702
STREAM	34	Tangipahoa River near Kentwood, Louisiana	240	238	205	6	0	0	0	218	907
STREAM	1104	Tangipahoa River near Lake Pontchartrain	24	24	7	8	0	0	0	24	87
STREAM	33	Tangipahoa River west of Robert, Louisiana	606	598	255	50	0	0	0	343	1852
STREAM	301	Bayou Bonfouca at Slidell, Louisiana	68	71	49	12	0	0	0	67	267
STREAM/ESTUARY	1078	Bayou Bonfouca, 3.2 miles South of Hwy. 433	24	25	6	7	0	0	0	23	85
STREAM/ESTUARY	1046	Bayou Castine at Prieto Marina	23	27	5	6	0	0	0	24	85
STREAM	303	Bayou Chinchuba near Mandeville, Louisiana	44	44	43	5	0	0	0	44	180
STREAM	1250	Bayou Lacombe at Highway 434 bridge near St. Tammany, Louisiana	0	0	0	0	0	0	0	0	0
STREAM/ESTUARY	1047	Bayou Lacombe at Hwy. 434 Bridge	23	26	6	6	0	0	0	27	88
STREAM	300	Bayou Lacombe below Highway 190, west of Slidell, Louisiana	67	69	48	10	0	0	0	69	263
STREAM/ESTUARY	1076	Bayou Liberty at Bayou Paquet	24	25	6	7	0	0	0	23	85
STREAM	1077	Bayou Liberty at Hwy. 433 Bridge	24	27	6	7	0	0	0	23	87
STREAM	411	Bogue Falaya at Covington, Louisiana	25	26	6	6	0	0	0	23	86
STREAM	987	Bogue Falaya at St. Benedict, Louisiana	0	0	0	1	0	0	0	0	1
STREAM	302	Cane Bayou east of Mandeville, Louisiana	66	71	48	10	0	0	0	68	263
STREAM/ESTUARY	1044	Salt Bayou at Hwy. 433 boat launch	24	25	6	8	0	0	0	23	86
STREAM/ESTUARY	106	Tchefuncte River at Madisonville, Louisiana	333	329	184	48	0	0	0	318	1212

STREAM	409	Tchefuncte River near Covington, Louisiana	0	0	0	0	0	0	0	0	0
STREAM/ESTUARY	638	Tchefuncte River south of Madisonville, Louisiana	24	25	6	6	0	0	0	23	84
STREAM	107	Tchefuncte River west of Covington, Louisiana	454	434	148	11	0	0	0	204	1251
BAY/ESTUARY	1043	Unnamed Canal at 450 Eden Isles Drive, Slidell, Louisiana	24	26	6	8	0	0	0	24	88
CANAL	1045	W-14 Canal at Voters Road Bridge, Slidell, Louisiana	24	24	6	7	0	0	0	23	84
LAKE/ESTUARY	139	Lake Pontchartrain (Causeway Crossover #1) near Covington, Louisiana	181	169	169	6	0	0	0	84	609
LAKE/ESTUARY	138	Lake Pontchartrain (Causeway Crossover #4) near Metairie, Louisiana	318	332	214	45	0	0	0	222	1131
LAKE/ESTUARY	137	Lake Pontchartrain (Causeway Crossover #7) near Metairie, Louisiana	183	168	170	6	0	0	0	84	611
LAKE/ESTUARY	1075	Lake Pontchartrain south of Treasure Isle channel marker #6	25	27	6	8	0	0	0	23	89
LAKE	217	Lake Pontchartrain-Causeway Crossover 2 south of Mandeville, Louisiana	16	0	0	0	0	0	0	0	16
LAKE/ESTUARY	216	Lake Pontchartrain-Causeway Crossover 6 north of Metairie, Louisiana	13	0	0	0	0	0	0	0	13
		Total number of samples tested	5906	5875	3516	624	0	0	0	4665	20586

Basin: Mississippi River			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	317	Mississippi River at Lake Providence, Louisiana	75	78	76	54	0	0	0	0	283
STREAM	21	Mississippi River at Lutcher, Louisiana	281	273	148	0	0	0	0	130	832
STREAM	53	Mississippi River at Plaquemine, Louisiana	341	330	146	52	59	35	41	184	1188
STREAM	319	Mississippi River east of Plaquemine, Louisiana	162	176	117	147	45	44	45	158	894
STREAM	54	Mississippi River near Plaquemine, Louisiana	300	277	140	6	1	1	1	129	855
STREAM	9	Mississippi River near St. Francisville, Louisiana	299	291	157	4	1	1	1	140	894
STREAM	55	Mississippi River near St. Francisville, Louisiana	339	341	146	50	59	34	39	195	1203
STREAM	321	Mississippi River south of Lutcher, Louisiana	53	53	52	49	0	0	0	47	254
STREAM	318	Mississippi River south of Saint Francisville, Louisiana	170	177	117	153	123	124	126	155	1145
LAKE	1107	Old River Lake at Old River Landing	32	32	10	10	0	0	0	30	114
STREAM	1098	Bayou Baton Rouge	32	43	10	11	0	0	0	32	128
STREAM	1108	Bayou Sara at Tunica St. Bridge	28	33	10	12	0	0	0	30	113
LAKE	583	Capitol Lake at Baton Rouge, Louisiana	33	44	10	11	0	0	0	32	130
STREAM	1115	Monte Sano Bayou south of Scotlandville, Louisiana	25	25	7	8	0	0	0	24	89
STREAM	323	Thompsons Creek east of Saint Francisville, Louisiana	118	125	99	15	0	0	0	118	475
STREAM	1116	Tunica Bayou near Tunica, Louisiana	24	24	7	8	0	0	0	23	86
STREAM/ESTUARY	1096	Batiste Collette at Equilon pipeline crossing	4	4	3	4	0	0	0	4	19
BAY/ESTUARY	1092	East Bay near Joseph Bayou	19	25	10	10	0	0	0	18	82
STREAM/ESTUARY	1094	Main Pass at intersection with Mississippi River	4	4	3	3	0	0	0	2	16
STREAM	51	Mississippi River at Belle Chasse, Louisiana	334	330	145	51	58	33	40	186	1177
STREAM	50	Mississippi River at Pointe a la Hache, Louisiana	232	217	132	0	0	0	0	133	714
STREAM	320	Mississippi River east of Belle Chasse, Louisiana	264	268	116	144	46	46	48	174	1106
STREAM	52	Mississippi River near Belle Chase, Louisiana	290	273	135	3	0	0	0	135	836
STREAM	48	Mississippi River near Luling, Louisiana	255	237	102	0	0	0	0	114	708
STREAM	322	Mississippi River west of Point a la Hache, Louisiana	135	129	88	81	78	78	78	85	752
STREAM/ESTUARY	1093	South Pass at Head of Passes	19	21	10	12	0	0	0	18	80
STREAM/ESTUARY	1097	Tiger Pass at Cypress Cove Marina	4	4	3	4	0	0	0	3	18
		Total number of samples tested	3872	3834	1999	902	470	396	419	2299	14191

Basin: Mississippi River Delta			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	3034	Bayou Cocodrie at the Hwy 565 bridge	24	10	4	4	0	0	0	12	54
STREAM	1228	Bayou Cocodrie south of Monterey, Louisiana	1	14	4	2	0	0	0	10	31
STREAM	1232	Bayou Cocodrie southwest of Feriday, Louisiana	24	25	9	7	0	0	0	24	89
STREAM	1234	Bayou Cocodrie southwest of Ridgecrest, Louisiana	24	24	9	7	0	0	0	23	87
LAKE	1229	Cocodrie Lake north of Monterey, Louisiana	1	17	5	2	0	0	0	10	35
LAKE	3055	Cocodrie Lake south of Stacy, Louisiana	12	16	4	4	0	0	0	12	48
LAKE	1231	Lake Concordia at Ferriday, Louisiana	24	28	8	7	0	0	0	24	91
LAKE	1230	Lake St. John at Spokane, Louisiana	28	30	10	8	0	0	0	24	100
STREAM	976	Bayou Chalpin, Louisiana	33	36	13	10	0	0	0	28	120
STREAM	336	Bayou Choctaw west of Port Allen, Louisiana	114	122	100	13	0	0	0	117	466
STREAM	978	Bayou Fordoche, Louisiana	22	23	8	4	0	0	0	19	76
STREAM	970	Bayou Grosse Tete, Louisiana	33	34	12	9	0	0	0	27	115
STREAM	977	Bayou Maringouin, Louisiana	33	35	12	8	0	0	0	28	116
STREAM	417	Bayou Plaquemine at Grand River, Louisiana	47	46	0	0	0	0	0	0	93
STREAM	972	Bayou Plaquemine, Louisiana	33	42	11	10	0	0	0	28	124
STREAM	968	Bayou Portage, Louisiana	19	19	6	4	0	0	0	13	61
STREAM	969	Bayou Poydras, Louisiana	34	34	12	9	0	0	0	28	117
CANAL	971	Chamberlin Canal, Louisiana	33	39	12	9	0	0	0	29	122
LAKE	335	False River south of New Roads, Louisiana	119	133	101	23	0	0	0	119	495
LAKE	974	False River, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	975	Intracoastal Waterway near Indian Village, Louisiana	22	23	7	5	0	0	0	18	75
STREAM	80	Lower Grand River at Bayou Sorrel, Louisiana	365	355	186	7	0	0	0	225	1138
STREAM	973	Upper Grand River, Louisiana	33	34	11	12	0	0	0	28	118
BAY/ESTUARY	1089	Bay Boudreau 5.18 nautical miles from Morgan Harbor	23	23	6	7	0	0	0	24	83
STREAM	6	Bay Gardene (Bayou Lost) East of Pointe a la Hache, Louisiana	256	257	207	15	0	0	0	236	971
STREAM/ESTUARY	1070	Bayou Bashman near Bayou Dupre	24	24	7	9	0	0	0	28	92
STREAM/ESTUARY	307	Bayou Bienvenue north of Chalmette, Louisiana	81	85	53	19	0	0	0	77	315
STREAM/ESTUARY	1062	Bayou Bienvenue, Louisiana	36	40	9	13	0	0	0	35	133
STREAM/ESTUARY	1063	Bayou Bienvenue, Louisiana	37	38	9	15	0	0	0	35	134
STREAM/ESTUARY	1071	Bayou Chaperon near Bayou Bienvenue	24	25	6	8	0	0	0	24	87
STREAM/ESTUARY	1069	Bayou Dupre adjacent to Toca loading dock	24	24	6	8	0	0	0	24	86
STREAM/ESTUARY	1079	Bayou Gentilly near Lake Petit, Louisiana	24	25	8	9	0	0	0	27	93
STREAM/ESTUARY	304	Bayou La Branche north of Norco, Louisiana	73	76	54	16	0	0	0	71	290
STREAM/ESTUARY	1086	Bayou La Loutre near Mississippi River Gulf Outlet	23	25	6	9	0	0	0	24	87
STREAM/ESTUARY	1084	Bayou Loutre at Breton Sound Marina	23	25	5	11	0	0	0	23	87
STREAM/ESTUARY	1066	Bayou Pirogue near New Canal	24	26	6	7	0	0	0	24	87
STREAM/ESTUARY	305	Bayou Saint John at New Orleans, Louisiana	22	31	6	8	0	0	0	24	91
STREAM/ESTUARY	1052	Bayou Sauvage at Lombards boat launch, Hwy. 90	24	28	6	7	0	0	0	23	88
STREAM/ESTUARY	1067	Bayou Terre Beau near New Canal, Louisiana	24	24	7	9	0	0	0	28	92
STREAM	3958	Bayou Trepagnier east of Laplace, Louisiana	4	6	2	2	0	0	0	6	20
STREAM/ESTUARY	150	Bayou Trepagnier north of Norco, Louisiana	24	27	7	7	0	0	0	24	89
CANAL	1048	Bonne Carre Spillway boat launch	24	24	7	7	0	0	0	24	86
BAY/ESTUARY	1095	Breton Sound near LLOG well head	19	21	9	12	0	0	0	18	79
BAY/ESTUARY	1082	Breton Sound near Mozambique Point	24	24	7	9	0	0	0	24	88
STREAM/ESTUARY	109	Chef Menteur Pass at Chef Menteur, Louisiana	239	222	184	7	0	0	0	218	870
BAY/ESTUARY	1091	Drum Bay, Louisiana	23	27	5	8	0	0	0	24	87
CANAL	1049	Duncan Canal at I-10 mile marker 221, Kenner, Louisiana	24	24	7	7	0	0	0	24	86
BAY/ESTUARY	1087	Eloi Bay near Mississippi River Gulf Outlet marker #76, Louisiana	23	23	6	10	0	0	0	24	86
CANAL	306	Inner Harbor Navigation Canal at New Orleans, Louisiana	107	108	90	13	0	0	0	111	429
CANAL/ESTUARY	1073	Intracoastal Waterway at intersection with unknown pass	24	25	6	9	0	0	0	23	87
CANAL/ESTUARY	1064	Intracoastal Waterway at New Orleans Public Service gas pipeline crossing	36	39	9	14	0	0	0	35	133

LAKE/ESTUARY	1074	Lake Borgne near mouth of Blind Rigolets	23	24	6	8	0	0	0	23	84
BAY/ESTUARY	1083	Lake Calebasse	24	27	7	10	0	0	0	24	92
LAKE/ESTUARY	1081	Lake Lery	25	28	7	8	0	0	0	24	92
LAKE	1072	Lake St. Catherine, Louisiana	24	25	6	8	0	0	0	23	86
CANAL/ESTUARY	1085	Mississippi River Gulf Outlet at marker #94	24	25	6	10	0	0	0	24	89
BAY/ESTUARY	1088	Morgan Harbor, Louisiana	23	26	6	7	0	0	0	24	86
CANAL/ESTUARY	1065	New Canal near Bayou Pirogue, Louisiana	24	29	7	9	0	0	0	28	97
STREAM/ESTUARY	1080	Oak River at Koch Gateway pipeline crossing	24	25	7	8	0	0	0	24	88
STREAM/ESTUARY	35	Pass Rigolets (The Rigolets) southeast of Slidell, Louisiana	264	263	211	15	0	0	0	239	992
LAKE/ESTUARY	7	Petit Lake south of Delacroix, Louisiana	261	260	207	13	0	0	0	237	978
BAY/ESTUARY	1090	Point Lydia, Louisiana	23	24	6	8	0	0	0	24	85
CANAL	1051	St. Charles Canal at Morrison Rd., New Orleans, Louisiana	23	23	6	8	0	0	0	24	84
CANAL	1050	Suburban Canal near pumping station #2, Avron Drive, Metairie, Louisiana	28	33	9	9	0	0	0	30	109
CANAL/ESTUARY	1068	Violet Canal near New Canal	24	24	7	9	0	0	0	28	92
BAY/ESTUARY	3000	Barataria Bay in Lake Grande Ecaille, northwest of Grand Ecaille, Louisiana	10	11	3	3	0	0	0	10	37
CANAL	899	Barataria Waterway Lafitte northeast of Lafitte, Louisiana	33	43	15	12	0	0	0	34	137
CANAL	907	Barataria Waterway south-southeast of Lafitte, Louisiana	33	42	11	11	0	0	0	34	131
BAY/ESTUARY	902	Bay Lanoux south of Port Sulphur, Louisiana	21	23	8	7	0	0	0	22	81
BAY/ESTUARY	989	Bay Lizette east of Leeville	0	0	0	0	0	0	0	0	0
BAY/ESTUARY	926	Bay Lizette east of Leeville, Louisiana	32	44	14	13	0	0	0	34	137
STREAM	994	Bayou Boeuf at Halpin Canal	0	0	0	0	0	0	0	0	0
STREAM	918	Bayou Boeuf at Halpin Canal, Louisiana	35	44	11	9	0	0	0	36	135
STREAM	84	Bayou Chevreuil near Chegby (Chackbay), Louisiana	234	235	156	19	0	0	0	209	853
STREAM	921	Bayou Des Allemands 0.5 mile south of Hwy 90 bridge in Des Allemands, LA	35	46	10	9	0	0	0	36	136
STREAM	292	Bayou Des Allemands at Des Allemands, Louisiana	76	89	58	14	0	0	0	77	314
STREAM/ESTUARY	909	Bayou Dulac west of Bay Sanbois, Louisiana	23	26	8	7	0	0	0	24	88
STREAM	903	Bayou Gauche northwest of Carmadelle, Louisiana	33	38	13	9	0	0	0	37	130
STREAM	38	Bayou Lafourche at Cut Off, Louisiana	152	150	117	0	0	0	0	133	552
STREAM	112	Bayou Lafourche at Raceland, Louisiana	256	244	141	3	0	0	0	171	815
STREAM	23	Bayou Lafourche near Donaldsonville, Louisiana	257	254	161	2	0	0	0	178	852
STREAM/ESTUARY	922	Bayou Lafourche north of Golden Meadow, Louisiana	36	42	12	8	0	0	0	36	134
STREAM	295	Bayou Lafourche south of Golden Meadow, Louisiana	42	42	42	3	0	0	0	41	170
STREAM	408	Bayou L'Onion near Chegby (Chackbay), Louisiana	127	126	0	0	0	0	0	0	253
STREAM/ESTUARY	900	Bayou Perot southwest of Barataria, Louisiana	33	35	13	10	0	0	0	33	124
STREAM	296	Bayou Segnette near Westwego, Louisiana	112	120	95	15	0	0	0	109	451
STREAM	3585	Bayou Segnette northeast of Lake Catouatchie, Louisiana	11	12	4	4	0	0	0	11	42
STREAM	906	Bayou Segnette southwest of Westwego, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	83	Grand Bayou near Chegby (Chackbay), Louisiana	407	390	140	2	0	0	0	173	1112
OCEAN	2150	Gulf of Mexico south of Southwest Pass, Louisiana	35	43	10	10	0	0	0	36	134
CANAL	905	Harvey Canal at Lapalco Blvd (east side of canal) south of Harvey, Louisiana	35	39	11	11	0	0	0	34	130
CANAL	898	Intracoastal Waterway southwest of Bayou Perot, Louisiana	33	35	13	11	0	0	0	34	126
LAKE	920	Lac Des Allemands north of Bayou Boeuf, Louisiana	34	43	14	13	0	0	0	36	140
LAKE	291	Lac Des Allemands north of Raceland, Louisiana	42	42	42	2	0	0	0	41	169
LAKE	919	Lake Boeuf north of Theriot Canal, Louisiana	35	38	11	9	0	0	0	36	129
LAKE	636	Lake Cataouatche south of Avondale, Louisiana	11	12	4	4	0	0	0	11	42
LAKE	901	Lake Salvador northeast of Point Chicot, Louisiana	33	36	13	10	0	0	0	32	124
CANAL/ESTUARY	289	Lake Washington Oil and Gas Field (Rosewood Resources)	0	0	0	0	0	0	0	1	1
LAKE	8	Little Lake at Temple, Louisiana	190	190	158	2	0	0	0	169	709
LAKE/ESTUARY	897	Little Lake south of Bayou Perot, Louisiana	33	35	13	10	0	0	0	34	125
CANAL	904	Main Canal, 2.1 miles south of Hwy 90 at water control structure	35	41	11	10	0	0	0	34	131
STREAM	47	Mississippi River at Luling, Louisiana	257	238	103	1	0	0	0	116	715
STREAM	81	Mississippi River near Lutcher, Louisiana	282	263	128	0	0	0	0	129	802
STREAM	49	Mississippi River near Pointe a la Hache, Louisiana	234	217	131	0	0	0	0	134	716
CANAL	910	Outer Cataouatche Canal west of Avondale, Louisiana	22	23	8	5	0	0	0	20	78
CANAL/ESTUARY	925	Southwestern Louisiana Canal at North Lake, Louisiana	32	35	11	10	0	0	0	34	122
CANAL/ESTUARY	924	Unnamed canal between Pass Fourchon and Bay Champagne, Louisiana	36	53	14	11	0	0	0	37	151

STREAM/ESTUARY	908	Wilkinson Bayou north of Barataria Bay, Louisiana	34	36	11	11	0	0	0	34	126
STREAM	114	Bayou Black at Gibson, Louisiana	410	389	141	2	0	0	0	175	1117
STREAM	339	Bayou Black west of Houma, Louisiana	78	80	57	11	0	0	0	77	303
STREAM/ESTUARY	2844	Bayou Blue southwest of Larose, Louisiana	26	34	10	11	0	0	0	26	107
STREAM	945	Bayou Blue SSW of Larose, Louisiana	38	52	17	13	0	0	0	38	158
CANAL	928	Bayou Boeuf at Amelia, Louisiana	39	46	12	15	0	0	0	37	149
STREAM	932	Bayou Carencro at Brady Canal, Louisiana	20	23	5	7	0	0	0	19	74
STREAM/ESTUARY	951	Bayou Charles Theriot north of Lake Barre, Louisiana	12	12	4	1	0	0	0	12	41
CANAL	345	Bayou Chauvin near Houma, Louisiana	44	44	44	3	0	0	0	42	177
CANAL	346	Bayou Chauvin south of Houma, Louisiana	80	83	53	14	0	0	0	77	307
STREAM	342	Bayou Chene southeast of Morgan City, Louisiana	43	43	43	5	0	0	0	43	177
STREAM	940	Bayou Du Large at Dr. Beautrous Bridge, Louisiana	34	41	10	10	0	0	0	35	130
STREAM/ESTUARY	941	Bayou Du Large at Fishermans Retreat Bridge, Louisiana	35	38	10	10	0	0	0	35	128
STREAM	350	Bayou Dularge south of Houma, Louisiana	43	44	44	2	0	0	0	42	175
CANAL	341	Bayou Folse north of Houma, Louisiana	78	81	53	14	0	0	0	74	300
STREAM	938	Bayou Grand Caillou at Cedar Grove Bridge, Louisiana	35	41	10	9	0	0	0	35	130
BAY/ESTUARY	992	Bayou Grand Caillou at China Island	0	0	0	0	0	0	0	0	0
STREAM/ESTUARY	948	Bayou Grand Caillou at China Island, Louisiana	35	40	10	11	0	0	0	33	129
STREAM/ESTUARY	113	Bayou Grand Caillou at Dulac, Louisiana	231	221	152	11	0	0	0	190	805
STREAM	348	Bayou Grand Caillou south of Houma, Louisiana	0	0	0	0	0	0	0	25	25
STREAM/ESTUARY	923	Bayou Lafourche at Belle Pass, Louisiana	35	39	11	9	0	0	0	36	130
STREAM	111	Bayou Lafourche at Larose, Louisiana	242	226	105	4	0	0	0	158	735
STREAM	294	Bayou Lafourche at Lockport, Louisiana	44	44	44	2	0	0	0	41	175
STREAM	993	Bayou Lafourche at T-Bois Bridge, at Larose, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	293	Bayou Lafourche at Thibodaux, Louisiana	180	202	87	41	0	0	0	178	688
STREAM	2843	Bayou L'Eau Bleu west of Larose, Louisiana	26	29	10	9	0	0	0	26	100
STREAM	931	Bayou L'eau Blue WSW of Valentine, Louisiana	12	12	4	1	0	0	0	12	41
STREAM	3586	Bayou Penchant southeast of Amelia, Louisiana	11	11	4	4	0	0	0	11	41
STREAM/ESTUARY	949	Bayou Petit Caillou at Cocodrie, Louisiana	34	37	11	9	0	0	0	34	125
STREAM	939	Bayou Petit Caillou at Klondyke Bridge, Louisiana	35	38	10	11	0	0	0	34	128
STREAM/ESTUARY	956	Bayou Petit Caillou at Tambour Bay, Louisiana	34	36	10	9	0	0	0	34	123
STREAM/ESTUARY	347	Bayou Petite Caillou south of Houma, Louisiana	80	80	54	12	0	0	0	77	303
STREAM	946	Bayou Point aux Chene east of Montegut, Louisiana	39	47	12	12	0	0	0	36	146
STREAM	110	Bayou Terrebonne at Houma, Louisiana	442	433	155	12	0	0	0	212	1254
STREAM/ESTUARY	943	Bayou Terrebonne in Bourg, Louisiana	34	35	10	10	0	0	0	34	123
STREAM/ESTUARY	3001	Bayou Terrebonne near Lapeyrouse, Louisiana	17	24	7	7	0	0	0	21	76
STREAM/ESTUARY	349	Bayou Terrebonne southeast of Houma, Louisiana	80	85	54	13	0	0	0	79	311
STREAM	337	Belle River north of Morgan City, Louisiana	52	62	47	5	0	0	0	52	218
BAY/ESTUARY	990	Caillou Bay south of Bayou Grand Caillou	0	0	0	0	0	0	0	0	0
BAY/ESTUARY	957	Caillou Bay south of Bayou Grand Caillou, Louisiana	35	37	10	10	0	0	0	34	126
LAKE/ESTUARY	351	Caillou Lake south of Houma, Louisiana	44	43	44	2	0	0	0	41	174
CANAL	944	Company Canal in Bourg, Louisiana	34	36	10	10	0	0	0	34	124
CANAL	947	Forty Arpent Canal in Cutoff, Louisiana	12	12	4	1	0	0	0	12	41
STREAM	82	Grand Bayou at Grand Bayou, Louisiana	193	182	140	3	0	0	0	174	692
STREAM/ESTUARY	950	Grand Bayou Du Large at Bayou Voisin, Louisiana	35	44	9	9	0	0	0	34	131
STREAM/ESTUARY	991	Grand Bayou Dularge at Bayou Voisin	0	0	0	0	0	0	0	0	0
STREAM	980	Grand Bayou, Louisiana	32	34	11	10	0	0	0	33	120
LAKE	929	Grassy Lake north of Simon Pass, Louisiana	0	0	0	0	0	0	0	0	0
OCEAN	927	Gulf of Mexico south of Belle Pass, Louisiana	35	44	11	9	0	0	0	36	135
OCEAN	962	Gulf of Mexico south of Wine Island Pass, Louisiana	34	40	10	9	0	0	0	34	127
CANAL/ESTUARY	988	Houma Navigation Canal at Coco Marina	0	0	0	0	0	0	0	0	0
CANAL	942	Houma Navigation Canal at Gulf Island Dock, Louisiana	35	37	11	8	0	0	0	35	126
CANAL	343	Houma Navigation Canal near Houma, Louisiana	44	44	44	2	0	0	0	44	178
CANAL	952	Houma Navigation Canal north of Bayou Petit Caillou, Louisiana	34	43	10	10	0	0	0	35	132
CANAL/ESTUARY	37	Houma Navigation Canal south of Cocodrie, Louisiana	147	149	115	0	0	0	0	136	547
CANAL	344	Houma Navigation Canal south of Houma, Louisiana	80	84	54	14	0	0	0	76	308
CANAL	934	Intracoastal Waterway at Venvirotek Dock, Louisiana	34	43	12	8	0	0	0	35	132

CANAL	340	Intracoastal Waterway east of Houma, Louisiana	78	88	54	12	0	0	0	77	309
BAY/ESTUARY	960	Lake Barre west of Cocodrie, Louisiana	32	39	12	8	0	0	0	36	127
LAKE	954	Lake Boudreaux south of Bayou Chauvin, Louisiana	36	49	14	13	0	0	0	36	148
LAKE/ESTUARY	937	Lake DeCade, Louisiana	35	45	11	10	0	0	0	36	137
LAKE	338	Lake Palourde near Morgan City, Louisiana	78	83	53	12	0	0	0	78	304
BAY/ESTUARY	961	Lake Pelto south of Cocodrie, Louisiana	34	35	10	10	0	0	0	34	123
LAKE	896	Lake Penchant southwest of Houma, Louisiana	11	11	4	4	0	0	0	11	41
LAKE	871	Lake Theriot southwest of Crozier, Louisiana	11	11	4	4	0	0	0	11	41
LAKE	144	Lake Verret at Attakapas Landing near Georgia, Louisiana	120	121	98	11	0	0	0	106	456
LAKE	145	Lake Verret near Pierre Part, Louisiana	47	47	47	0	0	0	0	34	175
LAKE/ESTUARY	955	Lost Lake west of Bayou De Cade, Louisiana	35	46	14	12	0	0	0	36	143
CANAL	936	Minors Canal north of Marmande Ridge, Louisiana	23	25	6	6	0	0	0	22	82
CANAL	935	Peoples Canal north of Bayou Mauvais Bois Ridge, Louisiana	23	26	6	7	0	0	0	22	84
LAKE	999	Saline Lake southeast of Deville, Louisiana	0	0	0	0	0	0	0	0	0
CANAL/ESTUARY	953	Southwestern Louisiana Canal west of Leeville, Louisiana	32	42	11	10	0	0	0	34	129
BAY/ESTUARY	958	Terrebonne Bay southeast of Cocodrie, Louisiana	32	46	15	11	0	0	0	36	140
CANAL	930	Terrebonne-Lafourche Drainage Canal west of Schriever, Louisiana	34	40	11	9	0	0	0	36	130
BAY/ESTUARY	995	Timbalier Bay south of Devils Island	0	0	0	0	0	0	0	0	0
BAY/ESTUARY	959	Timbalier Bay south of Devils Island, Louisiana	35	39	10	9	0	0	0	36	129
		Total number of samples tested	10818	11213	5705	1431	0	0	0	8908	38075

Basin: Pearl River			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	1038	Bogue Chitto River upstream from Wilson Slough	4	5	2	4	0	0	0	4	19
STREAM	63	Bogue Lusa Creek at Bogalusa, Louisiana	412	395	108	13	0	0	0	171	1099
STREAM	414	Bogue Lusa Creek near Bogalusa, Louisiana	55	137	0	0	0	0	0	0	192
STREAM	1039	Bradley Slough at intersection with Wilson Slough	4	5	2	4	0	0	0	4	19
STREAM	3594	East Pearl River at Curtis Johnson boat launch (Stennis)	11	15	3	3	0	0	0	10	42
STREAM	1054	East Pearl River at Curtis Johnson Waterfront Park boat launch	24	27	7	9	0	0	0	24	91
STREAM	3588	Headwaters of the Lower Bogue Chitto River, southeast of Sun, LA	11	15	4	4	0	0	0	11	45
STREAM	3592	Headwaters of Wilson and Bradley Slough at Pearl River, SE of Sun, LA	11	12	4	4	0	0	0	11	42
STREAM	1041	Holmes Bayou at West Pearl River	33	36	10	12	0	0	0	33	124
BAY/ESTUARY	1037	Little Lake adjacent to Channel Marker No. 7	24	25	6	8	0	0	0	23	86
BAY/ESTUARY	1055	Middle Pearl River at Hwy. 90	35	36	11	12	0	0	0	36	130
STREAM	1120	Morgan River, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	32	Pearl River (East) at Pearlington, Mississippi	276	272	216	16	0	0	0	251	1031
STREAM	105	Pearl River (West) southeast of Slidell, Louisiana	375	380	230	46	0	0	0	357	1388
STREAM	3589	Pearl River 1/4 mile upstream of Wilson Slough, NE of Bush, Louisiana	11	17	4	4	0	0	0	11	47
STREAM	62	Pearl River at Pools Bluff, Louisiana	415	399	109	14	0	0	0	169	1106
STREAM	1061	Pearl River at Walkian Bluff boat launch	21	26	6	9	0	0	0	23	85
STREAM	12	Pearl River east of Bogalusa, Louisiana	468	459	204	5	0	0	0	223	1359
CANAL	1053	Pearl River Navigation Canal at Lock #1	27	28	8	10	0	0	0	26	99
CANAL	1118	Pearl River Navigation Canal at Lock No. 3, Louisiana	34	39	11	12	0	0	0	36	132
CANAL	3642	Pearl River Navigation Canal upstream of Lock #1	0	0	0	0	0	0	0	0	0
STREAM	1117	Peters Creek at Highway 21, Louisiana	32	36	11	12	0	0	0	35	126
STREAM	1119	Pushepatapa Creek at Highway 436, Louisiana	34	36	11	12	0	0	0	34	127
STREAM	1042	West Pearl River upstream from Pearl River Barge Canal Lock No. 1	33	33	10	13	0	0	0	33	122
STREAM	1040	Wilson Slough at intersection with West Pearl River	4	4	2	3	0	0	0	4	17
STREAM	1058	Big Silver Creek at Hwy. 38	36	37	11	11	0	0	0	35	130
STREAM	65	Bogue Chitto River at Franklinton, Louisiana	427	401	139	4	0	0	0	179	1150
STREAM	64	Bogue Chitto River near Bush, Louisiana	330	342	186	46	0	0	0	318	1222

STREAM	1060	Bonner Creek at Hwy. 25	36	37	11	11	0	0	0	35	130
STREAM	1057	Lawrence Creek at Hwy. 16	38	38	11	11	0	0	0	35	133
STREAM	1059	Little Silver Creek at Old Lake Road	35	37	11	10	0	0	0	35	128
STREAM	1056	Thigpen Creek at Mill Creek Road	37	38	10	11	0	0	0	35	131
		Total number of samples tested	3293	3367	1358	333	0	0	0	2201	10552

Basin: Ouachita River			**Number of Samples per Parameter Lists**								**Total**
Station Type	**Site ID**	**Site Name**	**Field**	**Conventional**	**Metals**	**VOCs**	**Semi-VOCs**	**Pesticides**	**PCBs**	**Bacteria**	
STREAM	72	Bayou De L'Outre near Monroe, Louisiana	451	440	154	9	0	0	0	193	1247
STREAM	324	Bayou De L'Outre north of Farmerville, Louisiana	41	45	43	0	0	0	0	41	170
LAKE	997	Finch Lake West of Ouachita River	0	0	0	0	0	0	0	0	0
STREAM	13	Ouachita River at Sterlington, Louisiana	602	621	253	43	0	0	0	335	1854
STREAM	74	Bayou Bartholomew near Bastrop, Louisiana	456	442	153	9	0	0	0	197	1257
STREAM	779	Bayou D'Arbonne East of Dubach, Louisiana	34	39	11	7	0	0	0	34	125
STREAM	780	Bayou D'Arbonne in West Monroe, Louisiana	39	41	13	9	0	0	0	37	139
LAKE	416	Bayou D'Arbonne Lake at Farmerville, Louisiana	0	0	0	0	0	0	0	1	1
STREAM	73	Bayou D'Arbonne near Dubach, Louisiana	341	331	148	2	0	0	0	159	981
STREAM	777	Bayou D'Arbonne near Homer, Louisiana	35	44	13	9	0	0	0	31	132
STREAM	410	Bayou D'Arbonne near Monroe, Louisiana	75	73	0	0	0	0	0	0	148
STREAM	423	Bayou D'Arbonne near Monroe, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	18	Bayou D'Arbonne west of Rocky Branch, Louisiana	247	251	158	1	0	0	0	152	809
STREAM	3614	Corney Bayou at Cupps Crossing Road	0	0	0	0	0	0	0	0	0
STREAM	784	Corney Bayou East of Bernice, Louisiana	35	37	10	8	0	0	0	31	121
STREAM	418	Corney Bayou near Farmerville, Louisiana	23	23	0	0	0	0	0	0	46
STREAM	68	Corney Bayou near Lillie, Louisiana	336	324	142	1	0	0	0	159	962
STREAM	782	Corney Bayou Northwest of Summerfield, Louisiana	21	24	7	3	0	0	0	19	74
LAKE	783	Corney Lake at Spillway, Louisiana	32	42	13	9	0	0	0	30	126
STREAM	781	Cypress Creek East of Unionville, Louisiana	32	37	11	7	0	0	0	34	121
STREAM	575	Gray Creek near Choudrant, Louisiana	1	1	1	0	0	0	0	0	3
LAKE	778	Lake Claiborne at Spillway, Louisiana	33	35	11	7	0	0	0	30	116
LAKE	326	Lake D'Arbonne at Farmerville, Louisiana	113	134	57	9	0	0	0	74	387
STREAM	15	Little Corney Bayou east of Lillie, Louisiana	338	338	161	1	0	0	0	159	997
STREAM	785	Middle Fork Bayou D'Arbonne northeast of Dubach, Louisiana	35	39	10	8	0	0	0	34	126
STREAM	325	Middle Fork Bayou D'Arbonne west of Farmerville, Louisiana	41	45	41	1	0	0	0	42	170
STREAM	771	Bayou Chauvin at control structure on Ouachita River Levee N of Monroe, La.	35	38	13	8	0	0	0	34	128
LAKE	786	Bayou Desiard at control structure in Monroe, Louisiana	37	36	12	8	0	0	0	35	128
STREAM	773	Bayou Louis East of Harrisonburg, Louisiana	34	37	12	7	0	0	0	36	126
LAKE	788	Cheniere Brake Lake south of West Monroe, Louisiana	36	48	12	8	0	0	0	35	139
STREAM	3052	Cheniere Creek south of Mount Pleasant, Louisiana	22	23	7	7	0	0	0	22	81
STREAM	787	Cheniere Creek south of West Monroe, Louisiana	14	14	5	1	0	0	0	13	47
LAKE	774	Lake Louis West of Sicily Island, Louisiana	34	52	14	9	0	0	0	36	145
STREAM	770	Ouachita River at Columbia Lock and Dam near Riverton, Louisiana	36	35	12	7	0	0	0	36	126
STREAM	14	Ouachita River at Columbia, Louisiana	462	459	207	2	0	0	0	200	1330
STREAM	86	Ouachita River at Duty, Louisiana	209	220	178	7	0	0	0	208	822
STREAM	85	Ouachita River at Harrisonburg, Louisiana	352	382	225	47	0	0	0	330	1336
STREAM	67	Ouachita River at Monroe, Louisiana	308	294	186	2	0	0	0	203	993
STREAM	805	Beaucoup Creek west of Clarks, Louisiana	36	37	13	9	0	0	0	35	130
STREAM	334	Beaucoup Creek west of Columbia, Louisiana	45	45	43	1	0	0	0	42	176
LAKE	1016	Caney Creek Reservoir near Womack, Louisiana	0	0	0	0	0	0	0	0	0
LAKE	807	Caney Lake near Chatham, Louisiana	35	43	12	8	0	0	0	34	132
STREAM	79	Castor Creek near Tullos, Louisiana	223	248	189	12	0	0	0	230	902

STREAM	332	Castor Creek west of Columbia, Louisiana	44	45	43	1	0	0	0	42	175
LAKE	804	Chatham Lake in Chatham, Louisiana	32	37	11	7	0	0	0	31	118
STREAM	806	Flat Creek southeast of Sikes, Louisiana	34	34	11	7	0	0	0	32	118
STREAM	78	Dugdemona River near Hodge, Louisiana	185	204	170	4	0	0	0	187	750
STREAM	77	Dugdemona River near Rochelle, Louisiana	330	354	183	10	0	0	0	222	1099
STREAM	20	Dugdemona River northwest of Dodson, Louisiana	185	219	192	7	0	0	0	196	799
STREAM	802	Dugdemona River southwest of Dodson, Louisiana	36	50	12	8	0	0	0	35	141
STREAM	803	Dugdemona River west of Tullos, Louisiana	12	13	4	4	0	0	0	12	45
STREAM	818	Bayou Funny Louis southwest of Searcy, Louisiana	43	32	10	6	0	0	0	31	122
STREAM	815	Big Creek near Fishville, Louisiana	45	35	12	7	0	0	0	33	132
LAKE	810	Catahoula Lake east of Big Point, Louisiana	28	27	7	4	0	0	0	23	89
LAKE	3062	Catahoula Lake south of Jena, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	813	Fish Creek south of Lincecum, Louisiana	45	50	13	10	0	0	0	33	151
STREAM	816	Hemphill Creek east of Nebo, Louisiana	45	34	11	7	0	0	0	35	132
STREAM	87	Little River (French Fork) southwest of Archie, Louisiana	249	236	69	3	0	0	0	102	659
STREAM	76	Little River at Rochelle, Louisiana	184	208	173	7	0	0	0	195	767
STREAM	808	Little River east of Georgetown, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	801	Little River in Jonesville, Louisiana	36	44	12	8	0	0	0	35	135
STREAM	413	Little River near Jonesville, Louisiana	98	95	0	0	0	0	0	0	193
STREAM	809	Little River northeast of Ball, Louisiana	11	11	3	0	0	0	0	12	37
STREAM	25	Little River south of Rogers, Louisiana	399	414	197	9	0	0	0	211	1230
STREAM	89	Little River southwest of Jena, Louisiana	457	455	189	18	0	0	0	234	1353
STREAM	812	Little River southwest of Jonesville, Louisiana	45	36	11	7	0	0	0	35	134
STREAM	428	Little River, Hwy. 500 Bridge, Zenoria, Station #5, Louisiana	45	35	12	7	0	0	0	34	133
STREAM	817	Old River west of Archie, Louisiana	44	34	11	7	0	0	0	34	130
STREAM	772	Ouachita River near Jonesville, Louisiana	44	39	11	7	0	0	0	34	135
STREAM	814	Trout Creek Northwest of White Sulfur Springs, Louisana	46	35	12	7	0	0	0	34	134
STREAM	90	Black River at Jonesville, Louisiana	211	222	178	4	0	0	0	213	828
STREAM	776	Black River South of Book, Louisiana	45	43	14	9	0	0	0	36	147
STREAM	775	Black River south of Jonesville, Louisiana	46	38	12	7	0	0	0	33	136
		Total number of samples tested	8303	8496	4133	468	0	0	0	5475	26875

Basin: Red River			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	1233	Bayou Cocodrie west of Shaw, Louisiana	23	24	8	6	0	0	0	22	83
STREAM	2153	Bayou Natchitoches southwest of Shaw, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	1227	Big Creek at North Point, Louisiana	36	24	8	7	0	0	0	24	99
STREAM	700	Big Saline Bayou East of Deville, Louisiana	1	1	1	0	0	0	0	1	4
STREAM	1224	Big Saline Bayou northeast of North Point, Louisiana	40	31	10	9	0	0	0	25	115
LAKE	1223	Buhlow Lake northwest of Pineville, Louisiana	53	52	16	10	0	0	0	36	167
CANAL	3640	Catahoula Lake Diversion Canal north of Larto, Louisiana	9	8	2	3	0	0	0	8	30
STREAM	811	Catahoula Lake Diversion Canal south of Jonesville, Louisiana	37	27	10	4	0	0	0	26	104
STREAM	486	John's Bayou east of Alexandria, Louisiana	0	2	0	1	0	0	0	0	3
STREAM	1225	Larto Bayou west of Book, Louisiana	16	19	7	5	0	0	0	17	64
LAKE	3057	Larto Lake north of Larto, Louisiana	28	24	8	7	0	0	0	22	89
LAKE	1226	Larto Lake west of New Era, Louisiana	14	16	6	4	0	0	0	12	52
STREAM	88	Little River (Catahoula Lake Div. Canal) northeast of Holloway, LA	284	283	179	7	0	0	0	216	969
STREAM	1212	Little River east of Marksville, Louisiana	0	12	4	3	0	0	0	12	31
STREAM	3060	Little River ENE of Marksville, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	485	Muddy Bayou south of Jena, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	3063	Old River northeast of Mansura, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	1213	Old River southeast of Marksville, Louisiana	0	0	0	0	0	0	0	0	0

STREAM	3059	Old Saline Bayou east of North Point, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	1211	Red River northeast of Simmesport, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	24	Red River northwest of Marksville, Louisiana	487	524	248	42	0	0	0	325	1626
LAKE	371	Saline Bayou east of Alexandria, Louisiana	13	16	5	5	0	0	0	12	51
STREAM	3056	Saline Bayou upstream of Larto Lake	24	23	8	7	0	0	0	24	86
LAKE	3058	Saline Lake northeast of North Point, Louisiana	24	31	8	7	0	0	0	24	94
STREAM	10	Red River east of Hosston, Louisiana	265	265	40	0	0	0	0	34	604
STREAM	120	Red River North of Shreveport, Louisiana	327	354	210	42	0	0	0	322	1255
STREAM	61	Bayou Dorcheat west of Minden, Louisiana	390	373	106	7	0	0	0	153	1029
STREAM	274	Bayou Dorcheat west of Sibley, Louisiana	50	50	50	4	0	0	0	49	203
STREAM	275	Lake Bistineau Spillway west of Ringgold, Louisiana	69	73	58	8	0	0	0	72	280
STREAM	276	Loggy Bayou north of East Point, Louisiana	70	73	59	9	0	0	0	70	281
RESERVOIR	1182	Black Bayou Reservoir at Linton Road, southeast of Benton, Louisiana	12	12	4	3	0	0	0	11	42
RESERVOIR	3423	Black Bayou Reservoir southeast of Benton, Louisiana	12	20	4	4	0	0	0	12	52
STREAM	1180	Cypress Bayou at Highway 160, Hughes, Louisiana	21	28	7	6	0	0	0	22	84
RESERVOIR	1181	Cypress Bayou Reservoir southeast of Benton, Louisiana	24	25	8	7	0	0	0	24	88
STREAM	273	Fifi Bayou east of Bossier City, Louisiana	49	49	49	4	0	0	0	48	199
CANAL	363	Flat River Drainage Canal north of Bossier City, Louisiana	0	0	0	0	0	0	0	0	0
CANAL	389	Flat River Drainage Canal northeast of Bossier City, Louisiana	0	0	0	0	0	0	0	0	0
CANAL	390	Flat River Drainage Canal northeast of Shreveport, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	272	Flat River east of Taylortown, Louisiana	70	74	59	9	0	0	0	72	284
STREAM	1179	Red Chute Bayou at Swan Lake Road, east of Poole, Louisiana	23	30	10	5	0	0	0	23	91
STREAM	41	Red Chute Bayou east of Shreveport, Louisiana	187	187	160	4	0	0	0	179	717
STREAM	271	Red Chute east of Elm Grove, Louisiana	49	48	49	4	0	0	0	47	197
STREAM	3422	Bodcau Bayou near Bellevue, Louisiana	11	14	4	3	0	0	0	11	43
STREAM	11	Bodcau Bayou northwest of Bellevue, Louisiana	145	145	114	3	0	0	0	145	552
STREAM	58	Bodcau Bayou northwest of Sarepta, Louisiana	262	244	92	0	0	0	0	131	729
STREAM	1183	Bayou Pierre at Ellerbee Road, south of Gayles, Louisiana	21	28	7	5	0	0	0	25	86
STREAM	1185	Bayou Pierre at Highway 1, northwest of Natchitoches, Louisiana	32	36	13	11	0	0	0	33	125
STREAM	3595	Bayou Pierre at PR 407, southwest of Howard, Louisiana	11	12	3	4	0	0	0	11	41
STREAM	143	Bayou Pierre near Lake End, Louisiana	36	36	36	0	0	0	0	33	141
STREAM	278	Bayou Pierre near Shreveport, Louisiana	45	46	46	8	0	0	0	44	189
STREAM	277	Bayou Pierre west of Grand Bayou, Louisiana	51	51	51	5	0	0	0	50	208
STREAM	1207	Boggy Bayou southwest of Shreveport, Louisiana	43	50	10	8	0	0	0	35	146
STREAM	279	Brushy Bayou near Shreveport, Louisiana	50	51	51	5	0	0	0	50	207
LAKE	281	Clear Lake north of Mansfield, Louisiana	49	51	51	4	0	0	0	50	205
STREAM	280	Cypress Bayou south of Shreveport, Louisiana	51	52	52	4	0	0	0	50	209
LAKE	1208	Smithport Lake at spillway, west of Abington, Louisiana	33	48	11	5	0	0	0	25	122
STREAM	3584	Wallace Bayou west of Caspiana, Louisiana	11	14	3	4	0	0	0	11	43
LAKE	1184	Wallace Lake southeast of Shreveport, Louisiana	21	24	7	5	0	0	0	25	82
LAKE	3583	Wallace Lake southwest of Naylor, Louisiana	0	1	1	0	0	0	0	1	3
LAKE	3626	Wallace Lake, south of Shreveport, Louisiana	7	7	2	2	0	0	0	7	25
STREAM	1217	Cane River at Marco, Louisiana	33	38	12	10	0	0	0	33	126
LAKE	3054	Cotile Lake southwest of Hotwells, Louisiana	0	0	0	0	0	0	0	0	0
RESERVOIR	1219	Cotile Reservoir at Wilda, Louisiana	24	24	8	6	0	0	0	24	86
STREAM	557	Gray Creek south of Oak Grove, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	1222	Iatt Creek southeast of Iatt, Louisiana	30	31	11	10	0	0	0	26	108
LAKE	1221	Iatt Lake southwest of Fairfield, Louisiana	27	33	12	7	0	0	0	24	103
STREAM	3591	Kisatchie Bayou at FS 337, northwest of Kisatchie, Louisiana	12	11	4	4	0	0	0	11	42
STREAM	549	Kisatchie Bayou at Kisatchie, Louisiana	2	2	2	0	0	0	0	0	6
STREAM	42	Kisatchie Bayou near Lotus, Louisiana	238	248	204	7	0	0	0	224	921
STREAM	1218	Kisatchie Bayou south of Cypress, Louisiana	21	30	10	9	0	0	0	22	92
STREAM	550	Little Sandy Creek at Kisatchie, Louisiana	2	2	2	0	0	0	0	0	6
STREAM	1215	Nantachie Creek east of Montgomery, Louisiana	29	29	10	8	0	0	0	26	102
LAKE	1216	Nantachie Lake north of Waddel, Louisiana	29	29	10	8	0	0	0	26	102
STREAM	19	Red River at Boyce, Louisiana	329	339	187	11	0	0	0	194	1060
STREAM	115	Red River at Grand Ecore, Louisiana	221	218	178	4	0	0	0	210	831

STREAM	1210	Red River north of Alexandria, Louisiana	12	12	4	2	0	0	0	12	42
STREAM	1220	Rigolette Bayou northwest of Pineville, Louisiana	39	42	15	11	0	0	0	35	142
LAKE	1191	Sibley Lake at Natchitoches, Louisiana	33	38	13	11	0	0	0	33	128
STREAM	284	Saline Bayou east of Bienville, Louisiana	49	50	50	4	0	0	0	49	202
STREAM	3245	Saline Bayou east of Clarence, Louisiana	15	15	4	5	0	0	0	12	51
STREAM	75	Saline Bayou near Goldonna, Louisiana	223	248	186	16	0	0	0	225	898
STREAM	1214	Saline Bayou southest of Clarence, Louisiana	14	14	6	3	0	0	0	15	52
LAKE	1205	Saline Lake Dam at end of CheeChee Dam Road, north of Crews, LA	27	29	10	8	0	0	0	24	98
STREAM	1206	Unnamed tributary of Saline Bayou near Arcadia, Louisiana	23	26	10	8	0	0	0	22	89
STREAM	1187	Black Lake Bayou at Highway 155, east of Martin, Louisiana	28	31	9	10	0	0	0	26	104
STREAM	1186	Black Lake Bayou at Highway 793, southeast of Dubberly, Louisiana	25	28	9	8	0	0	0	24	94
STREAM	282	Black Lake Bayou west of Castor, Louisiana	48	49	49	4	0	0	0	49	199
LAKE	366	Black Lake north of Natchitoches, Louisiana	23	25	8	7	0	0	0	23	86
STREAM	1189	Castor Creek at Highway 507, southwest of Castor, Louisiana	29	33	11	10	0	0	0	24	107
STREAM	1190	Grand Bayou at Highway 507, north of Fairview Alpha, Louisiana	30	37	10	10	0	0	0	27	114
LAKE	1188	Kepler Creek Lake southeast of Jamestown, Louisiana	31	35	14	12	0	0	0	25	117
STREAM	283	Kepler Creek west of Bienville, Louisiana	77	82	60	12	0	0	0	75	306
STREAM	1194	Unnamed tributary of Castor Creek near Castor, Louisiana	19	21	7	7	0	0	0	18	72
STREAM	1195	Unnamed tributary of Grand Bayou near Hall Summit, Louisiana	8	10	3	4	0	0	0	6	31
STREAM	3906	Black Bayou at Highway 168 west of Rodessa	0	0	0	0	0	0	0	0	0
STREAM	1174	Black Bayou at Highway 530, southwest of Gilliam, Louisiana	35	46	12	12	0	0	0	36	141
LAKE	1173	Black Bayou Lake east of Vivian, Louisiana	36	38	12	12	0	0	0	36	134
STREAM	59	Black Bayou near Hosston, Louisiana	360	349	93	0	0	0	0	114	916
STREAM	60	Black Bayou near Rodessa, Louisiana	291	277	102	8	0	0	0	149	827
STREAM	270	Cross Bayou at Shreveport, Louisiana	86	88	64	15	0	0	0	86	339
STREAM	1193	Cross Bayou at South Lakeshore Drive, west of Shreveport, Louisiana	36	50	12	14	0	0	0	36	148
LAKE	1178	Cross Lake at Shreveport, Louisiana	38	48	15	12	0	0	0	36	149
STREAM	1192	Kelly Bayou at Huckaby Road, south of Hosston, Louisiana	36	38	13	13	0	0	0	36	136
STREAM	56	Kelly Bayou near Hosston, Louisiana	265	251	92	0	0	0	0	126	734
STREAM	1175	McCain Creek at Highway 3194, Shreveport, Louisiana	36	38	14	11	0	0	0	36	135
STREAM	1177	Paw Paw Bayou at Highway 169, south of Longwood, Louisiana	27	29	9	7	0	0	0	28	100
STREAM	269	Twelve Mile Bayou north of Blanchard, Louisiana	52	53	53	4	0	0	0	49	211
LAKE	1176	Caddo Lake at old Highway 538 bridge, Morringsport, Louisiana	39	40	15	12	0	0	0	36	142
STREAM	57	James Bayou southwest of Vivian, Louisiana	269	249	93	0	0	0	0	123	734
		Total number of samples tested	6942	7141	3682	675	0	0	0	5152	23592

Basin: Sabine River			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	285	Bayou San Patricio east of Benson, Louisiana	52	51	52	5	0	0	0	51	211
STREAM	40	Sabine River at Logansport, Louisiana	416	409	163	6	0	0	0	181	1175
RESERVOIR	1154	Toledo Bend Reservoir southwest of Haddens, Louisiana	30	36	12	11	0	0	0	26	115
LAKE	501	Anacoco Lake west of Leesville, Louisiana	28	29	11	7	0	0	0	21	96
STREAM	1167	Bayou Anacoco at Louisiana Highway 464, Louisiana	29	30	10	9	0	0	0	26	104
STREAM	1165	Bayou Anacoco at Standard, Louisiana	28	30	10	9	0	0	0	26	103
STREAM	1166	Bayou Anacoco southeast of Knight, Louisiana	29	34	10	8	0	0	0	25	106
STREAM	1161	Bayou Toro at Louisiana Highway 392, Louisiana	27	28	10	8	0	0	0	26	99
STREAM	1160	Bayou Toro northeast of Toro, Louisiana	28	31	11	10	0	0	0	23	103
STREAM/ESTUARY	1157	Black Bayou south of Orange, Texas	26	30	9	9	0	0	0	26	100
STREAM/ESTUARY	1169	Black Bayou south of Toomey, Louisiana	27	31	9	9	0	0	0	26	102
STREAM	1163	East Anacoco Creek northeast of Anacoco, Louisiana	25	32	11	10	0	0	0	23	101
STREAM	1156	Pearl Creek northwest of Burr Ferry, Louisiana	29	30	10	9	0	0	0	26	104
STREAM/ESTUARY	91	Sabine River northeast of Orange, Texas	366	355	185	14	0	0	0	243	1163

STREAM/ESTUARY	1155	Sabine River northwest of Toomey, Louisiana	31	40	13	14	0	0	0	26	124
STREAM	28	Sabine River West of Merryville, Louisiana	442	442	196	6	0	0	0	222	1308
LAKE	1164	Vernon Lake northeast of Standard, Louisiana	24	24	8	7	0	0	0	22	85
CANAL/ESTUARY	1168	Vinton Waterway south of Vinton, Louisiana	28	32	10	9	0	0	0	26	105
STREAM	1162	West Anacoco Creek at US Highway 171, Louisiana	28	33	13	12	0	0	0	25	111
LAKE/ESTUARY	1158	Sabine Lake near Blue Buck Point, Louisiana	24	24	8	7	0	0	0	24	87
STREAM/ESTUARY	1159	Sabine Pass south of Port Arthur, Texas	26	27	9	8	0	0	0	24	94
		Total number of samples tested	1743	1778	770	187	0	0	0	1118	5596

Basin: Tensas River			Number of Samples per Parameter Lists								Total
Station Type	Site ID	Site Name	Field	Conventional	Metals	VOCs	Semi-VOCs	Pesticides	PCBs	Bacteria	
STREAM	127	Bayou Bonne Idee East of Galion, Louisiana	99	97	64	0	0	0	0	73	333
STREAM	125	Bayou Bonne Idee East of Mer Rouge, Louisiana	101	99	67	0	0	0	0	74	341
STREAM	122	Bayou Bonne Idee Northeast of Oak Ridge, Louisiana	141	145	81	8	0	0	0	116	491
STREAM	126	Bayou Bonne Idee Southeast of Mer Rouge, Louisiana	99	98	64	0	0	0	0	74	335
STREAM	121	Bayou Galion Cutoff East of Galion, Louisiana	29	26	19	0	0	0	0	30	104
STREAM	129	Bayou Galion South of Mer Rouge, Louisiana	22	19	11	0	0	0	0	23	75
STREAM	71	Bayou Lafourche Canal near Columbia, Louisiana	227	217	155	9	0	0	0	198	806
CANAL	124	Bayou Lafourche Canal near Crew Lake, Louisiana	148	150	112	1	0	0	0	120	531
STREAM	328	Big Creek east of Rayville, Louisiana	44	45	41	2	0	0	0	41	173
STREAM	69	Big Creek near Winnsboro, Louisiana	226	221	152	9	0	0	0	195	803
STREAM	412	Boeuf River near Alto, Louisiana	139	135	0	0	0	0	0	0	274
STREAM	16	Boeuf River near Fort Necessity, Louisiana	340	346	176	10	0	0	0	196	1068
STREAM	17	Boeuf River west of Oak Grove, Louisiana	188	192	160	1	0	0	0	159	700
STREAM	327	Boeuf River west of Rayville, Louisiana	44	45	41	1	0	0	0	42	173
LAKE	793	Clear Lake near Rhymes, Louisiana	0	0	0	0	0	0	0	0	0
LAKE	792	Crew Lake near Start, Louisiana	36	35	12	8	0	0	0	36	127
STREAM	123	Cypress Bayou West of Oak Grove, Louisiana	31	28	19	0	0	0	0	31	109
STREAM	798	Deer Creek southwest of Holly Grove, Louisiana	33	33	11	7	0	0	0	34	118
CANAL	128	Galion Canal Southwest of Oak Ridge, Louisiana	99	97	63	0	0	0	0	73	332
LAKE	791	Lake Lafourche north of Rayville, Louisiana	36	36	12	8	0	0	0	36	128
STREAM	795	Staulkinghead Creek (Tisdale Brake), Louisiana	36	36	12	8	0	0	0	36	128
STREAM	130	Turkey Creek Cut-off at Baskin, Louisiana	150	152	106	2	0	0	0	124	534
LAKE	790	Turkey Creek Lake near Extension, Louisiana	34	43	11	8	0	0	0	35	131
STREAM	789	Turkey Creek near Jigger, Louisiana	12	11	5	0	0	0	0	12	40
STREAM	3051	Turkey Creek northeast of Baskin, Louisiana	22	23	7	7	0	0	0	22	81
STREAM	1444	Turkey Creek southwest of Chase, Louisiana	22	27	8	8	0	0	0	23	88
LAKE	794	Woolen Lake near Hebert, Louisiana	0	0	0	0	0	0	0	0	0
STREAM	329	Bayou Macon east of Oak Grove, Louisiana	38	41	41	1	0	0	0	42	163
STREAM	796	Bayou Macon east of Wisner, Louisiana	34	35	12	8	0	0	0	34	123
STREAM	70	Bayou Macon near Delhi, Louisiana	418	407	143	1	0	0	0	161	1130
STREAM	330	Bayou Macon southeast of Winnsboro, Louisiana	44	44	44	1	0	0	0	42	175
STREAM	797	Joe's Bayou southeast of Delhi, Louisiana	31	32	11	8	0	0	0	29	111
LAKE	141	Lake Bruin at Lake Bruin State Park, near St. Joseph, Louisiana	101	105	104	1	0	0	0	0	311
LAKE	140	Lake Bruin at North end near Newellton, Louisiana	135	148	114	9	0	0	0	36	442
LAKE	136	Lake Providence at Baxter Bayou near Lake Providence, Louisiana	22	21	17	0	0	0	0	0	60
LAKE	134	Lake Providence at mid lake near Lake Providence, Louisiana	22	21	17	0	0	0	0	0	60
LAKE	135	Lake Providence at North end near Lake Providence, Louisiana	79	80	51	0	0	0	0	0	210
LAKE	132	Lake Providence at Tensas Bayou near Lake Providence, Louisiana	113	125	65	7	0	0	0	36	346
LAKE	133	Lake Providence at the chute near Lake Providence, Louisiana	22	21	17	0	0	0	0	0	60
LAKE	800	Lake St. Joseph in Newellton, Louisiana	35	36	11	7	0	0	0	36	125
STREAM	159	Tensas River at Clayton, Louisiana	206	214	117	48	0	0	0	141	726

STREAM	799	Tensas River at Jonesville, Louisiana	14	14	4	0	0	0	0	14	46
STREAM	66	Tensas River at Tendal, Louisiana	420	405	145	1	0	0	0	162	1133
STREAM	331	Tensas River southeast of Winnsboro, Louisiana	44	44	44	3	0	0	0	41	176
		Total number of samples tested	4136	4149	2366	192	0	0	0	2577	13420

Appendix D: Public Groundwater System Usage Change Overtime

Public Groundwater System Values (MGD) Change Overtime (LDOTD Reports)

Parish	System	2005	2000	1995	1990	Change	% Change
Acadia	Church Point Water System	0.53	0.62	0.62	0.54	-0.01	-2%
Acadia	Crowley Water System	2.27	1.74	1.97	2.03	0.24	11%
Acadia	Egan Water Corp.	0.13	0.1				
Acadia	Estherwood Water System	0.07	0.07	0.08	0.07	0	0%
Acadia	Iota Water System	0.32	0.22	0.18	0.16	0.16	50%
Acadia	Mermentau Water System	0.05	0.06	0.08	0.06	-0.01	-20%
Acadia	Mire-Branch Water Corp.	0.55	0.49	0.29			
Acadia	Morse Water System	0.15	0.15	0.1	0.06	0.09	60%
Acadia	North of Crowley Water Corp.	0.22	0.22	0.17	0.11	0.11	50%
Acadia	Rayne Water Supply	1	1.09	0.98	1.25	-0.25	-25%
Acadia	South Rayne Water Corp.	0.16	0.16	0.1	0.04	0.12	75%
Allen	Allen Water Dist. 1	0.13	0.09	0.13	0.11	0.02	15%
Allen	East Allen Water Dist.	0.35	0.36	0.13	0.13	0.22	63%
Allen	Elizabeth Water System	0.06	0.07	0.07	0.06	0	0%
Allen	Fairview Water System	0.1	0.04	0.03	0.03	0.07	70%
Allen	Kinder Water System	0.36	0.36	0.05	0.2	0.16	44%
Allen	Oakdale Water System	0.99	0.65	0.88	1.52	-0.53	-54%
Allen	Oberlin Water System	0.16	0.16	0.49	0.18	-0.02	-13%
Allen	S. W. Allen Water Works Dist. 2	1.22	1.17	0.65	0.24	0.98	80%
Allen	South Oakdale Water System	0.1	0.08	0.08	0.1	0	0%
Allen	West Allen Water Dist.	0.26	0.21	0.18	0.17	0.09	35%
Ascension	Capitol Utilities Corp.		0.57	0.57	0.55		
Ascension	Diversion Water Co.	0.08	0.05				
Ascension	Gonzales Water System	1.36	1.27	1.17	0.89	0.47	35%
Ascension	Lambert's Water & Sewage				0.28		
Ascension	Parish Water Company	1.04	0.57	0.5			
Ascension	Port Diversion Water Co.			0.13			
Avoyelle	Avoyelles Ward 3 W.W. Dist	0.15	0.17		0.03	0.12	80%
Avoyelle	Brouillette Water System	0.22	0.21	0.21	0.17	0.05	23%
Avoyelle	Cottonport Water System	1	0.85	0.6	0.43	0.57	57%
Avoyelle	Evergreen Water System	0.13	0.13	0.13	0.12	0.01	8%
Avoyelle	Fifth Ward Water System	0.33	0.35	0.29	0.38	-0.05	-15%
Avoyelle	Hessmer Water System	0.62	0.32	0.32	0.19	0.43	69%
Avoyelle	Mansura Water System	0.31	0.3	0.14	0.04	0.27	87%
Avoyelle	Marksville Water System	0.82	0.85	0.73	0.98	-0.16	-20%
Avoyelle	Moreauville Water System	0.16	0.15	0.15	0.14	0.02	13%
Avoyelle	Morrow Water System Inc.	0.19	0.18	0.06	0.07	0.12	63%
Avoyelle	Plaucheville Water System	0.18	0.24	0.17	0.23	-0.05	-28%

Avoyelle	Simmesport Water System	0.08	0.36	0.47	0.27	-0.19	-238%
Avoyelle	Southwest Avoyelles W. W.	0.09	0.1	0.07	0.07	0.02	22%
Avoyelle	Ward 1 Water System - Effie	0.35	0.3	0.1	0.12	0.23	66%
Beauregard	Beauregard Dist. 2 Ward 5	0.49	0.42	0.26	0.12	0.37	76%
Beauregard	DeRidder Water System	1.59	2.32	2.18	2.5	-0.91	-57%
Beauregard	Green Acres Water & Sewer	0.07	0.07	0.09	0.08	-0.01	-14%
Beauregard	Merryville Water System	0.32	0.15	0.15	0.15	0.17	53%
Beauregard	S. Beauregard W. W. Dist. 3	1.23	1.16	0.91	0.65	0.58	47%
Beauregard	S. Merryville Water System	0.03	0.03	0.03	0.02	0.01	33%
Bienville	Alabama Water System	0.06	0.09	0.09	0.03	0.03	50%
Bienville	Alberta Water System	0.2	0.1	0.08	0.05	0.15	75%
Bienville	Arcadia Water System	0.46	0.46	0.31	0.33	0.13	28%
Bienville	Bryceland Water System	0.03	0.03	0.04	0.03	0	0%
Bienville	Castor Water System	0.24	0.02	0.02			
Bienville	Cypress Water System	0.06	0.04	0.04			
Bienville	DOTD Ada Rest Area		0.03				
Bienville	Friendship Water System	0.07	0.07	0.04	0.06	0.01	14%
Bienville	Gibsland Water System	0.22	0.18	0.17	0.15	0.07	32%
Bienville	Jamestown-Fryeburg W. S.	0.03					
Bienville	Lucky Water System	0.02	0.02		0.03	-0.01	-50%
Bienville	Mill Creek Water System		0.14				
Bienville	Mt. Calm Water System	0.03	0.02	0.02	0.02	0.01	33%
Bienville	Mt. Lebanon Water System	0.01	0.01				
Bienville	Mt. Olive Water System	0.04	0.08	0.02	0.02	0.02	50%
Bienville	Old Saline Comm. W. S.	0.03	0.03	0.02	0.02	0.01	33%
Bienville	Ringgold Water System	0.21	0.21	0.15	0.15	0.06	29%
Bienville	S. E. Bienville Water System	0.01	0.02	0.02			
Bienville	Saline Water System	0.04	0.04	0.04			
Bienville	Social Springs Water System	0.04	0.08	0.02	0.02	0.02	50%
Bienville	Springhill Community W. S.	0.09					
Bienville	Taylor Water System	0.04	0.04	0.04	0.03	0.01	25%
Bossier	Bellevue Water System	0.06	0.05				
Bossier	Bodcau Comm. W. S.	0.01	0.02				
Bossier	Central Bossier Water System	0.07	0.07	0.03			
Bossier	Evangeline Oaks W. S.	0.01					
Bossier	Haughton Water System	0.18	0.18	0.13	0.16	0.02	11%
Bossier	Oak Meadows Water Works		0.03				
Bossier	Plain Dealing Water System	0.16	0.28	0.26	0.26	-0.1	-63%
Bossier	Red Chute Utilities Co.	0.26	0.28	0.28	0.23	0.03	12%
Bossier	S. Bossier Water System	0.11	0.26	0.1	0.06	0.05	45%
Bossier	Sligo Water System, Inc.	0.09					
Bossier	St. Mary's Water System	0.02	0.05	0.04			
Bossier	Village Water System	0.74	0.6	0.52	0.53	0.21	28%

Caddo	Bel-Di-Gil Water System	0.13	0.07	0.08	0.13	0	0%
Caddo	Cypress Gardens Mar.	0.01					
Caddo	Deep Woods Utilities	0.06	0.06	0.04			
Caddo	Eagle Water Co.	0.19	0.19	0.08			
Caddo	Four Forks Water System	0.04	0.04	0.03	0.02	0.02	50%
Caddo	Greenwood Water System	0.02		0.39	0.2	-0.18	-900%
Caddo	Hosston Mira Water System	0.08	0.08	0.05	0.06	0.02	25%
Caddo	Ida Water System	0.02	0.03	0.03	0.02	0	0%
Caddo	Keithville Water Works Dist. 7	0.26	0.26				
Caddo	Meadowwood Estates Utility	0.01	0.01				
Caddo	Mooringsport Water System	0.11					
Caddo	North Caddo Utilities Inc.	0.03	0.03	0.04			
Caddo	Pine Hills Water Works	0.24	0.22	0.23	0.24	0	0%
Caddo	Rodessa Water System	0.02	0.02	0.03	0.03	-0.01	-50%
Caddo	Southview Estates	0.01					
Caddo	Tyson Comm. Water System	0.01					
Caddo	Wildwood S. Water System	0.03	0.03	0.03			
Caddo	Caddo Water Dist. 7			0.24	0.14		
Calcasieu	Bell City Water System	0.02	0.01				
Calcasieu	Brigas Subdivision		0.03	0.03	0.02		
Calcasieu	C & L Utilities		0.33		0.05		
Calcasieu	Calcasieu W. W. Dist. 2	0.22					
Calcasieu	Calcasieu W. W. Dist. 4	0.37	0.38	0.33	0.38	-0.01	-3%
Calcasieu	Calcasieu W. W. Dist. 5	0.67	0.36	0.36	0.18	0.49	73%
Calcasieu	Calcasieu W. W. Dist. 7	0.28	0.37	0.2	0.2	0.08	29%
Calcasieu	Calcasieu W. W. Dist. 8	0.54	0.63	0.04			
Calcasieu	Calcasieu W. W. Dist. 9	1.05	0.89	0.85	0.41	0.64	61%
Calcasieu	Country Pine Subdivision			0.08			
Calcasieu	DeQuincy Water System	0.49	0.75	0.6	0.59	-0.1	-20%
Calcasieu	Garden Height Subdivision			0.04			
Calcasieu	Gulfway Water Services	0.01					
Calcasieu	Hayes Water System	0.25	0.07	0.05	0.05	0.2	80%
Calcasieu	Iowa Water System	0.26	0.26	0.38	0.5	-0.24	-92%
Calcasieu	Lake Charles Water System	12.8	11.69	10.42	11.39	1.41	11%
Calcasieu	Lake Street Water Co.	0.09	0.03	0.04	0.02	0.07	78%
Calcasieu	Moss Bluff Water Dist. 1	2.18					
Calcasieu	Oak Meadows Water Works	0.03					
Calcasieu	Ponderosa Water Co.		0.02		0.02		
Calcasieu	Quail Ridge Community W.S.		0.05				
Calcasieu	St. Charles raintree Cove			0.02	0.02		
Calcasieu	Starks Water And Gas	0.04	0.04	0.05	0.02	0.02	50%
Calcasieu	Sulphur Water System	3.66	3.85	4.34	4.2	-0.54	-15%
Calcasieu	Util. Services of Lake Charles	0.01	0.03	0.03	0.02	-0.01	-100%

Calcasieu	Vinton Water System	0.65	0.92	0.97	0.83	-0.18	-28%
Calcasieu	W.W. Dist 1 of Ward 1		2.09	1.45	1.22		
Calcasieu	W.W. Dist 2 of Ward 4		0.2	0.19	0.09		
Calcasieu	Westlake Water System	1.06	1.2	0.94	1.1	-0.04	-4%
Caldwell	Clarks Water System	0.1	0.11	0.1	0.08	0.02	20%
Caldwell	Columbia Heights Water Dist.	0.28	0.27	0.23	0.1	0.18	64%
Caldwell	Columbia Water System	0.08	0.08	0.09	0.1	-0.02	-25%
Caldwell	Cottonplant Water System	0.05	0.05	0.05	0.02	0.03	60%
Caldwell	East Columbia Water Dist.	1.02	0.7	0.14	0.14	0.88	86%
Caldwell	Grayson Water System		0.18	0.22	0.04		
Caldwell	Hebert Water System	0.12	0.13	0.09	0.13	-0.01	-8%
Caldwell	Holum Water System			0.06	0.03		
Caldwell	Kelly Water System	0.06	0.06	0.06	0.05	0.01	17%
Caldwell	Vixen Water System	0.04	0.04	0.02			
Caldwell	Wards 4 & 5 Water System	0.05	0.05	0.07			
Cameron	Cameron W. W. Dist. 11	0.37	0.31	0.19	0.16	0.21	57%
Cameron	Cameron W. W. Dist. 9	0.25	0.24	0.37	0.37	-0.12	-48%
Cameron	Cameron W.W. Dist. 1	0.8	0.86	0.31	0.63	0.17	21%
Cameron	Cameron W.W. Dist. 2	0.33	0.52	0.59	0.82	-0.49	-148%
Cameron	Cameron W.W. Dist. 7	0.06	0.06	0.06	0.17	-0.11	-183%
Cameron	Holly Beach Water Works	0.28	0.22				
Catahoula	Black River Water System	0.24	0.2	0.12	0.06	0.18	75%
Catahoula	Enterprise W. W. Dist. 1	0.03	0.03	0.03	0.03	0	0%
Catahoula	Harrisonburg Water System	0.07	0.07	0.05	0.05	0.02	29%
Catahoula	Jonesville Water System	0.31	0.27	0.27	0.27	0.04	13%
Catahoula	Larto Mayna Water System		0.05	0.04	0.03		
Catahoula	Leland Water System	0.01	0.05	0.05	0.04	-0.03	-300%
Catahoula	Maitland W. W. District	0.04	0.05	0.04	0.04	0	0%
Catahoula	Manifest-Rhinehart W. S.	0.15	0.09	0.07	0.06	0.09	60%
Catahoula	S. Bayou Macon W. S.	0.07	0.07	0.12	0.07	0	0%
Catahoula	Sandy Lake Water System	0.09	0.22	0.22	0.19	-0.1	-111%
Catahoula	Sicily Island Water System	0.05	0.06	0.07	0.06	-0.01	-20%
Catahoula	Whitehall Water System	0.03	0.03	0.11	0.02	0.01	33%
Clairborne	Athens Water System	0.05	0.05	0.04	0.05	0	0%
Clairborne	Central Claiborne W. S.	0.26	0.14	0.12	0.11	0.15	58%
Clairborne	Claiborne Ward 9 W. S.	0.03	0.03	0.03	0.02	0.01	33%
Clairborne	Haynesville Water System	0.4	0.52	0.57	0.59	-0.19	-48%
Clairborne	Homer Water System	0.36	0.8	0.82	0.89	-0.53	-147%
Clairborne	Junction City Water System	0.04	0.05	0.06	0.05	-0.01	-25%
Clairborne	Leatherman Creek W. S.	0.03	0.03				
Clairborne	Lisbon Water System	0.05	0.04	0.03	0.02	0.03	60%
Clairborne	Middle Fork Water System	0.03	0.02	0.05			
Clairborne	Norton Shop Water System	0.01	0.02		0.02	-0.01	-100%

Clairborne	Pine Hill Water System	0.08	0.05	0.08	0.02	0.06	75%
Clairborne	South Claiborne W. S.	0.4	0.12	0.25	0.18	0.22	55%
Clairborne	Summerfield Water System	0.11	0.1	0.09	0.07	0.04	36%
Concordia	Clayton Water System	0.05	0.07	0.06	0.06	-0.01	-20%
Concordia	Concordia W. W. Dist. 1	0.61	0.91	0.73	0.86	-0.25	-41%
Concordia	Lake St. John Water Dist.	0.08	0.1	0.1	0.16	-0.08	-100%
Concordia	Monterey Rural Water System	0.24	0.26	0.25	0.25	-0.01	-4%
Concordia	Ridgecrest Water System	0.05	0.02	0.05	0.05	0	0%
Concordia	Vidalia Water System	0.71	0.71	0.74	0.79	-0.08	-11%
De Soto	Bayou Pierre Water System	0.11	0.11	0.11	0.07	0.04	36%
De Soto	East DeSoto Water System	0.11	0.1	0.1	0.08	0.03	27%
De Soto	Grand Cane Water System	0.05	0.05	0.04	0.04	0.01	20%
De Soto	Keatchie Water System	0.26	0.21	0.3	0.2	0.06	23%
De Soto	Mansfield Water System	0.14	0.25	0.26	0.32	-0.18	-129%
De Soto	North DeSoto Water System	0.26	0.23	0.15	0.15	0.11	42%
De Soto	Rambin-Wallace W. S.	0.09	0.11	0.09	0.05	0.04	44%
De Soto	Ricks Well Water Service	0.01	0.01				
De Soto	South DeSoto Water System	0.04	0.03	0.07	0.05	-0.01	-25%
De Soto	South Mansfield Water System	0.22	0.15	0.14	0.14	0.08	36%
De Soto	Stanley Water System	0.02	0.02	0.03	0.03	-0.01	-50%
East Baton Rouge	Alsen Water Works				0.1		
East Baton Rouge	Baker Utilities	2.45	2	1.92	1.95	0.5	20%
East Baton Rouge	Baton Rouge Water Company	47.36	49.06	43.46	43.38	3.98	8%
East Baton Rouge	Bellingrath Water Co., Inc.	0.23	0.26	0.2	0.19	0.04	17%
East Baton Rouge	Lambert's Water & Sewage				0.02		
East Baton Rouge	Parish Water Company	13.55	9.91	7.31	7.13	6.42	47%
East Baton Rouge	Red Oak Water Company	0.26	0.64	0.58	0.59	-0.33	-127%
East Baton Rouge	Slaughter Water System	0.03	0.03	0.03	0.08	-0.05	-167%
East Baton Rouge	Zachary Water System	2.16	1.9	1.43	1.23	0.93	43%
East Carroll	E. Carroll W. S. South	0.27	0.2				
East Carroll	Lake Providence W. S.	1.15	1.23	1.23	1.27	-0.12	-10%
East Feliciana	Clinton Water System	0.27	0.34	0.33	0.19	0.08	30%
East Feliciana	E. Feliciana Water District 1	0.05	0.06	0.06	0.06	-0.01	-20%
East Feliciana	E. Feliciana Water District 7	0.15	0.13	0.1	0.06	0.09	60%
East Feliciana	East Feliciana Rural W. S.	1.27	1.31	1.03	0.75	0.52	41%
East Feliciana	East Louisiana State Hospital		0.22				
East Feliciana	Jackson Water System	0.21	0.25	0.19	0.18	0.03	14%
East Feliciana	Norwood Water System	0.05	0.04	0.04	0.04	0.01	20%
East Feliciana	Plantation Utility Company	0.09	0.11	0.07	0.05	0.04	44%
East Feliciana	Slaughter Water System	0.13	0.13	0.11	0.05	0.08	62%
Evangeline	Basile Water System		0.3	0.44	0.41		
Evangeline	Bayou Des Cannes W. S.	0.59	0.57	0.16			
Evangeline	Chataignier Water System	0.03	0.09	0.07	0.06	-0.03	-100%

Evangeline	East Side Water System	0.34	0.25	0.31	0.22	0.12	35%
Evangeline	Evangeline Parish - Ward 4	0.12	0.03				
Evangeline	Evangeline Water Dist. 1	0.29	0.16	0.12	0.12	0.17	59%
Evangeline	Mamou Road Water Dist.	0.15	0.16	0.14	0.15	0	0%
Evangeline	Mamou Water System	0.99	0.99	0.71	0.58	0.41	41%
Evangeline	Point Blue Water System	0.12	0.14	0.14	0.15	-0.03	-25%
Evangeline	Reddell-Vidrine Water Dist.	0.19	0.21	0.15	0.13	0.06	32%
Evangeline	Savoy-Swords Water System	0.43	0.43	0.31	0.26	0.17	40%
Evangeline	Te Mamou Water Dist.	0.26	0.23	0.22	0.19	0.07	27%
Evangeline	Turkey Creek Water System	0.32	0.43	0.3	0.25	0.07	22%
Evangeline	Ville Platte Water System	1.46	1.73	1.48	1.1	0.36	25%
Franklin	Gilbert Water System		0.07	0.1	0.1		
Franklin	N. Franklin Water Works	0.65		0.03			
Franklin	Turkey Creek Water System	0.07					
Franklin	W. Winnsboro Water System	0.24	0.33	0.11	0.13	0.11	46%
Franklin	Winnsboro Water System	1.01	1.24	1.5	0.65	0.36	36%
Franklin	Wisner Water System	0.11	0.18	0.18	0.22	-0.11	-100%
Grant	Central Grant W. S.	0.12	0.21	0.21			
Grant	Colfax Water System	0.4	0.46	0.4	0.53	-0.13	-33%
Grant	Dry Prong Water System	0.06	0.04	0.05	0.06	0	0%
Grant	Grant Parish Zone 2 W. S.	0.1	0.11	0.11	0.08	0.02	20%
Grant	Jordan Hill\Red Hill W. W.	0.05	0.11	0.03	0.02	0.03	60%
Grant	Montgomery Water System	0.01	0.01	0.22	0.1	-0.09	-900%
Grant	Pollock Area Water System	0.23	0.15	0.13	0.1	0.13	57%
Grant	Pollock Water System	0.04	0.06	0.05	0.05	-0.01	-25%
Grant	S. E. Grant Water System	0.02	0.03	0.02			
Grant	South Grant Water Corp.	0.3	0.19	0.3	0.19	0.11	37%
Grant	West Grant Water Assoc.	0.23	0.13	0.14	0.13	0.1	43%
Iberia	Bayou Teche Water Works	1.37	0.65	0.5	0.53	0.84	61%
Iberia	Coteau Water System	0.52	0.39	0.31	0.2	0.32	62%
Iberia	Jeanerette Water System	1.33	1.31	1.31	1.06	0.27	20%
Iberia	Loreauville Water System	0.12	0.11	0.1	0.09	0.03	25%
Iberia	Lydia Water System		0.18	0.14	0.14		
Iberia	New Iberia Water System	6.46	6.52	5.02	5.73	0.73	11%
Iberia	Patoutville Village W. S.	0.05	0.05				
Iberville	Iberville W. W. Dist. 2				0.62		
Iberville	Iberville W. W. Dist. 3	0.37			1.04	-0.67	-181%
Iberville	Iberville W. W. Dist. 4	0.28	0.44	0.31	0.25	0.03	11%
Iberville	Maringouin Water System	1.18	1.18	1.18	1.25	-0.07	-6%
Iberville	Rosedale Water System	0.07	0.08	0.07	0.06	0.01	14%
Iberville	White Castle Water System	0.19	0.23	0.13	0.19	0	0%
Jackson	Bear Creek Water System	0.04	0.04	0.03	0.03	0.01	25%
Jackson	Chatham Water System	0.09	0.09	0.09	0.08	0.01	11%

Jackson	Clay Water System			0.02	0.02		
Jackson	East Hodge Water System	0.04	0.03	0.05	0.04	0	0%
Jackson	Ebeneezer Water System	0.03	0.03				
Jackson	Eros Community W. S.	0.05	0.05	0.05	0.03	0.02	40%
Jackson	Eros Water System	0.02	0.02		0.04	-0.02	-100%
Jackson	Hodge Water System	0.35	0.35	0.35	0.08	0.27	77%
Jackson	Jonesboro Water System	0.75	0.75	0.72	0.68	0.07	9%
Jackson	McDonald Water System	0.06	0.06	0.05	0.05	0.01	17%
Jackson	New Hope-St. Clair W. S.	0.01	0.01		0.02	-0.01	-100%
Jackson	North Hodge Water System	0.05	0.05	0.04	0.05	0	0%
Jackson	Punkin-Hilltop Water System	0.12	0.12	0.12	0.09	0.03	25%
Jackson	Quitman Water System	0.03	0.03		0.04	-0.01	-33%
Jackson	S. E. Hodge Water System	0.01	0.01				
Jackson	Shady Grove Water System	0.02	0.01				
Jackson	St. Rest Water System	0.03		0.03	0.03	0	0%
Jackson	Vixen Water System	0.01	0.02				
Jackson	Walker Community W. S.	0.02					
Jackson	Weston Water System	0.1	0.1	0.11	0.1	0	0%
Jefferson Davis	Fenton Water System	0.04	0.04	0.03	0.03	0.01	25%
Jefferson Davis	Jefferson Davis Central W. W.	0.44	0.39	0.3	0.22	0.22	50%
Jefferson Davis	Jefferson Davis W. W. Dist. 1	0.04	0.04	0.05	0.02	0.02	50%
Jefferson Davis	Jefferson Davis W. W. Dist. 4	0.25	0.23	0.21	0.13	0.12	48%
Jefferson Davis	Jefferson Davis W. W. Dist. 5	0.02	0.02	0.02			
Jefferson Davis	Jennings Water System	1.74	2	1.67	1.52	0.22	13%
Jefferson Davis	Lacassine Water System				0.03		
Jefferson Davis	Lake Arthur Water System	0.69	0.69	0.7	0.33	0.36	52%
Jefferson Davis	Welsh Water System	0.51	0.35	0.45	0.49	0.02	4%
Lafayette	Acadiana Treatment System			0.3	0.31		
Lafayette	Broussard Water System	0.47	0.47	0.28	0.26	0.21	45%
Lafayette	Carencro Water System	1.46	0.93	1.06	1	0.46	32%
Lafayette	Driftwood Util. Co.				0.02		
Lafayette	Duson Water System	0.16	0.21	0.11	0.17	-0.01	-6%
Lafayette	Garden Height Subdivision			0.03			
Lafayette	Lafayette Water System	19.78	18.65	16.48	16.09	3.69	19%
Lafayette	Milton Water System			0.29	0.21		
Lafayette	S. Lafayette Water Works Dist.	0.1	0.21	0.29	0.22	-0.12	-120%
Lafayette	Total Env. Solution, Inc.		0.27				
Lafayette	Water and Wastewater Util.	0.1					
Lafayette	Youngsville Water System	0.25	0.16	0.16	0.14	0.11	44%
LaSalle	Belah-Fellowship Water System	0.19	0.14	0.05	0.05	0.14	74%
LaSalle	East Jena Water System	0.08	0.08	0.05	0.06	0.02	25%
LaSalle	Goodpine Water System	0.31	0.3				
LaSalle	Jena Water System	0.43	0.56	0.42	0.48	-0.05	-12%

LaSalle	La Salle W. W. Dist. 1	0.31	0.25	0.3	0.16	0.15	48%
LaSalle	Nebo Water System	0.05	0.05	0.04	0.05	0	0%
LaSalle	Olla Water System	0.28	0.36	0.19	0.27	0.01	4%
LaSalle	Rogers Community W. S.	0.03	0.03	0.02	0.04	-0.01	-33%
LaSalle	Summerville-Rosefield Water	0.09	0.95	0.17	0.14	-0.05	-56%
LaSalle	Tullos Water System	0.08	0.09	0.04	0.08	0	0%
LaSalle	Urania Water System	0.07		0.14			
Lincoln	Choudrant Water System	0.08	0.08	0.08	0.08	0	0%
Lincoln	Culbertson Water System	0.25	0.3	0.37	0.1	0.15	60%
Lincoln	Dubach Water System	0.16	0.21	0.25	0.2	-0.04	-25%
Lincoln	Fellowship Water System	0.06	0.06	0.05	0.03	0.03	50%
Lincoln	Grambling Water System	0.56	0.56	0.38	0.58	-0.02	-4%
Lincoln	Greater Ward One W. W.	0.57	0.57	0.3	0.22	0.35	61%
Lincoln	Hico Water System	0.17	0.19	0.13	0.18	-0.01	-6%
Lincoln	Hilly-Greenwood W. S.	0.1	0.09	0.05			
Lincoln	Lincoln W. W. Dist. 1	0.04	0.05	0.04			
Lincoln	Lincoln W. W. Dist. 3	0.24	0.32	0.17	0.16	0.08	33%
Lincoln	Mineral Springs Water System	0.07	0.08	0.1	0.05	0.02	29%
Lincoln	Mt. Olive Water Dist.	0.05	0.05	0.08	0.09	-0.04	-80%
Lincoln	Mt. Zion Water System	0.12	0.12	0.08	0.05	0.07	58%
Lincoln	Ruston Utilities System	3.85	4.69	4.13	3.52	0.33	9%
Lincoln	Simsboro Water System	0.09	0.21	0.21	0.17	-0.08	-89%
Lincoln	Wesley Chapel Water System	0.22	0.22	0.12	0.13	0.09	41%
Livingston	Albany Water System	0.29	0.32	0.24	0.18	0.11	38%
Livingston	Capitol Utilities Corp.	0.4	0.4	0.39	0.08	0.32	80%
Livingston	Colyell Comm. Water Assoc.	0.19	0.2	0.16	0.11	0.08	42%
Livingston	Community Water Service		0.02				
Livingston	Denham Springs W. S.	3.37	3.6	3.05	2.61	0.76	23%
Livingston	Diversion Water Company	0.12	0.04				
Livingston	Fourth Ward Water Works	0.23	0.02	0.18	0.14	0.09	39%
Livingston	French Settlement W. S.	0.52	0.2	0.37	0.22	0.3	58%
Livingston	Head of Island Water System	0.2	0.17				
Livingston	Killian Water System	0.04	0.02	0.02			
Livingston	Livingston Water System	0.61	0.36	0.29	0.23	0.38	62%
Livingston	Port Vincent Water System	0.05	0.05	0.05	0.03	0.02	40%
Livingston	Springfield Water System	0.21	0.14				
Livingston	Tangipahoa Water District 2		0.23	0.08	0.05		
Livingston	Vincent Place Subdivision	0.03	0.03	0.03			
Livingston	Walker Water System	0.99	0.99	0.63	0.51	0.48	48%
Livingston	Ward 2 Water District	3.63	2.48	1.61	1	2.63	72%
Madison	Delta Water System	0.02	0.02	0.02	0.02	0	0%
Madison	Peoples Water Service Co.		1.32		1.23		
Madison	Tallulah Water Service	1.24		1.22			

Madison	Walnut Bayou Water Assoc	0.49	0.56	0.53	0.56	-0.07	-14%
Morehouse	Bayou Bonne Idee W. S.	0.09	0.09	0.09	0.07	0.02	22%
Morehouse	Beekman Water System	0.08	0.08	0.05	0.05	0.03	38%
Morehouse	Bonita Water System	0.04	0.04	0.04	0.08	-0.04	-100%
Morehouse	Collinston Water Service		0.04	0.03	0.05		
Morehouse	Gallion Subdivision		0.12				
Morehouse	Jones-McGinty Water System	0.1	0.13	0.13	0.12	-0.02	-20%
Morehouse	Mer Rouge Water System	0.12	0.17	0.12	0.11	0.01	8%
Morehouse	Morehouse Central W. S.	0.04	0.07	0.07	0.05	-0.01	-25%
Morehouse	Morehouse Parish W. W. Dist. 2	0.3	0.29	0.25	0.22	0.08	27%
Morehouse	Morehouse W. W. Dist. 1	0.13	0.13	0.13	0.13	0	0%
Morehouse	Oak Ridge Water System	0.03	0.03	0.05	0.03	0	0%
Morehouse	Peoples Water Service Co.	1.92	2.29	2.65	2.3	-0.38	-20%
Morehouse	S. Bonne Idee Water System	0.02	0.02	0.02	0.02	0	0%
Morehouse	Ward 3 Water System	0.07	0.01	0.18	0.29	-0.22	-314%
Natchitoches	Campti Water System	0.17	0.18	0.1	0.19	-0.02	-12%
Natchitoches	Chee Chee Bay Water System	0.02	0.02	0.02	0.02	0	0%
Natchitoches	Chestnut-Readhimer W.S.	0.03	0.03	0.04			
Natchitoches	Clarence Water System	0.09	0.09	0.08	0.06	0.03	33%
Natchitoches	Creston Water System	0.04	0.06	0.03	0.05	-0.01	-25%
Natchitoches	Goldonna Water System	0.05	0.05	0.05	0.03	0.02	40%
Natchitoches	Hagewood Water System	0.04	0.04	0.03	0.03	0.01	25%
Natchitoches	Natchitoches W. W. Dist. 2	0.4	0.24	0.22	0.31	0.09	23%
Natchitoches	Powhatan Water System	0.05	0.05	0.05	0.03	0.02	40%
Natchitoches	Provencal Water System	0.08	0.08	0.03	0.04	0.04	50%
Natchitoches	Robeline-Marthaville Water	0.12	0.09	0.07	0.06	0.06	50%
Ouachita	Aqua Water System	0.01					
Ouachita	Better Water Works	0.21	0.23	0.19	0.17	0.04	19%
Ouachita	Cadeville Water Dist.	0.28	0.27	0.19	0.13	0.15	54%
Ouachita	Calhoun Water System	0.08	0.07	0.03	0.04	0.04	50%
Ouachita	Charmingdale Subdivision		0.04				
Ouachita	Cheniere-Drew Water System	1.05	1.18	0.71	0.57	0.48	46%
Ouachita	D'arbonne Hills Subdivision	0.39	0.39	0.29			
Ouachita	Enterprise Water Co.	0.01					
Ouachita	Frost Town Water System	0.09	0.09	0.09	0.06	0.03	33%
Ouachita	Greater Ouachita Water. Co.	3.66	3.5	2.27	2.21	1.45	40%
Ouachita	Greenacres Water System		0.02	0.02			
Ouachita	Hickory Bend Water System	0.03	0.03	0.02			
Ouachita	Hillside Park Subdivision			0.07	0.05		
Ouachita	Indian Village Water System	0.1	0.1	0.09	0.03	0.07	70%
Ouachita	L & R Utilities	0.1	0.16	0.11	0.08	0.02	20%
Ouachita	LWC Management Co. Inc.	0.44					
Ouachita	McClendon Water System		0.01	0.05	0.05		

Ouachita	Neighbors Water Well Corp.	0.01					
Ouachita	Pine Bayou Subdivision Water System		0.09		0.16		
Ouachita	Pine Bayou-Tanglewood Water		0.19	0.16			
Ouachita	Prairie Road Water System	0.19	0.23	0.25	0.27	-0.08	-42%
Ouachita	S. W. Ouachita Water District	0.79	0.48	0.48	0.38	0.41	52%
Ouachita	Sikes Water System	0.03	0.01				
Ouachita	Swartz Water Works	0.02					
Ouachita	Tidwell Enterprises	0.21	0.21	0.17	0.17	0.04	19%
Ouachita	Toney Road Water System	0.01					
Ouachita	W. Monroe Water System	2.99	3.1	3.16	2.79	0.2	7%
Ouachita	Western Utilities Inc.	0.08	0.08	0.04			
Pointe Coupee	Brownview Water Supply Co.	0.04	0.04	0.04	0.05	-0.01	-25%
Pointe Coupee	False River Water Company	0.37	0.35	0.3	0.28	0.09	24%
Pointe Coupee	Fordoche Water System	0.15	0.13	0.11	0.1	0.05	33%
Pointe Coupee	Innis Water Works	0.17	0.18	0.14	0.14	0.03	18%
Pointe Coupee	John Lefeaux Water System			0.02			
Pointe Coupee	Livonia Water System	0.19	0.21	0.15	0.1	0.09	47%
Pointe Coupee	Lottie Water Work			0.02	0.02		
Pointe Coupee	M. & S. Water Supply	0.1	0.1	0.16	0.06	0.04	40%
Pointe Coupee	Maringouin Village W. S.	0.29	0.29				
Pointe Coupee	Morganza Water System	0.07	0.06	0.07	0.07	0	0%
Pointe Coupee	New Roads Water System	1.06	1.15	1.49	1.02	0.04	4%
Pointe Coupee	Old River Water Dist. 1	0.05	0.05	0.03			
Pointe Coupee	Pointe Coupee Area Water		0.03	0.03			
Pointe Coupee	Pointe Coupee W. W. Corp.	0.22	0.22	0.08	0.08	0.14	64%
Pointe Coupee	Pointe Coupee Water Dist. 1	0.22	0.23	0.21	0.15	0.07	32%
Pointe Coupee	Pointe Coupee Water Dist. 2	0.37	0.42	0.19	0.05	0.32	86%
Pointe Coupee	Torbert-Frisco Water System	0.05	0.06	0.05			
Pointe Coupee	Waterloo Water Service	0.01	0.01	0.04			
Rapides	Alexandria Water System	18.19	21.1	22.91	22.55	-4.36	-24%
Rapides	Avoyelles Ward 1 W. S.	0.15	0.17	0.1	0.12	0.03	20%
Rapides	Boyce Water System	0.16	0.16	0.15	0.09	0.07	44%
Rapides	Buckeye Water District 50	0.82	0.82	0.56	0.48	0.34	41%
Rapides	Bunkie Water System	0.63	0.67	0.71	0.73	-0.1	-16%
Rapides	Cheneyville Water System	0.13	0.15	0.1	0.13	0	0%
Rapides	Elmer-Melder-Cal W. S.	0.19	0.14	0.2	0.15	0.04	21%
Rapides	Forest Hill Water System	0.41	0.34	0.26	0.25	0.16	39%
Rapides	Gardner Comm Water System	0.31	0.31	0.24	0.2	0.11	35%
Rapides	Glenmora Water System	0.06	0.18	0.16	0.16	-0.1	-167%
Rapides	Hammock Water System	0.06	0.03	0.06	0.04	0.02	33%
Rapides	Hineston Water System	0.08	0.08	0.07	0.08	0	0%
Rapides	Kolin-Ruby-Wise Water Dist.	0.33	0.35	0.29	0.28	0.05	15%
Rapides	Lecompte Water System	0.28	0.23	0.22	0.22	0.06	21%

Rapides	Lena Water System	0.25	0.19	0.19	0.11	0.14	56%
Rapides	McNary Water System	0.08	0.06	0.05	0.05	0.03	38%
Rapides	Pineville Water System	3.33	2.81	1.76	5.5	-2.17	-65%
Rapides	Pollock Area Water System		0.08	0.07	0.05		
Rapides	Rapides Island Water Assoc.	0.41	0.44	0.33	0.33	0.08	20%
Rapides	Rapides Parish W. W. Dist. 3	0.91	0.66	0.62	0.66	0.25	27%
Rapides	Sieper Area Water System	0.05	0.1	0.05	0.05	0	0%
Rapides	Woodworth Water System	0.13	0.13	0.11	0.99	-0.86	-662%
Red River	Coushatta Water System	0.39	0.31	0.36	0.3	0.09	23%
Red River	East Cross Water System	0.03	0.03	0.03	0.03	0	0%
Red River	Edgefield Water System	0.03	0.02	0.03	0.02	0.01	33%
Red River	Halfway-Carroll Water System	0.03	0.05	0.05	0.03	0	0%
Red River	Hall Summit Water System	0.06	0.07	0.07	0.04	0.02	33%
Red River	Hickory Grove Water System	0.04	0.04	0.04	0.06	-0.02	-50%
Red River	Martin Water System	0.1	0.1	0.1	0.06	0.04	40%
Red River	Social Springs Water System	0.04	0.05	0.02	0.02	0.02	50%
Richland	Archibald Water System	0.27	0.16	0.11	0.08	0.19	70%
Richland	Delhi Water System	1	0.82	0.82	0.8	0.2	20%
Richland	Liddieville Water System	0.13	0.07	0.06			
Richland	Mangham Water System	0.18	0.18	0.18	0.18	0	0%
Richland	N. Franklin Water Works	0.74	0.74	0.62	0.49	0.25	34%
Richland	Rayville Water System	0.02	0.53	0.53	0.9	-0.88	-4400%
Richland	Richland Detention Ctr.	0.07					
Richland	River Road Water System	0.21	0.21	0.16			
Richland	Stuart Water System	0.16	0.16	0.2			
Sabine	Belmont Water System	0.39	0.34	0.24			
Sabine	Converse Water System	0.03	0.03	0.03	0.03	0	0%
Sabine	Fisher Water System	0.03	0.03	0.03	0.02	0.01	33%
Sabine	Many Water System	0.39	0.1	0.05	0.02	0.37	95%
Sabine	Noble Water System	0.03	0.03	0.04			
Sabine	Peg Leg Cove-Allied W.S.			0.02			
Sabine	Pleasant Hill Water System	0.11	0.11	0.11	0.1	0.01	9%
Sabine	Union Springs Water System	0.04	0.04	0.04	0.03	0.01	25%
Sabine	Zwolle Water System	0.19	0.19	0.18	0.18	0.01	5%
St. Helena	Crossroad Water Works	0.04	0.05	0.05	0.05	-0.01	-25%
St. Helena	Darlington W. W. Assoc.	0.02	0.02	0.03	0.02	0	0%
St. Helena	Dennis Mills W. W. Assoc.	0.07	0.07	0.05	0.05	0.02	29%
St. Helena	Greensburg Water System	0.15	0.13	0.14	0.12	0.03	20%
St. Helena	Montpelier Water System	0.03	0.03	0.03	0.02	0.01	33%
St. Helena	Pine Grove W. W. Assoc.	0.01	0.01		0.02	-0.01	-100%
St. Helena	St. Helena W. W. Dist. 2	0.29	0.17	0.16	0.18	0.11	38%
St. John the Baptist	St. John the Baptist Utilities	3.68	4.53	3.22	2.34	1.34	36%
St. Landry	Arnaudville Water System	0.33	0.28	0.2	0.24	0.09	27%

St. Landry	Cankton Water System	0.16	0.12	0.09	0.07	0.09	56%
St. Landry	Eunice Water System	1.66	1.84	1.62	1.79	-0.13	-8%
St. Landry	Garland-Whiteville Water			0.06	0.05		
St. Landry	Grand Coteau Water System	0.14	0.14	0.11	0.11	0.03	21%
St. Landry	Grand Prairie Water System	0.06	0.06	0.1			
St. Landry	Greenbriar-Prairie Basse W.S.	0.08	0.08	0.11			
St. Landry	K S Water System Inc	0.03	0.03	0.03			
St. Landry	Krotz Springs Water System	0.11	0.23	0.1	0.1	0.01	9%
St. Landry	Lawtell W. W. Dist. 1	0.24	0.23	0.21	0.24	0	0%
St. Landry	Leonville Water System	0.59	0.59	0.48	0.44	0.15	25%
St. Landry	Lewisburg-Bellevue W. S.	0.47	0.44	0.33	0.28	0.19	40%
St. Landry	Melville Water System	0.18	0.18	0.18	0.53	-0.35	-194%
St. Landry	Midway Water Works	0.01	0.01				
St. Landry	Morrow Water System Inc.			0.06	0.04		
St. Landry	Opelousas Water System	4.64	4.06	4.44	4.05	0.59	13%
St. Landry	Palmetto Water System	0.11	0.12	0.13	0.13	-0.02	-18%
St. Landry	Plaisance Water System	0.47	0.52	0.42	0.41	0.06	13%
St. Landry	Port Barre Water System	0.27	0.28	0.25	0.22	0.05	19%
St. Landry	Prairie Ronde W. S.	0.38	0.31	0.19	0.15	0.23	61%
St. Landry	Prairie Ronde-Garland/Whiteville		0.06				
St. Landry	Sunset Water System	0.2	0.2	0.19	0.2	0	0%
St. Landry	Washington Water System	0.11	0.13	0.15	0.13	-0.02	-18%
St. Martin	Acadiana Treatment System				0.03		
St. Martin	Breaux Bridge Water System	1.16	0.99	0.67	0.82	0.34	29%
St. Martin	Catahoula Water System	0.15	0.15	0.15	0.11	0.04	27%
St. Martin	Cecilia Water System	0.66	0.59	0.54	0.7	-0.04	-6%
St. Martin	Henderson-Nina W. S.	0.45	0.49	0.21	0.21	0.24	53%
St. Martin	Parks Water System	0.65	0.65	0.8	0.71	-0.06	-9%
St. Martin	River Ridge Estates W. S.	0.01					
St. Martin	St. Martin Parish W. & W.	1.82	1.82	1.75			
St. Martin	St. Martinville Water System	1.16	1.28	0.98	1.17	-0.01	-1%
St. Martin	United Water System	0.3	0.27	0.21	0.16	0.14	47%
St. Mary	Baldwin Water System	0.29	0.1				
St. Mary	Glencoe Comm Water System	0.2	0.02	0.02	0.02	0.18	90%
St. Mary	St. Mary Water Dist. 7	0.1	0.12	0.11	0.13	-0.03	-30%
St. Tammany	Abita Springs Water Co.	0.05	0.2	0.16	0.14	-0.09	-180%
St. Tammany	Alton Water System	0.02	0.02	0.02			
St. Tammany	Bayou Liberty Water Co.	0.99	1.01	0.83	0.53	0.46	46%
St. Tammany	Beau Chene Subdivision		0.45	0.48	0.54		
St. Tammany	Beau Village Subd.	0.01					
St. Tammany	Ben Thomas Rd. Water Dist.	0.04	0.04	0.03			
St. Tammany	Bleu Lake Water Co. Inc.		0.02	0.02			
St. Tammany	Coast W.W. Inc.			0.63			

St. Tammany	Covington Public Works Dept.	2.42	2.13	1.27	1.15	1.27	52%
St. Tammany	Cross Gates Utilities Co.	0.17	0.55	0.37	0.21	-0.04	-24%
St. Tammany	Eden Isles Water Supply	0.99	1.07				
St. Tammany	Folsom Water System	0.12	0.11	0.09	0.07	0.05	42%
St. Tammany	Greenleaves Utility Corp		0.53	0.53	0.12		
St. Tammany	King Forest Utility Co.		0.18		0.02		
St. Tammany	LA Water & Utilities Inc.	2.5	2.27	2.27	0.79	1.71	68%
St. Tammany	Lakeside Utilities				0.35		
St. Tammany	Lee Rd Water Co.	0.04	0.47	0.32	0.24	-0.2	-500%
St. Tammany	Lewisburg Estates W. S.	0.02					
St. Tammany	Madisonville Water System	0.07	0.13	0.13	0.13	-0.06	-86%
St. Tammany	Mandeville Water Supply	1.64	1.84	1.35	1.05	0.59	36%
St. Tammany	Northshore Utility Co.	0.07	0.04	0.02			
St. Tammany	Ozone Pine Subdivision	0.01					
St. Tammany	Park Waterworks		0.16				
St. Tammany	Pearl River Water System	0.12	0.2				
St. Tammany	Resolve Water System	0.48	0.44	0.35	0.4	0.08	17%
St. Tammany	Royal Garden Home Assoc.		0.03	0.03	0.02		
St. Tammany	S. E. LA Water & Sewer	1.4	0.66	0.67	0.48	0.92	66%
St. Tammany	Slidell Water System	3.38	3.53	4.43	4.45	-1.07	-32%
St. Tammany	St. Tammany Water Dist. 2	0.33	0.43	0.3	0.27	0.06	18%
St. Tammany	St. Tammany Water Dist. 3		0.3	0.3	0.29		
St. Tammany	Sun Water System	0.06	0.05	0.05	0.04	0.02	33%
St. Tammany	Tchefuncte Club Estate		0.37	0.14	0.1		
St. Tammany	Whisperwood Estates	0.45	0.44				
Tangipahoa	Amite Water System	1.68	2.43	1	1	0.68	40%
Tangipahoa	Bon Aire Estates Util. Co.	0.06	0.06	0.03	0.02	0.04	67%
Tangipahoa	Eastern Heights W. W.	0.13			0.08	0.05	38%
Tangipahoa	Fluker Water Works	0.03		0.03	0.02	0.01	33%
Tangipahoa	French Settlement W. S.			0.22	0.23		
Tangipahoa	Hammond Hgts. Water Co.	0.17	0.18	0.16	0.15	0.02	12%
Tangipahoa	Hammond Water System	4.52	4.31	4.75	4.19	0.33	7%
Tangipahoa	High Hat Water System	0.01					
Tangipahoa	Independence Water System	0.21	0.21	0.21	0.24	-0.03	-14%
Tangipahoa	Kentwood Water System	0.28	0.28	0.26	0.27	0.01	4%
Tangipahoa	Pine Hill Forest Subdivision	0.02	0.02	0.02	0.02	0	0%
Tangipahoa	Ponchatoula Water System	0.69	0.69	0.69	0.82	-0.13	-19%
Tangipahoa	Roseland Water System	0.5	0.5	0.5	0.22	0.28	56%
Tangipahoa	Tangipahoa W. W.	0.05	0.04	0.03	0.03	0.02	40%
Tangipahoa	Tangipahoa Water District 2	4.77	3.55	1.23	0.61	4.16	87%
Tangipahoa	Tickfaw Water System	0.07	0.07	0.04	0.04	0.03	43%
Tangipahoa	Westview Water Works	0.21	0.06	0.11	0.1	0.11	52%
Tensas	Newellton Water System	0.26					

Tensas	St. Joseph Water System	0.19	0.18	0.38	0.25	-0.06	-32%
Tensas	Waterproof Water System	0.13	0.08	0.09	0.25	-0.12	-92%
Union	Bernice Water System	0.18	0.29	0.28	0.25	-0.07	-39%
Union	Concord Water System	0.03	0.03	0.03			
Union	Corney Water System	0.02	0.03	0.03	0.03	-0.01	-50%
Union	Cox Ferry Water System	0.01					
Union	D'arbonne Water System N.	0.87	0.49	0.37	0.21	0.66	76%
Union	Downsville Water System	0.02	0.02	0.02	0.03	-0.01	-50%
Union	Farmerville Water System	2.44	2.58	1.47	0.34	2.1	86%
Union	Holmesville Water System	0.21	0.21	0.13	0.13	0.08	38%
Union	Junction City Water System	0.02					
Union	Linville-Haile Water System	0.15	0.15	0.16	0.1	0.05	33%
Union	Litroe Water System	0.05	0.05	0.06	0.04	0.01	20%
Union	Marion Water System	0.05	0.11	0.11	0.09	-0.04	-80%
Union	Point-Wilhite Water System	0.14	0.13	0.11	0.08	0.06	43%
Union	Randolph Water System	0.02	0.02	0.02	0.02	0	0%
Union	Rocky Branch W. W. Dist.	0.1	0.11	0.07	0.09	0.01	10%
Union	Salem Water System	0.03	0.04	0.03	0.03	0	0%
Union	Sardis Water System	0.08	0.08	0.08	0.05	0.03	38%
Union	Tri-Water System	0.2	0.2	0.21	0.1	0.1	50%
Union	Union W. W. Dist. 1	0.02	0.18	0.15	0.08	-0.06	-300%
Union	Wards Chapel W. S.	0.1	0.12	0.08	0.09	0.01	10%
Union	West Sterlington W. S.	0.08	0.08	0.08	0.06	0.02	25%
Vermilion	Abbeville Water System	2.1	2.06	2.04	2.1	0	0%
Vermilion	Acadiana Treatment System			0.03			
Vermilion	Delcambre Water System	0.87	0.88	0.58	0.55	0.32	37%
Vermilion	Erath Water System	0.39	0.37	0.25	0.25	0.14	36%
Vermilion	Grand Prairie Water System	0.02					
Vermilion	Gueydan Water System	0.42	0.28	0.28	0.17	0.25	60%
Vermilion	Kaplan Water System	0.56	0.6	0.64	0.64	-0.08	-14%
Vermilion	Magnolia Plantation W. S.	0.37	0.26				
Vermilion	Maurice Water System	0.11	0.1	0.07	0.06	0.05	45%
Vermilion	Nunez Water Works District 1	0.03	0.03				
Vermilion	Pecan Island W. W. Dist. 3	0.05					
Vermilion	Southeast W. W. Dist. 2	0.29	0.24				
Vermilion	Waterworks District 1		0.05	0.05			
Vernon	Anacoco Water System	0.1	0.1	0.08	0.06	0.04	40%
Vernon	E. Central Vernon W. S.	0.31	0.35	0.31			
Vernon	Hornbeck Water System	0.04	0.05	0.05	0.05	-0.01	-25%
Vernon	Leesville Water System	1.76	1.28	2.06	1.77	-0.01	-1%
Vernon	Pitkin Water System	0.07	0.06	0.06	0.04	0.03	43%
Vernon	Rosepine Water System	0.14	0.14	0.14	0.15	-0.01	-7%
Vernon	S. Vernon W. W. Dist. 1	0.15	0.11				

Vernon	Simpson Water System	0.05	0.08	0.04	0.03	0.02	40%
Vernon	Vernon Ward 4 Water Dist.	0.76	0.76	0.6	1	-0.24	-32%
Vernon	W. Vernon Parish W. W. Dist.	0.17					
Washington	Angie Water System	0.07	0.02	0.04	0.04	0.03	43%
Washington	Bogalusa Water System	9.83	12.13	4.62	3.59	6.24	63%
Washington	Bogue Lusa W. W. Dist.	0.35	0.35	0.34	0.29	0.06	17%
Washington	Franklinton Water System	0.97	0.81	0.5	0.46	0.51	53%
Washington	Rural Franklinton W. S.	0.19	0.34	0.27	0.19	0	0%
Washington	Varnado W. W. District	0.52	0.41	0.43	0.35	0.17	33%
Webster	Bistineau Water System	0.09	0.09	0.05	0.05	0.04	44%
Webster	Blocker Water Works Corp.	0.07	0.09	0.08	0.08	-0.01	-14%
Webster	Central Water System	0.03	0.11	0.11	0.04	-0.01	-33%
Webster	Cotton Valley Water System	0.06	0.06	0.06	0.06	0	0%
Webster	Cullen Water System	0.15	0.15	0.19	0.21	-0.06	-40%
Webster	Dixie Inn Water System			0.03	0.03		
Webster	Dixie Overland Water Works		0.1	0.11	0.08		
Webster	Dorcheat Acres Water System	0.02	0.04	0.04	0.05	-0.03	-150%
Webster	Doyline Water System	0.05	0.07	0.08	0.05	0	0%
Webster	Dubberly Water System	0.08	0.08	0.08	0.07	0.01	13%
Webster	Germantown Water System	0.14	0.05	0.14	0.11	0.03	21%
Webster	Gilark Water System	0.05	0.05	0.03	0.02	0.03	60%
Webster	Gilgal Water System	0.08	0.08	0.08	0.04	0.04	50%
Webster	Heflin Water System	0.04	0.05	0.02	0.04	0	0%
Webster	Horse Shoe Road W. S.	0.02	0.02				
Webster	Jenkins Comm. Water System	0.11	0.11	0.11	0.09	0.02	18%
Webster	Leton Water System	0.06	0.06	0.06	0.06	0	0%
Webster	McIntyre Water System	0.03	0.03	0.02	0.03	0	0%
Webster	Midway Water Works	0.04	0.03	0.03	0.03	0.01	25%
Webster	Minden Water System	2.09	1.96	2.06	2.83	-0.74	-35%
Webster	Palmetto Beach Water System		0.02		0.03		
Webster	Pleasant Valley Water System	0.05	0.08	0.05	0.05	0	0%
Webster	Salt Works Water System	0.03	0.04	0.04	0.04	-0.01	-33%
Webster	Sarepta Water System	0.12	0.12	0.14	0.12	0	0%
Webster	Shongaloo Water System	0.1	0.15	0.13	0.11	-0.01	-10%
Webster	Sibley Water System	0.11	0.32	0.22	0.14	-0.03	-27%
Webster	Simmons Water System			0.14			
Webster	Springhill Water System	1.76	1.76	0.69			
Webster	State Line Water System	0.02	0.05	0.03			
Webster	Thomasville Water System	0.02	0.02	0.05			
Webster	Union Grove Water System	0.03	0.03	0.03			
Webster	Village Water System	0.34	0.34	0.18			
West Baton Rouge	Plaquemine Light & Water	1.15	1.48	1.55	1.66	-0.51	-44%
West Baton Rouge	Port Allen Water System	0.58	0.62	0.63	0.68	-0.1	-17%

West Baton Rouge	W. Baton Rouge Gas & Water	2.77	1.86	1.71	1.38	1.39	50%
West Baton Rouge	W. Baton Rouge Water Dist. 1	0.16	0.21	0.23	0.26	-0.1	-63%
West Baton Rouge	W. Baton Rouge Water Dist. 2	0.99	0.95	0.59	0.75	0.24	24%
West Baton Rouge	W. Baton Rouge Water Dist. 4	0.91	0.76	0.61	0.51	0.4	44%
West Baton Rouge	Westport Properties	0.16	0.19	0.14	0.16	0	0%
West Carroll	Epps Water and Sewer	0.08	0.08	0.05	0.05	0.03	38%
West Carroll	Fiske Union Water System	0.24	0.24	0.14	0.14	0.1	42%
West Carroll	Forest Water System	0.1	0.11	0.11	0.12	-0.02	-20%
West Carroll	Goodwill Water System	0.18	0.1	0.07	0.07	0.11	61%
West Carroll	Monticello Water System	0.08	0.08	0.15	0.08	0	0%
West Carroll	N.- E.- W. Carroll W. S.	0.37	0.37	0.5	0.37	0	0%
West Carroll	Oak Grove Water System	0.4	0.27	0.33	0.35	0.05	13%
West Carroll	Pioneer-Darnell Water System	0.2	0.21	0.18	0.19	0.01	5%
West Feliciana	St. Francisville Water System	0.59	0.75	0.64	0.58	0.01	2%
West Feliciana	W. Feliciana Water District 13	1.42	1.26	0.9	0.49	0.93	65%
West Feliciana	W. Feliciana Water District 2	0.73	0.73	0.05	0.05	0.68	93%
Winn	Atlanta Water System	0.1	0.05	0.05	0.05	0.05	50%
Winn	Backwood Village W. S.	0.05	0.05	0.04			
Winn	Calvin Water System	0.04	0.03	0.03	0.03	0.01	25%
Winn	Dodson Water System	0.08	0.08	0.05	0.05	0.03	38%
Winn	Hudson-Gaars Mill W. S.	0.03	0.04	0.03	0.03	0	0%
Winn	Hwy 84 West Water System	0.05	0.05	0.05	0.06	-0.01	-20%
Winn	Jordan Hill\Red Hill W. W.	0.05		0.06	0.05	0	0%
Winn	Joyce Water System	0.04	0.04	0.03	0.02	0.02	50%
Winn	Pleasant Hill-Crossroads W.S.	0.03	0.03	0.03			
Winn	Sikes Water System	0.01	0.01				
Winn	St. Maurice Water System	0.05	0.05	0.05	0.03	0.02	40%
Winn	Tannehill Water System	0.2	0.2	0.15	0.13	0.07	35%
Winn	West Winn Water System, Inc.	0.09	0.08	0.07	0.07	0.02	22%
Winn	Wheeling Water System, Inc.	0.02	0.03	0.04			
Winn	Winnfield Water System	1.3	1.51	0.95	0.99	0.31	24%
	Net change	0.12	MGD				
	Increase demand	296	(62%)				
	Decreased demand	126	(26%)				
	No change in demand	55	(12%)				
	Average increase	0.27	MGD				
	Average decrease	-0.17	MGD				

Appendix E: Public Groundwater Useage Per Capita

Table: Groundwater Use per Capita (Source LDOTD 2005 Report and LDHH system population)

Parish	System	Population	2005	2005
			(MGD)	(G/P/D)
Acadia	Church Point Water System	4850	0.53	109
Acadia	Crowley Water System	19000	2.27	119
Acadia	Egan Water Corp.	4500	0.13	29
Acadia	Estherwood Water System	885	0.07	79
Acadia	Iota Water System	1450	0.32	221
Acadia	Mermentau Water System	846	0.05	59
Acadia	Mire-Branch Water Corp.	6768	0.55	81
Acadia	Morse Water System	782	0.15	192
Acadia	North of Crowley Water Corp.	3309	0.22	66
Acadia	Rayne Water Supply	8583	1	117
Acadia	South Rayne Water Corp.	37260	0.16	4
Allen	Allen Water Dist. 1	1305	0.13	100
Allen	East Allen Water Dist.	2700	0.35	130
Allen	Elizabeth Water System	900	0.06	67
Allen	Fairview Water System	426	0.1	235
Allen	Kinder Water System	2665	0.36	135
Allen	Oakdale Water System	7200	0.99	138
Allen	Oberlin Water System	2100	0.16	76
Allen	S. W. Allen Water Works Dist. 2	6916	1.22	176
Allen	South Oakdale Water System	1500	0.1	67
Allen	West Allen Water Dist.	2925	0.26	89
Ascension	Capitol Utilities Corp.			
Ascension	Diversion Water Co.	708	0.08	113
Ascension	Gonzales Water System	13560	1.36	100
Ascension	Parish Water Company	123130	1.04	8
Ascension	Lambert's Water & Sewage			
Ascension	Port Diversion Water Co.			
Avoyelle	Avoyelles Ward 3 W.W. Dist	2265	0.15	66
Avoyelle	Brouillette Water System	3618	0.22	61
Avoyelle	Cottonport Water System	2667	1	375
Avoyelle	Evergreen Water System	1995	0.13	65
Avoyelle	Fifth Ward Water System	5271	0.33	63
Avoyelle	Hessmer Water System	3069	0.62	202
Avoyelle	Mansura Water System	1881	0.31	165
Avoyelle	Marksville Water System	6191	0.82	132
Avoyelle	Moreauville Water System	1343	0.16	119
Avoyelle	Morrow Water System Inc.		0.19	

Avoyelle	Plaucheville Water System	3420	0.18	53
Avoyelle	Simmesport Water System	2853	0.08	28
Avoyelle	Southwest Avoyelles W. W.	960	0.09	94
Avoyelle	Ward 1 Water System - Effie	3300	0.35	106
Beauregard	Beauregard Dist. 2 Ward 5	6116	0.49	80
Beauregard	DeRidder Water System	12840	1.59	124
Beauregard	Green Acres Water & Sewer	1200	0.07	58
Beauregard	Merryville Water System	1200	0.32	267
Beauregard	S. Beauregard W. W. Dist. 3	18600	1.23	66
Beauregard	S. Merryville Water System		0.03	
Bienville	Alabama Water System	825	0.06	73
Bienville	Alberta Water System	1860	0.2	108
Bienville	Arcadia Water System	3508	0.46	131
Bienville	Bryceland Water System	243	0.03	123
Bienville	Castor Water System	441	0.24	544
Bienville	Cypress Water System	750	0.06	80
Bienville	DOTD Ada Rest Area	1000		
Bienville	Friendship Water System	777	0.07	90
Bienville	Gibsland Water System	1539	0.22	143
Bienville	Jamestown-Fryeburg W. S.	495	0.03	61
Bienville	Lucky Water System	315	0.02	63
Bienville	Mill Creek Water System	375		
Bienville	Mt. Calm Water System	342	0.03	88
Bienville	Mt. Lebanon Water System	225	0.01	44
Bienville	Mt. Olive Water System	640	0.04	63
Bienville	Old Saline Comm. W. S.	390	0.03	77
Bienville	Ringgold Water System	2283	0.21	92
Bienville	S. E. Bienville Water System	348	0.01	29
Bienville	Saline Water System	429	0.04	93
Bienville	Social Springs Water System		0.04	
Bienville	Springhill Community W. S.	183	0.09	492
Bienville	Taylor Water System	246	0.04	163
Bossier	Bellevue Water System	1125	0.06	53
Bossier	Bodcau Comm. W. S.	159	0.01	63
Bossier	Central Bossier Water System	921	0.07	76
Bossier	Evangeline Oaks W. S.	195	0.01	51
Bossier	Haughton Water System	3135	0.18	57
Bossier	Plain Dealing Water System	2778	0.16	58
Bossier	Red Chute Utilities Co.	3000	0.26	87
Bossier	S. Bossier Water System	1218	0.11	90
Bossier	Sligo Water System, Inc.	1653	0.09	54
Bossier	St. Mary's Water System	330	0.02	61
Bossier	Village Water System	10500	0.74	70

Caddo	Bel-Di-Gil Water System	1132	0.13	115
Caddo	Caddo Water Dist. 7	4740		
Caddo	Cypress Gardens Mar.	51	0.01	196
Caddo	Deep Woods Utilities	657	0.06	91
Caddo	Eagle Water Co.	1488	0.19	128
Caddo	Four Forks Water System	472	0.04	85
Caddo	Greenwood Water System	5116	0.02	4
Caddo	Hosston Mira Water System	804	0.08	100
Caddo	Ida Water System	402	0.02	50
Caddo	Keithville Water Works Dist. 7	1500	0.26	173
Caddo	Meadowwood Estates Utility	144	0.01	69
Caddo	Mooringsport Water System		0.11	
Caddo	North Caddo Utilities Inc.		0.03	
Caddo	Pine Hills Water Works	4350	0.24	55
Caddo	Rodessa Water System	366	0.02	55
Caddo	Southview Estates	204	0.01	49
Caddo	Tyson Comm. Water System	180	0.01	56
Caddo	Wildwood S. Water System	426	0.03	70
Calcasieu	Bell City Water System	228	0.02	88
Calcasieu	Brigas Subdivision	294		
Calcasieu	C & L Utilities			
Calcasieu	Calcasieu W. W. Dist. 2		0.22	
Calcasieu	Calcasieu W. W. Dist. 4	5600	0.37	66
Calcasieu	Calcasieu W. W. Dist. 5	3000	0.67	223
Calcasieu	Calcasieu W. W. Dist. 7	4479	0.28	63
Calcasieu	Calcasieu W. W. Dist. 8	4600	0.54	117
Calcasieu	Calcasieu W. W. Dist. 9	10800	1.05	97
Calcasieu	Country Pine Subdivision	1000		
Calcasieu	DeQuincy Water System	5880	0.49	83
Calcasieu	Garden Height Subdivision	351		
Calcasieu	Gulfway Water Services	160	0.01	63
Calcasieu	Hayes Water System	800	0.25	313
Calcasieu	Iowa Water System	2600	0.26	100
Calcasieu	Lake Charles Water System	80000	12.8	160
Calcasieu	Lake Street Water Co.	651	0.09	138
Calcasieu	Moss Bluff Water Dist. 1		2.18	
Calcasieu	Oak Meadows Water Works	343	0.03	87
Calcasieu	Ponderosa Water Co.			
Calcasieu	Quail Ridge Community W.S.	1000		
Calcasieu	St. Charles raintree Cove			
Calcasieu	Starks Water And Gas		0.04	
Calcasieu	Sulphur Water System	21000	3.66	174
Calcasieu	Util. Services of Lake Charles	343	0.01	29

Calcasieu	Vinton Water System	3338	0.65	195
Calcasieu	W.W. Dist 1 of Ward 1	23201		
Calcasieu	W.W. Dist 2 of Ward 4	5600		
Calcasieu	Westlake Water System	4920	1.06	215
Caldwell	Clarks Water System	996	0.1	100
Caldwell	Columbia Heights Water Dist.	1965	0.28	142
Caldwell	Columbia Water System	912	0.08	88
Caldwell	Cottonplant Water System	705	0.05	71
Caldwell	East Columbia Water Dist.	2568	1.02	397
Caldwell	Grayson Water System	1461		
Caldwell	Hebert Water System	3048	0.12	39
Caldwell	Holum Water System			
Caldwell	Kelly Water System	1140	0.06	53
Caldwell	Vixen Water System	486	0.04	82
Caldwell	Wards 4 & 5 Water System	921	0.05	54
Cameron	Cameron W. W. Dist. 11	4806	0.37	77
Cameron	Cameron W. W. Dist. 9	367	0.25	681
Cameron	Cameron W.W. Dist. 1	885	0.8	904
Cameron	Cameron W.W. Dist. 2	1600	0.33	206
Cameron	Cameron W.W. Dist. 7	744	0.06	81
Cameron	Holly Beach Water Works		0.28	
Catahoula	Black River Water System	972	0.24	247
Catahoula	Enterprise W. W. Dist. 1	600	0.03	50
Catahoula	Harrisonburg Water System	881	0.07	79
Catahoula	Jonesville Water System	2469	0.31	126
Catahoula	Larto Mayna Water System	1023		
Catahoula	Leland Water System	1101	0.01	9
Catahoula	Maitland W. W. District	750	0.04	53
Catahoula	Manifest-Rhinehart W. S.		0.15	
Catahoula	S. Bayou Macon W. S.		0.07	
Catahoula	Sandy Lake Water System	3045	0.09	30
Catahoula	Sicily Island Water System	807	0.05	62
Catahoula	Whitehall Water System		0.03	
Clairborne	Athens Water System	444	0.05	113
Clairborne	Central Claiborne W. S.	2859	0.26	91
Clairborne	Claiborne Ward 9 W. S.	489	0.03	61
Clairborne	Haynesville Water System	3900	0.4	103
Clairborne	Homer Water System	3427	0.36	105
Clairborne	Junction City Water System	810	0.04	49
Clairborne	Leatherman Creek W. S.	372	0.03	81
Clairborne	Lisbon Water System	390	0.05	128
Clairborne	Middle Fork Water System	441	0.03	68
Clairborne	Norton Shop Water System	375	0.01	27

Clairborne	Pine Hill Water System	498	0.08	161
Clairborne	South Claiborne W. S.	3600	0.4	111
Clairborne	Summerfield Water System	1260	0.11	87
Concordia	Clayton Water System	834	0.05	60
Concordia	Concordia W. W. Dist. 1	6921	0.61	88
Concordia	Lake St. John Water Dist.	1920	0.08	42
Concordia	Monterey Rural Water System	5250	0.24	46
Concordia	Ridgecrest Water System	900	0.05	56
Concordia	Vidalia Water System	6354	0.71	112
De Soto	Bayou Pierre Water System	1371	0.11	80
De Soto	East DeSoto Water System	1470	0.11	75
De Soto	Grand Cane Water System	418	0.05	120
De Soto	Keatchie Water System	3465	0.26	75
De Soto	Mansfield Water System	6354	0.14	22
De Soto	North DeSoto Water System	3936	0.26	66
De Soto	Rambin-Wallace W. S.	1200	0.09	75
De Soto	Ricks Well Water Service	80	0.01	125
De Soto	South DeSoto Water System	840	0.04	48
De Soto	South Mansfield Water System	1050	0.22	210
De Soto	Stanley Water System	400	0.02	50
East Baton Rouge	Alsen Water Works			
East Baton Rouge	Baker Utilities	14495	2.45	169
East Baton Rouge	Baton Rouge Water Company	385272	47.36	123
East Baton Rouge	Bellingrath Water Co., Inc.	2360	0.23	97
East Baton Rouge	Lambert's Water & Sewage			
East Baton Rouge	Parish Water Company	123130	13.55	110
East Baton Rouge	Red Oak Water Company	7280	0.26	36
East Baton Rouge	Slaughter Water System		0.03	
East Baton Rouge	Zachary Water System	16257	2.16	133
East Carroll	E. Carroll W. S. South		0.27	
East Carroll	Lake Providence W. S.	5850	1.15	197
East Feliciana	Clinton Water System	3200	0.27	84
East Feliciana	East Feliciana Rural W. S.	10632	1.27	119
East Feliciana	E. Feliciana Water District 1		0.05	
East Feliciana	E. Feliciana Water District 7	2628	0.15	57
East Feliciana	East Louisiana State Hospital	2500		
East Feliciana	Jackson Water System	2139	0.21	98
East Feliciana	Norwood Water System	752	0.05	66
East Feliciana	Plantation Utility Company		0.09	
East Feliciana	Slaughter Water System	2180	0.13	60
Evangeline	Basile Water System	2514		
Evangeline	Bayou Des Cannes W. S.	3831	0.59	154
Evangeline	Chataignier Water System	1101	0.03	27

Evangeline	East Side Water System	3630	0.34	94
Evangeline	Evangeline Parish - Ward 4	723	0.12	166
Evangeline	Evangeline Water Dist. 1	2300	0.29	126
Evangeline	Mamou Road Water Dist.		0.15	
Evangeline	Mamou Water System	3566	0.99	278
Evangeline	Point Blue Water System	2680	0.12	45
Evangeline	Reddell-Vidrine Water Dist.	2502	0.19	76
Evangeline	Savoy-Swords Water System		0.43	
Evangeline	Te Mamou Water Dist.	2202	0.26	118
Evangeline	Turkey Creek Water System	1248	0.32	256
Evangeline	Ville Platte Water System	9310	1.46	157
Franklin	N. Franklin Water Works	4050	0.65	160
Franklin	Gilbert Water System	915		
Franklin	Turkey Creek Water System	1248	0.07	56
Franklin	W. Winnsboro Water System	2430	0.24	99
Franklin	Winnsboro Water System	6627	1.01	152
Franklin	Wisner Water System	1476	0.11	75
Grant	Central Grant W. S.	2073	0.12	58
Grant	Colfax Water System	2552	0.4	157
Grant	Dry Prong Water System	905	0.06	66
Grant	Grant Parish Zone 2 W. S.	1239	0.1	81
Grant	Jordan Hill\Red Hill W. W.	1347	0.05	37
Grant	Montgomery Water System	1072	0.01	9
Grant	Pollock Area Water System	2550	0.23	90
Grant	Pollock Water System	1332	0.04	30
Grant	South Grant Water Corp.	4998	0.3	60
Grant	S. E. Grant Water System	540	0.02	37
Grant	West Grant Water Assoc.	3378	0.23	68
Iberia	Bayou Teche Water Works	8841	1.37	155
Iberia	Coteau Water System		0.52	
Iberia	Jeanerette Water System	5997	1.33	222
Iberia	Loreauville Water System	1227	0.12	98
Iberia	New Iberia Water System	57381	6.46	113
Iberia	Lydia Water System	2108		
Iberia	Patoutville Village W. S.		0.05	
Iberville	Iberville W. W. Dist. 2	6700		
Iberville	Iberville W. W. Dist. 3	9168	0.37	40
Iberville	Iberville W. W. Dist. 4	1287	0.28	218
Iberville	Maringouin Water System	5200	1.18	227
Iberville	Rosedale Water System	900	0.07	78
Iberville	White Castle Water System	3076	0.19	62
Jackson	Bear Creek Water System	360	0.04	111
Jackson	Chatham Water System	1137	0.09	79

Jackson	Clay Water System	216		
Jackson	East Hodge Water System	423	0.04	95
Jackson	Ebeneezer Water System	330	0.03	91
Jackson	Eros Community W. S.	693	0.05	72
Jackson	Eros Water System	345	0.02	58
Jackson	Hodge Water System	479	0.35	731
Jackson	Jonesboro Water System	6876	0.75	109
Jackson	McDonald Water System	657	0.06	91
Jackson	New Hope-St. Clair W. S.	273	0.01	37
Jackson	North Hodge Water System	570	0.05	88
Jackson	Punkin-Hilltop Water System	1620	0.12	74
Jackson	Quitman Water System	555	0.03	54
Jackson	S. E. Hodge Water System	120	0.01	83
Jackson	Shady Grove Water System	195	0.02	103
Jackson	St. Rest Water System	700	0.03	43
Jackson	Vixen Water System	288	0.01	35
Jackson	Walker Community W. S.	213	0.02	94
Jackson	Weston Water System	1050	0.1	95
Jefferson Davis	Fenton Water System	1300	0.04	31
Jefferson Davis	Jefferson Davis Central W. W.	2930	0.44	150
Jefferson Davis	Jefferson Davis W. W. Dist. 1	400	0.04	100
Jefferson Davis	Jefferson Davis W. W. Dist. 4	3307	0.25	76
Jefferson Davis	Jefferson Davis W. W. Dist. 5	400	0.02	50
Jefferson Davis	Jennings Water System	13000	1.74	134
Jefferson Davis	Lacassine Water System			
Jefferson Davis	Lake Arthur Water System	3037	0.69	227
Jefferson Davis	Welsh Water System	3300	0.51	155
Lafayette	Acadiana Treatment System	100		
Lafayette	Broussard Water System	9201	0.47	51
Lafayette	Carencro Water System	6207	1.46	235
Lafayette	Driftwood Util. Co.			
Lafayette	Duson Water System	1872	0.16	85
Lafayette	Garden Height Subdivision			
Lafayette	Lafayette Water System	141000	19.78	140
Lafayette	Milton Water System	7830		
Lafayette	S. Lafayette Water Works Dist.	9900	0.1	10
Lafayette	Water and Wastewater Util.		0.1	
Lafayette	Total Env. Solution, Inc.			
Lafayette	Youngsville Water System	8145	0.25	31
LaSalle	Belah-Fellowship Water System	1500	0.19	127
LaSalle	East Jena Water System	936	0.08	85
LaSalle	Goodpine Water System		0.31	
LaSalle	Jena Water System	3160	0.43	136

LaSalle	La Salle W. W. Dist. 1	2625	0.31	118
LaSalle	Nebo Water System	1089	0.05	46
LaSalle	Olla Water System	1963	0.28	143
LaSalle	Rogers Community W. S.	495	0.03	61
LaSalle	Summerville-Rosefield Water	1410	0.09	64
LaSalle	Tullos Water System	792	0.08	101
LaSalle	Urania Water System	784	0.07	89
Lincoln	Choudrant Water System	1272	0.08	63
Lincoln	Culbertson Water System	3012	0.25	83
Lincoln	Dubach Water System	1218	0.16	131
Lincoln	Fellowship Water System	660	0.06	91
Lincoln	Grambling Water System	2709	0.56	207
Lincoln	Greater Ward One W. W.	3333	0.57	171
Lincoln	Hico Water System	1500	0.17	113
Lincoln	Hilly-Greenwood W. S.	1200	0.1	83
Lincoln	Lincoln W. W. Dist. 1	499	0.04	80
Lincoln	Lincoln W. W. Dist. 3	2310	0.24	104
Lincoln	Mineral Springs Water System	810	0.07	86
Lincoln	Mt. Olive Water Dist.	900	0.05	56
Lincoln	Mt. Zion Water System	1500	0.12	80
Lincoln	Ruston Utilities System	22468	3.85	171
Lincoln	Simsboro Water System	1083	0.09	83
Lincoln	Wesley Chapel Water System	2832	0.22	78
Livingston	Albany Water System	4000	0.29	73
Livingston	Capitol Utilities Corp.		0.4	
Livingston	Colyell Comm. Water Assoc.	2272	0.19	84
Livingston	Denham Springs W. S.	28872	3.37	117
Livingston	Diversion Water Company	2997	0.12	40
Livingston	Fourth Ward Water Works	3100	0.23	74
Livingston	French Settlement W. S.	4003	0.52	130
Livingston	Community Water Service			
Livingston	Head of Island Water System	2688	0.2	74
Livingston	Killian Water System	780	0.04	51
Livingston	Livingston Water System	5668	0.61	108
Livingston	Port Vincent Water System	462	0.05	108
Livingston	Springfield Water System	400	0.21	525
Livingston	Tangipahoa Water District 2			
Livingston	Vincent Place Subdivision	200	0.03	150
Livingston	Walker Water System	12039	0.99	82
Livingston	Ward 2 Water District	47913	3.63	76
Madison	Delta Water System	399	0.02	50
Madison	Tallulah Water Service	9195	1.24	135
Madison	Peoples Water Service Co.			

Madison	Walnut Bayou Water Assoc	2275	0.49	215
Morehouse	Bayou Bonne Idee W. S.	1701	0.09	53
Morehouse	Beekman Water System	1275	0.08	63
Morehouse	Bonita Water System	576	0.04	69
Morehouse	Collinston Water Service	609		
Morehouse	Gallion Subdivision			
Morehouse	Jones-McGinty Water System	801	0.1	125
Morehouse	Mer Rouge Water System	1098	0.12	109
Morehouse	Morehouse Central W. S.	819	0.04	49
Morehouse	Morehouse W. W. Dist. 1	1266	0.13	103
Morehouse	Morehouse Parish W. W. Dist. 2		0.3	
Morehouse	Oak Ridge Water System	417	0.03	72
Morehouse	Peoples Water Service Co.		1.92	
Morehouse	S. Bonne Idee Water System	345	0.02	58
Morehouse	Ward 3 Water System	1752	0.07	40
Natchitoches	Campti Water System	1734	0.17	98
Natchitoches	Chee Chee Bay Water System	458	0.02	44
Natchitoches	Chestnut-Readhimer W.S.	732	0.03	41
Natchitoches	Clarence Water System	672	0.09	134
Natchitoches	Creston Water System	870	0.04	46
Natchitoches	Goldonna Water System	435	0.05	115
Natchitoches	Hagewood Water System	1050	0.04	38
Natchitoches	Natchitoches W. W. Dist. 2	713	0.4	561
Natchitoches	Powhatan Water System	546	0.05	92
Natchitoches	Provencal Water System	900	0.08	89
Natchitoches	Robeline-Marthaville Water	1341	0.12	89
Ouachita	Aqua Water System	144	0.01	69
Ouachita	Better Water Works	2160	0.21	97
Ouachita	Cadeville Water Dist.	3150	0.28	89
Ouachita	Calhoun Water System	999	0.08	80
Ouachita	Charmingdale Subdivision	459		
Ouachita	Cheniere-Drew Water System	9440	1.05	111
Ouachita	D'arbonne Hills Subdivision		0.39	
Ouachita	Enterprise Water Co.		0.01	
Ouachita	Frost Town Water System	1386	0.09	65
Ouachita	Greater Ouachita Water. Co.	5327	3.66	687
Ouachita	Greenacres Water System	150		
Ouachita	Hickory Bend Water System	318	0.03	94
Ouachita	Hillside Park Subdivision	504		
Ouachita	Indian Village Water System	1686	0.1	59
Ouachita	L & R Utilities		0.1	
Ouachita	LWC Management Co. Inc.		0.44	
Ouachita	McClendon Water System	336		

Ouachita	Neighbors Water Well Corp.	40	0.01	250
Ouachita	Pine Bayou Subdivision Water System	1791		
Ouachita	Pine Bayou-Tanglewood Water			
Ouachita	Prairie Road Water System	2286	0.19	83
Ouachita	Sikes Water System	69	0.03	435
Ouachita	S. W. Ouachita Water District	8469	0.79	93
Ouachita	Swartz Water Works	330	0.02	61
Ouachita	Tidwell Enterprises		0.21	
Ouachita	Toney Road Water System	166	0.01	60
Ouachita	W. Monroe Water System	15678	2.99	191
Ouachita	Western Utilities Inc.	747	0.08	107
Pointe Coupee	Brownview Water Supply Co.		0.04	
Pointe Coupee	False River Water Company	5012	0.37	74
Pointe Coupee	Fordoche Water System	1548	0.15	97
Pointe Coupee	Innis Water Works	3000	0.17	57
Pointe Coupee	John Lefeaux Water System			
Pointe Coupee	Livonia Water System	1973	0.19	96
Pointe Coupee	Lottie Water Work			
Pointe Coupee	M. & S. Water Supply	1760	0.1	57
Pointe Coupee	Maringouin Village W. S.		0.29	
Pointe Coupee	Morganza Water System	800	0.07	88
Pointe Coupee	New Roads Water System	8000	1.06	133
Pointe Coupee	Old River Water Dist. 1	280	0.05	179
Pointe Coupee	Pointe Coupee Area Water			
Pointe Coupee	Pointe Coupee W. W. Corp.		0.22	
Pointe Coupee	Pointe Coupee Water Dist. 1	4852	0.22	45
Pointe Coupee	Pointe Coupee Water Dist. 2	3154	0.37	117
Pointe Coupee	Torbert-Frisco Water System	1201	0.05	42
Pointe Coupee	Waterloo Water Service	99	0.01	101
Rapides	Alexandria Water System	54782	18.19	332
Rapides	Avoyelles Ward 1 W. S.		0.15	
Rapides	Boyce Water System	1650	0.16	97
Rapides	Buckeye Water District 50	10287	0.82	80
Rapides	Bunkie Water System		0.63	
Rapides	Cheneyville Water System	1531	0.13	85
Rapides	Elmer-Melder-Cal W. S.	2310	0.19	82
Rapides	Forest Hill Water System	2403	0.41	171
Rapides	Gardner Comm Water System	4200	0.31	74
Rapides	Glenmora Water System	1624	0.06	37
Rapides	Hammock Water System	900	0.06	67
Rapides	Hineston Water System	891	0.08	90
Rapides	Kolin-Ruby-Wise Water Dist.	4302	0.33	77
Rapides	Lecompte Water System	1441	0.28	194

Rapides	Lena Water System	3450	0.25	72
Rapides	McNary Water System	391	0.08	205
Rapides	Pineville Water System	20315	3.33	164
Rapides	Pollock Area Water System			
Rapides	Rapides Island Water Assoc.	5874	0.41	70
Rapides	Rapides Parish W. W. Dist. 3	19500	0.91	47
Rapides	Sieper Area Water System	900	0.05	56
Rapides	Woodworth Water System	2208	0.13	59
Red River	Coushatta Water System	3435	0.39	114
Red River	East Cross Water System	453	0.03	66
Red River	Edgefield Water System	360	0.03	83
Red River	Halfway-Carroll Water System	498	0.03	60
Red River	Hall Summit Water System	711	0.06	84
Red River	Hickory Grove Water System	570	0.04	70
Red River	Martin Water System	1260	0.1	79
Red River	Social Springs Water System	1365	0.04	29
Richland	Archibald Water System	2886	0.27	94
Richland	Delhi Water System	4071	1	246
Richland	Liddieville Water System	1323	0.13	98
Richland	Mangham Water System	768	0.18	234
Richland	N. Franklin Water Works		0.74	
Richland	Rayville Water System	4842	0.02	4
Richland	Richland Detention Ctr.	150	0.07	467
Richland	River Road Water System	2967	0.21	71
Richland	Stuart Water System		0.16	
Sabine	Belmont Water System	2565	0.39	152
Sabine	Converse Water System	405	0.03	74
Sabine	Fisher Water System	282	0.03	106
Sabine	Many Water System	4575	0.39	85
Sabine	Noble Water System	360	0.03	83
Sabine	Peg Leg Cove-Allied W.S.	189		
Sabine	Pleasant Hill Water System	990	0.11	111
Sabine	Union Springs Water System	1215	0.04	33
Sabine	Zwolle Water System	2250	0.19	84
St. Helena	Crossroad Water Works	1040	0.04	38
St. Helena	Darlington W. W. Assoc.	480	0.02	42
St. Helena	Dennis Mills W. W. Assoc.	1044	0.07	67
St. Helena	Greensburg Water System	1304	0.15	115
St. Helena	Montpelier Water System	236	0.03	127
St. Helena	Pine Grove W. W. Assoc.	280	0.01	36
St. Helena	St. Helena W. W. Dist. 2	2814	0.29	103
St. John the Baptist	St. John the Baptist Utilities	44010	3.68	84
St. Landry	Arnaudville Water System		0.33	

St. Landry	Cankton Water System	1785	0.16	90
St. Landry	Eunice Water System	15732	1.66	106
St. Landry	Garland-Whiteville Water			
St. Landry	Grand Coteau Water System	1066	0.14	131
St. Landry	Grand Prairie Water System	1350	0.06	44
St. Landry	Greenbriar-Prairie Basse W.S.	1338	0.08	60
St. Landry	K S Water System Inc	465	0.03	65
St. Landry	Krotz Springs Water System	2338	0.11	47
St. Landry	Lawtell W. W. Dist. 1	4101	0.24	59
St. Landry	Leonville Water System	7935	0.59	74
St. Landry	Lewisburg-Bellevue W. S.	5757	0.47	82
St. Landry	Melville Water System	1644	0.18	109
St. Landry	Midway Water Works	228	0.01	44
St. Landry	Morrow Water System Inc.	1653		
St. Landry	Opelousas Water System	23550	4.64	197
St. Landry	Palmetto Water System	2007	0.11	55
St. Landry	Plaisance Water System	6200	0.47	76
St. Landry	Port Barre Water System	3675	0.27	73
St. Landry	Prairie Ronde W. S.	5139	0.38	74
St. Landry	Prairie Ronde-Garland/Whiteville			
St. Landry	Sunset Water System	3393	0.2	59
St. Landry	Washington Water System	1550	0.11	71
St. Martin	Acadiana Treatment System			
St. Martin	Breaux Bridge Water System	8220	1.16	141
St. Martin	Catahoula Water System	2706	0.15	55
St. Martin	Cecilia Water System	10467	0.66	63
St. Martin	Henderson-Nina W. S.	3954	0.45	114
St. Martin	Parks Water System	10786	0.65	60
St. Martin	River Ridge Estates W. S.	75	0.01	133
St. Martin	St. Martin Parish W. & W.	2979	1.82	611
St. Martin	St. Martinville Water System	7467	1.16	155
St. Martin	United Water System	3729	0.3	80
St. Mary	Baldwin Water System	2500	0.29	116
St. Mary	Glencoe Comm Water System	352	0.2	568
St. Mary	St. Mary Water Dist. 7	2100	0.1	48
St. Tammany	Abita Springs Water Co.	2800	0.05	18
St. Tammany	Alton Water System	499	0.02	40
St. Tammany	Bayou Liberty Water Co.	13504	0.99	73
St. Tammany	Beau Chene Subdivision	4440		
St. Tammany	Beau Village Subd.	120	0.01	83
St. Tammany	Ben Thomas Rd. Water Dist.	220	0.04	182
St. Tammany	Bleu Lake Water Co. Inc.			
St. Tammany	Coast W.W. Inc.			

St. Tammany	Covington Public Works Dept.	14700	2.42	165
St. Tammany	Cross Gates Utilities Co.	9600	0.17	18
St. Tammany	Lewisburg Estates W. S.	60	0.02	333
St. Tammany	Eden Isles Water Supply	8713	0.99	114
St. Tammany	Folsom Water System	1600	0.12	75
St. Tammany	Greenleaves Utility Corp			
St. Tammany	King Forest Utility Co.			
St. Tammany	LA Water & Utilities Inc.		2.5	
St. Tammany	Lakeside Utilities			
St. Tammany	Lee Rd Water Co.	5697	0.04	7
St. Tammany	Madisonville Water System	650	0.07	108
St. Tammany	Mandeville Water Supply	13700	1.64	120
St. Tammany	Northshore Utility Co.		0.07	
St. Tammany	Ozone Pine Subdivision	168	0.01	60
St. Tammany	Park Waterworks			
St. Tammany	Pearl River Water System	2752	0.12	44
St. Tammany	Resolve Water System		0.48	
St. Tammany	Royal Garden Home Assoc.	300		
St. Tammany	Slidell Water System	38612	3.38	88
St. Tammany	St. Tammany Water Dist. 2	5200	0.33	63
St. Tammany	St. Tammany Water Dist. 3	2920		
St. Tammany	S. E. LA Water & Sewer	3430	1.4	408
St. Tammany	Sun Water System	729	0.06	82
St. Tammany	Tchefuncte Club Estate	1400		
St. Tammany	Whisperwood Estates	5141	0.45	88
Tangipahoa	Amite Water System	4300	1.68	391
Tangipahoa	Bon Aire Estates Util. Co.	692	0.06	87
Tangipahoa	Eastern Heights W. W.	1800	0.13	72
Tangipahoa	Fluker Water Works	200	0.03	150
Tangipahoa	French Settlement W. S.	5001		
Tangipahoa	Hammond Hgts. Water Co.	2125	0.17	80
Tangipahoa	Hammond Water System	21255	4.52	213
Tangipahoa	High Hat Water System	160	0.01	63
Tangipahoa	Independence Water System	3052	0.21	69
Tangipahoa	Kentwood Water System	2205	0.28	127
Tangipahoa	Pine Hill Forest Subdivision	192	0.02	104
Tangipahoa	Ponchatoula Water System	5180	0.69	133
Tangipahoa	Roseland Water System	2600	0.5	192
Tangipahoa	Tangipahoa W. W.	4112	0.05	12
Tangipahoa	Tangipahoa Water District 2	42237	4.77	113
Tangipahoa	Tickfaw Water System	1100	0.07	64
Tangipahoa	Westview Water Works	1400	0.21	150
Tensas	Newellton Water System		0.26	

Tensas	St. Joseph Water System	1761	0.19	108
Tensas	Waterproof Water System	1293	0.13	101
Union	Bernice Water System	2199	0.18	82
Union	Concord Water System	426	0.03	70
Union	Corney Water System	237	0.02	84
Union	Cox Ferry Water System	51	0.01	196
Union	D'arbonne Water System N.	6592	0.87	132
Union	Downsville Water System	216	0.02	93
Union	Farmerville Water System	4977	2.44	490
Union	Holmesville Water System	1845	0.21	114
Union	Junction City Water System	810	0.02	25
Union	Linville-Haile Water System	1635	0.15	92
Union	Litroe Water System	369	0.05	136
Union	Marion Water System	1146	0.05	44
Union	Point-Wilhite Water System	1950	0.14	72
Union	Randolph Water System	222	0.02	90
Union	Rocky Branch W. W. Dist.	1410	0.1	71
Union	Salem Water System	753	0.03	40
Union	Sardis Water System	1062	0.08	75
Union	Tri-Water System	1245	0.2	161
Union	Union W. W. Dist. 1	1626	0.02	12
Union	Wards Chapel W. S.	1350	0.1	74
Union	West Sterlington W. S.	978	0.08	82
Vermilion	Abbeville Water System	15450	2.1	136
Vermilion	Acadiana Treatment System			
Vermilion	Delcambre Water System	2185	0.87	398
Vermilion	Erath Water System	2850	0.39	137
Vermilion	Grand Prairie Water System	1350	0.02	15
Vermilion	Gueydan Water System	2490	0.42	169
Vermilion	Kaplan Water System	5600	0.56	100
Vermilion	Magnolia Plantation W. S.	6345	0.37	58
Vermilion	Maurice Water System	1323	0.11	83
Vermilion	Nunez Water Works District 1	496	0.03	60
Vermilion	Pecan Island W. W. Dist. 3	1544	0.05	32
Vermilion	Southeast W. W. Dist. 2	5700	0.29	51
Vermilion	Waterworks District 1	14472		
Vernon	Anacoco Water System	1506	0.1	66
Vernon	E. Central Vernon W. S.	5490	0.31	56
Vernon	Hornbeck Water System	558	0.04	72
Vernon	Leesville Water System	7923	1.76	222
Vernon	Pitkin Water System	750	0.07	93
Vernon	Rosepine Water System	1600	0.14	88
Vernon	S. Vernon W. W. Dist. 1	2616	0.15	57

Vernon	Simpson Water System	620	0.05	81
Vernon	Vernon Ward 4 Water Dist.	4824	0.76	158
Vernon	W. Vernon Parish W. W. Dist.	3153	0.17	54
Washington	Angie Water System	400	0.07	175
Washington	Bogalusa Water System	14000	9.83	702
Washington	Bogue Lusa W. W. Dist.	4200	0.35	83
Washington	Franklinton Water System	4150	0.97	234
Washington	Rural Franklinton W. S.	3150	0.19	60
Washington	Varnado W. W. District	4740	0.52	110
Webster	Bistineau Water System	882	0.09	102
Webster	Blocker Water Works Corp.	1200	0.07	58
Webster	Central Water System	1350	0.03	22
Webster	Cotton Valley Water System	1584	0.06	38
Webster	Cullen Water System	1650	0.15	91
Webster	Dixie Inn Water System	404		
Webster	Dixie Overland Water Works	1269		
Webster	Dorcheat Acres Water System	411	0.02	49
Webster	Doyline Water System	915	0.05	55
Webster	Dubberly Water System	1122	0.08	71
Webster	Germantown Water System	1200	0.14	117
Webster	Gilark Water System	488	0.05	102
Webster	Gilgal Water System	1350	0.08	59
Webster	Heflin Water System	245	0.04	163
Webster	Horse Shoe Road W. S.	270	0.02	74
Webster	Jenkins Comm. Water System	930	0.11	118
Webster	Leton Water System	654	0.06	92
Webster	McIntyre Water System	416	0.03	72
Webster	Midway Water Works	450	0.04	89
Webster	Minden Water System	16950	2.09	123
Webster	Palmetto Beach Water System			
Webster	Pleasant Valley Water System	918	0.05	54
Webster	Salt Works Water System	600	0.03	50
Webster	Sarepta Water System	1500	0.12	80
Webster	Shongaloo Water System	1485	0.1	67
Webster	Sibley Water System	1087	0.11	101
Webster	Simmons Water System			
Webster	Springhill Water System	7158	1.76	246
Webster	State Line Water System	399	0.02	50
Webster	Thomasville Water System	327	0.02	61
Webster	Union Grove Water System	110	0.03	273
Webster	Village Water System	10500	0.34	32
West Baton Rouge	Plaquemine Light & Water		1.15	
West Baton Rouge	Port Allen Water System	5500	0.58	105

West Baton Rouge	W. Baton Rouge Gas & Water	4424	2.77	626
West Baton Rouge	W. Baton Rouge Water Dist. 1	2700	0.16	59
West Baton Rouge	W. Baton Rouge Water Dist. 2	7976	0.99	124
West Baton Rouge	W. Baton Rouge Water Dist. 4	6856	0.91	133
West Baton Rouge	Westport Properties		0.16	
West Carroll	Epps Water and Sewer	696	0.08	115
West Carroll	Fiske Union Water System	1830	0.24	131
West Carroll	Forest Water System	1560	0.1	64
West Carroll	Goodwill Water System	1800	0.18	100
West Carroll	Monticello Water System	1140	0.08	70
West Carroll	N.- E.- W. Carroll W. S.	3618	0.37	102
West Carroll	Oak Grove Water System	3102	0.4	129
West Carroll	Pioneer-Darnell Water System	2100	0.2	95
West Feliciana	St. Francisville Water System	2304	0.59	256
West Feliciana	W. Feliciana Water District 2	660	0.73	1106
West Feliciana	W. Feliciana Water District 13	8532	1.42	166
Winn	Atlanta Water System	870	0.1	115
Winn	Backwood Village W. S.	783	0.05	64
Winn	Calvin Water System	350	0.04	114
Winn	Dodson Water System	507	0.08	158
Winn	Hudson-Gaars Mill W. S.	660	0.03	45
Winn	Hwy 84 West Water System	499	0.05	100
Winn	Jordan Hill\Red Hill W. W.	525	0.05	95
Winn	Joyce Water System	474	0.04	84
Winn	Pleasant Hill-Crossroads W.S.	624	0.03	48
Winn	Sikes Water System	69	0.01	145
Winn	St. Maurice Water System		0.05	
Winn	Tannehill Water System	1800	0.2	111
Winn	West Winn Water System, Inc.	1797	0.09	50
Winn	Wheeling Water System, Inc.	420	0.02	48
Winn	Winnfield Water System	7769	1.3	167
	Average	4817	0.57	114
	Total	2846931	344.33	63317
	Min	40	0.01	4
	Max	385272	47.36	1106
	St. Dev	19317	2.45	111

Appendix F: Industrial Groundwater System Usage Change Overtime

Table: Industrial Groundwater System Values (MGD) Change Overtime (LDOTD Reports)

Parish	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	Change
	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(MGD)	(1960-2005)
Acadia	2.14	3.16	11.18	8.93	5.79	2.31	1.71	0.37	0.02	0.01	-100%
Allen	13.32	12.24	9.92	10	0.4	0.48	0.43	0.37	0.28	0.07	-99%
Ascension	1.12	2.79	3.35	2.5	4.2	3.77	11.67	9.05	7.57	3.04	171%
Assumption	1.93	2.59	4.92	8.26	4.6	4.27	5.91	10.74	13.84	14.14	633%
Avoyelles	0.14	0.37	0.53	0.47	0.34	0	0.18	0.44	0.36	0.02	-86%
Beauregard	4.6	5.44	3.64	29	27.9	30	18.63	21.39	20.57	22.01	378%
Bienville	0.86	0.83	0.58	0.69	10.4	10	12.24	15.42	10.92	10.84	1160%
Bossier	0.15	0.42	1.26	1.48	0.44	0.49	0.44	0.36	0.69	0.42	180%
Caddo	0.05	0.14	1.14	1.7	0.23	0	0.04	0.03	0.09	0.09	80%
Calcasieu	81.3	71.24	120.28	119	109	41.6	67.65	68.6	60.28	43.63	-46%
Caldwell	0.1	0.08	0.08	0	0	0	0	0	0		
Cameron	6.68	3.17	4.83	2.4	2.96	0	0.19	0.22	0.17	0.62	-91%
Catahoula	0.11	0.12	0.05	0	0	0	0	0	0		
Claiborne	1.84	2.09	1.8	1.26	1.05	0.43	0.33	0.35	0		
Concordia	0.13	0.14	0.1	0	0	0	0	0	0		
De Soto	0.06	0.2	0.13	0.13	0.02	0.09	0	0	0.34	1.34	2133%
E. Baton Rouge	75.25	59.99	99.59	84.7	86.5	57	63.45	69.79	63.37	70.69	-6%
E. Carroll	0.08	0.08	0.66	0.02	0.02	0	0	0	0		
E. Feliciana	0.84	1.31	1.55	0.03	0.03	0.03	0.03	0.03	0.03	0.07	-92%
Evangeline	10.6	9.04	4.09	1.95	1.54	1.74	1.95	1.99	1.3	1.25	-88%
Franklin	0.07	1.49	1.64	0	0	0	0.2	1.12	0.76	0.75	971%
Grant	0.15	0.15	0.15	0.15	0.06	0.02	0.08	0.13	0.21	0.07	-53%
Iberia	4.3	4.63	8.91	10.9	4.45	2.26	2.84	2.29	1.24		
Iberville	5.82	7.59	11.49	30.1	36.9	25.6	20.81	16.97	23.43	18.17	212%
Jackson	10.53	13.03	13.03	13.6	3.22	3.31	2.49	3.69	0		
Jefferson	9.06	13.62	8.21	8.3	6.05	5.96	7.31	6.07	2.88	2.25	-75%
Jefferson Davis	5.31	5.87	1.6	0.06	0.11	0.39	0.61	0	0		
La Salle	0.69	0.41	0.14	0.06	0	0	0.02	0.1	0.03		
Lafayette	0.64	2.13	2.96	1.42	0	0.03	0.34	0.03	0.53	0.53	-17%
Lafourche	0.17	0.5	0	0	0	1.01	1.02	1.2	1.39		
Lincoln	1.2	2.32	1.71	1.67	0.68	0.97	1.26	0.5	0.16	0.66	-45%
Livingston	0.28	0.05	1.21	1.16	0.03	0	0.03	0.02	0.13	0.12	-57%
Madison	1.12	1.25	4	0.03	0.06	0.06	0	0	0		
Morehouse	19.83	17.62	20.12	15.2	11.9	5.11	6.09	7.41	4	4.33	-78%
Natchitoches	0.35	0.03	0	0	0	0	0	0	0		
Orleans	32.02	24.98	23.65	19	14.7	14.9	1.94	2.2	1.99	1.83	-94%
Ouachita	14.8	13.33	15.21	12.8	11.9	9.38	10.48	10.66	11.77	11	-26%

Plaquemines	0.04	0.05	0	0	0	0	0	0	0		
Pointe Coupee	1.01	2.01	2.27	2.96	0.13	2.29	2.39	4.48	7.35	5.98	492%
Rapides	0.6	1.59	14.48	1.93	1.51	0	0.05	0.04	0.02	0.65	8%
Red River	0.02	0.03	0.01	0.47	0.27	0.06	0	0	0.01		
Richland	0.68	2.98	2.52	0.04	0.05	0	0.01	0	0		
Sabine	0.1	0.31	0.12	0.25	0.12	0.33	0.26	0.26	0.32		
St. Bernard	2.16	2.72	1.63	1.43	1.38	0.9	0.05	0	0		
St. Charles	19.48	19.29	14.07	11	8.27	15.5	4.58	4.92	1.84	4.85	-75%
St. Helena	0.05	0	0	0	0	0	0	0.02	0.03		
St. James	5.41	7.83	5.36	5.15	7.47	7.38	5.97	4.31	5.06	3.01	-44%
St. John the Bapt.	0.18	3.83	5.25	3.88	4.03	6.21	6.77	7.78	5.71	9.55	5206%
St. Landry	1.42	1.42	1.42	0.96	1.05	0.56	1.63	2.61	5.06	1.19	-16%
St. Martin	2.76	2.15	4.09	6.4	5.46	0.97	1.81	0.15	0.35	0.23	-92%
St. Mary	0.95	3.25	5.21	4.84	2.17	2.7	2.26	1.95	1.85	2.15	126%
St. Tammany	2.96	1.71	3.64	2.48	0.16	0.18	0.07	0.17	0.31	0.14	-95%
Tangipahoa	1.08	1.09	1.61	1.14	0.3	0.43	0.49	0.95	0.97	1.31	21%
Tensas	0.06	0.12	0	0.48	0	0	0	0	0		
Terrebonne	0.5	0.2	0.74	0.54	0.16	0.07	0.02	0.05	0.11	0.24	-52%
Union	0.08	0.04	0.02	0.02	0.07	0	0	0.08	0.09	0.06	-25%
Vermilion	8.84	7.75	4.73	4.6	5.87	4.32	2.94	2.67	1.93	1.68	-81%
Vernon	0.3	2.34	3.28	0	0	0	0	0	0		
W. Baton Rouge	2	5.93	7.64	3.02	3.99	4.26	4.65	4.71	10.19	4.32	116%
W. Carroll	0.06	0.06	0.58	0.06	0.07	0	0.01	0.16	0		
W. Feliciana	7.01	7.76	6.35	1.78	5.48	1.84	1.45	1.48	1.59	1.25	-82%
Washington	8.26	19.15	18.52	20.9	20.1	15	14.14	11.99	11.99	15.37	86%
Webster	7.39	9.19	8.61	8.53	2.38	1.01	1.19	1	0.42	2.91	-61%
Winn	0.22	0.23	0.53	1.13	1.24	0.9	1.01	0.93	1.13	1.02	364%
Total Use	381.26	387.47	496.39	470.96	417.21	286.12	292.12	302.25	284.68	263.86	-31%
							Average change		248%		
							Maximum change		5206%		
							Minimum change		-100%		
							Standard Deviation		880%		

Appendix G: Public Surface Water System Usage Change Overtime

Table: Public Surface Water System Values (MGD) Change Overtime (LDOTD Reports)

Parish	LDHH Database	Intake	Population	2009	2008	2007	2006	2005	2000	1995	1990	% Change
	Mississippi River Basin											
Ascension	PEOPLES WTR CO.-DVILLE	MISSISSIPPI RIVER	16,224					1.53	2.36	1.64	1.57	-3%
Concordia	FERRIDAY TOWN OF	MARENGO BEND-LAKE CONCORDIA	3,698					1.5	1.5	0.92	0.92	63%
Jefferson	JEFFERSON WATER WORKS DIST NO 1 & 2	MISSISSIPPI RIVER										
Jefferson	E JEFFERSON WW DIST NO 1	MISSISSIPPI RIVER	308,362					49.69	50.11	49.09	51.88	-4%
Jefferson	W JEFFERSON WW DIST NO 2	MISSISSIPPI RIVER	209,972					23.85	28.67	23.96	24.92	-4%
Jefferson	GRETNA WATERWORKS	MISSISSIPPI RIVER	17,500					2.83	4.7	4.41	3.91	-28%
Jefferson	WESTWEGO WATERWORKS	MISSISSIPPI RIVER	10,975					2.58	1.73	2	1.9	36%
Orleans	NEW ORLEANS WATER WORKS (ALGIER AND CARROLLTON)	MISSISSIPPI RIVER	486,240	133.00		129.00		132.7	155.16	125.18	127	4%
Orleans	NEW ORLEANS ALGIERS WW	MISSISSIPPI RIVER	58,240									
Orleans	NEW ORLEANS CARROLLTON WW	MISSISSIPPI RIVER	428,000									
Plaquemines	BELLE CHASSE WATER DISTRICT	MISSISSIPPI RIVER	17,391					7.42	7.78	6.68	5.74	29%
Plaquemines	DALCOUR WATERWORKS DIST	MISSISSIPPI RIVER	2,666									
Plaquemines	POINTE A LA HACHE W S	MISSISSIPPI RIVER	1,400									
Plaquemines	PORT SULPHUR WATER DIST	MISSISSIPPI RIVER	8,922									
St. Bernard	ST BERNARD PAR WATERWORK	MISSISSIPPI RIVER	33,000					9.35	10.29	10.99	9.52	-2%
St. Charles	ST CHARLES WATER DIST NO 1 & 2	MISSISSIPPI RIVER		6.38	6.50							
St. Charles	ST CHARLES WATER DIST NO 1 EB	MISSISSIPPI RIVER	24,081					4.27	4.83	4.52	3.35	27%
St. Charles	ST CHARLES WATER DIST NO 2 WB	MISSISSIPPI RIVER	31,485					4.15	4.75	4.09	3.81	9%
St. James	GRAMERCY WATERWORKS	MISSISSIPPI RIVER	3,200					0.5	0.54	0.34	0.34	47%
St. James	LUTCHER WATERWORKS	MISSISSIPPI RIVER	4,781					0.53	0.59	0.57	0.46	15%
St. James	ST JAMES WATER DIST NO 1 & 2	MISSISSIPPI RIVER						1.46	1.75	1.8	1.65	-12%
St. James	ST JAMES WATER DIST NO 1	MISSISSIPPI RIVER	6,120									
St. James	ST JAMES WATER DIST NO 2	MISSISSIPPI RIVER	9,000									

St. John the Baptist	ST JOHN WATER DIST NO 1	MISSISSIPPI RIVER	44,010					2.66	2.7	2.23	2.46	8%
St. John the Baptist	ST JOHN WATER DIST NO 2	MISSISSIPPI RIVER	3,702									
West Feliciana	THE BLUFF ON THOMPSON CREEK								0.03			
Tensas	LAKE BRUIN WATER DIST. 1		1,188								0.05	
Tensas	LAKE BRUIN WATER SYSTEM	LAKE BRUIN	912					0.04	0.04	0.04	0.08	-50%
Tensas	NEWELLTON WATER SYSTEM	LAKE BRUIN	1,596					0.26	0.26	0.25	0.31	-16%
Tensas	TENSAS WATER DIST. ASSN.	LAKE BRUIN	2,910					0.23	0.3	0.28	0.21	10%
Mississippi River Delta Basin												
Assumption	ASSUMPTION PAR WW DIST 1	BAYOU LAFOURCHE	22,862					3.26	5.44	3.14	2.63	24%
Lafourche	LAFOURCHE WATER DISTRICT #1	BAYOU LAFOURCHE	78,760			9.07	9.28	9.92	9.75	7.94	7.94	25%
Lafourche	LAFOURCHE WATER DISTRICT #1 (LOCKPORT)	BAYOU LAFOURCHE						0.26	0.26	0.22	0.2	30%
Lafourche	LAFOURCHE WATER DISTRICT #1 (TERREBONNE)	BAYOU LAFOURCHE						8.55	10.62	8.5	9.17	-7%
Lafourche	THIBODAUX WATERWORKS	BAYOU LAFOURCHE	15,810					2.65	2.7	3.29	2.62	1%
Terrebonne	TERREBONNE WATER WORKS DIST. 1							4.85	5.62	4.75		
Terrebonne	HOUMA WATER TP SERVICE AREA	INTRACOASTAL WATERWAY, BLACK BAYOU & INTRACOASTAL	33,578								7.33	
Terrebonne	SCHRIEVER WTP SERVICE AREA	BAYOU CUT OFF / HOLLYWOOD CANAL	65,000									
Red River Basin												
Bossier	BOSSIER CITY WATER SYSTEM, CITY OF	RED RIVER	59,611					10.67	9.69	8.66	7.49	42%
Caddo	BLANCHARD WATER SYSTEM	CADDO LAKE	11,700					0.7	0.7	0.7	0.58	21%
Caddo	CADDO WATER DIST. 1									0.22	0.27	
Caddo	EAST COVE UTILITIES	CADDO LAKE	450					0.03	0.03	0.04		
Caddo	EAST MOORINGSPORT WATER SYSTEM	CADDO LAKE	255					0.02	0.04	0.02		
Caddo	GREENWOOD, TOWN OF	CADDO LAKE	5,116					0.43	0.39			

Caddo	MOORINGSPORT WATER SYSTEM	CADDO LAKE	956					0.11	0.12	0.11	0.11	0%
Caddo	CADDO WATERWORKS - OIL CITY WATER SYSTEM	CADDO LAKE	2,250					0.26	0.26			
Caddo	SHREVEPORT WATER SYSTEM	CROSS LAKE	201,000					47.92	44.96	30.35	36.75	30%
Caddo	VIVIAN WATER SYSTEM	CADDO LAKE	4,425					0.58	0.4	0.41	0.4	45%
Natchitoches	NATCHITOCHES WATER SYSTEM	SIBLEY LAKE	30,000					5.18	5.12	5.4	4.7	10%
Natchitoches	SANDY POINT 480 WATER SYSTEM	BLACK LAKE	458					0.03		0.03		
Natchitoches	FAIRVIEW UNION WATER SYSTEM	GRAND BAYOU RESERVOIR	1,950									
Sabine River Basin												
De Soto	MANSFIELD WATER SYSTEM	TOLEDO BEND	6,354					0.99	0.95	0.53	0.45	120%
De Soto	LOGANSPORT WATER SYSTEM	SABINE RIVER	1,760					0.64	0.69	0.9	0.66	-3%
De Soto	DESOTO PARISH WATER WORKS DISTRICT #1	TOLEDO BEND	4,680									
Sabine	EBARB WATER SYSTEM							0.26	0.26	0.26	0.19	37%
Sabine	FLORIEN WATER SYSTEM								0.08			
Sabine	MANY WATER SYSTEM, CITY OF	TOLEDO BEND	4,575					0.43	0.87	0.85	1.08	-60%
Sabine	PENDLETON WATER ASSSOCIATION	TOLEDO BEND	1,896					0.12	0.1	0.06	0.06	100%
Sabine	PIRATE COVE WATER WORKS								0.02	0.02	0.02	
Sabine	SOUTH TOLEDO BEND WATER DISTRICT	TOLEDO BEND	3,866					0.55	0.17			
Calcasieu-Mermentau Rivers Basin												
Calcasieu	HOUSTON WATER WORKS DIST. 11		4,650					0.41	0.41	0.25	0.1	310%
Ouachita River Basin												
Grant	GEORGETOWN WATER SUPPLY	GEORGETOWN RESERVOIR	302					0.01	0.01	0.03	0.02	-50%
Rapides	RAPIDES PARISH WATERWORKS DISTRICT NO 3	BIG CREEK	19,500					2.03	2.53	2.66	2.53	-20%

Ouachita	MONROE WATER SYSTEM	BAYOU DESIARD & OUTACHITA RIVER	52,572					11.07	12.19	13.14	10.4	6%
Atchafalaya-Vermilion-Teche Rivers Basin												
St. Mary	AMELIA WATER AND SEWER COMM.								0.91			
St. Mary	BERWICK BAYOU VISTA WW COMMISSION	ATCHAFALAYA RIVER	8,876							1.19	1.25	
St. Mary	FRANKLIN WATER SUPPLY CITY OF	BAYOU TECHE	8,354					1.12	1.31	1.2	1.2	-7%
St. Mary	MORGAN CITY WATER SYSTEM	LOWER ATCHAFALAYA RIVER / BERWICK BAY & FLAT LAKE	12,703					3.54	4.22	4.59	2.91	22%
St. Mary	PATTERSON WATER SYSTEM	LOWER ATCHAFALAYA	4,500					0.57	0.51	0.99	0.46	24%
St. Mary	ST MARY PARISH WATER SEWERAGE COMM NO 1	BAYOU BOEUF	2,823					0.91				
St. Mary	WATER & SEWER COMMISSION #4 OF ST MARY	LAKE FAUSSE POINT/CHARENTON CANAL & GRAND LAKE	9,348									
St. Mary	ST MARY PARISH WW DIST NO 2							1.19	1.23	0.8	0.64	86%
St. Mary	ST MARY PARISH WW DIST NO 5	GRAND LAKE/SIX MILE LAKE	7,500					1.11	0.8	1.1	1	11%
St. Mary	ST MARY PARISH WW DIST NO 6							1.39	1.35	1.4	0.71	96%
Iberville	IBERVILLE WATER WORKS DISTRICT #3	LOWER GRAND RIVER	9,168				0.70	1.04	1.04	1.04		
						Number of system exhibiting an increase					14	32%
						Number of system exhibiting a decrease					29	66%
						Number of system exhibiting no change					1	2%
								Average change (1990-2005)				23%

Appendix H: Public Surface Water Usage per Capita

Table: Public Surface Water Use per Capita
(Source LDOTD 2005 Report and LDHH system population)

Parish	System	Population	2005	2005
			(MGD)	(G/D/P)
Mississippi River Basin				
Ascension	PEOPLES WTR CO.-DVILLE	16224	1.53	94
Concordia	FERRIDAY TOWN OF	3698	1.5	406
Jefferson	JEFFERSON WATER WORKS DIST NO 1 & 2			
Jefferson	E JEFFERSON WW DIST NO 1	308362	49.69	161
Jefferson	W JEFFERSON WW DIST NO 2	209972	23.85	114
Jefferson	GRETNA WATERWORKS	17500	2.83	162
Jefferson	WESTWEGO WATERWORKS	10975	2.58	235
Orleans	NEW ORLEANS WATER WORKS (ALGIER AND CARROLLTON)		132.7	273
Orleans	NEW ORLEANS ALGIERS WW	58240		
Orleans	NEW ORLEANS CARROLLTON WW	428000		
Plaquemines	BELLE CHASSE WATER DISTRICT	17391	7.42	427
Plaquemines	DALCOUR WATERWORKS DIST	2666		
Plaquemines	POINTE A LA HACHE W S	1400		
Plaquemines	PORT SULPHUR WATER DIST	8922		
St. Bernard	ST BERNARD PAR WATERWORK	33000	9.35	283
St. Charles	ST CHARLES WATER DIST NO 1 & 2			
St. Charles	ST CHARLES WATER DIST NO 1 EB	24081	4.27	177
St. Charles	ST CHARLES WATER DIST NO 2 WB	31485	4.15	132
St. James	GRAMERCY WATERWORKS	3200	0.5	156
St. James	LUTCHER WATERWORKS	4781	0.53	111
St. James	ST JAMES WATER DIST NO 1 & 2		1.46	
St. James	ST JAMES WATER DIST NO 1	6120		
St. James	ST JAMES WATER DIST NO 2	9000		
St. John the Baptist	ST JOHN WATER DIST NO 1 & 2	47712	2.66	56
West Feliciana	THE BLUFF ON THOMPSON CREEK			
Tensas	LAKE BRUIN WATER DIST. 1	1188		
Tensas	LAKE BRUIN WATER SYSTEM	912	0.04	44
Tensas	NEWELLTON WATER SYSTEM	1596	0.26	163
Tensas	TENSAS WATER DIST. ASSN.	2910	0.23	79
Mississippi River Delta Basin				
Assumption	ASSUMPTION PAR WW DIST 1	22862	3.26	143
Lafourche	LAFOURCHE WATER DISTRICT #1	78760	9.92	126

Lafourche	LAFOURCHE WATER DISTRICT #1 (LOCKPORT)		0.26	
Lafourche	LAFOURCHE WATER DISTRICT #1 (TERREBONNE)		8.55	
Lafourche	THIBODAUX WATERWORKS	15810	2.65	168
Terrebonne	TERREBONNE WATER WORKS DIST. 1		4.85	
Terrebonne	HOUMA WATER TP SERVICE AREA	33578		
Terrebonne	SCHRIEVER WTP SERVICE AREA	65000		
Red River Basin				
Bossier	BOSSIER CITY WATER SYSTEM, CITY OF	59611	10.67	179
Caddo	BLANCHARD WATER SYSTEM	11700	0.7	60
Caddo	CADDO WATER DIST. 1			
Caddo	EAST COVE UTILITIES	450	0.03	67
Caddo	EAST MOORINGSPORT WATER SYSTEM	255	0.02	78
Caddo	GREENWOOD, TOWN OF	5116	0.43	84
Caddo	MOORINGSPORT WATER SYSTEM	956	0.11	115
Caddo	CADDO WATERWORKS - OIL CITY WATER SYSTEM	2250	0.26	116
Caddo	SHREVEPORT WATER SYSTEM	201000	47.92	238
Caddo	VIVIAN WATER SYSTEM	4425	0.58	131
Natchitoches	NATCHITOCHES WATER SYSTEM	30000	5.18	173
Natchitoches	SANDY POINT 480 WATER SYSTEM	458	0.03	66
Natchitoches	FAIRVIEW UNION WATER SYSTEM	1950		
Sabine River Basin				
De Soto	MANSFIELD WATER SYSTEM	6354	0.99	156
De Soto	LOGANSPORT WATER SYSTEM	1760	0.64	364
De Soto	DESOTO PARISH WATER WORKS DISTRICT #1	4680		
Sabine	EBARB WATER SYSTEM		0.26	
Sabine	FLORIEN WATER SYSTEM			
Sabine	MANY WATER SYSTEM, CITY OF	4575	0.43	94
Sabine	PENDLETON WATER ASSSOCIATION	1896	0.12	63
Sabine	PIRATE COVE WATER WORKS			
Sabine	SOUTH TOLEDO BEND WATER DISTRICT	3866	0.55	142
Calcasieu-Mermentau Rivers Basin				
Calcasieu	HOUSTON WATER WORKS DIST. 11	4650	0.41	88
Ouachita River Basin				
Grant	GEORGETOWN WATER SUPPLY	302	0.01	33
Rapides	RAPIDES PARISH WATERWORKS DISTRICT NO 3	19500	2.03	104

Ouachita	MONROE WATER SYSTEM	52572	11.07	211
Atchafalaya-Vermilion-Teche Rivers Basin				
St. Mary	AMELIA WATER AND SEWER COMM.			
St. Mary	BERWICK BAYOU VISTA WW COMMISSION	8876		
St. Mary	FRANKLIN WATER SUPPLY CITY OF	8354	1.12	134
St. Mary	MORGAN CITY WATER SYSTEM	12703	3.54	279
St. Mary	PATTERSON WATER SYSTEM	4500	0.57	127
St. Mary	ST MARY PARISH WATER SEWERAGE COMM NO 1	2823	0.91	322
St. Mary	WATER & SEWER COMMISSION #4 OF ST MARY	9348		
St. Mary	ST MARY PARISH WW DIST NO 2		1.19	
St. Mary	ST MARY PARISH WW DIST NO 5	7500	1.11	148
St. Mary	ST MARY PARISH WW DIST NO 6		1.39	
Iberville	IBERVILLE WATER WORKS DISTRICT #3	9168	1.04	113
	Average	32,999	6.95	156
	Total	1,946,943	368.35	7193
	Minima	255	0.01	33
	Maxima	428,000	132.70	427
	Standard Deviation	75,305	20.14	93

Appendix I: Industrial Surface Water System Usage Change Overtime

Table: Industrial Surface Water System Values (MGD) Change Overtime (LDOTD Reports)

Parish	1960 (MGD)	1965 (MGD)	1970 (MGD)	1975 (MGD)	1980 (MGD)	1985 (MGD)	1990 (MGD)	1995 (MGD)	2000 (MGD)	2005 (MGD)	Change (1960-2005)
Acadia	0.08	0	0.73	0	0.01	0	0	0	0	0	-100%
Allen	0.01	0.09	0.36	0	0	0	0	0	0		
Ascension	2	12.23	108.53	115	202	178	180.05	209.05	199.46	188.77	9339%
Assumption	0	14.34	20.72	10.1	18.9	5.06	4.62	13.15	9.56	1.52	
Avoyelles	0	0	0.14	0.14	0.11	0	0	0	0		
Beauregard	0	0	0	0	0	0	4.99	0	0		
Bienville	0.55	0.03	0.02	0.02	0	0	0.17	0.03	0.06		
Bossier	0.06	0.7	0.09	0.06	0	0	0.01	0.01	0.01	0.02	-67%
Caddo	340.2	0	1.19	0.35	0.52	0.68	0.36	0.41	0.29	0.04	-100%
Calcasieu	749.17	620	642.09	314	311	179	191.83	170.74	210.85	180.24	-76%
Caldwell	0	0	0	0	1.45	0	0	0	0		
Cameron	13.2	0	11.75	0	0	22	1.33	1.33	1.35	4.66	-65%
Catahoula	0	0	1.5	1.5	0	0	0	0.02	0.01		
Claiborne	0	0	0	0	0	0	0	0	0		
Concordia	0.43	0.36	0.43	0	0	0	0	0	0		
De Soto	0	0	0.02	0	0	9.43	9.23	9.25	16.63	16.7	
E. Baton Rouge	374.18	339.96	361.53	114	69	33.7	21.53	19.89	18.49	20.41	-95%
E. Carroll	0	0	0	0.3	0	0	0	0	0		
E. Feliciana	2.6	0	0	0	0	0	0	0	0		
Evangeline	61.7	0	0	0.14	0	0	0	0	0		
Franklin	0	0	0	0	0	0	0	0	0		
Grant	3.1	0	0	0	1.3	1.75	1.87	2.14	1.44		
Iberia	5.5	1.66	26.09	17.3	11.5	6.29	7.67	6.44	7.76		
Iberville	291	278.42	525.11	643	655	445	516.39	492.45	553.58	516.92	78%
Jackson	0.01	0	0	0	0	0	0	0	0		
Jefferson	351.5	50.16	26.07	34.1	20.6	11.3	7.19	14.69	7.28	4.7	-99%
Jefferson Davis	0.07	0.73	0	0	0	0	0	0	0		
La Salle	1.9	0	0.1	0	0	0.24	0.13	0.15	0.12		
Lafayette	0	0	0	0	0	0	0	0	0		
Lafourche	4	15.9	22.23	29	15.6	9.64	8.17	5.34	9.07	7.75	94%
Lincoln	0	0	0	0	0	0	0	0	0		
Livingston	3	0	0	0	0	0	0	0	0		
Madison	0	0	0	0	0	0	0	0	0		
Morehouse	36	26.5	27.19	20.6	23	20	24.67	26.86	20.99	27.27	-24%
Natchitoches	0	0	0	6.58	1.55	7.26	8.56	9.06	12.69	14.1	
Orleans	346.5	5.47	1.78	0.01	0	0	0	0	0.01		

Ouachita	379.99	56.47	10.52	25.9	21.6	20.2	30.46	22.16	22.08	14.82	-96%
Plaquemines	46.3	10.79	23.84	171	152	109	105.44	108.09	95.19	128.54	178%
Pointe Coupee	0	0	0	0.48	0	0	0	0	0		
Rapides	7.2	2.4	0	0	1.11	0	13.38	0	0		
Red River	0.5	0	0	0	0	0	0	0	0		
Richland	0	0	0	0	0	0	0	0	0		
Sabine	0	0	0.05	0.02	0.1	0.04	0.09	0.05	0		
St. Bernard	448.8	502.9	590.59	710	654	127	252.22	294.64	271.17	281.42	-37%
St. Charles	62.4	196.61	837.46	604	712	348	377.13	454.82	582.51	973.85	1461%
St. Helena	0.5	0	0	0	0	0	5.08	0	0		
St. James	42.4	8.08	220	275	264	180	224.87	229.47	227.33	363.1	756%
St. John the Bapt.	15.7	32.6	53.73	87.7	93.7	35	91	84.17	80.68	50.71	223%
St. Landry	0	0	0	0	0	0	0	1.44	0		
St. Martin	0	0.71	4.63	3.3	1.29	0.03	0.63	0.25	0		
St. Mary	72.23	4.33	42.27	17.1	1.78	2.36	45.14	58.26	7.05	3.85	-95%
St. Tammany	0.6	0	0.08	0	0	0	0	0	0		
Tangipahoa	7.9	0	0	0	0	0	0	0	0		
Tensas	0	0	0	0.14	0	0	0	0	0		
Terrebonne	0	9.01	11.56	3.36	0.07	0	0	2.3	0.08		
Union	0	0	0	0	0	0	0	0	0		
Vermilion	0	1.36	1.18	0	0	4.43	0.05	0	0		
Vernon	0	0	0	0	0	0	0	0	0		
W. Baton Rouge	0	0	0	0	0	0	0	0	0		
W. Carroll	0	0	0	0	0	0	0	0	0		
W. Feliciana	0	0	32	35.5	29.8	27.7	29.44	28.99	29.73	33.29	
Washington	3.6	12	14.99	20	17	10.1	9.99	11.86	11.93	5.58	55%
Webster	30.2	32.22	36.92	17.6	0	0	0.47	1.03	0.2		
Winn	0	0	0.04	0	0	0	0	0	0		
Total Use	3705.08	2236.03	3657.53	3277.3	3279.99	1793.21	2174.16	2278.54	2397.6	2838.26	-23%
							Average change		596%		
							Maximum change		9339%		
							Minimum change		-100%		
							Standard Deviation		2152%		

Appendix C
Water Use Tables

Table C-1 Total Water Use by Region in Louisiana (1960 - 2005) (MGD)

Region	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
I	970	979	886	983	1,184	920	551	579	877	762
II	2,072	2,433	2,812	3,022	3,192	2,037	2,036	1,960	2,106	1,935
III	2,372	3,288	5,367	7,724	8,068	7,449	6,767	7,224	7,394	7,602
Total	5,415	6,700	9,066	11,730	12,444	10,408	9,354	9,763	10,377	10,299

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-2 Water Use by Consumer (1960 -2005) (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture[1]	0	0	0	0	151	192	541	234	243	271
General Irrigation	27	29	30	77	44	43	62	61	135	205
Rice Irrigation	967	1,379	1,526	1,865	2,031	1,441	646	708	888	787
Rural Domestic	41	42	67	42	54	46	50	39	41	44
Public Supply	267	357	384	502	602	628	629	646	758	719
Power Generation[2]	0	2,245	2,883	5,476	5,849	5,967	4,951	5,485	5,610	5,155
Livestock	26	24	22	19	15	11	9	9	19	8
Industrial	4,086	2,624	4,154	3,748	3,697	2,079	2,466	2,581	2,682	3,109
Total	5,414	6,700	9,066	11,730	12,444	10,408	9,354	9,764	1,038	10,298

[1]Aquaculture water use reported with irrigation water use until 1980.
[2].Power generation water use was reported with Industrial water use in 1960.
Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-3 Total Water Use by Source (1960 - 2005)

Source		**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**
Groundwater		1,029	1,170	1,524	1,563	1,780	1,436	1,341	1,258	1,634	1,572
	19%	17%	17%	13%	14%	14%	14%	13%	16%	15%	
Surface Water	4,385	5,530	7,542	10,167	10,664	8,971	8,012	8,506	8,743	8,727	
	81%	83%	83%	87%	86%	86%	86%	87%	84%	85%	

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-4 2005 Estimated Water Use in Louisiana

User	Groundwater (MGD)	(%)	Surface Water (MGD)	(%)	Total (MGD)	(%)
Public Supply	353.65	22%	365.34	4%	718.99	7%
Industry	266.65	17%	2,843.45	33%	3110.09	30%
Power Generation	16.66	1%	5,138.78	59%	5,155.44	50%
Rural Domestic	43.68	3%	0	0%	43.68	<1%
Livestock	4.18	<1%	3.82	<1%	8.00	<1%
Rice Irrigation	526.42	33%	260.89	3%	787.30	8%
General Irrigation	158.08	10%	46.74	1%	204.83	2%
Aquaculture	202.66	13%	68.39	1%	271.05	3%
Total	1,571.98 15%	100%	8,727.4 85%	100%	10,299.40 100%	100%

Source: LGS 2010 from Sargent, 2007

Table C-5 Surface Water Use by User Group (1960 - 2005) (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture[1]	0	0	0	0	101	125	323	130	115	68
General Irrigation	18	15	7	21	15	9	8	9	26	47
Rice Irrigation	473	814	776	1,115	1,124	758	248	285	206	261
Public Supply	174	237	243	300	337	352	344	344	404	365
Power Generation[2]	0	2,218	2,848	5,445	5,802	5,931	4,910	5,454	5,582	5,139
Livestock	14	11	11	9	5	4	5	5	13	4
Industrial	3,705	2,236	3,658	3,277	3,280	1,793	2,174	2,279	2,398	2,842
Total	4,385	5,530	7,542	10,167	10,664	8,971	8,012	8,506	8,743	8,726

[1]Aquaculture water use reported with irrigation water use until 1980.
[2].Power generation water use was reported with Industrial water use in 1960.
Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-6 Surface Water Use by Region (1960 - 2005) (MGD)

Region	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
I	851	835	700	692	871	587	294	294	507	362
II	1,382	1,681	1,827	2,096	2,108	1,255	1,275	1,304	1,189	1,155
III	2,151	3,013	5,015	7,378	7,684	7,128	6,443	6,907	7,047	7,211
Total	4,385	5,530	7,542	10,167	10,664	8,971	8,012	8,506	8,743	8,727

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-7 Surface Water Use by User Group in Region I (1960 - 2005) (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture[1]	0	0	0	0	3	3	6	1	3	4
General Irrigation	11	12	5	3	10	6	5	8	24	44
Rice Irrigation	10	5	18	54	97	85	24	37	46	43
Public Supply	32	36	40	49	61	62	67	66	82	84
Power Generation[2]	0	660	555	509	648	370	114	108	267	111
Livestock	6	6	4	4	2	1	2	2	10	1
Industrial	793	116	78	73	49	60	76	71	75	73
Total	851	835	700	692	871	587	294	294	507	362

[1]Aquaculture water use reported with irrigation water use until 1980.
[2].Power generation water use was reported with Industrial water use in 1960.
Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-8 Surface Water Use by User Group in Region II (1960 - 2005) (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture	0	0	0	0	62	78	189	92	74	64
General Irrigation	2	0.2	0.1	6	4	2	2	0.2	1	2
Rice Irrigation	463	801	759	1061	1026	672	224	248	161	217
Public Supply	6	7	7	11	9	10	8	13	12	11
Power Generation	0	239	328	665	678	279	584	712	715	665
Livestock	3	2	4	1	2	1	2	2	1	1
Industrial	909	631	729	352	327	214	265	238	227	194
Total	1,383	1,682	1,828	2,097	2,108	1,256	1,276	1,305	1,190	1,156

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-9 Surface Water Use by User Group in Region III (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture	0	0	0	0	36	44	128	37	38	0
General Irrigation	6	2	1	12	0.3	1	1	1	1	0.4
Rice Irrigation	0	8	0	0	0.3	1	0	0.1	0	0
Public Supply	137	193	195	240	267	280	268	266	311	271
Power Generation	0	1318	1,964	4,271	4,476	5,282	4,212	4,634	4,600	4,362
Livestock	5	3	4	3	2	1	1	1	1	1
Industrial	2,003	1,488	2,850	2,852	2,904	1,520	1,833	1,969	2,096	2,576
Total	2,151	3,013	5,016	7,378	7,685	7,129	6,443	6,907	7,047	7,210

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-10 Groundwater Use by Region (1960 - 2005) (MGD)

Region	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
I	119	144	186	290	313	333	257	286	370	400
II	689	751	985	926	1,084	782	761	656	917	780
III	221	275	353	347	383	321	324	317	347	391
Total	1,029	1,170	1,524	1,563	1,780	1,436	1,341	1,258	1,634	1,572

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-11 Groundwater Use by User Group (1960 - 2005) (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture	0	0	0	0	51	67	219	104	128	203
General Irrigation	9	15	24	57	29	34	53	52	109	158
Rice Irrigation	494	565	750	750	907	682	398	423	682	526
Rural Domestic	41	42	67	42	54	46	50	39	41	44
Public Supply	93	121	141	201	265	276	285	303	354	354
Power Generation	0	27	36	31	47	36	40	32	28	17
Livestock	12	12	11	10	10	8	4	4	6	4
Industrial	381	387	496	471	417	286	292	302	285	267
Total	1,029	1,170	1,524	1,563	1,781	1,436	1,341	1,258	1,634	1,572

[1]Aquaculture water use reported with irrigation water use until 1980.

[2].Power generation water use was reported with Industrial water use in 1960.

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-12 Groundwater Use by User Group in Region I (1960 - 2005) (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	0	0	0	0	7	13	35	31	39	22
General Irrigation	4	8	19	37	15	20	42	50	101	149
Rice Irrigation	22	31	52	149	183	204	77	93	119	120
Rural Domestic	12	11	11	5	10	14	15	9	9	9
Public Supply	17	23	25	37	46	47	50	58	68	66
Power Generation	0	0.2	0.1	0	0.02	0	0.2	0.2	0	0
Livestock	4	4	5	2	4	3	1	1	3	1
Industrial	61	67	74	60	44	32	36	42	31	34
Total	119	144	186	290	309	333	257	286	370	401

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-13 Groundwater Use by User Group in Region II (1960 - 2005)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	0	0	0	0	42.71	54	171	69	86	131
General Irrigation	2	1	0.05	15	7	11	9	0.4	6	6
Rice Irrigation	472	533	697	600	718	473	319	329	561	404
Rural Domestic	21	20	19	9	12	18	19	14	15	16
Public Supply	41	47	55	88	116	117	124	122	133	134
Power Generation	0	5	5	0.4	10	12	9	9	13	3
Livestock	7	6	3	5	3	2	1	1	2	2
Industrial	144	136	201	202	169	87	103	103	94	77
Total	687	749	981	920	1,077	774	757	650	910	772

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Table C-14 Groundwater Use by User Group in Region III (MGD)

Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	0	0	0	0	34	44	128	37	38	0
General Irrigation	4	5	4	5	3	3	2	2	2	3
Rice Irrigation	0	1	1	1	6	5	1	1	2	3
Rural Domestic	7	11	37	29	32	14	17	15	17	19
Public Supply	32	48	57	70	96	105	106	116	145	146
Power Generation	0	22	30	31	37	23	31	22	16	13
Livestock	1	3	3	3	3	2	1	2	1	1
Industrial	177	185	221	208	204	167	153	157	160	156
Total	221	275	353	346	418	364	438	351	382	341

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Appendix D
Water Well Prior Notification

Water Well Notification Form

The water well notification data is submitted to Louisiana Office of Conservation, Environmental Division, Groundwater Resources (GWR) via a Water Well Notification In addition to the Well Use, the GWR-01 form requests:

- Owner Information –
  - Owner’s name (company name if owner);
  - Contact's name/number and current mailing address; and
  - Owner's phone/fax numbers and email address.

- Driller Information –
  - LaDOTD Water Well Contractor’s License Number;
  - Name phone/fax numbers and email address of the drilling company, and
  - Contact person's name.

- Well Location-
  - Parish Name
  - Well location coordinates (Latitude and Longitude)

- Well Construction Details-
  - Casing Diameter (Inches);
  - Screen Diameter (Inches);
  - Screen Top Depth (Feet);
  - Screen Bottom Depth (Feet);
  - Total Depth (Feet);
  - Aquifer Screened;
  - Owner’s Well Number (if any);
  - Owner’s Well Name (if any);

- Water Withdrawal -
  - Pumping rate (gallons per day) and;
  - The number of days per year that the well will be pumped.

- Estimated Completion Date (or Actual Completion Date for Post Filings)

- Certification Statement-
  - The owner or owner's authorized agent must certify the truthfulness and accuracy of the information completed on the form with their printed name, signature and date.

The form also has an area for the Office of Conversation to identify the well reviewer and date of review, and Area of Groundwater Concern (AGC) Orders that may apply to the proposed location of the well, and a GWR identification number which should be unique to the well.

A GWR ID Number is issued only after the notification form has been determined by technical staff to be both administratively and technically complete and the form data has been entered into the Louisiana DNR Strategic Online Natural Resources Information System (SONRIS). Louisiana DNR is working to integrate the GWR-ID Number as a subset to the Louisiana DOTD Well Number so the well will have one number from pre-permitting to plug and abandonment (P&A).

GWR Well Review

The Environmental Division conducts a Technical Staff Review, following the Ground Water Well Prior Notification Form Evaluation Checklist (see Attachment 3-2). The checklist is designed to evaluate the well location for the following criteria:

1. Location in areas where agency restrictions or other permitting requirements or restrictions may exist and apply, including:
    a. AGC and/or critical AGC as designated by the Office of Conservation;
    b. One of the Capital Area Groundwater Conservation Commission parishes;
    c. Within the geographical area of any local or parish drinking water protection ordinances listed and delineated by the DEQ Aquifer Evaluation Program; and
    d. Within a Source Water Assessment Program areas (SWAP)/ Wellhead Protection area, per the SWAP/ Wellhead Protection area database on SONRIS;

2. Regional or local ground water related issues or immediate effects reported in the area of the proposed well location, as identified by the USGS, DEQ, and DHH/OPH databases and other resources, including:
    a. Salt Water Encroachment;
    b. Water Level Decline;
    c. Land Subsidence;
    d. Groundwater Contamination (from Louisiana DOTD registered monitoring wells within ¼ mile of the proposed well or published Louisiana DEQ or DHH reports of groundwater contamination or public drinking water supply notices for the area);

3. Potential well interference issues with registered wells screened in the target aquifer zone, as identified from the Louisiana DNR-OC/Louisiana DOTD databases, within ¼ mile radius of proposed well location, including:
    a. Potential for adverse effects on nearby registered water wells, based on proposed production and well spacing;
    b. Potential for adverse effects on nearby potential water wells as identified by structures on area aerial maps;
    c. Hydraulic connectivity between different zones or geologic formations within the aquifer to be produced based on published geologic water resources bulletins or oil and gas electric logs;
    d. Hydraulic connectivity between different fresh water aquifers located in the area surrounding the proposed water well under evaluation, based on published geologic water resources bulletins or oil and gas electric logs;

If potential well interference issues are identified above, Louisiana DNR predicts/projects effect of proposed well use on existing wells located within ¼ mile by calculating potential drawdown on the nearest well (see drawdown calculations below).

Based on the overall findings of items 1, 2 and 3, GWR evaluates potential for adverse effects on nearby water wells and the sustainabili1y of the aquifer from which the proposed well is to produce. If the potential exists, GWR will request the well owner to provide a Ground Water Use Impact Study on potential effects on surrounding wells and aquifer sustainabili1y. If the study confirms adverse impacts to the area wells, or if no study was submitted or if the study is deemed unacceptable, GWR will issues recommendations to place restrictions, emit production, require well relocation, etc. in accordance with statutory and regulatory requirements.

GWR Drawdown Calculation Procedures

For GWR to calculate the drawdown within a well and the cone of depression within the aquifer caused by a specific pumping rate, the transmissivity and storitivity of the aquifer is required.

The transmissivity (T) for horizontal flow of in an aquifer with a saturated thickness of (b) and horizontal hydraulic conductivity (K) is:

$$T = Kb$$

Unless area specific conditions are known, transmissivity is calculated based on the aquifer data listed in Table 4-1 - Hydraulic Characteristics of the Aquifers in Louisiana.

Table 4-1 Hydraulic Characteristics of the Aquifers in Louisiana

Aquifer System	Range Of Thickness Of Freshwater Interval (Feet)	Range Of Well Depths (Feet)	Typical Well Yields (Gal/Min)	Hydraulic Conductivity (Feet/Day)	Specific Capacity (Gal/Min/Ft Of Drawdown)
ALLUVIAL	20 - 500	30 - 500	<500 - 4000	10 - 530	5 - 90
TERRACE of central and north Louisiana	20 - 150	40 - 150	40 - 400	150 - 270	1 - 50
CHICOT	50 - 1050	50 - 800	500 - 2500	40 - 220	2 - 35
SOUTHEAST LOUISIANA	50 - 600	<100 - 3300	100 - 2100	10 - 200	10 - 200
EVANGELINE	50 - 1900	200 - 2200	200 - 1000	20 - 180	2 - 38
MIOCENE of central Louisiana	50 - 1250	200 - 2200	50 - 1200	20 - 60	2 - 30
COCKFIELD	50 - 600	200 - 900	100 - 1800	25 - 100	1.5 - 75
SPARTA	50 - 700	200 - 900	100 - 1800	25 - 100	1.5 - 7.5
CARRIZO-WILCOX	50 - 850	100 - 600	30 - 300	2 - 40	0.5 - 4

From Recharge Potential of Louisiana Aquifers, prepared by the Louisiana Geological Society for the Louisiana Department of Environmental Quality, 1989.

Louisiana DNR uses the Theis equation to calculate potential drawdown of area wells.

$$s = \frac{Q}{4 \cdot \pi \cdot T} \int_u^{\infty} \frac{e^{-u} du}{u}$$

Where: s = drawdown

Q = pumping rate
T = transmissivity

$$u = \frac{r^2 S}{4Tt}$$

r = radius of well
(Distance to observation well)

t = time pumping
S = storativity

For the Theis method to work the following assumptions must be true for the aquifer, the observation well and the pumping well:

1. Aquifer is confined.
2. Aquifer is homogeneous and isotropic.
3. Aquifer is of constant thickness.
4. Pump Rate (Q) is constant.
5. Well penetrates entire fracture zone or aquifer.
6. Potentiometric surface is horizontal prior to pumping.
7. Well diameter is infinitely small relative to other aquifer dimensions.
8. Aquifer (fracture zone) is of infinite extent in all directions.
9. Water discharge is instantaneous with drop in head.
10. Water flow to well is laminar.

Most aquifers do not meet all these assumptions, but the equation still works if the aquifer is generally homogenous and the cone of depression does not intersect a recharge or barrier boundary.

Theis solved the integral in his radial model with a summation function W(u) such that:

$$\int_u^{\infty} \frac{e^{-u} du}{u} = W(u) = [\ -0.5772 - \ln u + u - \frac{u^2}{2x2!} + \frac{u^3}{3x3!} - \frac{u^4}{4x4!} \ldots\ ]$$

Cooper-Jacobs found that when *u* □□0.01, *W(u)* reduces to:

$$W(u) = -0.5772 - \ln u \quad \text{or,}$$
$$W(u) = -0.5772 - \ln \frac{r^2 S}{4Tt}$$

Drawdown is calculated as

$$s = \frac{Q}{4pT}\ W(u)$$

Since storativity primarily effects primarily the amplitude of the drawdown (The lower the storativity, the deeper the drawdown), the evaluation will select a storativity such that *W(u)* is =>10. In this way the rate and duration of discharge, transmissivity, and distance between wells are used provide a high potential rate of drawdown in adjacent wells.

By using these conservative values, the GWR review can quickly identify areas where a proposed well may impact adjacent wells or cause significant drawdown within an aquifer.

GWR typical calculates drawdown for the well nearest to the proposed well location. While this procedure should typically be sufficient, it is possible that if the nearest well is screen at a substantially deeper interval than other wells within the ¼ mile radius (or greater dependent on the calculated cone of depression), then it is possible that potential impacts could be missed. To alleviate this issue, if there are multiple wells within the potential area of impact, the drawdown should be calculated at varying distances within the ¼ mile radius or predicted significant cone of depression (whichever is greater) to develop a drawdown curve over distance from the proposed well that could be compared to the existing well depths at increasing distances from the proposed well location.

Current Registration Forms

Louisiana utilizes three separate water well registration forms: the Water Well Registration Long Form (GW-1) used to register Community public supply wells, Non-community public supply wells, Industrial wells, Irrigation/agricultural wells, Power generation wells, Observation wells, Dewatering wells, and Test holes; the Water Well Registration Long Form (GW-1S) used to register Domestic wells, Rig-supply wells, Monitoring wells, Heat pump supply wells, Heat pump holes (closed loop system), and Abandoned pilot holes; and the Water Well Plugging and Abandonment Form (GW-2) used to document the plugging and abandonment procedures utilized when abandoning any of the above listed wells.

Common Requested Data

Both the Long and Short Water Well Registration forms request the following information:

- Owner Information –
  - Owner’s name, current mailing address, and phone number
  - Owner's well identification (if any).

- Well Location-
  - Parish Name

- Town or city near well
- Distance from landmark (crossroads, railroad, etc.)
- Sketch of well location
- Well location coordinates (Latitude and Longitude) are not requested or either form.

■ Well Information / Construction Details-
- Depth of Hole (Feet)
- Depth of Well (Feet)
- Casing Type
- Casing Diameter (Inches) and Length (feet);
- Screen Type
- Screen Diameter (Inches) and Length (feet);
- Total Depth (Feet);
- Cemented distance (feet) to ground surface.
- Driller's Log of well (Description and color of cuttings, such as, shale, sand, etc. in feet below ground level).
- Name of person who drilled the well

■ Water Level and Yield Information
- Static water level relative to ground surface (and date measured)

■ Use of Well
- Both Long and Short forms have use of well, but are specific to each form.

■ Abandonment Information
- Does this well replace an existing well;
- The long form also asks if the owner has been informed of state regulations requiring plugging of abandoned wells

■ Remarks
- Both Long and Short forms have a space for this data, but the long form suggests information such as engineer, pump information, acreage irrigated, water well subcontractor and license no., etc.

■ Water Well Contractor (WWC) Information –
- Name of the WWC
- LDOTD WWC License Number;
- Authorized Signature and Date

Both the Long and Short Well Registration forms have Office Use Only areas that allow for the Parish Federal Information Processing Standard (FIPS) code, assigned Well Number, record identification number, revised coordinates (Latitude and Longitude), Section, Township, and Range, Elevation, Quadrangle Number (by Louisiana identifier), geologic unit, and use of well codes. This data would be entered following an inspection of the well by the State.

Additional information may be submitted with the well registration, including:

- an electronic or geophysical log of the well;
- the driller's log of the well;
- mechanical analysis of the drill cuttings;
- water quality analysis;
- bacteriological analysis;
- pumping test data;
- static water level;
- aquifer test (method and results); and
- other pertinent data.

Data Specific to the Long Water Well Registration Form

The Long Water Well Registration Form requests the following additional information:

- Well Information / Construction Details-
  - Ground elevation (feet above mean sea level);
  - Is well gravel-packed
  - Name of Person who drilled the well;
  - Pumpdown cementing method (only) was used Inside casing and/or Outside casing;

- Water Level and Yield Information
  - How was the static water level determined and was it above or below ground surface;
  - The pumping water level relative to ground surface;
  - Pump Test Results -Well yield (gpm), drawdown (feet), duration of continuous pumping (hours), date of test, description of how yield was measured;
  - Planned Pump Rate of Well (gpm, hours per day, days per year, proposed average rate in gallons per day)
  - Motor HP
  - Pump intake setting (feet)

- Use of Well
  - Irrigation, Agricultural, Industrial, Power Generation, Community Public Supply, Non-community Public Supply, Dewatering, Observation, Test Hole, or other specified use.
  - Industrial wells require one of the following subuse be selected-
    - Food and Kindred Products
    - Textile Mill Products
    - Lumber & Wood Products (Except Furniture),
    - Paper and Allied Products
    - Chemicals and Allied Products
    - Petroleum Refining & Related Industries
    - Primary Metal Products
    - Other (Specified Use)
  - Public Supply wells require one of the following subuse be selected -
    - Municipal
    - Therapeutic

- Rural
- Institutional/Government
- Commercial
- Other (Specified Use)

Data Specific to the Short Water Well Registration Form

The Short Water Well Registration Form request the following additional information:

- Well Information / Construction Details-
  - Pumpdown or Gravity Method used for cementing.
  - Screen slot size

- Use of Well
  - Domestic, Rig Supply, Monitoring, Piezometer, Recovery, Heat Pump Hole, Heat Pump Supply, Abandoned Pilot Hole, or Other (Specified Use)

Data Specific to the Well Plugging and Abandonment Form

The Well Plugging and Abandonment Form (LDOTD-GW-2) requests the same well owner, driller and location information and both the Long and Short Well Registration forms. In addition, it requests:

- Well Information -
  - Casing Type;
  - Casing Diameter (Inches);
  - Depth of well;
  - Original driller of well and date drilled;

- Details of how the hole was plugged
  - Materials used, amount of casing and/or screen removed, or left in hole, etc.
  - Additional Remarks

Appendix E
Louisiana Reservoir Priority and Development Program

Louisiana Reservoir Priority and Development Program Issues, Concerns and Recommendations

The 2010 Louisiana Reservoir Priority and Development Program (LRPD Program) (MWH, 2009) found several issues that can affect water resources conditions throughout Louisiana including the following:

- **Groundwater over pumping.** As noted in previous sections of this report, the State of Louisiana has designated' "Areas of Groundwater Concern" in the Sparta aquifer in northern Louisiana. In addition, groundwater over-pumping in other regions has created drawdown and induced water quality and water supply issues with current users. Continued reliance on groundwater resources in areas already subject to over-pumping will likely make these conditions more severe, and additional development of groundwater resources would accelerate these concerns.

- **Population and water use forecast uncertainty.** Water resource planners generally use estimates of future population trends to develop associated future water demand estimates. A review of historical population projections in Louisiana demonstrates that such population estimates are highly error prone and may not be as relevant to water supply planning as once thought. Reliance on state-wide population projections as a basis to identify future water needs and potential water resources issues may not provide the necessary insight to anticipate future needs.

- **Limited information on sustainable yield.** Although information is available on the types of water uses and total water supply for each use, information to characterize the sustainable yield of surface water and groundwater aquifers is less readily available. In particular, detailed information needed to develop estimates of sustainable groundwater and surface water yield is not widely available for over drafted aquifers and rivers that could be potential replacement sources of water supply. Future planning and project development will require more accurate estimates of these and other important parameters to help more accurately evaluate the consequences of future decisions.

- **Agricultural demand water.** Throughout the state of Louisiana, agricultural use for irrigation, livestock, and aquaculture comprise the greatest-consumptive use of groundwater and surface water. These uses have contributed to groundwater overdraft, reduced surface water flow, and impaired surface waters.

- **Industry and energy demands for water.** Some of the greatest demands for water in Louisiana are related to oil and gas extraction and refining, petrochemical processing, and energy generation. Although not all water for industrial and energy purposes is consumptively used, the diversion and extraction of large volumes of groundwater and surface water affect regional conditions. Demands for these industrial developments are driven by economic conditions that are external to the state of Louisiana and can be difficult to anticipate. Consequently, some regions of the state can be subject to abrupt changes in water demand in response to large-scale resource development.

- **Declining water quality in certain surface and groundwater resources.** Extraction of surface water and groundwater resources, Combined with waste product discharges from industrial and agricultural users, has resulted in degraded water quality at locations throughout the state. Impaired surface waters have been identified in all areas of the state, and groundwater quality is impacted by over-pumping in several locations. Alternatives to replace groundwater in areas of over-pumping may also need to address impaired surface water and groundwater quality.

- **Climate change uncertainty.** Throughout the world, water resource planners are concerned about the effects of climate change on the availability and occurrence of water resources. In Louisiana, climate change forecasts suggest that extreme events will become more extreme. Hurricane intensity is expected to increase and drought conditions, such as those experienced in 1999 to 2002, are expected to become more frequent and prolonged. As a result, water resource planning for future needs will need to consider greater variability than has occurred in the past.

- **Increasing complexity of complying with environmental regulations.** In the late 1960s and early 1970s, Federal legislation and regulations were promulgated to address the impact of water use on the environment and public health. As these regulations, and companion requirements of the State of Louisiana, are implemented, the requirements on water resource development and use become more restrictive. Water resources project developers and operators are sometimes ill-prepared to address the scope and complexity of multiple environmental requirements, often leading to extensive time and cost to prepare project plans.

- **Increasing competition for water resources.** As described elsewhere in this report, water resource development and use throughout Louisiana is diverse, including uses for municipal, rural domestic, agricultural, environmental, recreation, energy, and industrial needs. As resource limitations have become evident through reduced available supply or impaired water quality, the competition for water supplies has grown. Competition for water resources is more pronounced in areas where water resources development and use is not coordinated.

The LRPD Program Report summarizes the condition of water resources throughout the state and found a set of common issues (MWH, 2009). The Report presented a framework for water resources management focused on increased coordination and development of information on sustainable water use, and suggested the following actions:

- The Governor should direct water-related state agencies to collectively develop a coordinated plan for water resources management. The plan would identify the highest priorities at a state-wide and regional level, and highlight how each agency would be involved in advancing those objectives. These priorities should be reflected in agency budgets.

- The State of Louisiana should provide guidelines and funding to encourage local and regional cooperation in water resources planning and management. The State also should have the authority/responsibility to identify important issues in various regions and initiate the process to address them.

- The State of Louisiana should require municipalities, industries, and agricultural operations using more than a specified threshold amount of water to prepare water supply plans projecting their water needs 20 years into the future and identifying proposed water sources.

- The State of Louisiana should provide guidance to regional planning groups on the application of scenario-based planning to address areas of uncertainty, including emerging environmental requirements, population forecasts, and expected adoption of conservation measures.

- The State of Louisiana should provide funding for water projects to reduce unsustainable groundwater use. The Reservoir Priority Development Program is one method to achieving this goal. Other options may include tax incentives to private entities to encourage investments in alternative water supplies.

- In coordination with regional planning groups, the State of Louisiana should review ongoing groundwater and surface water monitoring programs and identify necessary modifications to assure that necessary data for long-term management and model development is collected. Emphasis should be placed on the importance of groundwater monitoring in aquifer management.

- In coordination with regional planning groups and Federal agencies, the State of Louisiana should develop models to estimate the sustainable yield of groundwater and surface water resources. State and Federal leadership is needed to provide consistent approaches in model development and assure that they receive adequate peer review.

- Through regional planning groups, water resource needs assessments should be completed on a regular basis. A consistent approach should be applied to allow information to be aggregated at a statewide level on a periodic basis. State-wide priorities also should be adjusted as necessary as information from regional planning processes reveal changes.

Reference

MWH, 2009. Louisiana State Reservoir Priority and Development Program, Freshwater Basins Characterization Report, Submitted to LaDOTD.

002783.LD14.01

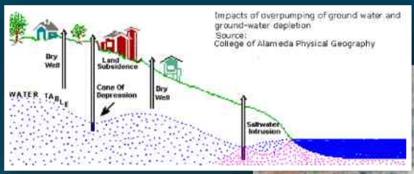
Appendices

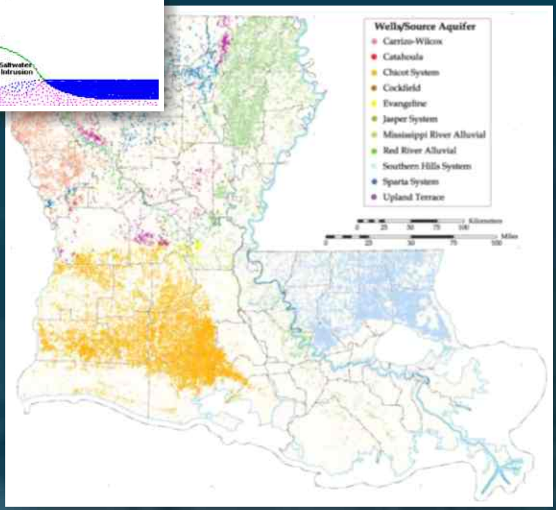
APPENDIX F ONLY

Recommendations for a Statewide Ground Water Management Plan

December 7, 2011

DNR Contract No. 2215-10-04





Prepared for

Office of Conservation
Louisiana Department of Natural Resources

Prepared by

ecology and environment, inc.
Global Environmental Specialists

Appendix F
Financial Viability Analysis, Cost Comparison, and estimating Free Cash Flows

General Assumptions Used in Estimating Free Cash Flows

Start Year	**2011**	**Comment**
Discount Rate:	5%	Per Jason El Koubi, Director of State Economic Competitiveness via an e-mail to Jeff Foshee, dated July 25, 2011
Depreciation Rate	3.33%	Straight line over 30 years
Debt Financing	50%	Of total capital costs
Interest Rate on Debt	3.90%	Per year
Debt Term	20	Years
Receivables, Days Outstanding	30	Days of revenue
Payables, Days Outstanding	15	Days of annual operations and maintenance costs
Salvage Value	5%	Of total capital costs
Years Covered by Modeling	26	
Combined Federal and State Corporate Income Tax Rate	38.5%	

These general assumptions are discussed in turn below.

Start Year: The present year was chosen as the start year for analysis to reflect an expeditious start on the construction of the alternatives.
Discount Rate: A rate of 5% was used to discount the cash flows to calculate their net present

$$\mathrm{PV(C)} = \sum_{t=0}^{n} \frac{\mathrm{C_t}}{(1+\mathrm{r})^{\mathrm{t}}}$$

worth on the basis that it is the rate used by Louisiana Economic Development in evaluating the financial viability of projects[i]. Discounting of cash flows is necessary because the costs and revenues associated with the alternatives occur over time, making it necessary to take the time value of money into account. The following formula is used in discounting cash flows:
Where:

PV(C)	=	Present value of cash flows cash flows (= the sum of discounted cash flows)
C_t	=	Undiscounted annual cash flows
r	=	Discount rate
t	=	The year, starting with the first year (t = 0)

The discounting process accounts for the fact that a future cash sum is worth “less” than the same cash sum today. The reason is that cash available today can be invested and earn a return. For instance, to have, say, $1 million dollars available next year, it is only necessary to put aside today $1 million divided by one plus the interest rate. Assuming an interest rate of 5% per annum, only $952,381 needs to be set aside today to have $1 million next year, since by next year $47,169 in interest will have been added to the $952,381 yielding $1 million. Or, to put it another way, the present value of $1 million to be received in a year’s time is $952,381, since that is the amount that one would need in hand today to have $1 million in a year’s time at an interest rate of 5%.

The discount rate represents the return on the available funds if they were invested in the next best available option (Seitz 1990). It therefore represents the opportunity cost (in the sense of the opportunity forgone) of investing the funds in an alternative. The financial viability of an alternative is judged by the relationship of its anticipated rate of return relative to the discount rate. For instance, if a project's anticipated rate of return is less than the discount rate, the alternative is not financially viable since it would make no financial sense to invest in it. A financially viable alternative is one for which the anticipated rate of return is at least as large as the discount rate.

Depreciation Rate: Since the assets created under the alternatives will have long lives, a 30 year depreciation period and straight-line depreciation were assumed resulting in an annual depreciation rate of 3.33% to be applied to capital assets.

Debt Financing: It was assumed that 50% of the financing would come from the issuance of long-term bonds. This percentage of debt is in line with the percentage of debt in the financing structure of water utilities in the United States (Damodaran 2009).

Interest Rate on Debt: The assumed interest rate on debt was based on the 3.87% rate applied by Barclay's Capital when it bought $300 million of Louisiana state-backed general obligation bonds from the State Bond Commission in March 2011. (Nola.com 2011).

Debt Term: A 20-year debt term was assumed to reflect the long-lived nature of the assets purchased with the debt[ii].

Receivables and Payables: These assumptions relate to the time required for customers to pay their bills (receivables) and the time required for the alternatives to pay their suppliers (payables). When an alternative's customers pay sometime after they receive the water but the alternative pays its bills on a more prompt basis, there is a mismatch that consumes cash. This mismatch is the alternative's net working capital requirement. When net working capital increases, more cash is consumed; and when it decreases, cash is liberated. Changes in net working capital must, therefore, be taken into account in calculating cash flows.

Salvage Value: It is assumed that at the end of 30 years, the assets can be sold on at 5% of their original value[iii].

Years Covered by Modeling: Since some of the alternatives will take some time to construct and put into operation, it was decided to analyze cash flows over a relatively lengthy, 26 year, period.

Combined Federal and State Corporate Income Tax Rate: This rate was taken from the website of the Tax Foundation (Tax Foundation 2011).

The alternative-specific assumptions relate to the time required to construct the alternative and the time required thereafter for the alternative to achieve full production. These alternative-specific assumptions are shown in Table 7-12

[i] In E & E's proposal, it was said that the real weighted average cost of capital would be used. However, the use of the discount rate provides a sterner test of financial viability because it is higher. The weighted average cost of capital is calculated by weighting the cost of each funding source by its contribution to the funds invested in the alternative and summing the result. Aswath Damodaran, Professor of Finance at the Stern School of Business at New York University has provided a spreadsheet from which it can be calculated that the nominal weighted average cost of capital for water utility companies operating in the United States is presently 5.95% (Damodaran 2009). Adjusting for consumer price inflation, which was 2.8%, calculated using the average consumer price indices for the first half of 2010 and 2011 (Bureau of Labor Statistics 2011), this yields a real weighted average cost of capital of 3.1%.

[ii] The assumptions relating to debt affect the pro-forma income statements for the alternatives but not the analysis of free cash flows because those flows are not affected by financing decisions.

[iii] Although it is customary to consider salvage value and to assume a salvage value in the area of 5% in analyzing free cash flows, the relatively small size of this value and the fact that it occurs 30 years into the future, means that the inclusion or exclusion of salvage value makes little difference to the analysis of alternative's free cash flows.

Appendix F
Estimating Free Cash Flows

ASSUMPTIONS

Current Supply Gap

Aquifer	**2010 Level Use Mgal/Day**	**Sustainable Use as of 2010 Mgal/Day**	**Current Gap Mgal/day**	**Current Gap Mgal/Yr**
Chicot Aquifer System	757.90	416.89	341.01	124,468.65
Jasper Aquifer System	184.93	101.71	83.22	30,375.30
Cockfield Aquifer	6.92	3.81	3.11	1,135.15
Sparta Aquifer	64.99	35.44	29.55	10,785.75
Carrizo-Wilcox	19.46	10.70	8.76	3,197.40

Alternatives

Chicot Aquifer System	Waste Water Recycling
	Reservoirs for Rainharvesting
Jasper Aquifer System	Waste Water Recycling
	Reservoirs for Rainharvesting
	Pipeline Conveyance of Red River Water
Cockfield Aquifer	Waste Water Recycling
	Reservoirs for Rainharvesting
Sparta Aquifer	Waste Water Recycling
	Reservoirs for Rainharvesting
	Pipeline Conveyance of Ouachita River Water
Carrizo-Wilcox	Red River/Use Red River Alluvial Aquifer
	Reservoirs for Rainharvesting

GENERAL ASSUMPTIONS AND PARAMETERS

Aquifer	2010 Level Use MGal/Day	Sustainable Use as of 2010 MGal/Day	Current Gap MGal/day	Current Gap Mgal/yr	Cost Alternatives							
					Pipeline Transport from River to terminal point (e.g. reservoir) [5]		*Reservoir Construction* [1,2,3]		*Waste Water Recycling* [4]		*Pumping and conveyance from Unutilized Aquifer* [6]	
					Capital	***O&M***	***Capital***	***O&M***	***Capital***	***O&M***	***Capital***	***O&M***
Chicot Aquifer System	757.9	416.9	341.0	124,468.7	705,488,308.2	$35,274,415	$731,253,319	$877,504	$700,575,786	$95,978,883	$712,308,508	$49,861,596
Jasper Aquifer System	184.9	101.7	83.2	30,375.3	224,200,089.3	$11,210,004	$448,035,675	$1,254,500	$170,968,350	$23,422,664	$225,864,489	$15,810,514
Cockfiled Aquifer	6.9	3.8	3.1	1,135.2	8,378,542.2	$418,927	$16,743,463	$46,882	$6,389,228	$875,324	$8,440,742	$590,852
Sparta Aquifer	65.0	35.4	29.6	10,785.8	79,609,620.8	$3,980,481	$159,089,813	$445,451	$60,707,940	$8,316,988	$80,200,621	$5,614,043
Carrizo-Wilcox	19.5	10.7	8.8	3,197.4	23,600,009.4	$1,180,000	$47,161,650	$132,053	$17,996,668	$2,465,544	$23,775,209	$1,664,265

Notes:

1. For Large Reservoirs (> 100,000 MGY) Capital Costs per MGY = $3,735 per MGY ($5,875 per MGY present cost); Annual O&M Costs = 0.12% of Capital Costs
2. For Medium Reservoirs (<100,000 MGY) Capital Costs per MGY = $9,376 per MGY ($14,750 per MGY present cost); Annual O&M Costs = 0.28% of Capital Costs
3. Estimated cost for reservoirs, from 1999 Comprehensive Sabine Watershed Management Plan from Freese and Nichols (Adjusted to present cost using RS Means Historical Cost Index)
4. Estimated cost for Waste Water Recycling, from 2009 Business Case for Funding of the West Monroe/Graphic Packaging's Wastewater Recycle Project
   10 MGD-3,650 MGY (Capital Cost- $20M and O&M Cost -$0.75/1000 gallons ($2,737,500 annual or 13.7% of Capital Cost)
   10 MGD (Capital Cost- $20,544,142 and O&M Cost - 13.7% of Capital Cost (Adjusted to present cost using RS Means Historical Cost Index)
5. Estimated cost for Pipelines, from 1999 Comprehensive Sabine Watershed Management Plan from Freese and Nichols (Adjusted to present cost using RS Means Historical Cost Index)
   Capital Costs are based on pipeline conveyance from 60 to 90 mile ranges. O&M 5% of Capital Cost.

Unit Costs

	Cost Alternatives							
	Pipeline Transport from River to		*Reservoir Construction* [1,2,3]		*Waste Water Recycling* [4]		*Pumping and conveyance from*	
	Capital	***O&M***	***Capital***	***O&M***	***Capital***	***O&M***	***Capital***	***O&M***
Chicot Aquifer System	$5,668	5.00%	$5,875	0.12%	$5,629	13.70%	$5,723	7.00%
Jasper Aquifer System	$7,381	5.00%	$14,750	0.28%	$5,629	13.70%	$7,436	7.00%
Cockfield Aquifer	$7,381	5.00%	$14,750	0.28%	$5,629	13.70%	$7,436	7.00%
Sparta Aquifer	$7,381	5.00%	$14,750	0.28%	$5,629	13.70%	$7,436	7.00%
Carrizo-Wilcox	$7,381	5.00%	$14,750	0.28%	$5,629	13.70%	$7,436	7.00%

Appendix 6 Financial Viability Analysis and Cost Comparison of Alternatives

ASSUMPTIONS:

Start Year	2011		
Discount Rate:	5%	Per Jason El Koubi, Director of State Economic Competitiveness via an E-mail to Jeff Foshee, dated July 25, 2011	
Depreciation Rate (Straight Line Over 30 Years)	3.33%		
Debt Financing	50%	of Total Capital Costs	<=Based on Damodaran's Weighted Average Cost of Capital Spreadsheet (E/(D+E))=.53
Interest Rate on Debt	3.90%	per year	
Debt Term	20	Years	
Receivables Days Outstanding	30	Days of Revenue	
Payables Days Outstanding	15	Days of Operating Expenses	
Salvage Value	5%	of Total Capital Costs	
Years Covered by Modeling	30		

GENERAL PARAMETERS:

Combined Federal and State Corporate Income Tax Rate:	38.5%
State Income Tax Rate:	7.7%

PROJECT PARAMETERS

Lookup Table:

Aquifer	Alternative	Lookup String	Supply Gap (Millions of Gallons per Year)	Water Supplied by Alternative (Millions of Gallons per Year)	Capital Cost (Per Million Gallons)	O&M Cost as % of Capital Costs	Total Capital Cost	Total O&M Cost	Years to Construct	Years Required to Reach 100% Capacity
Chicot Aquifer System	Waste Water Recycling	Chicot Aquifer SystemWaste Water Recycling	124,468.65	124,468.65	$5,629	13.70%	$700,575,786	$95,978,883	5	2
Chicot Aquifer System	Reservoirs for Rainharvesting	Chicot Aquifer SystemReservoirs for Rainharvesting	124,468.65	124,468.65	$5,875	0.12%	$731,253,319	$877,504	5	2
Jasper Aquifer System	Waste Water Recycling	Jasper Aquifer SystemWaste Water Recycling	30,375.30	30,375.30	$5,629	13.70%	$170,968,350	$23,422,664	5	2
Jasper Aquifer System	Reservoirs for Rainharvesting	Jasper Aquifer SystemReservoirs for Rainharvesting	30,375.30	30,375.30	$14,750	0.28%	$448,035,675	$1,254,500	5	2
Jasper Aquifer System	Pipeline Conveyance of Red River Water	Jasper Aquifer SystemPipeline Conveyance of Red River Water	30,375.30	30,375.30	$7,381	5.00%	$224,200,089	$11,210,004	5	2
Cockfield Aquifer	Waste Water Recycling	Cockfield AquiferWaste Water Recycling	1,135.15	1,135.15	$5,629	13.70%	$6,389,228	$875,324	5	2
Cockfield Aquifer	Reservoirs for Rainharvesting	Cockfield AquiferReservoirs for Rainharvesting	1,135.15	1,135.15	$14,750	0.28%	$16,743,463	$46,882	5	2
Sparta Aquifer	Waste Water Recycling	Sparta AquiferWaste Water Recycling	10,785.75	10,785.75	$5,629	13.70%	$60,707,940	$8,316,988	5	2
Sparta Aquifer	Reservoirs for Rainharvesting	Sparta AquiferReservoirs for Rainharvesting	10,785.75	10,785.75	$14,750	0.28%	$159,089,813	$445,451	5	2
Sparta Aquifer	Pipeline Conveyance of Ouachita River Water	Sparta AquiferPipeline Conveyance of Ouachita River Water	10,785.75	10,785.75	$7,381	5.00%	$79,609,621	$3,980,481	5	2
Carrizo-Wilcox	Red River/Use Red River Alluvial Aquifer	Carrizo-WilcoxRed River/Use Red River Alluvial Aquifer	3,197.40	3,197.40	$7,436	7.00%	$23,775,209	$1,664,265	5	2
Carrizo-Wilcox	Reservoirs for Rainharvesting	Carrizo-WilcoxReservoirs for Rainharvesting	3,197.40	3,197.40	$14,750	0.28%	$47,161,650	$132,053	5	2

Amortization Schedule

Principal:	$1	
Interest Rate:	3.90%	
Term	20	Years

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Beginning Balance	$1.0000	$0.9661	$0.9308	$0.8942	$0.8561	$0.8166	$0.7755	$0.7328	$0.6885	$0.6424	$0.5945	$0.5448	$0.4931	$0.4394	$0.3836	$0.3256	$0.2654	$0.2028	$0.1378	$0.0702
Debt Interest Payment	$0.0390	$0.0377	$0.0363	$0.0349	$0.0334	$0.0318	$0.0302	$0.0286	$0.0268	$0.0251	$0.0232	$0.0212	$0.0192	$0.0171	$0.0150	$0.0127	$0.0103	$0.0079	$0.0054	$0.0027
Debt Principal Payment	$0.0339	$0.0353	$0.0366	$0.0381	$0.0395	$0.0411	$0.0427	$0.0444	$0.0461	$0.0479	$0.0497	$0.0517	$0.0537	$0.0558	$0.0580	$0.0602	$0.0626	$0.0650	$0.0676	$0.0702
Total Debt Payment	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729	$0.0729
Ending Balance	$0.9661	$0.9308	$0.8942	$0.8561	$0.8166	$0.7755	$0.7328	$0.6885	$0.6424	$0.5945	$0.5448	$0.4931	$0.4394	$0.3836	$0.3256	$0.2654	$0.2028	$0.1378	$0.0702	$0.0000

TABLE 6-7

BASE CASE - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Chicot Aquifer System
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$700.58	
Total O&M Costs:	$95.98	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$61.76	$123.51	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($31.99)	($63.99)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$29.76*	*$59.53*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($13.66)	($13.20)	($12.72)	($12.22)	($11.70)	($11.16)	($10.59)	($10.01)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.25)*	*$22.98*	*$53.22*	*$53.72*	*$54.24*	*$54.78*	*$55.34*	*$55.92*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$2.79	($8.85)	($20.49)	($20.68)	($20.88)	($21.09)	($21.31)	($21.53)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.46)*	*$14.13*	*$32.73*	*$33.04*	*$33.36*	*$33.69*	*$34.04*	*$34.39*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$8.40	$8.12	$7.82	$7.51	$7.19	$6.86	$6.52	$6.16
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($5.08)	($10.15)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$1.31	$2.63	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.76)	($7.52)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.76)	($3.76)	($3.76)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$23.53	$41.84	$60.14	$63.90	$63.90	$63.90	$63.90	$63.90
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
	($592.85)												
IV. Net Cash Flows	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	$23.53	$41.84	$60.14	$63.90	$63.90	$63.90	$63.90	$63.90
Cumulative Cash Flows	($140.12)	($280.23)	($420.35)	($560.46)	($700.58)	($677.04)	($635.20)	($575.06)	($511.16)	($447.26)	($383.35)	($319.45)	($255.55)
V. Cost Stream	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	($38.22)	($81.67)	($125.13)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*
Depreciation	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	($9.41)	($8.78)	($8.12)	($7.44)	($6.74)	($6.00)	($5.24)	($4.45)	($3.63)	($2.77)	($1.88)	($0.96)	$0.00
Taxable Income	*$56.53*	*$57.16*	*$57.81*	*$58.49*	*$59.20*	*$59.93*	*$60.70*	*$61.49*	*$62.31*	*$63.17*	*$64.05*	*$64.98*	*$65.94*
Income Tax	($21.76)	($22.01)	($22.26)	($22.52)	($22.79)	($23.07)	($23.37)	($23.67)	($23.99)	($24.32)	($24.66)	($25.02)	($25.39)
Net Operating Income	*$34.77*	*$35.15*	*$35.56*	*$35.97*	*$36.41*	*$36.86*	*$37.33*	*$37.82*	*$38.32*	*$38.85*	*$39.39*	*$39.96*	*$40.55*
B. Add Back Items													
Depreciation	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$5.78	$5.40	$4.99	$4.58	$4.14	$3.69	$3.22	$2.74	$2.23	$1.70	$1.16	$0.59	$0.00
C. Change in Net Working Capital													
Receivables	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90
III. Terminal Year Cash Flows													
Salvage Value													$35.03
Recovery of Net Working Capital													$11.28
Total Termination Cash Flows													$46.31
IV. Net Cash Flows	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$110.21
Cumulative Cash Flows	($191.64)	($127.74)	($63.84)	$0.07	$63.97	$127.87	$191.77	$255.68	$319.58	$383.48	$447.39	$511.29	$621.51
V. Cost Stream	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($75.05)

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$1,811
Net Present Value of Cost Flows (at 5%)	($1,811)
Net Present Value of Output Stream (at 5%)	1,216,918
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.49
Levelized Revenue	$1.49
Levelized Profit	$0.00

NPV Profile

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
NPV Net Cash Flows	-$140.12	-$133.44	-$127.09	-$121.04	-$115.27	$18.44	$31.22	$42.74	$43.25	$41.19	$39.23	$37.36	$35.58

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
NPV Net Cash Flows	$33.89	$32.28	$30.74	$29.27	$27.88	$26.55	$25.29	$24.08	$22.94	$21.85	$20.81	$19.81	$32.55

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: **Chicot Aquifer System**
Alternative: **Waste Water Recycling**

Parameters:

Water Supplied:	112,022	Million Gallons per Year **<= Reduced by 10% compared to base case**
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$700.58	
Total O&M Costs:	$95.98	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	37,341	74,681	112,022	112,022	112,022	112,022	112,022	112,022
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$55.58	$111.16	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($31.99)	($63.99)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$23.59*	*$47.17*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($13.66)	($13.20)	($12.72)	($12.22)	($11.70)	($11.16)	($10.59)	($10.01)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($13.43)*	*$10.62*	*$34.69*	*$35.19*	*$35.71*	*$36.25*	*$36.81*	*$37.40*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$5.17	($4.09)	($13.36)	($13.55)	($13.75)	($13.96)	($14.17)	($14.40)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($8.26)*	*$6.53*	*$21.34*	*$21.64*	*$21.96*	*$22.30*	*$22.64*	*$23.00*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$8.40	$8.12	$7.82	$7.51	$7.19	$6.86	$6.52	$6.16
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($4.57)	($9.14)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$1.31	$2.63	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.25)	($6.51)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.25)	($3.25)	($3.25)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$20.24	$34.75	$49.26	$52.51	$52.51	$52.51	$52.51	$52.51
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	$20.24	$34.75	$49.26	$52.51	$52.51	$52.51	$52.51	$52.51
Cumulative Cash Flows	($140.12)	($280.23)	($420.35)	($560.46)	($700.58)	($680.33)	($645.58)	($596.33)	($543.82)	($491.31)	($438.80)	($386.29)	($333.78)
V. Cost Stream	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	($35.34)	($76.41)	($117.48)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)
VI. Financial Results													
Payback Period	20												
Internal Rate of Return	3.4%												
Net Present Value of Net Cash Flows (at 5%)	($111)												
Net Present Value of Revenue Flows (at 5%)	$1,630												
Net Present Value of Cost Flows (at 5%)	($1,741)												
Net Present Value of Output Stream (at 5%)	1,095,226												
VII. Levelized Calculations (Per Thousand Gallons)													
Levelized Cost	$1.59												
Levelized Revenue	$1.49												
Levelized Profit	($0.10)												
NPV Net Cash Flows	-$140.12	-$133.44	-$127.09	-$121.04	-$115.27	$15.86	$25.93	$35.01	$35.54	$33.85	$32.24	$30.70	$29.24

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74	$166.74
Operating Expenses	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*	*$70.76*
Depreciation	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	($9.41)	($8.78)	($8.12)	($7.44)	($6.74)	($6.00)	($5.24)	($4.45)	($3.63)	($2.77)	($1.88)	($0.96)	$0.00
Taxable Income	*$38.00*	*$38.63*	*$39.29*	*$39.97*	*$40.67*	*$41.41*	*$42.17*	*$42.96*	*$43.78*	*$44.64*	*$45.53*	*$46.45*	*$47.41*
Income Tax	($14.63)	($14.87)	($15.13)	($15.39)	($15.66)	($15.94)	($16.24)	($16.54)	($16.86)	($17.19)	($17.53)	($17.88)	($18.25)
Net Operating Income	*$23.37*	*$23.76*	*$24.16*	*$24.58*	*$25.01*	*$25.47*	*$25.93*	*$26.42*	*$26.93*	*$27.45*	*$28.00*	*$28.57*	*$29.16*
B. Add Back Items													
Depreciation	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$5.78	$5.40	$4.99	$4.58	$4.14	$3.69	$3.22	$2.74	$2.23	$1.70	$1.16	$0.59	$0.00
C. Change in Net Working Capital													
Receivables	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)	($13.70)
Payables	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)	($9.76)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51
III. Terminal Year Cash Flows													
Salvage Value													$35.03
Recovery of Net Working Capital													$9.76
Total Termination Cash Flows													$44.79
IV. Net Cash Flows	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$52.51	$97.30
Cumulative Cash Flows	($281.27)	($228.76)	($176.25)	($123.74)	($71.24)	($18.73)	$33.78	$86.29	$138.80	$191.31	$243.82	$296.33	$393.63
V. Cost Stream	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($114.23)	($69.44)
NPV Net Cash Flows	$27.85	$26.52	$25.26	$24.06	$22.91	$21.82	$20.78	$19.79	$18.85	$17.95	$17.10	$16.28	$28.73

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	**Chicot Aquifer System**	
Alternative:	**Waste Water Recycling**	

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$770.63	**<= Increased by 10% compared to base case**
Total O&M Costs:	$95.98	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($154.13)	($154.13)	($154.13)	($154.13)	($154.13)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$61.76	$123.51	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($31.99)	($63.99)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$29.76*	*$59.53*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($15.03)	($14.52)	($13.99)	($13.44)	($12.87)	($12.27)	($11.65)	($11.01)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($10.95)*	*$19.32*	*$49.61*	*$50.16*	*$50.74*	*$51.33*	*$51.95*	*$52.59*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$4.22	($7.44)	($19.10)	($19.31)	($19.53)	($19.76)	($20.00)	($20.25)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($6.74)*	*$11.88*	*$30.51*	*$30.85*	*$31.20*	*$31.57*	*$31.95*	*$32.34*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$9.24	$8.93	$8.60	$8.26	$7.91	$7.55	$7.17	$6.77
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($5.08)	($10.15)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$1.31	$2.63	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.76)	($7.52)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.76)	($3.76)	($3.76)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$24.43	$42.74	$61.04	$64.80	$64.80	$64.80	$64.80	$64.80
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($154.13)	($154.13)	($154.13)	($154.13)	($154.13)	$24.43	$42.74	$61.04	$64.80	$64.80	$64.80	$64.80	$64.80
Cumulative Cash Flows	($154.13)	($308.25)	($462.38)	($616.51)	($770.63)	($746.20)	($703.46)	($642.42)	($577.62)	($512.82)	($448.02)	($383.21)	($318.41)
V. Cost Stream	($154.13)	($154.13)	($154.13)	($154.13)	($154.13)	($37.32)	($80.77)	($124.23)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)
NPV Net Cash Flows	-$154.13	-$146.79	-$139.80	-$133.14	-$126.80	$19.14	$31.89	$43.38	$43.86	$41.77	$39.78	$37.89	$36.08

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*
Depreciation	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)	($25.69)
Debt Interest Payment	($10.35)	($9.65)	($8.93)	($8.19)	($7.41)	($6.60)	($5.76)	($4.89)	($3.99)	($3.05)	($2.07)	($1.05)	$0.00
Taxable Income	*$53.25*	*$53.95*	*$54.67*	*$55.41*	*$56.19*	*$57.00*	*$57.84*	*$58.71*	*$59.61*	*$60.55*	*$61.53*	*$62.55*	*$63.60*
Income Tax	($20.50)	($20.77)	($21.05)	($21.33)	($21.63)	($21.94)	($22.27)	($22.60)	($22.95)	($23.31)	($23.69)	($24.08)	($24.49)
Net Operating Income	*$32.75*	*$33.18*	*$33.62*	*$34.08*	*$34.56*	*$35.05*	*$35.57*	*$36.11*	*$36.66*	*$37.24*	*$37.84*	*$38.47*	*$39.11*
B. Add Back Items													
Depreciation	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69	$25.69
After Tax Interest on Debt	$6.36	$5.94	$5.49	$5.03	$4.56	$4.06	$3.54	$3.01	$2.45	$1.87	$1.27	$0.65	$0.00
C. Change in Net Working Capital													
Receivables	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80
III. Terminal Year Cash Flows													
Salvage Value													$38.53
Recovery of Net Working Capital													$11.28
Total Termination Cash Flows													$49.81
IV. Net Cash Flows	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$64.80	$114.62
Cumulative Cash Flows	($253.61)	($188.81)	($124.01)	($59.20)	$5.60	$70.40	$135.20	$200.01	$264.81	$329.61	$394.41	$459.21	$573.83
V. Cost Stream	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($120.47)	($70.65)
NPV Net Cash Flows	$34.37	$32.73	$31.17	$29.69	$28.27	$26.93	$25.64	$24.42	$23.26	$22.15	$21.10	$20.09	$33.85

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($53)
Net Present Value of Revenue Flows (at 5%)	$1,811
Net Present Value of Cost Flows (at 5%)	($1,865)
Net Present Value of Output Stream (at 5%)	1,216,918
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.53
Levelized Revenue	$1.49
Levelized Profit	($0.04)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Chicot Aquifer System
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$700.58	
Total O&M Costs:	$105.58	<= Increased by 10% compared to base case
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$61.76	$123.51	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($35.19)	($70.38)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)	($105.58)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$26.56*	*$53.13*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*	*$79.69*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($13.66)	($13.20)	($12.72)	($12.22)	($11.70)	($11.16)	($10.59)	($10.01)	($9.41)	($8.78)	($8.12)	($7.44)	($6.74)	($6.00)	($5.24)	($4.45)	($3.63)	($2.77)	($1.88)	($0.96)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($10.45)*	*$16.58*	*$43.62*	*$44.12*	*$44.64*	*$45.18*	*$45.74*	*$46.33*	*$46.93*	*$47.56*	*$48.22*	*$48.90*	*$49.60*	*$50.34*	*$51.10*	*$51.89*	*$52.71*	*$53.57*	*$54.46*	*$55.38*	*$56.34*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$4.02	($6.38)	($16.79)	($16.99)	($17.19)	($17.40)	($17.61)	($17.84)	($18.07)	($18.31)	($18.56)	($18.82)	($19.10)	($19.38)	($19.67)	($19.98)	($20.29)	($20.62)	($20.97)	($21.32)	($21.69)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($6.43)*	*$10.19*	*$26.83*	*$27.14*	*$27.45*	*$27.79*	*$28.13*	*$28.49*	*$28.86*	*$29.25*	*$29.65*	*$30.07*	*$30.51*	*$30.96*	*$31.43*	*$31.91*	*$32.42*	*$32.94*	*$33.49*	*$34.06*	*$34.65*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$8.40	$8.12	$7.82	$7.51	$7.19	$6.86	$6.52	$6.16	$5.78	$5.40	$4.99	$4.58	$4.14	$3.69	$3.22	$2.74	$2.23	$1.70	$1.16	$0.59	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($5.08)	($10.15)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$1.45	$2.89	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34	$4.34
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.63)	($7.26)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)	($10.89)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($3.63)	($3.63)	($3.63)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$21.70	$38.03	$54.37	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00
III. Terminal Year Cash Flows																										
Salvage Value																										$35.03
Recovery of Net Working Capital																										$10.89
Total Termination Cash Flows																										$45.92
IV. Net Cash Flows	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	$21.70	$38.03	$54.37	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$58.00	$103.92
Cumulative Cash Flows	($140.12)	($280.23)	($420.35)	($560.46)	($700.58)	($678.88)	($640.84)	($586.47)	($528.47)	($470.47)	($412.47)	($354.47)	($296.47)	($238.47)	($180.47)	($122.47)	($64.47)	($6.47)	$51.53	$109.53	$167.53	$225.53	$283.53	$341.53	$399.53	$503.45
V. Cost Stream	($140.12)	($140.12)	($140.12)	($140.12)	($140.12)	($40.06)	($85.48)	($130.90)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($127.27)	($81.35)
VI. Financial Results																										
Payback Period	19																									
Internal Rate of Return	4.2%																									
Net Present Value of Net Cash Flows (at 5%)	($58)																									
Net Present Value of Revenue Flows (at 5%)	$1,811																									
Net Present Value of Cost Flows (at 5%)	($1,869)																									
Net Present Value of Output Stream (at 5%)	1,216,918																									
VII. Levelized Calculations (Per Thousand Gallons)																										
Levelized Cost	$1.54																									
Levelized Revenue	$1.49																									
Levelized Profit	($0.05)																									
NPV Net Cash Flows	-$140.12	-$133.44	-$127.09	-$121.04	-$115.27	$17.00	$28.38	$38.64	$39.26	$37.39	$35.61	$33.91	$32.30	$30.76	$29.29	$27.90	$26.57	$25.31	$24.10	$22.95	$21.86	$20.82	$19.83	$18.88	$17.98	$30.69

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Chicot Aquifer System
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$700.58	
Total O&M Costs:	$95.98	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($116.76)	($116.76)	($116.76)	($116.76)	($116.76)	($116.76)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$61.76	$123.51	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($31.99)	($63.99)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$29.76*	*$59.53*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($13.66)	($13.20)	($12.72)	($12.22)	($11.70)	($11.16)	($10.59)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.25)*	*$22.98*	*$53.22*	*$53.72*	*$54.24*	*$54.78*	*$55.34*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.79	($8.85)	($20.49)	($20.68)	($20.88)	($21.09)	($21.31)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.46)*	*$14.13*	*$32.73*	*$33.04*	*$33.36*	*$33.69*	*$34.04*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$8.40	$8.12	$7.82	$7.51	$7.19	$6.86	$6.52
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($5.08)	($10.15)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.31	$2.63	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($3.76)	($7.52)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($3.76)	($3.76)	($3.76)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$23.53	$41.84	$60.14	$63.90	$63.90	$63.90	$63.90
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($116.76)	($116.76)	($116.76)	($116.76)	($116.76)	($116.76)	$23.53	$41.84	$60.14	$63.90	$63.90	$63.90	$63.90
Cumulative Cash Flows	($116.76)	($233.53)	($350.29)	($467.05)	($583.81)	($700.58)	($677.04)	($635.20)	($575.06)	($511.16)	($447.26)	($383.35)	($319.45)
V. Cost Stream	($116.76)	($116.76)	($116.76)	($116.76)	($116.76)	($116.76)	($38.22)	($81.67)	($125.13)	($121.36)	($121.36)	($121.36)	($121.36)
NPV Net Cash Flows	-$116.76	-$111.20	-$105.91	-$100.86	-$96.06	-$91.49	$17.56	$29.73	$40.71	$41.19	$39.23	$37.36	$35.58

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27	$185.27
Operating Expenses	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)	($95.98)
Earnings Before Depreciation and Tax	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*	*$89.29*
Depreciation	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)	($23.35)
Debt Interest Payment	($10.01)	($9.41)	($8.78)	($8.12)	($7.44)	($6.74)	($6.00)	($5.24)	($4.45)	($3.63)	($2.77)	($1.88)	($0.96)
Taxable Income	*$55.92*	*$56.53*	*$57.16*	*$57.81*	*$58.49*	*$59.20*	*$59.93*	*$60.70*	*$61.49*	*$62.31*	*$63.17*	*$64.05*	*$64.98*
Income Tax	($21.53)	($21.76)	($22.01)	($22.26)	($22.52)	($22.79)	($23.07)	($23.37)	($23.67)	($23.99)	($24.32)	($24.66)	($25.02)
Net Operating Income	*$34.39*	*$34.77*	*$35.15*	*$35.56*	*$35.97*	*$36.41*	*$36.86*	*$37.33*	*$37.82*	*$38.32*	*$38.85*	*$39.39*	*$39.96*
B. Add Back Items													
Depreciation	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35	$23.35
After Tax Interest on Debt	$6.16	$5.78	$5.40	$4.99	$4.58	$4.14	$3.69	$3.22	$2.74	$2.23	$1.70	$1.16	$0.59
C. Change in Net Working Capital													
Receivables	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)	($15.23)
Payables	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94	$3.94
Net Working Capital	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)	($11.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90
III. Terminal Year Cash Flows													
Salvage Value													$35.03
Recovery of Net Working Capital													$11.28
Total Termination Cash Flows													$46.31
IV. Net Cash Flows	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$63.90	$110.21
Cumulative Cash Flows	($255.55)	($191.64)	($127.74)	($63.84)	$0.07	$63.97	$127.87	$191.77	$255.68	$319.58	$383.48	$447.39	$557.60
V. Cost Stream	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($121.36)	($75.05)
NPV Net Cash Flows	$33.89	$32.28	$30.74	$29.27	$27.88	$26.55	$25.29	$24.08	$22.94	$21.85	$20.81	$19.81	$32.55

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($33)
Net Present Value of Revenue Flows (at 5%)	$1,673
Net Present Value of Cost Flows (at 5%)	($1,706)
Net Present Value of Output Stream (at 5%)	1,123,964
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.52
Levelized Revenue	$1.49
Levelized Profit	($0.03)

SUMMARY AND SENSITIVITY ANALYSIS FOR CHICOT AQUIFER SYSTEM: WASTE WATER RECYCl

Aquifer: **Chicot Aquifer System**
Alternative: **Waste Water Recycling**

Table x: The Results of Sensitivity Analysis for theChicot Aquifer System: Waste Water Recycling Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	3.4%	3.2
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.2%	1.6
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

TABLE 2-6
BASE CASE - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Chicot Aquifer System**
Alternative:	**Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	**$0.75**	Per Thousand Gallons
Total Capital Costs:	$731.25	
Total O&M Costs:	$0.88	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$31.26	$62.51	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.59)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$30.96*	*$61.93*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($14.26)	($13.78)	($13.27)	($12.75)	($12.21)	($11.64)	($11.06)	($10.45)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.67)*	*$23.78*	*$55.24*	*$55.76*	*$56.31*	*$56.87*	*$57.46*	*$58.07*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$2.95	($9.15)	($21.27)	($21.47)	($21.68)	($21.90)	($22.12)	($22.36)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.72)*	*$14.62*	*$33.97*	*$34.29*	*$34.63*	*$34.98*	*$35.34*	*$35.71*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$8.77	$8.47	$8.16	$7.84	$7.51	$7.16	$6.80	$6.43
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($2.57)	($5.14)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($5.11)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($2.56)	($2.56)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$25.87	$44.91	$63.95	$66.51	$66.51	$66.51	$66.51	$66.51
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	$25.87	$44.91	$63.95	$66.51	$66.51	$66.51	$66.51	$66.51
Cumulative Cash Flows	($146.25)	($292.50)	($438.75)	($585.00)	($731.25)	($705.38)	($660.47)	($596.52)	($530.00)	($463.49)	($396.98)	($330.47)	($263.96)
V. Cost Stream	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	($5.39)	($17.60)	($29.81)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)
NPV Net Cash Flows	-$146.25	-$139.29	-$132.65	-$126.34	-$120.32	$20.27	$33.51	$45.45	$45.02	$42.87	$40.83	$38.89	$37.04

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*
Depreciation	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)
Debt Interest Payment	($9.82)	($9.16)	($8.48)	($7.77)	($7.03)	($6.27)	($5.47)	($4.64)	($3.78)	($2.89)	($1.96)	($1.00)	$0.00
Taxable Income	*$58.70*	*$59.35*	*$60.04*	*$60.75*	*$61.48*	*$62.25*	*$63.05*	*$63.87*	*$64.73*	*$65.62*	*$66.55*	*$67.51*	*$68.51*
Income Tax	($22.60)	($22.85)	($23.11)	($23.39)	($23.67)	($23.97)	($24.27)	($24.59)	($24.92)	($25.26)	($25.62)	($25.99)	($26.38)
Net Operating Income	*$36.10*	*$36.50*	*$36.92*	*$37.36*	*$37.81*	*$38.28*	*$38.77*	*$39.28*	*$39.81*	*$40.36*	*$40.93*	*$41.52*	*$42.14*
B. Add Back Items													
Depreciation	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38
After Tax Interest on Debt	$6.04	$5.63	$5.21	$4.78	$4.32	$3.85	$3.36	$2.86	$2.33	$1.78	$1.21	$0.62	$0.00
C. Change in Net Working Capital													
Receivables	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51
III. Terminal Year Cash Flows													
Salvage Value													$36.56
Recovery of Net Working Capital													$7.67
Total Termination Cash Flows													$44.23
IV. Net Cash Flows	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$110.75
Cumulative Cash Flows	($197.45)	($130.93)	($64.42)	$2.09	$68.60	$135.11	$201.62	$268.14	$334.65	$401.16	$467.67	$534.18	$644.93
V. Cost Stream	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	$16.98
NPV Net Cash Flows	$35.27	$33.59	$31.99	$30.47	$29.02	$27.64	$26.32	$25.07	$23.87	$22.74	$21.65	$20.62	$32.70

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$917
Net Present Value of Cost Flows (at 5%)	($917)
Net Present Value of Output Stream (at 5%)	1,216,918
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$0.75
Levelized Revenue	$0.75
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Chicot Aquifer System
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	112,022	Million Gallons per Year <= Reduced by 10% compared to base case
Water Price:	$0.75	Per Thousand Gallons
Total Capital Costs:	$731.25	
Total O&M Costs:	$0.88	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	37,341	74,681	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022	112,022
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$28.13	$56.26	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39	$84.39
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.59)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$27.84*	*$55.68*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*	*$83.51*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($14.26)	($13.78)	($13.27)	($12.75)	($12.21)	($11.64)	($11.06)	($10.45)	($9.82)	($9.16)	($8.48)	($7.77)	($7.03)	($6.27)	($5.47)	($4.64)	($3.78)	($2.89)	($1.96)	($1.00)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($10.80)*	*$17.52*	*$45.87*	*$46.39*	*$46.93*	*$47.49*	*$48.08*	*$48.69*	*$49.32*	*$49.98*	*$50.66*	*$51.37*	*$52.11*	*$52.87*	*$53.67*	*$54.50*	*$55.35*	*$56.25*	*$57.17*	*$58.14*	*$59.14*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$4.16	($6.75)	($17.66)	($17.86)	($18.07)	($18.29)	($18.51)	($18.75)	($18.99)	($19.24)	($19.50)	($19.78)	($20.06)	($20.36)	($20.66)	($20.98)	($21.31)	($21.65)	($22.01)	($22.38)	($22.77)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($6.64)*	*$10.78*	*$28.21*	*$28.53*	*$28.86*	*$29.21*	*$29.57*	*$29.94*	*$30.33*	*$30.74*	*$31.16*	*$31.59*	*$32.05*	*$32.52*	*$33.01*	*$33.51*	*$34.04*	*$34.59*	*$35.16*	*$35.75*	*$36.37*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$8.77	$8.47	$8.16	$7.84	$7.51	$7.16	$6.80	$6.43	$6.04	$5.63	$5.21	$4.78	$4.32	$3.85	$3.36	$2.86	$2.33	$1.78	$1.21	$0.62	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($2.31)	($4.62)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)	($6.94)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.30)	($4.60)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)	($6.90)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.30)	($2.30)	($2.30)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$24.20	$41.32	$58.44	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74
III. Terminal Year Cash Flows																										
Salvage Value																										$36.56
Recovery of Net Working Capital																										$6.90
Total Termination Cash Flows																										$43.46
IV. Net Cash Flows	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	$24.20	$41.32	$58.44	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$60.74	$104.21
Cumulative Cash Flows	($146.25)	($292.50)	($438.75)	($585.00)	($731.25)	($707.05)	($665.72)	($607.28)	($546.53)	($485.79)	($425.04)	($364.30)	($303.55)	($242.81)	($182.06)	($121.32)	($60.57)	$0.17	$60.92	$121.66	$182.41	$243.15	$303.90	$364.64	$425.39	$529.59
V. Cost Stream	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	($3.93)	($14.94)	($25.95)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	($23.65)	$19.82
VI. Financial Results																										
Payback Period	18																									
Internal Rate of Return	4.2%																									
Net Present Value of Net Cash Flows (at 5%)	($56)																									
Net Present Value of Revenue Flows (at 5%)	$825																									
Net Present Value of Cost Flows (at 5%)	($881)																									
Net Present Value of Output Stream (at 5%)	1,095,226																									
VII. Levelized Calculations (Per Thousand Gallons)																										
Levelized Cost	$0.80																									
Levelized Revenue	$0.75																									
Levelized Profit	($0.05)																									
NPV Net Cash Flows	-$146.25	-$139.29	-$132.65	-$126.34	-$120.32	$18.96	$30.84	$41.54	$41.11	$39.16	$37.29	$35.52	$33.83	$32.21	$30.68	$29.22	$27.83	$26.50	$25.24	$24.04	$22.89	$21.80	$20.77	$19.78	$18.84	$30.77

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Chicot Aquifer System
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	$0.75	Per Thousand Gallons
Total Capital Costs:	$804.38	<= Increased by 10% compared to base case
Total O&M Costs:	$0.88	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($160.88)	($160.88)	($160.88)	($160.88)	($160.88)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$31.26	$62.51	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.59)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$30.96*	*$61.93*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($15.69)	($15.15)	($14.60)	($14.03)	($13.43)	($12.81)	($12.16)	($11.49)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($11.53)*	*$19.96*	*$51.48*	*$52.05*	*$52.65*	*$53.27*	*$53.91*	*$54.58*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$4.44	($7.68)	($19.82)	($20.04)	($20.27)	($20.51)	($20.76)	($21.01)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.09)*	*$12.28*	*$31.66*	*$32.01*	*$32.38*	*$32.76*	*$33.16*	*$33.57*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$9.65	$9.32	$8.98	$8.63	$8.26	$7.88	$7.48	$7.07
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($2.57)	($5.14)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($5.11)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($2.56)	($2.56)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$26.81	$45.85	$64.89	$67.45	$67.45	$67.45	$67.45	$67.45
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($160.88)	($160.88)	($160.88)	($160.88)	($160.88)	$26.81	$45.85	$64.89	$67.45	$67.45	$67.45	$67.45	$67.45
Cumulative Cash Flows	($160.88)	($321.75)	($482.63)	($643.50)	($804.38)	($777.57)	($731.72)	($666.83)	($599.38)	($531.93)	($464.48)	($397.03)	($329.58)
V. Cost Stream	($160.88)	($160.88)	($160.88)	($160.88)	($160.88)	($4.45)	($16.66)	($28.87)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)
VI. Financial Results													
Payback Period	18												
Internal Rate of Return	4.3%												
Net Present Value of Net Cash Flows (at 5%)	($56)												
Net Present Value of Revenue Flows (at 5%)	$917												
Net Present Value of Cost Flows (at 5%)	($972)												
Net Present Value of Output Stream (at 5%)	1,216,918												
VII. Levelized Calculations (Per Thousand Gallons)													
Levelized Cost	$0.80												
Levelized Revenue	$0.75												
Levelized Profit	($0.05)												
NPV Net Cash Flows	-$160.88	-$153.21	-$145.92	-$138.97	-$132.35	$21.01	$34.21	$46.12	$45.65	$43.48	$41.41	$39.44	$37.56

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*
Depreciation	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)	($26.81)
Debt Interest Payment	($10.80)	($10.08)	($9.32)	($8.54)	($7.73)	($6.89)	($6.02)	($5.11)	($4.16)	($3.18)	($2.16)	($1.10)	$0.00
Taxable Income	*$55.28*	*$56.00*	*$56.75*	*$57.53*	*$58.34*	*$59.19*	*$60.06*	*$60.97*	*$61.91*	*$62.90*	*$63.92*	*$64.98*	*$66.08*
Income Tax	($21.28)	($21.56)	($21.85)	($22.15)	($22.46)	($22.79)	($23.12)	($23.47)	($23.84)	($24.22)	($24.61)	($25.02)	($25.44)
Net Operating Income	*$34.00*	*$34.44*	*$34.90*	*$35.38*	*$35.88*	*$36.40*	*$36.94*	*$37.50*	*$38.08*	*$38.68*	*$39.31*	*$39.96*	*$40.64*
B. Add Back Items													
Depreciation	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81	$26.81
After Tax Interest on Debt	$6.64	$6.20	$5.73	$5.25	$4.76	$4.24	$3.70	$3.14	$2.56	$1.96	$1.33	$0.68	$0.00
C. Change in Net Working Capital													
Receivables	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45
III. Terminal Year Cash Flows													
Salvage Value													$40.22
Recovery of Net Working Capital													$7.67
Total Termination Cash Flows													$47.89
IV. Net Cash Flows	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$67.45	$115.34
Cumulative Cash Flows	($262.13)	($194.68)	($127.23)	($59.78)	$7.67	$75.13	$142.58	$210.03	$277.48	$344.93	$412.38	$479.83	$595.17
V. Cost Stream	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	($26.32)	$21.57
NPV Net Cash Flows	$35.77	$34.07	$32.44	$30.90	$29.43	$28.03	$26.69	$25.42	$24.21	$23.06	$21.96	$20.91	$34.06

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Chicot Aquifer System**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	124,469	Million Gallons per Year
Water Price:	**$0.75**	Per Thousand Gallons
Total Capital Costs:	$731.25	
Total O&M Costs:	**$0.97**	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$31.26	$62.51	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.32)	($0.64)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)	($0.97)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$30.93*	*$61.87*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*	*$92.80*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($14.26)	($13.78)	($13.27)	($12.75)	($12.21)	($11.64)	($11.06)	($10.45)	($9.82)	($9.16)	($8.48)	($7.77)	($7.03)	($6.27)	($5.47)	($4.64)	($3.78)	($2.89)	($1.96)	($1.00)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.70)*	*$23.72*	*$55.15*	*$55.68*	*$56.22*	*$56.78*	*$57.37*	*$57.98*	*$58.61*	*$59.27*	*$59.95*	*$60.66*	*$61.40*	*$62.16*	*$62.96*	*$63.78*	*$64.64*	*$65.54*	*$66.46*	*$67.43*	*$68.43*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$2.96	($9.13)	($21.23)	($21.44)	($21.64)	($21.86)	($22.09)	($22.32)	($22.56)	($22.82)	($23.08)	($23.35)	($23.64)	($23.93)	($24.24)	($24.56)	($24.89)	($25.23)	($25.59)	($25.96)	($26.34)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.74)*	*$14.59*	*$33.92*	*$34.24*	*$34.57*	*$34.92*	*$35.28*	*$35.66*	*$36.05*	*$36.45*	*$36.87*	*$37.31*	*$37.76*	*$38.23*	*$38.72*	*$39.23*	*$39.76*	*$40.30*	*$40.87*	*$41.47*	*$42.08*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$8.77	$8.47	$8.16	$7.84	$7.51	$7.16	$6.80	$6.43	$6.04	$5.63	$5.21	$4.78	$4.32	$3.85	$3.36	$2.86	$2.33	$1.78	$1.21	$0.62	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($2.57)	($5.14)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.03	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($5.11)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($2.56)	($2.56)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$25.85	$44.88	$63.90	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46
III. Terminal Year Cash Flows																										
Salvage Value																										$36.56
Recovery of Net Working Capital																										$7.67
Total Termination Cash Flows																										$44.23
IV. Net Cash Flows	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	$25.85	$44.88	$63.90	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$66.46	$110.69
Cumulative Cash Flows	($146.25)	($292.50)	($438.75)	($585.00)	($731.25)	($705.40)	($660.52)	($596.62)	($530.16)	($463.71)	($397.25)	($330.79)	($264.33)	($197.87)	($131.42)	($64.96)	$1.50	$67.96	$134.41	$200.87	$267.33	$333.79	$400.25	$466.70	$533.16	$643.85
V. Cost Stream	($146.25)	($146.25)	($146.25)	($146.25)	($146.25)	($5.40)	($17.63)	($29.87)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	($27.31)	$16.92
VI. Financial Results																										
Payback Period	17																									
Internal Rate of Return	5.0%																									
Net Present Value of Net Cash Flows (at 5%)	($1)																									
Net Present Value of Revenue Flows (at 5%)	$917																									
Net Present Value of Cost Flows (at 5%)	($917)																									
Net Present Value of Output Stream (at 5%)	1,216,918																									
VII. Levelized Calculations (Per Thousand Gallons)																										
Levelized Cost	$0.75																									
Levelized Revenue	$0.75																									
Levelized Profit	($0.00)																									
NPV Net Cash Flows	-$146.25	-$139.29	-$132.65	-$126.34	-$120.32	$20.26	$33.49	$45.41	$44.98	$42.84	$40.80	$38.86	$37.01	$35.24	$33.57	$31.97	$30.45	$29.00	$27.61	$26.30	$25.05	$23.85	$22.72	$21.64	$20.61	$32.69

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR CHICOT AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Chicot Aquifer System**	
Alternative:	**Reservoirs for Rainharvesting**	
Parameters:		
Water Supplied:	124,469	Million Gallons per Year
Water Price:	**$0.75**	Per Thousand Gallons
Total Capital Costs:	$731.25	
Total O&M Costs:	$0.88	
Years to Construct	**6**	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	41,490	82,979	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($121.88)	($121.88)	($121.88)	($121.88)	($121.88)	($121.88)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$31.26	$62.51	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.59)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$30.96*	*$61.93*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($14.26)	($13.78)	($13.27)	($12.75)	($12.21)	($11.64)	($11.06)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.67)*	*$23.78*	*$55.24*	*$55.76*	*$56.31*	*$56.87*	*$57.46*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.95	($9.15)	($21.27)	($21.47)	($21.68)	($21.90)	($22.12)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.72)*	*$14.62*	*$33.97*	*$34.29*	*$34.63*	*$34.98*	*$35.34*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$8.77	$8.47	$8.16	$7.84	$7.51	$7.16	$6.80
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($2.57)	($5.14)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($5.11)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($2.56)	($2.56)	($2.56)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$25.87	$44.91	$63.95	$66.51	$66.51	$66.51	$66.51
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($121.88)	($121.88)	($121.88)	($121.88)	($121.88)	($121.88)	$25.87	$44.91	$63.95	$66.51	$66.51	$66.51	$66.51
Cumulative Cash Flows	($121.88)	($243.75)	($365.63)	($487.50)	($609.38)	($731.25)	($705.38)	($660.47)	($596.52)	($530.00)	($463.49)	($396.98)	($330.47)
V. Cost Stream	($121.88)	($121.88)	($121.88)	($121.88)	($121.88)	($121.88)	($5.39)	($17.60)	($29.81)	($27.26)	($27.26)	($27.26)	($27.26)
NPV Net Cash Flows	-$121.88	-$116.07	-$110.54	-$105.28	-$100.27	-$95.49	$19.30	$31.92	$43.29	$42.87	$40.83	$38.89	$37.04

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469	124,469
Water Sales Price ($/Thousand Gallons)	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75	$0.75
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77	$93.77
Operating Expenses	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*	*$92.89*
Depreciation	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)	($24.38)
Debt Interest Payment	($10.45)	($9.82)	($9.16)	($8.48)	($7.77)	($7.03)	($6.27)	($5.47)	($4.64)	($3.78)	($2.89)	($1.96)	($1.00)
Taxable Income	*$58.07*	*$58.70*	*$59.35*	*$60.04*	*$60.75*	*$61.48*	*$62.25*	*$63.05*	*$63.87*	*$64.73*	*$65.62*	*$66.55*	*$67.51*
Income Tax	($22.36)	($22.60)	($22.85)	($23.11)	($23.39)	($23.67)	($23.97)	($24.27)	($24.59)	($24.92)	($25.26)	($25.62)	($25.99)
Net Operating Income	*$35.71*	*$36.10*	*$36.50*	*$36.92*	*$37.36*	*$37.81*	*$38.28*	*$38.77*	*$39.28*	*$39.81*	*$40.36*	*$40.93*	*$41.52*
B. Add Back Items													
Depreciation	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38	$24.38
After Tax Interest on Debt	$6.43	$6.04	$5.63	$5.21	$4.78	$4.32	$3.85	$3.36	$2.86	$2.33	$1.78	$1.21	$0.62
C. Change in Net Working Capital													
Receivables	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)	($7.71)
Payables	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)	($7.67)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51
III. Terminal Year Cash Flows													
Salvage Value													$36.56
Recovery of Net Working Capital													$7.67
Total Termination Cash Flows													$44.23
IV. Net Cash Flows	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$66.51	$110.75
Cumulative Cash Flows	($263.96)	($197.45)	($130.93)	($64.42)	$2.09	$68.60	$135.11	$201.62	$268.14	$334.65	$401.16	$467.67	$578.42
V. Cost Stream	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	($27.26)	$16.98
NPV Net Cash Flows	$35.27	$33.59	$31.99	$30.47	$29.02	$27.64	$26.32	$25.07	$23.87	$22.74	$21.65	$20.62	$32.70

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($34)
Net Present Value of Revenue Flows (at 5%)	$847
Net Present Value of Cost Flows (at 5%)	($881)
Net Present Value of Output Stream (at 5%)	1,123,964
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$0.78
Levelized Revenue	$0.75
Levelized Profit	($0.03)

SUMMARY AND SENSITIVITY ANALYSIS FOR CHICOT AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTI

Aquifer: Chicot Aquifer System
Alternative: Reservoirs for Rainharvesting

Table x: The Results of Sensitivity Analysis for theChicot Aquifer System: Reservoirs for Rainharvesting Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.2%	1.5
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	5.0%	0.0
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

BASE CASE - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	**Jasper Aquifer System**
Alternative:	**Waste Water Recycling**

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	**$1.49**	Per Thousand Gallons
Total Capital Costs:	$170.97	
Total O&M Costs:	$23.42	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$15.07	$30.14	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($7.81)	($15.62)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$7.26*	*$14.53*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.33)	($3.22)	($3.10)	($2.98)	($2.85)	($2.72)	($2.59)	($2.44)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.77)*	*$5.61*	*$12.99*	*$13.11*	*$13.24*	*$13.37*	*$13.51*	*$13.65*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.68	($2.16)	($5.00)	($5.05)	($5.10)	($5.15)	($5.20)	($5.25)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.09)*	*$3.45*	*$7.99*	*$8.06*	*$8.14*	*$8.22*	*$8.31*	*$8.39*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.05	$1.98	$1.91	$1.83	$1.76	$1.67	$1.59	$1.50
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.24)	($2.48)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.32	$0.64	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($1.84)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.92)	($0.92)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.74	$10.21	$14.68	$15.59	$15.59	$15.59	$15.59	$15.59
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	$5.74	$10.21	$14.68	$15.59	$15.59	$15.59	$15.59	$15.59
Cumulative Cash Flows	($34.19)	($68.39)	($102.58)	($136.77)	($170.97)	($165.23)	($155.02)	($140.34)	($124.74)	($109.15)	($93.55)	($77.96)	($62.36)
V. Cost Stream	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	($9.33)	($19.93)	($30.54)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21
Operating Expenses	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)
Earnings Before Depreciation and Tax	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*
Depreciation	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)
Debt Interest Payment	($2.30)	($2.14)	($1.98)	($1.82)	($1.64)	($1.46)	($1.28)	($1.09)	($0.88)	($0.68)	($0.46)	($0.23)	$0.00
Taxable Income	*$13.80*	*$13.95*	*$14.11*	*$14.27*	*$14.45*	*$14.63*	*$14.81*	*$15.01*	*$15.21*	*$15.41*	*$15.63*	*$15.86*	*$16.09*
Income Tax	($5.31)	($5.37)	($5.43)	($5.50)	($5.56)	($5.63)	($5.70)	($5.78)	($5.85)	($5.93)	($6.02)	($6.10)	($6.20)
Net Operating Income	*$8.48*	*$8.58*	*$8.68*	*$8.78*	*$8.88*	*$9.00*	*$9.11*	*$9.23*	*$9.35*	*$9.48*	*$9.61*	*$9.75*	*$9.90*
B. Add Back Items													
Depreciation	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70
After Tax Interest on Debt	$1.41	$1.32	$1.22	$1.12	$1.01	$0.90	$0.79	$0.67	$0.54	$0.42	$0.28	$0.14	$0.00
C. Change in Net Working Capital													
Receivables	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)
Payables	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Net Working Capital	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59
III. Terminal Year Cash Flows													
Salvage Value													$8.55
Recovery of Net Working Capital													$2.75
Total Termination Cash Flows													$11.30
IV. Net Cash Flows	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$26.90
Cumulative Cash Flows	($46.77)	($31.17)	($15.58)	$0.02	$15.61	$31.21	$46.80	$62.40	$77.99	$93.59	$109.18	$124.78	$151.67
V. Cost Stream	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($18.32)

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$442
Net Present Value of Cost Flows (at 5%)	($442)
Net Present Value of Output Stream (at 5%)	296,976

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.49
Levelized Revenue	$1.49
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	Jasper Aquifer System
Alternative:	Waste Water Recycling

Parameters:

Water Supplied:	27,338	Million Gallons per Year	**<= Reduced by 10% compared to base case**
Water Price:	$1.49	Per Thousand Gallons	
Total Capital Costs:	$170.97		
Total O&M Costs:	$23.42		
Years to Construct	5		
Years Required to Reach 100%			
Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	9,113	18,225	27,338	27,338	27,338	27,338	27,338	27,338
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$13.56	$27.13	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($7.81)	($15.62)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$5.76*	*$11.51*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.33)	($3.22)	($3.10)	($2.98)	($2.85)	($2.72)	($2.59)	($2.44)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($3.28)*	*$2.59*	*$8.47*	*$8.59*	*$8.72*	*$8.85*	*$8.98*	*$9.13*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.26	($1.00)	($3.26)	($3.31)	($3.36)	($3.41)	($3.46)	($3.51)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.02)*	*$1.59*	*$5.21*	*$5.28*	*$5.36*	*$5.44*	*$5.53*	*$5.61*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.05	$1.98	$1.91	$1.83	$1.76	$1.67	$1.59	$1.50
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.11)	($2.23)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.32	$0.64	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.79)	($1.59)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.79)	($0.79)	($0.79)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$4.94	$8.48	$12.02	$12.81	$12.81	$12.81	$12.81	$12.81
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	$4.94	$8.48	$12.02	$12.81	$12.81	$12.81	$12.81	$12.81
Cumulative Cash Flows	($34.19)	($68.39)	($102.58)	($136.77)	($170.97)	($166.03)	($157.55)	($145.53)	($132.71)	($119.90)	($107.08)	($94.27)	($81.46)
V. Cost Stream	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	($8.62)	($18.65)	($28.67)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69	$40.69
Operating Expenses	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)
Earnings Before Depreciation and Tax	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*	*$17.27*
Depreciation	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)
Debt Interest Payment	($2.30)	($2.14)	($1.98)	($1.82)	($1.64)	($1.46)	($1.28)	($1.09)	($0.88)	($0.68)	($0.46)	($0.23)	$0.00
Taxable Income	*$9.27*	*$9.43*	*$9.59*	*$9.75*	*$9.93*	*$10.10*	*$10.29*	*$10.48*	*$10.69*	*$10.89*	*$11.11*	*$11.34*	*$11.57*
Income Tax	($3.57)	($3.63)	($3.69)	($3.76)	($3.82)	($3.89)	($3.96)	($4.04)	($4.11)	($4.19)	($4.28)	($4.36)	($4.45)
Net Operating Income	*$5.70*	*$5.80*	*$5.90*	*$6.00*	*$6.10*	*$6.21*	*$6.33*	*$6.45*	*$6.57*	*$6.70*	*$6.83*	*$6.97*	*$7.12*
B. Add Back Items													
Depreciation	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70
After Tax Interest on Debt	$1.41	$1.32	$1.22	$1.12	$1.01	$0.90	$0.79	$0.67	$0.54	$0.42	$0.28	$0.14	$0.00
C. Change in Net Working Capital													
Receivables	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)	($3.34)
Payables	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Net Working Capital	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)	($2.38)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81
III. Terminal Year Cash Flows													
Salvage Value													$8.55
Recovery of Net Working Capital													$2.38
Total Termination Cash Flows													$10.93
IV. Net Cash Flows	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$12.81	$23.74
Cumulative Cash Flows	($68.64)	($55.83)	($43.01)	($30.20)	($17.38)	($4.57)	$8.24	$21.06	$33.87	$46.69	$59.50	$72.32	$96.06
V. Cost Stream	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($27.88)	($16.95)

VI. Financial Results	
Payback Period	20
Internal Rate of Return	3.4%
Net Present Value of Net Cash Flows (at 5%)	($27)
Net Present Value of Revenue Flows (at 5%)	$398
Net Present Value of Cost Flows (at 5%)	($425)
Net Present Value of Output Stream (at 5%)	267,279

VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.59
Levelized Revenue	$1.49
Levelized Profit	($0.10)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	**Jasper Aquifer System**	
Alternative:	**Waste Water Recycling**	

Parameters:

Water Supplied:	30,375	Million Gallons per Year	
Water Price:	**$1.49**	Per Thousand Gallons	
Total Capital Costs:	**$188.07**		**<= Increased by 10% compared to base case**
Total O&M Costs:	$23.42		
Years to Construct	5		
Years Required to Reach 100% Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($37.61)	($37.61)	($37.61)	($37.61)	($37.61)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$15.07	$30.14	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($7.81)	($15.62)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$7.26*	*$14.53*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)	($6.27)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.67)	($3.54)	($3.41)	($3.28)	($3.14)	($2.99)	($2.84)	($2.69)	($2.52)	($2.36)	($2.18)	($2.00)	($1.81)	($1.61)	($1.41)	($1.19)	($0.97)	($0.74)	($0.51)	($0.26)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.67)*	*$4.71*	*$12.11*	*$12.24*	*$12.38*	*$12.53*	*$12.68*	*$12.83*	*$13.00*	*$13.17*	*$13.34*	*$13.52*	*$13.71*	*$13.91*	*$14.11*	*$14.33*	*$14.55*	*$14.78*	*$15.02*	*$15.26*	*$15.52*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.03	($1.82)	($4.66)	($4.71)	($4.77)	($4.82)	($4.88)	($4.94)	($5.00)	($5.07)	($5.14)	($5.21)	($5.28)	($5.36)	($5.43)	($5.52)	($5.60)	($5.69)	($5.78)	($5.88)	($5.98)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.64)*	*$2.90*	*$7.45*	*$7.53*	*$7.61*	*$7.70*	*$7.80*	*$7.89*	*$7.99*	*$8.10*	*$8.20*	*$8.32*	*$8.43*	*$8.55*	*$8.68*	*$8.81*	*$8.95*	*$9.09*	*$9.23*	*$9.39*	*$9.55*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27	$6.27
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.26	$2.18	$2.10	$2.02	$1.93	$1.84	$1.75	$1.65	$1.55	$1.45	$1.34	$1.23	$1.11	$0.99	$0.87	$0.73	$0.60	$0.46	$0.31	$0.16	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.24)	($2.48)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.32	$0.64	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($1.84)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.92)	($0.92)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.96	$10.43	$14.90	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81
III. Terminal Year Cash Flows																										
Salvage Value																										$9.40
Recovery of Net Working Capital																										$2.75
Total Termination Cash Flows																										$12.16
IV. Net Cash Flows	($37.61)	($37.61)	($37.61)	($37.61)	($37.61)	$5.96	$10.43	$14.90	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$15.81	$27.97
Cumulative Cash Flows	($37.61)	($75.23)	($112.84)	($150.45)	($188.07)	($182.10)	($171.67)	($156.78)	($140.96)	($125.15)	($109.33)	($93.52)	($77.71)	($61.89)	($46.08)	($30.26)	($14.45)	$1.37	$17.18	$32.99	$48.81	$64.62	$80.44	$96.25	$112.07	$140.04
V. Cost Stream	($37.61)	($37.61)	($37.61)	($37.61)	($37.61)	($9.11)	($19.71)	($30.32)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($29.40)	($17.24)

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($13)
Net Present Value of Revenue Flows (at 5%)	$442
Net Present Value of Cost Flows (at 5%)	($455)
Net Present Value of Output Stream (at 5%)	296,976

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.53
Levelized Revenue	$1.49
Levelized Profit	($0.04)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Jasper Aquifer System
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$170.97	
Total O&M Costs:	$25.76	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$15.07	$30.14	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($8.59)	($17.18)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)	($25.76)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$6.48*	*$12.97*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*	*$19.45*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.33)	($3.22)	($3.10)	($2.98)	($2.85)	($2.72)	($2.59)	($2.44)	($2.30)	($2.14)	($1.98)	($1.82)	($1.64)	($1.46)	($1.28)	($1.09)	($0.88)	($0.68)	($0.46)	($0.23)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.55)*	*$4.05*	*$10.65*	*$10.77*	*$10.89*	*$11.03*	*$11.16*	*$11.31*	*$11.45*	*$11.61*	*$11.77*	*$11.93*	*$12.10*	*$12.28*	*$12.47*	*$12.66*	*$12.86*	*$13.07*	*$13.29*	*$13.51*	*$13.75*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.98	($1.56)	($4.10)	($4.15)	($4.19)	($4.25)	($4.30)	($4.35)	($4.41)	($4.47)	($4.53)	($4.59)	($4.66)	($4.73)	($4.80)	($4.88)	($4.95)	($5.03)	($5.12)	($5.20)	($5.29)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.57)*	*$2.49*	*$6.55*	*$6.62*	*$6.70*	*$6.78*	*$6.87*	*$6.95*	*$7.04*	*$7.14*	*$7.24*	*$7.34*	*$7.44*	*$7.55*	*$7.67*	*$7.79*	*$7.91*	*$8.04*	*$8.17*	*$8.31*	*$8.46*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.05	$1.98	$1.91	$1.83	$1.76	$1.67	$1.59	$1.50	$1.41	$1.32	$1.22	$1.12	$1.01	$0.90	$0.79	$0.67	$0.54	$0.42	$0.28	$0.14	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.24)	($2.48)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.35	$0.71	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06	$1.06
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.89)	($1.77)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)	($2.66)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.89)	($0.89)	($0.89)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.30	$9.28	$13.27	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15
III. Terminal Year Cash Flows																										
Salvage Value																										$8.55
Recovery of Net Working Capital																										$2.66
Total Termination Cash Flows																										$11.21
IV. Net Cash Flows	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	$5.30	$9.28	$13.27	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$14.15	$25.36
Cumulative Cash Flows	($34.19)	($68.39)	($102.58)	($136.77)	($170.97)	($165.67)	($156.39)	($143.12)	($128.97)	($114.81)	($100.66)	($86.51)	($72.35)	($58.20)	($44.04)	($29.89)	($15.73)	($1.58)	$12.58	$26.73	$40.88	$55.04	$69.19	$83.35	$97.50	$122.86
V. Cost Stream	($34.19)	($34.19)	($34.19)	($34.19)	($34.19)	($9.78)	($20.86)	($31.94)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($31.06)	($19.85)

VI. Financial Results	
Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($14)
Net Present Value of Revenue Flows (at 5%)	$442
Net Present Value of Cost Flows (at 5%)	($456)
Net Present Value of Output Stream (at 5%)	296,976
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.54
Levelized Revenue	$1.49
Levelized Profit	($0.05)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Jasper Aquifer System
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$170.97	
Total O&M Costs:	$23.42	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($28.49)	($28.49)	($28.49)	($28.49)	($28.49)	($28.49)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$15.07	$30.14	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21	$45.21
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($7.81)	($15.62)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)	($23.42)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$7.26*	*$14.53*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*	*$21.79*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)	($5.70)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($3.33)	($3.22)	($3.10)	($2.98)	($2.85)	($2.72)	($2.59)	($2.44)	($2.30)	($2.14)	($1.98)	($1.82)	($1.64)	($1.46)	($1.28)	($1.09)	($0.88)	($0.68)	($0.46)	($0.23)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.77)*	*$5.61*	*$12.99*	*$13.11*	*$13.24*	*$13.37*	*$13.51*	*$13.65*	*$13.80*	*$13.95*	*$14.11*	*$14.27*	*$14.45*	*$14.63*	*$14.81*	*$15.01*	*$15.21*	*$15.41*	*$15.63*	*$15.86*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.68	($2.16)	($5.00)	($5.05)	($5.10)	($5.15)	($5.20)	($5.25)	($5.31)	($5.37)	($5.43)	($5.50)	($5.56)	($5.63)	($5.70)	($5.78)	($5.85)	($5.93)	($6.02)	($6.10)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.09)*	*$3.45*	*$7.99*	*$8.06*	*$8.14*	*$8.22*	*$8.31*	*$8.39*	*$8.48*	*$8.58*	*$8.68*	*$8.78*	*$8.88*	*$9.00*	*$9.11*	*$9.23*	*$9.35*	*$9.48*	*$9.61*	*$9.75*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70	$5.70
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.05	$1.98	$1.91	$1.83	$1.76	$1.67	$1.59	$1.50	$1.41	$1.32	$1.22	$1.12	$1.01	$0.90	$0.79	$0.67	$0.54	$0.42	$0.28	$0.14
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.24)	($2.48)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)	($3.72)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.32	$0.64	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96	$0.96
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($1.84)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)	($2.75)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.92)	($0.92)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.74	$10.21	$14.68	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59
III. Terminal Year Cash Flows																										
Salvage Value																										$8.55
Recovery of Net Working Capital																										$2.75
Total Termination Cash Flows																										$11.30
IV. Net Cash Flows	($28.49)	($28.49)	($28.49)	($28.49)	($28.49)	($28.49)	$5.74	$10.21	$14.68	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$15.59	$26.90
Cumulative Cash Flows	($28.49)	($56.99)	($85.48)	($113.98)	($142.47)	($170.97)	($165.23)	($155.02)	($140.34)	($124.74)	($109.15)	($93.55)	($77.96)	($62.36)	($46.77)	($31.17)	($15.58)	$0.02	$15.61	$31.21	$46.80	$62.40	$77.99	$93.59	$109.18	$136.08
V. Cost Stream	($28.49)	($28.49)	($28.49)	($28.49)	($28.49)	($28.49)	($9.33)	($19.93)	($30.54)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($29.62)	($18.32)
VI. Financial Results																										
Payback Period	18																									
Internal Rate of Return	4.5%																									
Net Present Value of Net Cash Flows (at 5%)	($8)																									
Net Present Value of Revenue Flows (at 5%)	$408																									
Net Present Value of Cost Flows (at 5%)	($416)																									
Net Present Value of Output Stream (at 5%)	274,292																									
VII. Levelized Calculations (Per Thousand Gallons)																										
Levelized Cost	$1.52																									
Levelized Revenue	$1.49																									
Levelized Profit	($0.03)																									

SUMMARY AND SENSITIVITY ANALYSIS FOR JASPER AQUIFER SYSTEM: WASTE WATER RECYCL

Aquifer: **Jasper Aquifer System**
Alternative: **Waste Water Recycling**

Table x: The Results of Sensitivity Analysis for theJasper Aquifer System: Waste Water Recycling Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	3.4%	3.2
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.2%	1.6
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

.ING ALTERNATIVE

BASE CASE - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Jasper Aquifer System
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$448.04	
Total O&M Costs:	$1.25	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$19.39	$38.78	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.42)	($0.84)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$18.97*	*$37.94*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($8.74)	($8.44)	($8.13)	($7.81)	($7.48)	($7.13)	($6.78)	($6.40)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.70)*	*$14.57*	*$33.85*	*$34.17*	*$34.50*	*$34.85*	*$35.21*	*$35.58*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.81	($5.61)	($13.03)	($13.15)	($13.28)	($13.42)	($13.55)	($13.70)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.89)*	*$8.96*	*$20.82*	*$21.01*	*$21.22*	*$21.43*	*$21.65*	*$21.88*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$5.37	$5.19	$5.00	$4.80	$4.60	$4.39	$4.17	$3.94
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.59)	($3.19)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.03	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.58)	($3.15)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.58)	($1.58)	($1.58)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$15.84	$27.51	$39.18	$40.75	$40.75	$40.75	$40.75	$40.75
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	$15.84	$27.51	$39.18	$40.75	$40.75	$40.75	$40.75	$40.75
Cumulative Cash Flows	($89.61)	($179.21)	($268.82)	($358.43)	($448.04)	($432.19)	($404.69)	($365.51)	($324.76)	($284.00)	($243.25)	($202.50)	($161.75)
V. Cost Stream	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	($3.55)	($11.27)	($18.99)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*
Depreciation	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	($6.01)	($5.61)	($5.19)	($4.76)	($4.31)	($3.84)	($3.35)	($2.84)	($2.32)	($1.77)	($1.20)	($0.61)	$0.00
Taxable Income	*$35.97*	*$36.37*	*$36.79*	*$37.22*	*$37.67*	*$38.14*	*$38.63*	*$39.14*	*$39.66*	*$40.21*	*$40.78*	*$41.37*	*$41.98*
Income Tax	($13.85)	($14.00)	($14.16)	($14.33)	($14.50)	($14.68)	($14.87)	($15.07)	($15.27)	($15.48)	($15.70)	($15.93)	($16.16)
Net Operating Income	*$22.12*	*$22.37*	*$22.62*	*$22.89*	*$23.17*	*$23.46*	*$23.76*	*$24.07*	*$24.39*	*$24.73*	*$25.08*	*$25.44*	*$25.82*
B. Add Back Items													
Depreciation	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$3.70	$3.45	$3.19	$2.93	$2.65	$2.36	$2.06	$1.75	$1.43	$1.09	$0.74	$0.38	$0.00
C. Change in Net Working Capital													
Receivables	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75
III. Terminal Year Cash Flows													
Salvage Value													$22.40
Recovery of Net Working Capital													$4.73
Total Termination Cash Flows													$27.13
IV. Net Cash Flows	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$67.88
Cumulative Cash Flows	($120.99)	($80.24)	($39.49)	$1.27	$42.02	$82.77	$123.52	$164.28	$205.03	$245.78	$286.53	$327.29	$395.17
V. Cost Stream	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	$9.71

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$569
Net Present Value of Cost Flows (at 5%)	($569)
Net Present Value of Output Stream (at 5%)	296,976

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Jasper Aquifer System**
Alternative:	**Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	27,338	Million Gallons per Year	**<= Reduced by 10% compared to base case**
Water Price:	$1.92	Per Thousand Gallons	
Total Capital Costs:	$448.04		
Total O&M Costs:	$1.25		
Years to Construct	5		
Years Required to Reach 100%			
Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	9,113	18,225	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$17.45	$34.90	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35	$52.35
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.42)	($0.84)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$17.03*	*$34.07*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*	*$51.10*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($8.74)	($8.44)	($8.13)	($7.81)	($7.48)	($7.13)	($6.78)	($6.40)	($6.01)	($5.61)	($5.19)	($4.76)	($4.31)	($3.84)	($3.35)	($2.84)	($2.32)	($1.77)	($1.20)	($0.61)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($6.64)*	*$10.69*	*$28.03*	*$28.35*	*$28.68*	*$29.03*	*$29.39*	*$29.76*	*$30.15*	*$30.55*	*$30.97*	*$31.40*	*$31.86*	*$32.33*	*$32.81*	*$33.32*	*$33.85*	*$34.39*	*$34.96*	*$35.55*	*$36.16*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$2.56	($4.12)	($10.79)	($10.92)	($11.04)	($11.18)	($11.31)	($11.46)	($11.61)	($11.76)	($11.92)	($12.09)	($12.26)	($12.45)	($12.63)	($12.83)	($13.03)	($13.24)	($13.46)	($13.69)	($13.92)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.08)*	*$6.57*	*$17.24*	*$17.44*	*$17.64*	*$17.85*	*$18.07*	*$18.30*	*$18.54*	*$18.79*	*$19.05*	*$19.31*	*$19.59*	*$19.88*	*$20.18*	*$20.49*	*$20.82*	*$21.15*	*$21.50*	*$21.86*	*$22.24*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$5.37	$5.19	$5.00	$4.80	$4.60	$4.39	$4.17	$3.94	$3.70	$3.45	$3.19	$2.93	$2.65	$2.36	$2.06	$1.75	$1.43	$1.09	$0.74	$0.38	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.43)	($2.87)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)	($4.30)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.03	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.42)	($2.83)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)	($4.25)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.42)	($1.42)	($1.42)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$14.81	$25.28	$35.76	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18
III. Terminal Year Cash Flows																										
Salvage Value																										$22.40
Recovery of Net Working Capital																										$4.25
Total Termination Cash Flows																										$26.65
IV. Net Cash Flows	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	$14.81	$25.28	$35.76	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$37.18	$63.83
Cumulative Cash Flows	($89.61)	($179.21)	($268.82)	($358.43)	($448.04)	($433.23)	($407.94)	($372.19)	($335.01)	($297.84)	($260.66)	($223.49)	($186.31)	($149.13)	($111.96)	($74.78)	($37.61)	($0.43)	$36.74	$73.92	$111.09	$148.27	$185.44	$222.62	$259.79	$323.62
V. Cost Stream	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	($2.64)	($9.62)	($16.59)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	($15.18)	$11.48

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($35)
Net Present Value of Revenue Flows (at 5%)	$512
Net Present Value of Cost Flows (at 5%)	($547)
Net Present Value of Output Stream (at 5%)	267,279

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$2.05
Levelized Revenue	$1.92
Levelized Profit	($0.13)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Jasper Aquifer System**
Alternative:	**Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	30,375	Million Gallons per Year	
Water Price:	$1.92	Per Thousand Gallons	
Total Capital Costs:	$492.84		**<= Increased by 10% compared to base case**
Total O&M Costs:	$1.25		
Years to Construct	5		
Years Required to Reach 100% Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($98.57)	($98.57)	($98.57)	($98.57)	($98.57)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$19.39	$38.78	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.42)	($0.84)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$18.97*	*$37.94*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($9.61)	($9.28)	($8.95)	($8.59)	($8.23)	($7.85)	($7.45)	($7.04)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($7.07)*	*$12.23*	*$31.54*	*$31.89*	*$32.26*	*$32.64*	*$33.03*	*$33.44*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$2.72	($4.71)	($12.14)	($12.28)	($12.42)	($12.57)	($12.72)	($12.88)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.35)*	*$7.52*	*$19.40*	*$19.61*	*$19.84*	*$20.07*	*$20.32*	*$20.57*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$5.91	$5.71	$5.50	$5.28	$5.06	$4.83	$4.58	$4.33
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.59)	($3.19)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.03	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.58)	($3.15)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.58)	($1.58)	($1.58)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$16.42	$28.08	$39.75	$41.33	$41.33	$41.33	$41.33	$41.33
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($98.57)	($98.57)	($98.57)	($98.57)	($98.57)	$16.42	$28.08	$39.75	$41.33	$41.33	$41.33	$41.33	$41.33
Cumulative Cash Flows	($98.57)	($197.14)	($295.70)	($394.27)	($492.84)	($476.42)	($448.34)	($408.59)	($367.26)	($325.93)	($284.61)	($243.28)	($201.95)
V. Cost Stream	($98.57)	($98.57)	($98.57)	($98.57)	($98.57)	($2.97)	($10.70)	($18.42)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*
Depreciation	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)	($16.43)
Debt Interest Payment	($6.62)	($6.17)	($5.71)	($5.24)	($4.74)	($4.22)	($3.69)	($3.13)	($2.55)	($1.95)	($1.32)	($0.67)	$0.00
Taxable Income	*$33.87*	*$34.31*	*$34.77*	*$35.25*	*$35.75*	*$36.27*	*$36.80*	*$37.36*	*$37.94*	*$38.54*	*$39.16*	*$39.81*	*$40.49*
Income Tax	($13.04)	($13.21)	($13.39)	($13.57)	($13.76)	($13.96)	($14.17)	($14.38)	($14.61)	($14.84)	($15.08)	($15.33)	($15.59)
Net Operating Income	*$20.83*	*$21.10*	*$21.39*	*$21.68*	*$21.99*	*$22.30*	*$22.63*	*$22.98*	*$23.33*	*$23.70*	*$24.09*	*$24.48*	*$24.90*
B. Add Back Items													
Depreciation	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43	$16.43
After Tax Interest on Debt	$4.07	$3.80	$3.51	$3.22	$2.91	$2.60	$2.27	$1.92	$1.57	$1.20	$0.81	$0.41	$0.00
C. Change in Net Working Capital													
Receivables	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33
III. Terminal Year Cash Flows													
Salvage Value													$24.64
Recovery of Net Working Capital													$4.73
Total Termination Cash Flows													$29.37
IV. Net Cash Flows	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$41.33	$70.70
Cumulative Cash Flows	($160.62)	($119.29)	($77.97)	($36.64)	$4.69	$46.02	$87.34	$128.67	$170.00	$211.33	$252.66	$293.98	$364.68
V. Cost Stream	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	($16.84)	$12.53

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($34)
Net Present Value of Revenue Flows (at 5%)	$569
Net Present Value of Cost Flows (at 5%)	($603)
Net Present Value of Output Stream (at 5%)	296,976
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$2.03
Levelized Revenue	$1.92
Levelized Profit	($0.11)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Jasper Aquifer System**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$448.04	
Total O&M Costs:	$1.38	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$19.39	$38.78	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.46)	($0.92)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$18.93*	*$37.86*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($8.74)	($8.44)	($8.13)	($7.81)	($7.48)	($7.13)	($6.78)	($6.40)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.74)*	*$14.49*	*$33.72*	*$34.04*	*$34.38*	*$34.72*	*$35.08*	*$35.45*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.83	($5.58)	($12.98)	($13.11)	($13.23)	($13.37)	($13.51)	($13.65)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.92)*	*$8.91*	*$20.74*	*$20.94*	*$21.14*	*$21.35*	*$21.57*	*$21.80*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$5.37	$5.19	$5.00	$4.80	$4.60	$4.39	$4.17	$3.94
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.59)	($3.19)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.04	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.57)	($3.15)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($1.57)	($1.57)	($1.57)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$15.82	$27.46	$39.10	$40.68	$40.68	$40.68	$40.68	$40.68
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	$15.82	$27.46	$39.10	$40.68	$40.68	$40.68	$40.68	$40.68
Cumulative Cash Flows	($89.61)	($179.21)	($268.82)	($358.43)	($448.04)	($432.22)	($404.76)	($365.66)	($324.98)	($284.31)	($243.63)	($202.96)	($162.28)
V. Cost Stream	($89.61)	($89.61)	($89.61)	($89.61)	($89.61)	($3.57)	($11.32)	($19.07)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)	($1.38)
Earnings Before Depreciation and Tax	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*	*$56.79*
Depreciation	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	($6.01)	($5.61)	($5.19)	($4.76)	($4.31)	($3.84)	($3.35)	($2.84)	($2.32)	($1.77)	($1.20)	($0.61)	$0.00
Taxable Income	*$35.84*	*$36.24*	*$36.66*	*$37.10*	*$37.55*	*$38.02*	*$38.50*	*$39.01*	*$39.54*	*$40.08*	*$40.65*	*$41.24*	*$41.86*
Income Tax	($13.80)	($13.95)	($14.11)	($14.28)	($14.46)	($14.64)	($14.82)	($15.02)	($15.22)	($15.43)	($15.65)	($15.88)	($16.11)
Net Operating Income	*$22.04*	*$22.29*	*$22.55*	*$22.81*	*$23.09*	*$23.38*	*$23.68*	*$23.99*	*$24.32*	*$24.65*	*$25.00*	*$25.36*	*$25.74*
B. Add Back Items													
Depreciation	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$3.70	$3.45	$3.19	$2.93	$2.65	$2.36	$2.06	$1.75	$1.43	$1.09	$0.74	$0.38	$0.00
C. Change in Net Working Capital													
Receivables	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06	$0.06
Net Working Capital	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)	($4.72)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68
III. Terminal Year Cash Flows													
Salvage Value													$22.40
Recovery of Net Working Capital													$4.72
Total Termination Cash Flows													$27.13
IV. Net Cash Flows	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$40.68	$67.80
Cumulative Cash Flows	($121.61)	($80.93)	($40.25)	$0.42	$41.10	$81.77	$122.45	$163.12	$203.80	$244.48	$285.15	$325.83	$393.63
V. Cost Stream	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	($17.49)	$9.63

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$569
Net Present Value of Cost Flows (at 5%)	($569)
Net Present Value of Output Stream (at 5%)	296,976

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	($0.00)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Jasper Aquifer System
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$448.04	
Total O&M Costs:	$1.25	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($74.67)	($74.67)	($74.67)	($74.67)	($74.67)	($74.67)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$19.39	$38.78	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.42)	($0.84)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$18.97*	*$37.94*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($8.74)	($8.44)	($8.13)	($7.81)	($7.48)	($7.13)	($6.78)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($4.70)*	*$14.57*	*$33.85*	*$34.17*	*$34.50*	*$34.85*	*$35.21*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.81	($5.61)	($13.03)	($13.15)	($13.28)	($13.42)	($13.55)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.89)*	*$8.96*	*$20.82*	*$21.01*	*$21.22*	*$21.43*	*$21.65*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.37	$5.19	$5.00	$4.80	$4.60	$4.39	$4.17
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.59)	($3.19)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.03	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.58)	($3.15)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.58)	($1.58)	($1.58)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$15.84	$27.51	$39.18	$40.75	$40.75	$40.75	$40.75
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($74.67)	($74.67)	($74.67)	($74.67)	($74.67)	($74.67)	$15.84	$27.51	$39.18	$40.75	$40.75	$40.75	$40.75
Cumulative Cash Flows	($74.67)	($149.35)	($224.02)	($298.69)	($373.36)	($448.04)	($432.19)	($404.69)	($365.51)	($324.76)	($284.00)	($243.25)	($202.50)
V. Cost Stream	($74.67)	($74.67)	($74.67)	($74.67)	($74.67)	($74.67)	($3.55)	($11.27)	($18.99)	($17.42)	($17.42)	($17.42)	($17.42)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17	$58.17
Operating Expenses	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)	($1.25)
Earnings Before Depreciation and Tax	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*	*$56.92*
Depreciation	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)	($14.93)
Debt Interest Payment	($6.40)	($6.01)	($5.61)	($5.19)	($4.76)	($4.31)	($3.84)	($3.35)	($2.84)	($2.32)	($1.77)	($1.20)	($0.61)
Taxable Income	*$35.58*	*$35.97*	*$36.37*	*$36.79*	*$37.22*	*$37.67*	*$38.14*	*$38.63*	*$39.14*	*$39.66*	*$40.21*	*$40.78*	*$41.37*
Income Tax	($13.70)	($13.85)	($14.00)	($14.16)	($14.33)	($14.50)	($14.68)	($14.87)	($15.07)	($15.27)	($15.48)	($15.70)	($15.93)
Net Operating Income	*$21.88*	*$22.12*	*$22.37*	*$22.62*	*$22.89*	*$23.17*	*$23.46*	*$23.76*	*$24.07*	*$24.39*	*$24.73*	*$25.08*	*$25.44*
B. Add Back Items													
Depreciation	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93	$14.93
After Tax Interest on Debt	$3.94	$3.70	$3.45	$3.19	$2.93	$2.65	$2.36	$2.06	$1.75	$1.43	$1.09	$0.74	$0.38
C. Change in Net Working Capital													
Receivables	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)	($4.78)
Payables	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05	$0.05
Net Working Capital	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)	($4.73)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75
III. Terminal Year Cash Flows													
Salvage Value													$22.40
Recovery of Net Working Capital													$4.73
Total Termination Cash Flows													$27.13
IV. Net Cash Flows	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$40.75	$67.88
Cumulative Cash Flows	($161.75)	($120.99)	($80.24)	($39.49)	$1.27	$42.02	$82.77	$123.52	$164.28	$205.03	$245.78	$286.53	$354.42
V. Cost Stream	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	($17.42)	$9.71

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($21)
Net Present Value of Revenue Flows (at 5%)	$525
Net Present Value of Cost Flows (at 5%)	($546)
Net Present Value of Output Stream (at 5%)	274,292
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.99
Levelized Revenue	$1.92
Levelized Profit	($0.08)

SUMMARY AND SENSITIVITY ANALYSIS FOR JASPER AQUIFER SYSTEM: RESERVOIRS FOR RAII

Aquifer: **Jasper Aquifer System**
Alternative: **Reservoirs for Rainharvesting**

Table x: The Results of Sensitivity Analysis for theJasper Aquifer System: Reservoirs for Rainharvesting Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.2%	1.5
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	5.0%	0.0
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

NHARVESTING ALTERNATIVE

BASE CASE - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: PIPELINE CONVEYANCE OF RED RIVER WATER ALTERNATIVE

Aquifer:	**Jasper Aquifer System**
Alternative:	**Pipeline Conveyance of Red River Water**

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	**$1.31**	Per Thousand Gallons
Total Capital Costs:	$224.20	
Total O&M Costs:	$11.21	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$13.24	$26.48	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($3.74)	($7.47)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$9.50*	*$19.01*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($4.37)	($4.22)	($4.07)	($3.91)	($3.74)	($3.57)	($3.39)	($3.20)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.34)*	*$7.31*	*$16.97*	*$17.13*	*$17.30*	*$17.47*	*$17.65*	*$17.84*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	($2.82)	($6.53)	($6.60)	($6.66)	($6.73)	($6.80)	($6.87)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.44)*	*$4.50*	*$10.44*	*$10.54*	*$10.64*	*$10.74*	*$10.85*	*$10.97*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.69	$2.60	$2.50	$2.40	$2.30	$2.20	$2.09	$1.97
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.09)	($2.18)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.31	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.93)	($1.87)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.93)	($0.93)	($0.93)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$7.79	$13.63	$19.48	$20.41	$20.41	$20.41	$20.41	$20.41
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	$7.79	$13.63	$19.48	$20.41	$20.41	$20.41	$20.41	$20.41
Cumulative Cash Flows	($44.84)	($89.68)	($134.52)	($179.36)	($224.20)	($216.41)	($202.78)	($183.30)	($162.89)	($142.47)	($122.06)	($101.65)	($81.23)
V. Cost Stream	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	($5.45)	($12.85)	($20.25)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*
Depreciation	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	($3.01)	($2.81)	($2.60)	($2.38)	($2.16)	($1.92)	($1.68)	($1.42)	($1.16)	($0.89)	($0.60)	($0.31)	$0.00
Taxable Income	*$18.03*	*$18.23*	*$18.44*	*$18.66*	*$18.88*	*$19.12*	*$19.36*	*$19.62*	*$19.88*	*$20.15*	*$20.44*	*$20.73*	*$21.04*
Income Tax	($6.94)	($7.02)	($7.10)	($7.18)	($7.27)	($7.36)	($7.45)	($7.55)	($7.65)	($7.76)	($7.87)	($7.98)	($8.10)
Net Operating Income	*$11.09*	*$11.21*	*$11.34*	*$11.48*	*$11.61*	*$11.76*	*$11.91*	*$12.06*	*$12.23*	*$12.39*	*$12.57*	*$12.75*	*$12.94*
B. Add Back Items													
Depreciation	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$1.85	$1.73	$1.60	$1.46	$1.33	$1.18	$1.03	$0.88	$0.71	$0.55	$0.37	$0.19	$0.00
C. Change in Net Working Capital													
Receivables	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41
III. Terminal Year Cash Flows													
Salvage Value													$11.21
Recovery of Net Working Capital													$2.80
Total Termination Cash Flows													$14.01
IV. Net Cash Flows	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$34.43
Cumulative Cash Flows	($60.82)	($40.41)	($20.00)	$0.42	$20.83	$41.24	$61.66	$82.07	$102.48	$122.90	$143.31	$163.72	$198.15
V. Cost Stream	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($5.30)

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$388
Net Present Value of Cost Flows (at 5%)	($388)
Net Present Value of Output Stream (at 5%)	296,976

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.31
Levelized Revenue	$1.31
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: PIPELINE CONVEYANCE OF RED RIVER WATER ALTERNATIVE

Aquifer: **Jasper Aquifer System**
Alternative: **Pipeline Conveyance of Red River Water**

Parameters:

Water Supplied:	27,338	Million Gallons per Year	**<= Reduced by 10% compared to base case**
Water Price:	$1.31	Per Thousand Gallons	
Total Capital Costs:	$224.20		
Total O&M Costs:	$11.21		
Years to Construct	5		
Years Required to Reach 100%			
Capacity	2		

All Monetary Amounts in Millions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	9,113	18,225	27,338	27,338	27,338	27,338	27,338	27,338
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$11.92	$23.83	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($3.74)	($7.47)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$8.18*	*$16.36*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($4.37)	($4.22)	($4.07)	($3.91)	($3.74)	($3.57)	($3.39)	($3.20)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($3.66)*	*$4.66*	*$13.00*	*$13.16*	*$13.33*	*$13.50*	*$13.68*	*$13.86*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	($1.80)	($5.00)	($5.07)	($5.13)	($5.20)	($5.27)	($5.34)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.25)*	*$2.87*	*$7.99*	*$8.09*	*$8.19*	*$8.30*	*$8.41*	*$8.53*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.69	$2.60	$2.50	$2.40	$2.30	$2.20	$2.09	$1.97
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.98)	($1.96)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.31	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.83)	($1.65)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.83)	($0.83)	($0.83)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$7.08	$12.11	$17.14	$17.97	$17.97	$17.97	$17.97	$17.97
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	$7.08	$12.11	$17.14	$17.97	$17.97	$17.97	$17.97	$17.97
Cumulative Cash Flows	($44.84)	($89.68)	($134.52)	($179.36)	($224.20)	($217.12)	($205.00)	($187.86)	($169.89)	($151.92)	($133.95)	($115.98)	($98.01)
V. Cost Stream	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	($4.83)	($11.72)	($18.61)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338	27,338
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75	$35.75
Operating Expenses	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*	*$24.54*
Depreciation	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	($3.01)	($2.81)	($2.60)	($2.38)	($2.16)	($1.92)	($1.68)	($1.42)	($1.16)	($0.89)	($0.60)	($0.31)	$0.00
Taxable Income	*$14.06*	*$14.26*	*$14.47*	*$14.69*	*$14.91*	*$15.15*	*$15.39*	*$15.64*	*$15.91*	*$16.18*	*$16.47*	*$16.76*	*$17.07*
Income Tax	($5.41)	($5.49)	($5.57)	($5.65)	($5.74)	($5.83)	($5.93)	($6.02)	($6.12)	($6.23)	($6.34)	($6.45)	($6.57)
Net Operating Income	*$8.65*	*$8.77*	*$8.90*	*$9.03*	*$9.17*	*$9.32*	*$9.47*	*$9.62*	*$9.78*	*$9.95*	*$10.13*	*$10.31*	*$10.50*
B. Add Back Items													
Depreciation	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$1.85	$1.73	$1.60	$1.46	$1.33	$1.18	$1.03	$0.88	$0.71	$0.55	$0.37	$0.19	$0.00
C. Change in Net Working Capital													
Receivables	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)	($2.94)
Payables	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)	($2.48)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97
III. Terminal Year Cash Flows													
Salvage Value													$11.21
Recovery of Net Working Capital													$2.48
Total Termination Cash Flows													$13.69
IV. Net Cash Flows	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$17.97	$31.66
Cumulative Cash Flows	($80.04)	($62.07)	($44.10)	($26.13)	($8.16)	$9.81	$27.78	$45.75	$63.72	$81.69	$99.66	$117.63	$149.29
V. Cost Stream	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($17.78)	($4.09)

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.0%
Net Present Value of Net Cash Flows (at 5%)	($24)
Net Present Value of Revenue Flows (at 5%)	$350
Net Present Value of Cost Flows (at 5%)	($373)
Net Present Value of Output Stream (at 5%)	267,279

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.40
Levelized Revenue	$1.31
Levelized Profit	($0.09)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: PIPELINE CONVEYANCE OF RED RIVER WATER ALTERNATIVE

Aquifer:	**Jasper Aquifer System**	
Alternative:	**Pipeline Conveyance of Red River Water**	
Parameters:		
Water Supplied:	30,375	Million Gallons per Year
Water Price:	**$1.31**	Per Thousand Gallons
Total Capital Costs:	**$246.62**	**<= Increased by 10% compared to base case**
Total O&M Costs:	$11.21	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($49.32)	($49.32)	($49.32)	($49.32)	($49.32)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$13.24	$26.48	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($3.74)	($7.47)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$9.50*	*$19.01*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($4.81)	($4.65)	($4.48)	($4.30)	($4.12)	($3.93)	($3.73)	($3.52)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($3.53)*	*$6.14*	*$15.82*	*$15.99*	*$16.18*	*$16.37*	*$16.56*	*$16.77*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.36	($2.36)	($6.09)	($6.16)	($6.23)	($6.30)	($6.38)	($6.46)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.17)*	*$3.78*	*$9.73*	*$9.84*	*$9.95*	*$10.07*	*$10.19*	*$10.31*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.96	$2.86	$2.75	$2.64	$2.53	$2.42	$2.29	$2.17
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.09)	($2.18)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.31	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.93)	($1.87)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.93)	($0.93)	($0.93)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$8.08	$13.92	$19.77	$20.70	$20.70	$20.70	$20.70	$20.70
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($49.32)	($49.32)	($49.32)	($49.32)	($49.32)	$8.08	$13.92	$19.77	$20.70	$20.70	$20.70	$20.70	$20.70
Cumulative Cash Flows	($49.32)	($98.65)	($147.97)	($197.30)	($246.62)	($238.54)	($224.62)	($204.86)	($184.16)	($163.46)	($142.75)	($122.05)	($101.35)
V. Cost Stream	($49.32)	($49.32)	($49.32)	($49.32)	($49.32)	($5.17)	($12.56)	($19.96)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*
Depreciation	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)	($8.22)
Debt Interest Payment	($3.31)	($3.09)	($2.86)	($2.62)	($2.37)	($2.11)	($1.84)	($1.57)	($1.28)	($0.98)	($0.66)	($0.34)	$0.00
Taxable Income	*$16.98*	*$17.20*	*$17.43*	*$17.67*	*$17.92*	*$18.18*	*$18.45*	*$18.73*	*$19.02*	*$19.32*	*$19.63*	*$19.96*	*$20.29*
Income Tax	($6.54)	($6.62)	($6.71)	($6.80)	($6.90)	($7.00)	($7.10)	($7.21)	($7.32)	($7.44)	($7.56)	($7.68)	($7.81)
Net Operating Income	*$10.44*	*$10.58*	*$10.72*	*$10.87*	*$11.02*	*$11.18*	*$11.35*	*$11.52*	*$11.70*	*$11.88*	*$12.07*	*$12.27*	*$12.48*
B. Add Back Items													
Depreciation	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22	$8.22
After Tax Interest on Debt	$2.04	$1.90	$1.76	$1.61	$1.46	$1.30	$1.13	$0.96	$0.78	$0.60	$0.41	$0.21	$0.00
C. Change in Net Working Capital													
Receivables	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70
III. Terminal Year Cash Flows													
Salvage Value													$12.33
Recovery of Net Working Capital													$2.80
Total Termination Cash Flows													$15.14
IV. Net Cash Flows	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$20.70	$35.84
Cumulative Cash Flows	($80.65)	($59.95)	($39.25)	($18.55)	$2.15	$22.85	$43.55	$64.25	$84.96	$105.66	$126.36	$147.06	$182.89
V. Cost Stream	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($19.02)	($3.89)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($17)
Net Present Value of Revenue Flows (at 5%)	$388
Net Present Value of Cost Flows (at 5%)	($405)
Net Present Value of Output Stream (at 5%)	296,976
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.37
Levelized Revenue	$1.31
Levelized Profit	($0.06)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: PIPELINE CONVEYANCE OF RED RIVER WATER ALTERNATIVE

Aquifer:	**Jasper Aquifer System**
Alternative:	**Pipeline Conveyance of Red River Water**

Parameters:

Water Supplied:	30,375	Million Gallons per Year	
Water Price:	$1.31	Per Thousand Gallons	
Total Capital Costs:	$224.20		
Total O&M Costs:	$12.33		**<= Increased by 10% compared to base case**
Years to Construct	5		
Years Required to Reach 100% Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$13.24	$26.48	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($4.11)	($8.22)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$9.13*	*$18.26*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($4.37)	($4.22)	($4.07)	($3.91)	($3.74)	($3.57)	($3.39)	($3.20)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.71)*	*$6.56*	*$15.85*	*$16.01*	*$16.18*	*$16.35*	*$16.53*	*$16.72*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$1.05	($2.53)	($6.10)	($6.16)	($6.23)	($6.29)	($6.36)	($6.44)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.67)*	*$4.04*	*$9.75*	*$9.85*	*$9.95*	*$10.05*	*$10.17*	*$10.28*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.69	$2.60	$2.50	$2.40	$2.30	$2.20	$2.09	$1.97
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($1.09)	($2.18)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.17	$0.34	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($1.84)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.92)	($0.92)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$7.57	$13.19	$18.80	$19.72	$19.72	$19.72	$19.72	$19.72
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	$7.57	$13.19	$18.80	$19.72	$19.72	$19.72	$19.72	$19.72
Cumulative Cash Flows	($44.84)	($89.68)	($134.52)	($179.36)	($224.20)	($216.63)	($203.44)	($184.63)	($164.91)	($145.19)	($125.46)	($105.74)	($86.01)
V. Cost Stream	($44.84)	($44.84)	($44.84)	($44.84)	($44.84)	($5.67)	($13.29)	($20.92)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)	($12.33)
Earnings Before Depreciation and Tax	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*	*$27.39*
Depreciation	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	($3.01)	($2.81)	($2.60)	($2.38)	($2.16)	($1.92)	($1.68)	($1.42)	($1.16)	($0.89)	($0.60)	($0.31)	$0.00
Taxable Income	*$16.91*	*$17.11*	*$17.32*	*$17.54*	*$17.76*	*$18.00*	*$18.24*	*$18.50*	*$18.76*	*$19.03*	*$19.32*	*$19.61*	*$19.92*
Income Tax	($6.51)	($6.59)	($6.67)	($6.75)	($6.84)	($6.93)	($7.02)	($7.12)	($7.22)	($7.33)	($7.44)	($7.55)	($7.67)
Net Operating Income	*$10.40*	*$10.52*	*$10.65*	*$10.79*	*$10.92*	*$11.07*	*$11.22*	*$11.37*	*$11.54*	*$11.71*	*$11.88*	*$12.06*	*$12.25*
B. Add Back Items													
Depreciation	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$1.85	$1.73	$1.60	$1.46	$1.33	$1.18	$1.03	$0.88	$0.71	$0.55	$0.37	$0.19	$0.00
C. Change in Net Working Capital													
Receivables	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51	$0.51
Net Working Capital	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)	($2.76)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72
III. Terminal Year Cash Flows													
Salvage Value													$11.21
Recovery of Net Working Capital													$2.76
Total Termination Cash Flows													$13.97
IV. Net Cash Flows	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$19.72	$33.69
Cumulative Cash Flows	($66.29)	($46.57)	($26.84)	($7.12)	$12.60	$32.33	$52.05	$71.78	$91.50	$111.22	$130.95	$150.67	$184.36
V. Cost Stream	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($20.00)	($6.03)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.7%
Net Present Value of Net Cash Flows (at 5%)	($7)
Net Present Value of Revenue Flows (at 5%)	$388
Net Present Value of Cost Flows (at 5%)	($395)
Net Present Value of Output Stream (at 5%)	296,976
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.33
Levelized Revenue	$1.31
Levelized Profit	($0.02)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR JASPER AQUIFER SYSTEM: PIPELINE CONVEYANCE OF RED RIVER WATER ALTERNATIVE

Aquifer: Jasper Aquifer System
Alternative: Pipeline Conveyance of Red River Water

Parameters:

Water Supplied:	30,375	Million Gallons per Year
Water Price:	$1.31	Per Thousand Gallons
Total Capital Costs:	$224.20	
Total O&M Costs:	$11.21	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	10,125	20,250	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($37.37)	($37.37)	($37.37)	($37.37)	($37.37)	($37.37)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$13.24	$26.48	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($3.74)	($7.47)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$9.50*	*$19.01*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($4.37)	($4.22)	($4.07)	($3.91)	($3.74)	($3.57)	($3.39)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.34)*	*$7.31*	*$16.97*	*$17.13*	*$17.30*	*$17.47*	*$17.65*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.90	($2.82)	($6.53)	($6.60)	($6.66)	($6.73)	($6.80)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.44)*	*$4.50*	*$10.44*	*$10.54*	*$10.64*	*$10.74*	*$10.85*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.69	$2.60	$2.50	$2.40	$2.30	$2.20	$2.09
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.09)	($2.18)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.15	$0.31	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.93)	($1.87)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.93)	($0.93)	($0.93)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$7.79	$13.63	$19.48	$20.41	$20.41	$20.41	$20.41
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($37.37)	($37.37)	($37.37)	($37.37)	($37.37)	($37.37)	$7.79	$13.63	$19.48	$20.41	$20.41	$20.41	$20.41
Cumulative Cash Flows	($37.37)	($74.73)	($112.10)	($149.47)	($186.83)	($224.20)	($216.41)	($202.78)	($183.30)	($162.89)	($142.47)	($122.06)	($101.65)
V. Cost Stream	($37.37)	($37.37)	($37.37)	($37.37)	($37.37)	($37.37)	($5.45)	($12.85)	($20.25)	($19.31)	($19.31)	($19.31)	($19.31)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375	30,375
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72	$39.72
Operating Expenses	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)	($11.21)
Earnings Before Depreciation and Tax	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*	*$28.51*
Depreciation	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)	($7.47)
Debt Interest Payment	($3.20)	($3.01)	($2.81)	($2.60)	($2.38)	($2.16)	($1.92)	($1.68)	($1.42)	($1.16)	($0.89)	($0.60)	($0.31)
Taxable Income	*$17.84*	*$18.03*	*$18.23*	*$18.44*	*$18.66*	*$18.88*	*$19.12*	*$19.36*	*$19.62*	*$19.88*	*$20.15*	*$20.44*	*$20.73*
Income Tax	($6.87)	($6.94)	($7.02)	($7.10)	($7.18)	($7.27)	($7.36)	($7.45)	($7.55)	($7.65)	($7.76)	($7.87)	($7.98)
Net Operating Income	*$10.97*	*$11.09*	*$11.21*	*$11.34*	*$11.48*	*$11.61*	*$11.76*	*$11.91*	*$12.06*	*$12.23*	*$12.39*	*$12.57*	*$12.75*
B. Add Back Items													
Depreciation	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47	$7.47
After Tax Interest on Debt	$1.97	$1.85	$1.73	$1.60	$1.46	$1.33	$1.18	$1.03	$0.88	$0.71	$0.55	$0.37	$0.19
C. Change in Net Working Capital													
Receivables	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)	($3.26)
Payables	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46	$0.46
Net Working Capital	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)	($2.80)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41
III. Terminal Year Cash Flows													
Salvage Value													$11.21
Recovery of Net Working Capital													$2.80
Total Termination Cash Flows													$14.01
IV. Net Cash Flows	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$20.41	$34.43
Cumulative Cash Flows	($81.23)	($60.82)	($40.41)	($20.00)	$0.42	$20.83	$41.24	$61.66	$82.07	$102.48	$122.90	$143.31	$177.74
V. Cost Stream	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($19.31)	($5.30)

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($11)
Net Present Value of Revenue Flows (at 5%)	$359
Net Present Value of Cost Flows (at 5%)	($369)
Net Present Value of Output Stream (at 5%)	274,292

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.35
Levelized Revenue	$1.31
Levelized Profit	($0.04)

SUMMARY AND SENSITIVITY ANALYSIS FOR JASPER AQUIFER SYSTEM: PIPELINE CON

Aquifer: **Jasper Aquifer System**
Alternative: **Pipeline Conveyance of Red River Wate**

Table x: The Results of Sensitivity Analysis for theJasper Aquifer System: Pipeline Conveyance of Red River

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.0%	2.1
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.7%	0.6
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

NVEYANCE OF RED RIVER WATER ALTERNATIVE

r

' Water Alternative

BASE CASE - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Cockfield Aquifer
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$6.39	
Total O&M Costs:	$0.88	
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$1.13	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.58)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.27*	*$0.54*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.12)	($0.12)	($0.12)	($0.11)	($0.11)	($0.10)	($0.10)	($0.09)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.07)*	*$0.21*	*$0.49*	*$0.49*	*$0.49*	*$0.50*	*$0.50*	*$0.51*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	($0.08)	($0.19)	($0.19)	($0.19)	($0.19)	($0.19)	($0.20)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.04)*	*$0.13*	*$0.30*	*$0.30*	*$0.30*	*$0.31*	*$0.31*	*$0.31*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08	$0.07	$0.07	$0.07	$0.07	$0.06	$0.06	$0.06
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.09)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.07)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.03)	($0.03)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.21	$0.38	$0.55	$0.58	$0.58	$0.58	$0.58	$0.58
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	$0.21	$0.38	$0.55	$0.58	$0.58	$0.58	$0.58	$0.58
Cumulative Cash Flows	($1.28)	($2.56)	($3.83)	($5.11)	($6.39)	($6.17)	($5.79)	($5.24)	($4.66)	($4.08)	($3.50)	($2.91)	($2.33)
V. Cost Stream	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	($0.35)	($0.74)	($1.14)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69
Operating Expenses	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*
Depreciation	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)
Debt Interest Payment	($0.09)	($0.08)	($0.07)	($0.07)	($0.06)	($0.05)	($0.05)	($0.04)	($0.03)	($0.03)	($0.02)	($0.01)	$0.00
Taxable Income	*$0.52*	*$0.52*	*$0.53*	*$0.53*	*$0.54*	*$0.55*	*$0.55*	*$0.56*	*$0.57*	*$0.58*	*$0.58*	*$0.59*	*$0.60*
Income Tax	($0.20)	($0.20)	($0.20)	($0.21)	($0.21)	($0.21)	($0.21)	($0.22)	($0.22)	($0.22)	($0.22)	($0.23)	($0.23)
Net Operating Income	*$0.32*	*$0.32*	*$0.32*	*$0.33*	*$0.33*	*$0.34*	*$0.34*	*$0.34*	*$0.35*	*$0.35*	*$0.36*	*$0.36*	*$0.37*
B. Add Back Items													
Depreciation	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
After Tax Interest on Debt	$0.05	$0.05	$0.05	$0.04	$0.04	$0.03	$0.03	$0.02	$0.02	$0.02	$0.01	$0.01	$0.00
C. Change in Net Working Capital													
Receivables	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)
Payables	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58
III. Terminal Year Cash Flows													
Salvage Value													$0.32
Recovery of Net Working Capital													$0.10
Total Termination Cash Flows													$0.42
IV. Net Cash Flows	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$1.01
Cumulative Cash Flows	($1.75)	($1.16)	($0.58)	$0.00	$0.58	$1.17	$1.75	$2.33	$2.91	$3.50	$4.08	$4.66	$5.67
V. Cost Stream	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($0.68)

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$17
Net Present Value of Cost Flows (at 5%)	($17)
Net Present Value of Output Stream (at 5%)	11,098
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.49
Levelized Revenue	$1.49
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	**Cockfield Aquifer**
Alternative:	**Waste Water Recycling**

Parameters:

Water Supplied:	1,022 Million Gallons per Year	**<= Reduced by 10% compared to base case**
Water Price:	$1.49 Per Thousand Gallons	
Total Capital Costs:	$6.39	
Total O&M Costs:	$0.88	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	341	681	1,022	1,022	1,022	1,022	1,022	1,022
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.51	$1.01	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.58)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.22*	*$0.43*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.12)	($0.12)	($0.12)	($0.11)	($0.11)	($0.10)	($0.10)	($0.09)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.12)*	*$0.10*	*$0.32*	*$0.32*	*$0.33*	*$0.33*	*$0.34*	*$0.34*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	($0.04)	($0.12)	($0.12)	($0.13)	($0.13)	($0.13)	($0.13)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.08)*	*$0.06*	*$0.19*	*$0.20*	*$0.20*	*$0.20*	*$0.21*	*$0.21*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08	$0.07	$0.07	$0.07	$0.07	$0.06	$0.06	$0.06
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.04)	($0.08)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.06)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.03)	($0.03)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.18	$0.32	$0.45	$0.48	$0.48	$0.48	$0.48	$0.48
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	$0.18	$0.32	$0.45	$0.48	$0.48	$0.48	$0.48	$0.48
Cumulative Cash Flows	($1.28)	($2.56)	($3.83)	($5.11)	($6.39)	($6.20)	($5.89)	($5.44)	($4.96)	($4.48)	($4.00)	($3.52)	($3.04)
V. Cost Stream	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	($0.32)	($0.70)	($1.07)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52
Operating Expenses	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*	*$0.65*
Depreciation	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)
Debt Interest Payment	($0.09)	($0.08)	($0.07)	($0.07)	($0.06)	($0.05)	($0.05)	($0.04)	($0.03)	($0.03)	($0.02)	($0.01)	$0.00
Taxable Income	*$0.35*	*$0.35*	*$0.36*	*$0.36*	*$0.37*	*$0.38*	*$0.38*	*$0.39*	*$0.40*	*$0.41*	*$0.42*	*$0.42*	*$0.43*
Income Tax	($0.13)	($0.14)	($0.14)	($0.14)	($0.14)	($0.15)	($0.15)	($0.15)	($0.15)	($0.16)	($0.16)	($0.16)	($0.17)
Net Operating Income	*$0.21*	*$0.22*	*$0.22*	*$0.22*	*$0.23*	*$0.23*	*$0.24*	*$0.24*	*$0.25*	*$0.25*	*$0.26*	*$0.26*	*$0.27*
B. Add Back Items													
Depreciation	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
After Tax Interest on Debt	$0.05	$0.05	$0.05	$0.04	$0.04	$0.03	$0.03	$0.02	$0.02	$0.02	$0.01	$0.01	$0.00
C. Change in Net Working Capital													
Receivables	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)	($0.12)
Payables	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)	($0.09)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48
III. Terminal Year Cash Flows													
Salvage Value													$0.32
Recovery of Net Working Capital													$0.09
Total Termination Cash Flows													$0.41
IV. Net Cash Flows	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.48	$0.89
Cumulative Cash Flows	($2.57)	($2.09)	($1.61)	($1.13)	($0.65)	($0.17)	$0.31	$0.79	$1.27	$1.74	$2.22	$2.70	$3.59
V. Cost Stream	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($0.63)

VI. Financial Results	
Payback Period	20
Internal Rate of Return	3.4%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$15
Net Present Value of Cost Flows (at 5%)	($16)
Net Present Value of Output Stream (at 5%)	9,988
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.59
Levelized Revenue	$1.49
Levelized Profit	($0.10)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: **Cockfield Aquifer**
Alternative: **Waste Water Recycling**

Parameters:

Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$7.03	**<= Increased by 10% compared to base case**
Total O&M Costs:	$0.88	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($1.41)	($1.41)	($1.41)	($1.41)	($1.41)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$1.13	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.58)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.27*	*$0.54*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.14)	($0.13)	($0.13)	($0.12)	($0.12)	($0.11)	($0.11)	($0.10)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.10)*	*$0.18*	*$0.45*	*$0.46*	*$0.46*	*$0.47*	*$0.47*	*$0.48*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.04	($0.07)	($0.17)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.06)*	*$0.11*	*$0.28*	*$0.28*	*$0.28*	*$0.29*	*$0.29*	*$0.29*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08	$0.08	$0.08	$0.08	$0.07	$0.07	$0.07	$0.06
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.09)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.07)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.03)	($0.03)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.39	$0.56	$0.59	$0.59	$0.59	$0.59	$0.59
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($1.41)	($1.41)	($1.41)	($1.41)	($1.41)	$0.22	$0.39	$0.56	$0.59	$0.59	$0.59	$0.59	$0.59
Cumulative Cash Flows	($1.41)	($2.81)	($4.22)	($5.62)	($7.03)	($6.81)	($6.42)	($5.86)	($5.27)	($4.68)	($4.09)	($3.49)	($2.90)
V. Cost Stream	($1.41)	($1.41)	($1.41)	($1.41)	($1.41)	($0.34)	($0.74)	($1.13)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69
Operating Expenses	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*
Depreciation	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)	($0.23)
Debt Interest Payment	($0.09)	($0.09)	($0.08)	($0.07)	($0.07)	($0.06)	($0.05)	($0.04)	($0.04)	($0.03)	($0.02)	($0.01)	$0.00
Taxable Income	*$0.49*	*$0.49*	*$0.50*	*$0.51*	*$0.51*	*$0.52*	*$0.53*	*$0.54*	*$0.54*	*$0.55*	*$0.56*	*$0.57*	*$0.58*
Income Tax	($0.19)	($0.19)	($0.19)	($0.19)	($0.20)	($0.20)	($0.20)	($0.21)	($0.21)	($0.21)	($0.22)	($0.22)	($0.22)
Net Operating Income	*$0.30*	*$0.30*	*$0.31*	*$0.31*	*$0.32*	*$0.32*	*$0.32*	*$0.33*	*$0.33*	*$0.34*	*$0.35*	*$0.35*	*$0.36*
B. Add Back Items													
Depreciation	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23	$0.23
After Tax Interest on Debt	$0.06	$0.05	$0.05	$0.05	$0.04	$0.04	$0.03	$0.03	$0.02	$0.02	$0.01	$0.01	$0.00
C. Change in Net Working Capital													
Receivables	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)
Payables	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59
III. Terminal Year Cash Flows													
Salvage Value													$0.35
Recovery of Net Working Capital													$0.10
Total Termination Cash Flows													$0.45
IV. Net Cash Flows	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$0.59	$1.05
Cumulative Cash Flows	($2.31)	($1.72)	($1.13)	($0.54)	$0.05	$0.64	$1.23	$1.82	$2.42	$3.01	$3.60	$4.19	$5.23
V. Cost Stream	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($1.10)	($0.64)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$17
Net Present Value of Cost Flows (at 5%)	($17)
Net Present Value of Output Stream (at 5%)	11,098

VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.53
Levelized Revenue	$1.49
Levelized Profit	($0.04)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Cockfield Aquifer
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$6.39	
Total O&M Costs:	$0.96	<= Increased by 10% compared to base case
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$1.13	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.32)	($0.64)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)	($0.96)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.24*	*$0.48*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*	*$0.73*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.12)	($0.12)	($0.12)	($0.11)	($0.11)	($0.10)	($0.10)	($0.09)	($0.09)	($0.08)	($0.07)	($0.07)	($0.06)	($0.05)	($0.05)	($0.04)	($0.03)	($0.03)	($0.02)	($0.01)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.10)*	*$0.15*	*$0.40*	*$0.40*	*$0.41*	*$0.41*	*$0.42*	*$0.42*	*$0.43*	*$0.43*	*$0.44*	*$0.45*	*$0.45*	*$0.46*	*$0.47*	*$0.47*	*$0.48*	*$0.49*	*$0.50*	*$0.51*	*$0.51*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.04	($0.06)	($0.15)	($0.15)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.17)	($0.17)	($0.17)	($0.17)	($0.18)	($0.18)	($0.18)	($0.19)	($0.19)	($0.19)	($0.19)	($0.20)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.06)*	*$0.09*	*$0.24*	*$0.25*	*$0.25*	*$0.25*	*$0.26*	*$0.26*	*$0.26*	*$0.27*	*$0.27*	*$0.27*	*$0.28*	*$0.28*	*$0.29*	*$0.29*	*$0.30*	*$0.30*	*$0.31*	*$0.31*	*$0.32*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08	$0.07	$0.07	$0.07	$0.07	$0.06	$0.06	$0.06	$0.05	$0.05	$0.05	$0.04	$0.04	$0.03	$0.03	$0.02	$0.02	$0.02	$0.01	$0.01	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.09)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.03	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.07)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.03)	($0.03)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.20	$0.35	$0.50	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53
III. Terminal Year Cash Flows																										
Salvage Value																										$0.32
Recovery of Net Working Capital																										$0.10
Total Termination Cash Flows																										$0.42
IV. Net Cash Flows	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	$0.20	$0.35	$0.50	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.95
Cumulative Cash Flows	($1.28)	($2.56)	($3.83)	($5.11)	($6.39)	($6.19)	($5.84)	($5.35)	($4.82)	($4.29)	($3.76)	($3.23)	($2.70)	($2.17)	($1.65)	($1.12)	($0.59)	($0.06)	$0.47	$1.00	$1.53	$2.06	$2.59	$3.11	$3.64	$4.59
V. Cost Stream	($1.28)	($1.28)	($1.28)	($1.28)	($1.28)	($0.37)	($0.78)	($1.19)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($0.74)

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$17
Net Present Value of Cost Flows (at 5%)	($17)
Net Present Value of Output Stream (at 5%)	11,098

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.54
Levelized Revenue	$1.49
Levelized Profit	($0.05)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Cockfield Aquifer
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$6.39	
Total O&M Costs:	$0.88	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($1.06)	($1.06)	($1.06)	($1.06)	($1.06)	($1.06)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$1.13	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69	$1.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.58)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.27*	*$0.54*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*	*$0.81*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)	($0.21)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.12)	($0.12)	($0.12)	($0.11)	($0.11)	($0.10)	($0.10)	($0.09)	($0.09)	($0.08)	($0.07)	($0.07)	($0.06)	($0.05)	($0.05)	($0.04)	($0.03)	($0.03)	($0.02)	($0.01)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.07)*	*$0.21*	*$0.49*	*$0.49*	*$0.49*	*$0.50*	*$0.50*	*$0.51*	*$0.52*	*$0.52*	*$0.53*	*$0.53*	*$0.54*	*$0.55*	*$0.55*	*$0.56*	*$0.57*	*$0.58*	*$0.58*	*$0.59*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	($0.08)	($0.19)	($0.19)	($0.19)	($0.19)	($0.19)	($0.20)	($0.20)	($0.20)	($0.20)	($0.21)	($0.21)	($0.21)	($0.21)	($0.22)	($0.22)	($0.22)	($0.22)	($0.23)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.04)*	*$0.13*	*$0.30*	*$0.30*	*$0.30*	*$0.31*	*$0.31*	*$0.31*	*$0.32*	*$0.32*	*$0.32*	*$0.33*	*$0.33*	*$0.34*	*$0.34*	*$0.34*	*$0.35*	*$0.35*	*$0.36*	*$0.36*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.08	$0.07	$0.07	$0.07	$0.07	$0.06	$0.06	$0.06	$0.05	$0.05	$0.05	$0.04	$0.04	$0.03	$0.03	$0.02	$0.02	$0.02	$0.01	$0.01
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.09)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)	($0.14)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.02	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04	$0.04
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.07)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)	($0.10)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.03)	($0.03)	($0.03)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.21	$0.38	$0.55	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58
III. Terminal Year Cash Flows																										
Salvage Value																										$0.32
Recovery of Net Working Capital																										$0.10
Total Termination Cash Flows																										$0.42
IV. Net Cash Flows	($1.06)	($1.06)	($1.06)	($1.06)	($1.06)	($1.06)	$0.21	$0.38	$0.55	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$0.58	$1.01
Cumulative Cash Flows	($1.06)	($2.13)	($3.19)	($4.26)	($5.32)	($6.39)	($6.17)	($5.79)	($5.24)	($4.66)	($4.08)	($3.50)	($2.91)	($2.33)	($1.75)	($1.16)	($0.58)	$0.00	$0.58	$1.17	$1.75	$2.33	$2.91	$3.50	$4.08	$5.09
V. Cost Stream	($1.06)	($1.06)	($1.06)	($1.06)	($1.06)	($1.06)	($0.35)	($0.74)	($1.14)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($1.11)	($0.68)

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$15
Net Present Value of Cost Flows (at 5%)	($16)
Net Present Value of Output Stream (at 5%)	10,251

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.52
Levelized Revenue	$1.49
Levelized Profit	($0.03)

SUMMARY AND SENSITIVITY ANALYSIS FOR COCKFIELD AQUIFER: WASTE WATER I

Aquifer: **Cockfield Aquifer**
Alternative: **Waste Water Recycling**

Table x: The Results of Sensitivity Analysis for theCockfield Aquifer: Waste Water Recycling Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	3.4%	3.2
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.2%	1.6
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

RECYCLING ALTERNATIVE

BASE CASE - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Cockfield Aquifer**	
Alternative:	**Reservoirs for Rainharvesting**	
Parameters:		
Water Supplied:	1,135	Million Gallons per Year
Water Price:	**$1.92**	Per Thousand Gallons
Total Capital Costs:	$16.74	
Total O&M Costs:	$0.05	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.72	$1.45	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.02)	($0.03)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.71*	*$1.42*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.32)	($0.30)	($0.29)	($0.28)	($0.27)	($0.25)	($0.24)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.18)*	*$0.54*	*$1.26*	*$1.28*	*$1.29*	*$1.30*	*$1.32*	*$1.33*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	($0.21)	($0.49)	($0.49)	($0.50)	($0.50)	($0.51)	($0.51)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.11)*	*$0.33*	*$0.78*	*$0.79*	*$0.79*	*$0.80*	*$0.81*	*$0.82*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.20	$0.19	$0.19	$0.18	$0.17	$0.16	$0.16	$0.15
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.06)	($0.06)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.59	$1.03	$1.46	$1.52	$1.52	$1.52	$1.52	$1.52
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	$0.59	$1.03	$1.46	$1.52	$1.52	$1.52	$1.52	$1.52
Cumulative Cash Flows	($3.35)	($6.70)	($10.05)	($13.39)	($16.74)	($16.15)	($15.12)	($13.66)	($12.14)	($10.61)	($9.09)	($7.57)	($6.04)
V. Cost Stream	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	($0.13)	($0.42)	($0.71)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*
Depreciation	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	($0.22)	($0.21)	($0.19)	($0.18)	($0.16)	($0.14)	($0.13)	($0.11)	($0.09)	($0.07)	($0.04)	($0.02)	$0.00
Taxable Income	*$1.34*	*$1.36*	*$1.37*	*$1.39*	*$1.41*	*$1.43*	*$1.44*	*$1.46*	*$1.48*	*$1.50*	*$1.52*	*$1.55*	*$1.57*
Income Tax	($0.52)	($0.52)	($0.53)	($0.54)	($0.54)	($0.55)	($0.56)	($0.56)	($0.57)	($0.58)	($0.59)	($0.60)	($0.60)
Net Operating Income	*$0.83*	*$0.84*	*$0.85*	*$0.86*	*$0.87*	*$0.88*	*$0.89*	*$0.90*	*$0.91*	*$0.92*	*$0.94*	*$0.95*	*$0.96*
B. Add Back Items													
Depreciation	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.14	$0.13	$0.12	$0.11	$0.10	$0.09	$0.08	$0.07	$0.05	$0.04	$0.03	$0.01	$0.00
C. Change in Net Working Capital													
Receivables	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52
III. Terminal Year Cash Flows													
Salvage Value													$0.84
Recovery of Net Working Capital													$0.18
Total Termination Cash Flows													$1.01
IV. Net Cash Flows	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$2.54
Cumulative Cash Flows	($4.52)	($3.00)	($1.48)	$0.05	$1.57	$3.09	$4.62	$6.14	$7.66	$9.19	$10.71	$12.23	$14.77
V. Cost Stream	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	$0.36

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$21
Net Present Value of Cost Flows (at 5%)	($21)
Net Present Value of Output Stream (at 5%)	11,098
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	($0.00)

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Cockfield Aquifer**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	1,022	Million Gallons per Year **<= Reduced by 10% compared to base case**
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$16.74	
Total O&M Costs:	$0.05	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	341	681	1,022	1,022	1,022	1,022	1,022	1,022
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.65	$1.30	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.02)	($0.03)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.64*	*$1.27*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.32)	($0.30)	($0.29)	($0.28)	($0.27)	($0.25)	($0.24)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.25)*	*$0.40*	*$1.05*	*$1.06*	*$1.07*	*$1.08*	*$1.10*	*$1.11*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	($0.15)	($0.40)	($0.41)	($0.41)	($0.42)	($0.42)	($0.43)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.15)*	*$0.25*	*$0.64*	*$0.65*	*$0.66*	*$0.67*	*$0.68*	*$0.68*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.20	$0.19	$0.19	$0.18	$0.17	$0.16	$0.16	$0.15
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.11)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.11)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.05)	($0.05)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.55	$0.94	$1.34	$1.39	$1.39	$1.39	$1.39	$1.39
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	$0.55	$0.94	$1.34	$1.39	$1.39	$1.39	$1.39	$1.39
Cumulative Cash Flows	($3.35)	($6.70)	($10.05)	($13.39)	($16.74)	($16.19)	($15.25)	($13.91)	($12.52)	($11.13)	($9.74)	($8.35)	($6.96)
V. Cost Stream	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	($0.10)	($0.36)	($0.62)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022	1,022
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96	$1.96
Operating Expenses	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*	*$1.91*
Depreciation	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	($0.22)	($0.21)	($0.19)	($0.18)	($0.16)	($0.14)	($0.13)	($0.11)	($0.09)	($0.07)	($0.04)	($0.02)	$0.00
Taxable Income	*$1.13*	*$1.14*	*$1.16*	*$1.17*	*$1.19*	*$1.21*	*$1.23*	*$1.25*	*$1.26*	*$1.29*	*$1.31*	*$1.33*	*$1.35*
Income Tax	($0.43)	($0.44)	($0.45)	($0.45)	($0.46)	($0.47)	($0.47)	($0.48)	($0.49)	($0.49)	($0.50)	($0.51)	($0.52)
Net Operating Income	*$0.69*	*$0.70*	*$0.71*	*$0.72*	*$0.73*	*$0.74*	*$0.75*	*$0.77*	*$0.78*	*$0.79*	*$0.80*	*$0.82*	*$0.83*
B. Add Back Items													
Depreciation	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.14	$0.13	$0.12	$0.11	$0.10	$0.09	$0.08	$0.07	$0.05	$0.04	$0.03	$0.01	$0.00
C. Change in Net Working Capital													
Receivables	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)	($0.16)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39
III. Terminal Year Cash Flows													
Salvage Value													$0.84
Recovery of Net Working Capital													$0.16
Total Termination Cash Flows													$1.00
IV. Net Cash Flows	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$1.39	$2.39
Cumulative Cash Flows	($5.57)	($4.18)	($2.79)	($1.41)	($0.02)	$1.37	$2.76	$4.15	$5.54	$6.93	$8.32	$9.71	$12.09
V. Cost Stream	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	($0.57)	$0.43

VI. Financial Results	
Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$19
Net Present Value of Cost Flows (at 5%)	($20)
Net Present Value of Output Stream (at 5%)	9,988
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$2.05
Levelized Revenue	$1.92
Levelized Profit	($0.13)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Cockfield Aquifer**	
Alternative:	**Reservoirs for Rainharvesting**	
Parameters:		
Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$18.42	**<= Increased by 10% compared to base case**
Total O&M Costs:	$0.05	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($3.68)	($3.68)	($3.68)	($3.68)	($3.68)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.72	$1.45	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.02)	($0.03)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.71*	*$1.42*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)	($0.61)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.36)	($0.35)	($0.33)	($0.32)	($0.31)	($0.29)	($0.28)	($0.26)	($0.25)	($0.23)	($0.21)	($0.20)	($0.18)	($0.16)	($0.14)	($0.12)	($0.10)	($0.07)	($0.05)	($0.03)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.26)*	*$0.46*	*$1.18*	*$1.19*	*$1.21*	*$1.22*	*$1.23*	*$1.25*	*$1.27*	*$1.28*	*$1.30*	*$1.32*	*$1.34*	*$1.36*	*$1.38*	*$1.40*	*$1.42*	*$1.44*	*$1.46*	*$1.49*	*$1.51*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	($0.18)	($0.45)	($0.46)	($0.46)	($0.47)	($0.48)	($0.48)	($0.49)	($0.49)	($0.50)	($0.51)	($0.51)	($0.52)	($0.53)	($0.54)	($0.55)	($0.55)	($0.56)	($0.57)	($0.58)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.16)*	*$0.28*	*$0.72*	*$0.73*	*$0.74*	*$0.75*	*$0.76*	*$0.77*	*$0.78*	*$0.79*	*$0.80*	*$0.81*	*$0.82*	*$0.83*	*$0.85*	*$0.86*	*$0.87*	*$0.89*	*$0.90*	*$0.92*	*$0.93*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61	$0.61
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.22	$0.21	$0.21	$0.20	$0.19	$0.18	$0.17	$0.16	$0.15	$0.14	$0.13	$0.12	$0.11	$0.10	$0.08	$0.07	$0.06	$0.04	$0.03	$0.02	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.06)	($0.06)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.61	$1.05	$1.49	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54
III. Terminal Year Cash Flows																										
Salvage Value																										$0.92
Recovery of Net Working Capital																										$0.18
Total Termination Cash Flows																										$1.10
IV. Net Cash Flows	($3.68)	($3.68)	($3.68)	($3.68)	($3.68)	$0.61	$1.05	$1.49	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$1.54	$2.64
Cumulative Cash Flows	($3.68)	($7.37)	($11.05)	($14.73)	($18.42)	($17.80)	($16.75)	($15.27)	($13.72)	($12.18)	($10.64)	($9.09)	($7.55)	($6.00)	($4.46)	($2.91)	($1.37)	$0.18	$1.72	$3.26	$4.81	$6.35	$7.90	$9.44	$10.99	$13.63
V. Cost Stream	($3.68)	($3.68)	($3.68)	($3.68)	($3.68)	($0.11)	($0.40)	($0.69)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	($0.63)	$0.47

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$21
Net Present Value of Cost Flows (at 5%)	($23)
Net Present Value of Output Stream (at 5%)	11,098
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$2.03
Levelized Revenue	$1.92
Levelized Profit	($0.11)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Cockfield Aquifer**	
Alternative:	**Reservoirs for Rainharvesting**	
Parameters:		
Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$16.74	
Total O&M Costs:	$0.05	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.72	$1.45	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.02)	($0.03)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.71*	*$1.41*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.32)	($0.30)	($0.29)	($0.28)	($0.27)	($0.25)	($0.24)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.18)*	*$0.54*	*$1.26*	*$1.27*	*$1.28*	*$1.30*	*$1.31*	*$1.32*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	($0.21)	($0.49)	($0.49)	($0.49)	($0.50)	($0.50)	($0.51)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.11)*	*$0.33*	*$0.78*	*$0.78*	*$0.79*	*$0.80*	*$0.81*	*$0.81*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.20	$0.19	$0.19	$0.18	$0.17	$0.16	$0.16	$0.15
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.06)	($0.06)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.59	$1.03	$1.46	$1.52	$1.52	$1.52	$1.52	$1.52
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	$0.59	$1.03	$1.46	$1.52	$1.52	$1.52	$1.52	$1.52
Cumulative Cash Flows	($3.35)	($6.70)	($10.05)	($13.39)	($16.74)	($16.15)	($15.13)	($13.66)	($12.14)	($10.62)	($9.10)	($7.58)	($6.06)
V. Cost Stream	($3.35)	($3.35)	($3.35)	($3.35)	($3.35)	($0.13)	($0.42)	($0.71)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*	*$2.12*
Depreciation	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	($0.22)	($0.21)	($0.19)	($0.18)	($0.16)	($0.14)	($0.13)	($0.11)	($0.09)	($0.07)	($0.04)	($0.02)	$0.00
Taxable Income	*$1.34*	*$1.35*	*$1.37*	*$1.39*	*$1.40*	*$1.42*	*$1.44*	*$1.46*	*$1.48*	*$1.50*	*$1.52*	*$1.54*	*$1.56*
Income Tax	($0.52)	($0.52)	($0.53)	($0.53)	($0.54)	($0.55)	($0.55)	($0.56)	($0.57)	($0.58)	($0.58)	($0.59)	($0.60)
Net Operating Income	*$0.82*	*$0.83*	*$0.84*	*$0.85*	*$0.86*	*$0.87*	*$0.88*	*$0.90*	*$0.91*	*$0.92*	*$0.93*	*$0.95*	*$0.96*
B. Add Back Items													
Depreciation	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.14	$0.13	$0.12	$0.11	$0.10	$0.09	$0.08	$0.07	$0.05	$0.04	$0.03	$0.01	$0.00
C. Change in Net Working Capital													
Receivables	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52
III. Terminal Year Cash Flows													
Salvage Value													$0.84
Recovery of Net Working Capital													$0.18
Total Termination Cash Flows													$1.01
IV. Net Cash Flows	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$2.53
Cumulative Cash Flows	($4.54)	($3.02)	($1.50)	$0.02	$1.54	$3.06	$4.58	$6.10	$7.62	$9.14	$10.66	$12.18	$14.71
V. Cost Stream	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	$0.36

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$21
Net Present Value of Cost Flows (at 5%)	($21)
Net Present Value of Output Stream (at 5%)	11,098
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	($0.00)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR COCKFIELD AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Cockfield Aquifer
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	1,135	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$16.74	
Total O&M Costs:	$0.05	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	378	757	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($2.79)	($2.79)	($2.79)	($2.79)	($2.79)	($2.79)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.72	$1.45	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.02)	($0.03)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.71*	*$1.42*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.32)	($0.30)	($0.29)	($0.28)	($0.27)	($0.25)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.18)*	*$0.54*	*$1.26*	*$1.28*	*$1.29*	*$1.30*	*$1.32*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.07	($0.21)	($0.49)	($0.49)	($0.50)	($0.50)	($0.51)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.11)*	*$0.33*	*$0.78*	*$0.79*	*$0.79*	*$0.80*	*$0.81*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.20	$0.19	$0.19	$0.18	$0.17	$0.16	$0.16
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.12)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.06)	($0.06)	($0.06)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.59	$1.03	$1.46	$1.52	$1.52	$1.52	$1.52
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($2.79)	($2.79)	($2.79)	($2.79)	($2.79)	($2.79)	$0.59	$1.03	$1.46	$1.52	$1.52	$1.52	$1.52
Cumulative Cash Flows	($2.79)	($5.58)	($8.37)	($11.16)	($13.95)	($16.74)	($16.15)	($15.12)	($13.66)	($12.14)	($10.61)	($9.09)	($7.57)
V. Cost Stream	($2.79)	($2.79)	($2.79)	($2.79)	($2.79)	($2.79)	($0.13)	($0.42)	($0.71)	($0.65)	($0.65)	($0.65)	($0.65)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
Operating Expenses	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)	($0.05)
Earnings Before Depreciation and Tax	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*	*$2.13*
Depreciation	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)	($0.56)
Debt Interest Payment	($0.24)	($0.22)	($0.21)	($0.19)	($0.18)	($0.16)	($0.14)	($0.13)	($0.11)	($0.09)	($0.07)	($0.04)	($0.02)
Taxable Income	*$1.33*	*$1.34*	*$1.36*	*$1.37*	*$1.39*	*$1.41*	*$1.43*	*$1.44*	*$1.46*	*$1.48*	*$1.50*	*$1.52*	*$1.55*
Income Tax	($0.51)	($0.52)	($0.52)	($0.53)	($0.54)	($0.54)	($0.55)	($0.56)	($0.56)	($0.57)	($0.58)	($0.59)	($0.60)
Net Operating Income	*$0.82*	*$0.83*	*$0.84*	*$0.85*	*$0.86*	*$0.87*	*$0.88*	*$0.89*	*$0.90*	*$0.91*	*$0.92*	*$0.94*	*$0.95*
B. Add Back Items													
Depreciation	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56	$0.56
After Tax Interest on Debt	$0.15	$0.14	$0.13	$0.12	$0.11	$0.10	$0.09	$0.08	$0.07	$0.05	$0.04	$0.03	$0.01
C. Change in Net Working Capital													
Receivables	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Net Working Capital	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)	($0.18)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52
III. Terminal Year Cash Flows													
Salvage Value													$0.84
Recovery of Net Working Capital													$0.18
Total Termination Cash Flows													$1.01
IV. Net Cash Flows	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$1.52	$2.54
Cumulative Cash Flows	($6.04)	($4.52)	($3.00)	($1.48)	$0.05	$1.57	$3.09	$4.62	$6.14	$7.66	$9.19	$10.71	$13.24
V. Cost Stream	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	($0.65)	$0.36

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$20
Net Present Value of Cost Flows (at 5%)	($20)
Net Present Value of Output Stream (at 5%)	10,251

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.99
Levelized Revenue	$1.92
Levelized Profit	($0.08)

SUMMARY AND SENSITIVITY ANALYSIS FOR COCKFIELD AQUIFER: RESERVOIRS FC

Aquifer: **Cockfield Aquifer**
Alternative: **Reservoirs for Rainharvesting**

Table x: The Results of Sensitivity Analysis for theCockfield Aquifer: Reservoirs for Rainharvesting Altern

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.2%	1.5
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	5.0%	0.0
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

)R RAINHARVESTING ALTERNATIVE

ative

BASE CASE - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Waste Water Recycling

Parameters:		Appendix 6 Financial Viability Analysis and Cost Comparison of Alternatives
Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$60.71	
Total O&M Costs:	$8.32	
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$5.35	$10.70	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($2.77)	($5.54)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.58*	*$5.16*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.18)	($1.14)	($1.10)	($1.06)	($1.01)	($0.97)	($0.92)	($0.87)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.63)*	*$1.99*	*$4.61*	*$4.66*	*$4.70*	*$4.75*	*$4.80*	*$4.85*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.24	($0.77)	($1.78)	($1.79)	($1.81)	($1.83)	($1.85)	($1.87)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.39)*	*$1.22*	*$2.84*	*$2.86*	*$2.89*	*$2.92*	*$2.95*	*$2.98*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.73	$0.70	$0.68	$0.65	$0.62	$0.59	$0.56	$0.53
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.44)	($0.88)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.11	$0.23	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.65)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$2.04	$3.63	$5.21	$5.54	$5.54	$5.54	$5.54	$5.54
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	$2.04	$3.63	$5.21	$5.54	$5.54	$5.54	$5.54	$5.54
Cumulative Cash Flows	($12.14)	($24.28)	($36.42)	($48.57)	($60.71)	($58.67)	($55.04)	($49.83)	($44.29)	($38.76)	($33.22)	($27.68)	($22.14)
V. Cost Stream	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	($3.31)	($7.08)	($10.84)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*
Depreciation	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)
Debt Interest Payment	($0.81)	($0.76)	($0.70)	($0.64)	($0.58)	($0.52)	($0.45)	($0.39)	($0.31)	($0.24)	($0.16)	($0.08)	$0.00
Taxable Income	*$4.90*	*$4.95*	*$5.01*	*$5.07*	*$5.13*	*$5.19*	*$5.26*	*$5.33*	*$5.40*	*$5.47*	*$5.55*	*$5.63*	*$5.71*
Income Tax	($1.89)	($1.91)	($1.93)	($1.95)	($1.98)	($2.00)	($2.02)	($2.05)	($2.08)	($2.11)	($2.14)	($2.17)	($2.20)
Net Operating Income	*$3.01*	*$3.05*	*$3.08*	*$3.12*	*$3.15*	*$3.19*	*$3.23*	*$3.28*	*$3.32*	*$3.37*	*$3.41*	*$3.46*	*$3.51*
B. Add Back Items													
Depreciation	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02
After Tax Interest on Debt	$0.50	$0.47	$0.43	$0.40	$0.36	$0.32	$0.28	$0.24	$0.19	$0.15	$0.10	$0.05	$0.00
C. Change in Net Working Capital													
Receivables	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54
III. Terminal Year Cash Flows													
Salvage Value													$3.04
Recovery of Net Working Capital													$0.98
Total Termination Cash Flows													$4.01
IV. Net Cash Flows	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$9.55
Cumulative Cash Flows	($16.61)	($11.07)	($5.53)	$0.01	$5.54	$11.08	$16.62	$22.16	$27.69	$33.23	$38.77	$44.31	$53.86
V. Cost Stream	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($6.50)

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$157
Net Present Value of Cost Flows (at 5%)	($157)
Net Present Value of Output Stream (at 5%)	105,451
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.49
Levelized Revenue	$1.49
Levelized Profit	($0.00)

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Waste Water Recycling

Parameters:

Water Supplied:	9,707	Million Gallons per Year **<= Reduced by 10% compared to base case**
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$60.71	
Total O&M Costs:	$8.32	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,236	6,471	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$4.82	$9.63	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45	$14.45
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($2.77)	($5.54)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.04*	*$4.09*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*	*$6.13*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.18)	($1.14)	($1.10)	($1.06)	($1.01)	($0.97)	($0.92)	($0.87)	($0.81)	($0.76)	($0.70)	($0.64)	($0.58)	($0.52)	($0.45)	($0.39)	($0.31)	($0.24)	($0.16)	($0.08)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.16)*	*$0.92*	*$3.01*	*$3.05*	*$3.09*	*$3.14*	*$3.19*	*$3.24*	*$3.29*	*$3.35*	*$3.40*	*$3.46*	*$3.52*	*$3.59*	*$3.65*	*$3.72*	*$3.79*	*$3.87*	*$3.95*	*$4.03*	*$4.11*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.45	($0.35)	($1.16)	($1.17)	($1.19)	($1.21)	($1.23)	($1.25)	($1.27)	($1.29)	($1.31)	($1.33)	($1.36)	($1.38)	($1.41)	($1.43)	($1.46)	($1.49)	($1.52)	($1.55)	($1.58)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.72)*	*$0.57*	*$1.85*	*$1.88*	*$1.90*	*$1.93*	*$1.96*	*$1.99*	*$2.03*	*$2.06*	*$2.09*	*$2.13*	*$2.17*	*$2.21*	*$2.25*	*$2.29*	*$2.33*	*$2.38*	*$2.43*	*$2.48*	*$2.53*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.73	$0.70	$0.68	$0.65	$0.62	$0.59	$0.56	$0.53	$0.50	$0.47	$0.43	$0.40	$0.36	$0.32	$0.28	$0.24	$0.19	$0.15	$0.10	$0.05	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.40)	($0.79)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)	($1.19)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.11	$0.23	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.28)	($0.56)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)	($0.85)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.28)	($0.28)	($0.28)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$1.75	$3.01	$4.27	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55
III. Terminal Year Cash Flows																										
Salvage Value																										$3.04
Recovery of Net Working Capital																										$0.85
Total Termination Cash Flows																										$3.88
IV. Net Cash Flows	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	$1.75	$3.01	$4.27	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$4.55	$8.43
Cumulative Cash Flows	($12.14)	($24.28)	($36.42)	($48.57)	($60.71)	($58.95)	($55.94)	($51.67)	($47.12)	($42.57)	($38.02)	($33.47)	($28.92)	($24.37)	($19.82)	($15.27)	($10.72)	($6.17)	($1.62)	$2.93	$7.48	$12.03	$16.58	$21.13	$25.68	$34.11
V. Cost Stream	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	($3.06)	($6.62)	($10.18)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($9.90)	($6.02)

VI. Financial Results

Payback Period	20
Internal Rate of Return	3.4%
Net Present Value of Net Cash Flows (at 5%)	($10)
Net Present Value of Revenue Flows (at 5%)	$141
Net Present Value of Cost Flows (at 5%)	($151)
Net Present Value of Output Stream (at 5%)	94,906

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.59
Levelized Revenue	$1.49
Levelized Profit	($0.10)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	Sparta Aquifer
Alternative:	Waste Water Recycling

Parameters:

Water Supplied:	10,786	Million Gallons per Year	
Water Price:	$1.49	Per Thousand Gallons	
Total Capital Costs:	$66.78		**<= Increased by 10% compared to base case**
Total O&M Costs:	$8.32		
Years to Construct	5		
Years Required to Reach 100% Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($13.36)	($13.36)	($13.36)	($13.36)	($13.36)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$5.35	$10.70	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($2.77)	($5.54)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.58*	*$5.16*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.30)	($1.26)	($1.21)	($1.16)	($1.11)	($1.06)	($1.01)	($0.95)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.95)*	*$1.67*	*$4.30*	*$4.35*	*$4.40*	*$4.45*	*$4.50*	*$4.56*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.37	($0.64)	($1.66)	($1.67)	($1.69)	($1.71)	($1.73)	($1.75)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.58)*	*$1.03*	*$2.64*	*$2.67*	*$2.70*	*$2.74*	*$2.77*	*$2.80*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.80	$0.77	$0.75	$0.72	$0.69	$0.65	$0.62	$0.59
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.44)	($0.88)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.11	$0.23	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.65)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$2.12	$3.70	$5.29	$5.62	$5.62	$5.62	$5.62	$5.62
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($13.36)	($13.36)	($13.36)	($13.36)	($13.36)	$2.12	$3.70	$5.29	$5.62	$5.62	$5.62	$5.62	$5.62
Cumulative Cash Flows	($13.36)	($26.71)	($40.07)	($53.42)	($66.78)	($64.66)	($60.96)	($55.67)	($50.05)	($44.44)	($38.82)	($33.21)	($27.59)
V. Cost Stream	($13.36)	($13.36)	($13.36)	($13.36)	($13.36)	($3.23)	($7.00)	($10.76)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*
Depreciation	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)	($2.23)
Debt Interest Payment	($0.90)	($0.84)	($0.77)	($0.71)	($0.64)	($0.57)	($0.50)	($0.42)	($0.35)	($0.26)	($0.18)	($0.09)	$0.00
Taxable Income	*$4.61*	*$4.67*	*$4.74*	*$4.80*	*$4.87*	*$4.94*	*$5.01*	*$5.09*	*$5.17*	*$5.25*	*$5.33*	*$5.42*	*$5.51*
Income Tax	($1.78)	($1.80)	($1.82)	($1.85)	($1.87)	($1.90)	($1.93)	($1.96)	($1.99)	($2.02)	($2.05)	($2.09)	($2.12)
Net Operating Income	*$2.84*	*$2.87*	*$2.91*	*$2.95*	*$2.99*	*$3.04*	*$3.08*	*$3.13*	*$3.18*	*$3.23*	*$3.28*	*$3.33*	*$3.39*
B. Add Back Items													
Depreciation	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23	$2.23
After Tax Interest on Debt	$0.55	$0.51	$0.48	$0.44	$0.39	$0.35	$0.31	$0.26	$0.21	$0.16	$0.11	$0.06	$0.00
C. Change in Net Working Capital													
Receivables	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62
III. Terminal Year Cash Flows													
Salvage Value													$3.34
Recovery of Net Working Capital													$0.98
Total Termination Cash Flows													$4.32
IV. Net Cash Flows	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$5.62	$9.93
Cumulative Cash Flows	($21.98)	($16.36)	($10.75)	($5.13)	$0.49	$6.10	$11.72	$17.33	$22.95	$28.56	$34.18	$39.79	$49.72
V. Cost Stream	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($10.44)	($6.12)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($5)
Net Present Value of Revenue Flows (at 5%)	$157
Net Present Value of Cost Flows (at 5%)	($162)
Net Present Value of Output Stream (at 5%)	105,451

VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.53
Levelized Revenue	$1.49
Levelized Profit	($0.04)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer: **Sparta Aquifer**
Alternative: **Waste Water Recycling**

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$60.71	
Total O&M Costs:	$9.15	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$5.35	$10.70	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($3.05)	($6.10)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)	($9.15)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.30*	*$4.60*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*	*$6.91*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.18)	($1.14)	($1.10)		($1.01)	($0.97)	($0.92)	($0.87)	($0.81)	($0.76)	($0.70)	($0.64)	($0.58)	($0.52)	($0.45)	($0.39)	($0.31)	($0.24)	($0.16)	($0.08)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.91)*	*$1.44*	*$3.78*	*$4.88*	*$3.87*	*$3.92*	*$3.96*	*$4.01*	*$4.07*	*$4.12*	*$4.18*	*$4.24*	*$4.30*	*$4.36*	*$4.43*	*$4.50*	*$4.57*	*$4.64*	*$4.72*	*$4.80*	*$4.88*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.35	($0.55)	($1.46)	($1.88)	($1.49)	($1.51)	($1.53)	($1.55)	($1.57)	($1.59)	($1.61)	($1.63)	($1.65)	($1.68)	($1.70)	($1.73)	($1.76)	($1.79)	($1.82)	($1.85)	($1.88)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.56)*	*$0.88*	*$2.32*	*$3.00*	*$2.38*	*$2.41*	*$2.44*	*$2.47*	*$2.50*	*$2.53*	*$2.57*	*$2.61*	*$2.64*	*$2.68*	*$2.72*	*$2.77*	*$2.81*	*$2.85*	*$2.90*	*$2.95*	*$3.00*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.73	$0.70	$0.68	$0.00	$0.62	$0.59	$0.56	$0.53	$0.50	$0.47	$0.43	$0.40	$0.36	$0.32	$0.28	$0.24	$0.19	$0.15	$0.10	$0.05	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.44)	($0.88)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.13	$0.25	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38	$0.38
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.31)	($0.63)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)	($0.94)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.31)	($0.31)	($0.31)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$1.88	$3.30	$4.71	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03
III. Terminal Year Cash Flows																										
Salvage Value																										$3.04
Recovery of Net Working Capital																										$0.94
Total Termination Cash Flows																										$3.98
IV. Net Cash Flows	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	$1.88	$3.30	$4.71	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$5.03	$9.00
Cumulative Cash Flows	($12.14)	($24.28)	($36.42)	($48.57)	($60.71)	($58.83)	($55.53)	($50.82)	($45.79)	($40.77)	($35.74)	($30.72)	($25.69)	($20.66)	($15.64)	($10.61)	($5.59)	($0.56)	$4.47	$9.49	$14.52	$19.54	$24.57	$29.60	$34.62	$43.63
V. Cost Stream	($12.14)	($12.14)	($12.14)	($12.14)	($12.14)	($3.47)	($7.41)	($11.34)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($11.03)	($7.05)

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($5)
Net Present Value of Revenue Flows (at 5%)	$157
Net Present Value of Cost Flows (at 5%)	($162)
Net Present Value of Output Stream (at 5%)	105,451

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.54
Levelized Revenue	$1.49
Levelized Profit	($0.05)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: WASTE WATER RECYCLING ALTERNATIVE

Aquifer:	Sparta Aquifer	
Alternative:	Waste Water Recycling	
Parameters:		
Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.49	Per Thousand Gallons
Total Capital Costs:	$60.71	
Total O&M Costs:	$8.32	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($10.12)	($10.12)	($10.12)	($10.12)	($10.12)	($10.12)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.35	$10.70	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($2.77)	($5.54)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.58*	*$5.16*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.18)	($1.14)	($1.10)	($1.06)	($1.01)	($0.97)	($0.92)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.63)*	*$1.99*	*$4.61*	*$4.66*	*$4.70*	*$4.75*	*$4.80*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.24	($0.77)	($1.78)	($1.79)	($1.81)	($1.83)	($1.85)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.39)*	*$1.22*	*$2.84*	*$2.86*	*$2.89*	*$2.92*	*$2.95*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.73	$0.70	$0.68	$0.65	$0.62	$0.59	$0.56
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.44)	($0.88)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.11	$0.23	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.65)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.04	$3.63	$5.21	$5.54	$5.54	$5.54	$5.54
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($10.12)	($10.12)	($10.12)	($10.12)	($10.12)	($10.12)	$2.04	$3.63	$5.21	$5.54	$5.54	$5.54	$5.54
Cumulative Cash Flows	($10.12)	($20.24)	($30.35)	($40.47)	($50.59)	($60.71)	($58.67)	($55.04)	($49.83)	($44.29)	($38.76)	($33.22)	($27.68)
V. Cost Stream	($10.12)	($10.12)	($10.12)	($10.12)	($10.12)	($10.12)	($3.31)	($7.08)	($10.84)	($10.52)	($10.52)	($10.52)	($10.52)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49	$1.49
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05	$16.05
Operating Expenses	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)	($8.32)
Earnings Before Depreciation and Tax	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*	*$7.74*
Depreciation	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)	($2.02)
Debt Interest Payment	($0.87)	($0.81)	($0.76)	($0.70)	($0.64)	($0.58)	($0.52)	($0.45)	($0.39)	($0.31)	($0.24)	($0.16)	($0.08)
Taxable Income	*$4.85*	*$4.90*	*$4.95*	*$5.01*	*$5.07*	*$5.13*	*$5.19*	*$5.26*	*$5.33*	*$5.40*	*$5.47*	*$5.55*	*$5.63*
Income Tax	($1.87)	($1.89)	($1.91)	($1.93)	($1.95)	($1.98)	($2.00)	($2.02)	($2.05)	($2.08)	($2.11)	($2.14)	($2.17)
Net Operating Income	*$2.98*	*$3.01*	*$3.05*	*$3.08*	*$3.12*	*$3.15*	*$3.19*	*$3.23*	*$3.28*	*$3.32*	*$3.37*	*$3.41*	*$3.46*
B. Add Back Items													
Depreciation	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02	$2.02
After Tax Interest on Debt	$0.53	$0.50	$0.47	$0.43	$0.40	$0.36	$0.32	$0.28	$0.24	$0.19	$0.15	$0.10	$0.05
C. Change in Net Working Capital													
Receivables	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)	($1.32)
Payables	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34	$0.34
Net Working Capital	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54
III. Terminal Year Cash Flows													
Salvage Value													$3.04
Recovery of Net Working Capital													$0.98
Total Termination Cash Flows													$4.01
IV. Net Cash Flows	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$5.54	$9.55
Cumulative Cash Flows	($22.14)	($16.61)	($11.07)	($5.53)	$0.01	$5.54	$11.08	$16.62	$22.16	$27.69	$33.23	$38.77	$48.32
V. Cost Stream	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($10.52)	($6.50)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($3)
Net Present Value of Revenue Flows (at 5%)	$145
Net Present Value of Cost Flows (at 5%)	($148)
Net Present Value of Output Stream (at 5%)	97,396
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.52
Levelized Revenue	$1.49
Levelized Profit	($0.03)

SUMMARY AND SENSITIVITY ANALYSIS FOR SPARTA AQUIFER: WASTE WATER RECYCLING ALT

Aquifer: Sparta Aquifer
Alternative: Waste Water Recycling

Table x: The Results of Sensitivity Analysis for theSparta Aquifer: Waste Water Recycling Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	3.4%	3.2
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.2%	1.6
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

TERNATIVE

BASE CASE - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$159.09	
Total O&M Costs:	$0.45	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$6.89	$13.77	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.30)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$6.74*	*$13.47*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.10)	($3.00)	($2.89)	($2.77)	($2.66)	($2.53)	($2.41)	($2.27)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.67)*	*$5.17*	*$12.02*	*$12.13*	*$12.25*	*$12.37*	*$12.50*	*$12.63*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.64	($1.99)	($4.63)	($4.67)	($4.72)	($4.76)	($4.81)	($4.86)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.03)*	*$3.18*	*$7.39*	*$7.46*	*$7.53*	*$7.61*	*$7.69*	*$7.77*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$1.91	$1.84	$1.78	$1.71	$1.63	$1.56	$1.48	$1.40
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.57)	($1.13)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($1.12)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.62	$9.77	$13.91	$14.47	$14.47	$14.47	$14.47	$14.47
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	$5.62	$9.77	$13.91	$14.47	$14.47	$14.47	$14.47	$14.47
Cumulative Cash Flows	($31.82)	($63.64)	($95.45)	($127.27)	($159.09)	($153.46)	($143.70)	($129.79)	($115.32)	($100.85)	($86.37)	($71.90)	($57.43)
V. Cost Stream	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	($1.26)	($4.00)	($6.74)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*
Depreciation	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	($2.14)	($1.99)	($1.84)	($1.69)	($1.53)	($1.36)	($1.19)	($1.01)	($0.82)	($0.63)	($0.43)	($0.22)	$0.00
Taxable Income	*$12.77*	*$12.91*	*$13.06*	*$13.22*	*$13.38*	*$13.54*	*$13.72*	*$13.90*	*$14.08*	*$14.28*	*$14.48*	*$14.69*	*$14.91*
Income Tax	($4.92)	($4.97)	($5.03)	($5.09)	($5.15)	($5.21)	($5.28)	($5.35)	($5.42)	($5.50)	($5.57)	($5.66)	($5.74)
Net Operating Income	*$7.85*	*$7.94*	*$8.03*	*$8.13*	*$8.23*	*$8.33*	*$8.44*	*$8.55*	*$8.66*	*$8.78*	*$8.90*	*$9.03*	*$9.17*
B. Add Back Items													
Depreciation	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$1.31	$1.23	$1.13	$1.04	$0.94	$0.84	$0.73	$0.62	$0.51	$0.39	$0.26	$0.13	$0.00
C. Change in Net Working Capital													
Receivables	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47
III. Terminal Year Cash Flows													
Salvage Value													$7.95
Recovery of Net Working Capital													$1.68
Total Termination Cash Flows													$9.63
IV. Net Cash Flows	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$24.10
Cumulative Cash Flows	($42.96)	($28.49)	($14.02)	$0.45	$14.92	$29.39	$43.86	$58.33	$72.80	$87.27	$101.74	$116.21	$140.32
V. Cost Stream	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	$3.45

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$202
Net Present Value of Cost Flows (at 5%)	($202)
Net Present Value of Output Stream (at 5%)	105,451

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	9,707	Million Gallons per Year **<= Reduced by 10% compared to base case**
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$159.09	
Total O&M Costs:	$0.45	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,236	6,471	9,707	9,707	9,707	9,707	9,707	9,707
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$6.20	$12.39	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.30)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$6.05*	*$12.10*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.10)	($3.00)	($2.89)	($2.77)	($2.66)	($2.53)	($2.41)	($2.27)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.36)*	*$3.80*	*$9.95*	*$10.07*	*$10.19*	*$10.31*	*$10.44*	*$10.57*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.91	($1.46)	($3.83)	($3.88)	($3.92)	($3.97)	($4.02)	($4.07)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.45)*	*$2.33*	*$6.12*	*$6.19*	*$6.26*	*$6.34*	*$6.42*	*$6.50*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$1.91	$1.84	$1.78	$1.71	$1.63	$1.56	$1.48	$1.40
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.51)	($1.02)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.50)	($1.01)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.50)	($0.50)	($0.50)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.26	$8.98	$12.70	$13.20	$13.20	$13.20	$13.20	$13.20
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	$5.26	$8.98	$12.70	$13.20	$13.20	$13.20	$13.20	$13.20
Cumulative Cash Flows	($31.82)	($63.64)	($95.45)	($127.27)	($159.09)	($153.83)	($144.85)	($132.16)	($118.96)	($105.76)	($92.56)	($79.36)	($66.16)
V. Cost Stream	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	($0.94)	($3.42)	($5.89)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59	$18.59
Operating Expenses	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*	*$18.14*
Depreciation	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	($2.14)	($1.99)	($1.84)	($1.69)	($1.53)	($1.36)	($1.19)	($1.01)	($0.82)	($0.63)	($0.43)	($0.22)	$0.00
Taxable Income	*$10.71*	*$10.85*	*$11.00*	*$11.15*	*$11.31*	*$11.48*	*$11.65*	*$11.83*	*$12.02*	*$12.21*	*$12.41*	*$12.62*	*$12.84*
Income Tax	($4.12)	($4.18)	($4.23)	($4.29)	($4.35)	($4.42)	($4.49)	($4.55)	($4.63)	($4.70)	($4.78)	($4.86)	($4.94)
Net Operating Income	*$6.58*	*$6.67*	*$6.76*	*$6.86*	*$6.96*	*$7.06*	*$7.17*	*$7.28*	*$7.39*	*$7.51*	*$7.63*	*$7.76*	*$7.90*
B. Add Back Items													
Depreciation	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$1.31	$1.23	$1.13	$1.04	$0.94	$0.84	$0.73	$0.62	$0.51	$0.39	$0.26	$0.13	$0.00
C. Change in Net Working Capital													
Receivables	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)	($1.53)
Payables	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)	($1.51)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20
III. Terminal Year Cash Flows													
Salvage Value													$7.95
Recovery of Net Working Capital													$1.51
Total Termination Cash Flows													$9.46
IV. Net Cash Flows	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$13.20	$22.66
Cumulative Cash Flows	($52.96)	($39.75)	($26.55)	($13.35)	($0.15)	$13.05	$26.25	$39.45	$52.65	$65.85	$79.05	$92.25	$114.91
V. Cost Stream	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	($5.39)	$4.07

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($12)
Net Present Value of Revenue Flows (at 5%)	$182
Net Present Value of Cost Flows (at 5%)	($194)
Net Present Value of Output Stream (at 5%)	94,906

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$2.05
Levelized Revenue	$1.92
Levelized Profit	($0.13)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Sparta Aquifer**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	10,786	Million Gallons per Year	
Water Price:	$1.92	Per Thousand Gallons	
Total Capital Costs:	$175.00		**<= Increased by 10% compared to base case**
Total O&M Costs:	$0.45		
Years to Construct	5		
Years Required to Reach 100% Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($35.00)	($35.00)	($35.00)	($35.00)	($35.00)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$6.89	$13.77	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.30)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$6.74*	*$13.47*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.41)	($3.30)	($3.18)	($3.05)	($2.92)	($2.79)	($2.65)	($2.50)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($2.51)*	*$4.34*	*$11.20*	*$11.33*	*$11.45*	*$11.59*	*$11.73*	*$11.88*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.97	($1.67)	($4.31)	($4.36)	($4.41)	($4.46)	($4.52)	($4.57)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.54)*	*$2.67*	*$6.89*	*$6.96*	*$7.04*	*$7.13*	*$7.21*	*$7.30*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$2.10	$2.03	$1.95	$1.88	$1.80	$1.71	$1.63	$1.54
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.57)	($1.13)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($1.12)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.83	$9.97	$14.11	$14.67	$14.67	$14.67	$14.67	$14.67
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($35.00)	($35.00)	($35.00)	($35.00)	($35.00)	$5.83	$9.97	$14.11	$14.67	$14.67	$14.67	$14.67	$14.67
Cumulative Cash Flows	($35.00)	($70.00)	($105.00)	($140.00)	($175.00)	($169.17)	($159.20)	($145.08)	($130.41)	($115.73)	($101.06)	($86.38)	($71.71)
V. Cost Stream	($35.00)	($35.00)	($35.00)	($35.00)	($35.00)	($1.06)	($3.80)	($6.54)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)
VI. Financial Results													
Payback Period	18												
Internal Rate of Return	4.3%												
Net Present Value of Net Cash Flows (at 5%)	($12)												
Net Present Value of Revenue Flows (at 5%)	$202												
Net Present Value of Cost Flows (at 5%)	($214)												
Net Present Value of Output Stream (at 5%)	105,451												
VII. Levelized Calculations (Per Thousand Gallons)													
Levelized Cost	$2.03												
Levelized Revenue	$1.92												
Levelized Profit	($0.11)												

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*
Depreciation	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)	($5.83)
Debt Interest Payment	($2.35)	($2.19)	($2.03)	($1.86)	($1.68)	($1.50)	($1.31)	($1.11)	($0.91)	($0.69)	($0.47)	($0.24)	$0.00
Taxable Income	*$12.03*	*$12.18*	*$12.35*	*$12.52*	*$12.69*	*$12.88*	*$13.07*	*$13.27*	*$13.47*	*$13.68*	*$13.91*	*$14.14*	*$14.38*
Income Tax	($4.63)	($4.69)	($4.75)	($4.82)	($4.89)	($4.96)	($5.03)	($5.11)	($5.19)	($5.27)	($5.35)	($5.44)	($5.53)
Net Operating Income	*$7.40*	*$7.49*	*$7.59*	*$7.70*	*$7.81*	*$7.92*	*$8.04*	*$8.16*	*$8.28*	*$8.42*	*$8.55*	*$8.69*	*$8.84*
B. Add Back Items													
Depreciation	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83	$5.83
After Tax Interest on Debt	$1.44	$1.35	$1.25	$1.14	$1.03	$0.92	$0.80	$0.68	$0.56	$0.43	$0.29	$0.15	$0.00
C. Change in Net Working Capital													
Receivables	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67
III. Terminal Year Cash Flows													
Salvage Value													$8.75
Recovery of Net Working Capital													$1.68
Total Termination Cash Flows													$10.43
IV. Net Cash Flows	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$14.67	$25.10
Cumulative Cash Flows	($57.03)	($42.36)	($27.68)	($13.01)	$1.67	$16.34	$31.01	$45.69	$60.36	$75.04	$89.71	$104.39	$129.49
V. Cost Stream	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	($5.98)	$4.45

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Sparta Aquifer**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$159.09	
Total O&M Costs:	$0.49	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$6.89	$13.77	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.16)	($0.33)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)	($0.49)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$6.72*	*$13.44*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*	*$20.17*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($3.10)	($3.00)	($2.89)	($2.77)	($2.66)	($2.53)	($2.41)	($2.27)	($2.14)	($1.99)	($1.84)	($1.69)	($1.53)	($1.36)	($1.19)	($1.01)	($0.82)	($0.63)	($0.43)	($0.22)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.68)*	*$5.14*	*$11.97*	*$12.09*	*$12.21*	*$12.33*	*$12.46*	*$12.59*	*$12.73*	*$12.87*	*$13.02*	*$13.17*	*$13.33*	*$13.50*	*$13.67*	*$13.85*	*$14.04*	*$14.23*	*$14.43*	*$14.64*	*$14.86*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.65	($1.98)	($4.61)	($4.65)	($4.70)	($4.75)	($4.80)	($4.85)	($4.90)	($4.95)	($5.01)	($5.07)	($5.13)	($5.20)	($5.26)	($5.33)	($5.40)	($5.48)	($5.56)	($5.64)	($5.72)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.04)*	*$3.16*	*$7.36*	*$7.43*	*$7.51*	*$7.58*	*$7.66*	*$7.74*	*$7.83*	*$7.91*	*$8.01*	*$8.10*	*$8.20*	*$8.30*	*$8.41*	*$8.52*	*$8.63*	*$8.75*	*$8.88*	*$9.01*	*$9.14*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$1.91	$1.84	$1.78	$1.71	$1.63	$1.56	$1.48	$1.40	$1.31	$1.23	$1.13	$1.04	$0.94	$0.84	$0.73	$0.62	$0.51	$0.39	$0.26	$0.13	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.57)	($1.13)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($1.12)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$5.62	$9.75	$13.88	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44
III. Terminal Year Cash Flows																										
Salvage Value																										$7.95
Recovery of Net Working Capital																										$1.68
Total Termination Cash Flows																										$9.63
IV. Net Cash Flows	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	$5.62	$9.75	$13.88	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$14.44	$24.08
Cumulative Cash Flows	($31.82)	($63.64)	($95.45)	($127.27)	($159.09)	($153.47)	($143.72)	($129.84)	($115.40)	($100.95)	($86.51)	($72.07)	($57.62)	($43.18)	($28.74)	($14.29)	$0.15	$14.59	$29.04	$43.48	$57.92	$72.37	$86.81	$101.25	$115.70	$139.77
V. Cost Stream	($31.82)	($31.82)	($31.82)	($31.82)	($31.82)	($1.27)	($4.02)	($6.77)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	($6.21)	$3.42

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$202
Net Present Value of Cost Flows (at 5%)	($202)
Net Present Value of Output Stream (at 5%)	105,451

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	($0.00)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$159.09	
Total O&M Costs:	$0.45	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($26.51)	($26.51)	($26.51)	($26.51)	($26.51)	($26.51)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$6.89	$13.77	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.30)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$6.74*	*$13.47*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($3.10)	($3.00)	($2.89)	($2.77)	($2.66)	($2.53)	($2.41)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.67)*	*$5.17*	*$12.02*	*$12.13*	*$12.25*	*$12.37*	*$12.50*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.64	($1.99)	($4.63)	($4.67)	($4.72)	($4.76)	($4.81)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.03)*	*$3.18*	*$7.39*	*$7.46*	*$7.53*	*$7.61*	*$7.69*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.91	$1.84	$1.78	$1.71	$1.63	$1.56	$1.48
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.57)	($1.13)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($1.12)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.56)	($0.56)	($0.56)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$5.62	$9.77	$13.91	$14.47	$14.47	$14.47	$14.47
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($26.51)	($26.51)	($26.51)	($26.51)	($26.51)	($26.51)	$5.62	$9.77	$13.91	$14.47	$14.47	$14.47	$14.47
Cumulative Cash Flows	($26.51)	($53.03)	($79.54)	($106.06)	($132.57)	($159.09)	($153.46)	($143.70)	($129.79)	($115.32)	($100.85)	($86.37)	($71.90)
V. Cost Stream	($26.51)	($26.51)	($26.51)	($26.51)	($26.51)	($26.51)	($1.26)	($4.00)	($6.74)	($6.18)	($6.18)	($6.18)	($6.18)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66	$20.66
Operating Expenses	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Earnings Before Depreciation and Tax	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*	*$20.21*
Depreciation	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)	($5.30)
Debt Interest Payment	($2.27)	($2.14)	($1.99)	($1.84)	($1.69)	($1.53)	($1.36)	($1.19)	($1.01)	($0.82)	($0.63)	($0.43)	($0.22)
Taxable Income	*$12.63*	*$12.77*	*$12.91*	*$13.06*	*$13.22*	*$13.38*	*$13.54*	*$13.72*	*$13.90*	*$14.08*	*$14.28*	*$14.48*	*$14.69*
Income Tax	($4.86)	($4.92)	($4.97)	($5.03)	($5.09)	($5.15)	($5.21)	($5.28)	($5.35)	($5.42)	($5.50)	($5.57)	($5.66)
Net Operating Income	*$7.77*	*$7.85*	*$7.94*	*$8.03*	*$8.13*	*$8.23*	*$8.33*	*$8.44*	*$8.55*	*$8.66*	*$8.78*	*$8.90*	*$9.03*
B. Add Back Items													
Depreciation	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30	$5.30
After Tax Interest on Debt	$1.40	$1.31	$1.23	$1.13	$1.04	$0.94	$0.84	$0.73	$0.62	$0.51	$0.39	$0.26	$0.13
C. Change in Net Working Capital													
Receivables	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)	($1.70)
Payables	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02	$0.02
Net Working Capital	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)	($1.68)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47
III. Terminal Year Cash Flows													
Salvage Value													$7.95
Recovery of Net Working Capital													$1.68
Total Termination Cash Flows													$9.63
IV. Net Cash Flows	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$14.47	$24.10
Cumulative Cash Flows	($57.43)	($42.96)	($28.49)	($14.02)	$0.45	$14.92	$29.39	$43.86	$58.33	$72.80	$87.27	$101.74	$125.85
V. Cost Stream	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	($6.18)	$3.45

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($7)
Net Present Value of Revenue Flows (at 5%)	$187
Net Present Value of Cost Flows (at 5%)	($194)
Net Present Value of Output Stream (at 5%)	97,396

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.99
Levelized Revenue	$1.92
Levelized Profit	($0.08)

SUMMARY AND SENSITIVITY ANALYSIS FOR SPARTA AQUIFER: RESERVOIRS FOR R

Aquifer: **Sparta Aquifer**
Alternative: **Reservoirs for Rainharvesting**

Table x: The Results of Sensitivity Analysis for theSparta Aquifer: Reservoirs for Rainharvesting Alternati

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.2%	1.5
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	5.0%	0.0
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

AINHARVESTING ALTERNATIVE

ive

BASE CASE - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: PIPELINE CONVEYANCE OF OUACHITA RIVER WATER ALTERNATIVE

Aquifer:	**Sparta Aquifer**
Alternative:	**Pipeline Conveyance of Ouachita River Water**

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	**$1.31**	Per Thousand Gallons
Total Capital Costs:	$79.61	
Total O&M Costs:	$3.98	
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$4.70	$9.40	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($1.33)	($2.65)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$3.37*	*$6.75*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.55)	($1.50)	($1.44)	($1.39)	($1.33)	($1.27)	($1.20)	($1.14)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.83)*	*$2.60*	*$6.03*	*$6.08*	*$6.14*	*$6.20*	*$6.27*	*$6.33*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.32	($1.00)	($2.32)	($2.34)	($2.36)	($2.39)	($2.41)	($2.44)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.51)*	*$1.60*	*$3.71*	*$3.74*	*$3.78*	*$3.82*	*$3.85*	*$3.90*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.95	$0.92	$0.89	$0.85	$0.82	$0.78	$0.74	$0.70
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.39)	($0.77)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.11	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.66)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$2.77	$4.84	$6.92	$7.25	$7.25	$7.25	$7.25	$7.25
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	$2.77	$4.84	$6.92	$7.25	$7.25	$7.25	$7.25	$7.25
Cumulative Cash Flows	($15.92)	($31.84)	($47.77)	($63.69)	($79.61)	($76.84)	($72.00)	($65.09)	($57.84)	($50.59)	($43.34)	($36.09)	($28.85)
V. Cost Stream	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	($1.94)	($4.56)	($7.19)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*
Depreciation	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	($1.07)	($1.00)	($0.92)	($0.85)	($0.77)	($0.68)	($0.60)	($0.51)	($0.41)	($0.31)	($0.21)	($0.11)	$0.00
Taxable Income	*$6.40*	*$6.47*	*$6.55*	*$6.63*	*$6.71*	*$6.79*	*$6.88*	*$6.97*	*$7.06*	*$7.16*	*$7.26*	*$7.36*	*$7.47*
Income Tax	($2.46)	($2.49)	($2.52)	($2.55)	($2.58)	($2.61)	($2.65)	($2.68)	($2.72)	($2.76)	($2.79)	($2.83)	($2.88)
Net Operating Income	*$3.94*	*$3.98*	*$4.03*	*$4.07*	*$4.12*	*$4.18*	*$4.23*	*$4.28*	*$4.34*	*$4.40*	*$4.46*	*$4.53*	*$4.59*
B. Add Back Items													
Depreciation	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.66	$0.61	$0.57	$0.52	$0.47	$0.42	$0.37	$0.31	$0.25	$0.19	$0.13	$0.07	$0.00
C. Change in Net Working Capital													
Receivables	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25
III. Terminal Year Cash Flows													
Salvage Value													$3.98
Recovery of Net Working Capital													$1.00
Total Termination Cash Flows													$4.98
IV. Net Cash Flows	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$12.22
Cumulative Cash Flows	($21.60)	($14.35)	($7.10)	$0.15	$7.40	$14.65	$21.89	$29.14	$36.39	$43.64	$50.89	$58.14	$70.36
V. Cost Stream	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($1.88)

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$138
Net Present Value of Cost Flows (at 5%)	($138)
Net Present Value of Output Stream (at 5%)	105,451

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.31
Levelized Revenue	$1.31
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: PIPELINE CONVEYANCE OF OUACHITA RIVER WATER ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Pipeline Conveyance of Ouachita River Water

Parameters:

Water Supplied:	9,707	Million Gallons per Year **<= Reduced by 10% compared to base case**
Water Price:	$1.31	Per Thousand Gallons
Total Capital Costs:	$79.61	
Total O&M Costs:	$3.98	
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,236	6,471	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707	9,707
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$4.23	$8.46	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69	$12.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($1.33)	($2.65)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.90*	*$5.81*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*	*$8.71*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.55)	($1.50)	($1.44)	($1.39)	($1.33)	($1.27)	($1.20)	($1.14)	($1.07)	($1.00)	($0.92)	($0.85)	($0.77)	($0.68)	($0.60)	($0.51)	($0.41)	($0.31)	($0.21)	($0.11)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.30)*	*$1.66*	*$4.62*	*$4.67*	*$4.73*	*$4.79*	*$4.86*	*$4.92*	*$4.99*	*$5.06*	*$5.14*	*$5.21*	*$5.30*	*$5.38*	*$5.47*	*$5.56*	*$5.65*	*$5.75*	*$5.85*	*$5.95*	*$6.06*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.50	($0.64)	($1.78)	($1.80)	($1.82)	($1.85)	($1.87)	($1.90)	($1.92)	($1.95)	($1.98)	($2.01)	($2.04)	($2.07)	($2.10)	($2.14)	($2.17)	($2.21)	($2.25)	($2.29)	($2.33)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.80)*	*$1.02*	*$2.84*	*$2.87*	*$2.91*	*$2.95*	*$2.99*	*$3.03*	*$3.07*	*$3.11*	*$3.16*	*$3.21*	*$3.26*	*$3.31*	*$3.36*	*$3.42*	*$3.47*	*$3.53*	*$3.60*	*$3.66*	*$3.73*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.95	$0.92	$0.89	$0.85	$0.82	$0.78	$0.74	$0.70	$0.66	$0.61	$0.57	$0.52	$0.47	$0.42	$0.37	$0.31	$0.25	$0.19	$0.13	$0.07	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.35)	($0.70)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)	($1.04)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.11	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.59)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)	($0.88)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.29)	($0.29)	($0.29)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$2.51	$4.30	$6.09	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38
III. Terminal Year Cash Flows																										
Salvage Value																										$3.98
Recovery of Net Working Capital																										$0.88
Total Termination Cash Flows																										$4.86
IV. Net Cash Flows	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	$2.51	$4.30	$6.09	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$6.38	$11.24
Cumulative Cash Flows	($15.92)	($31.84)	($47.77)	($63.69)	($79.61)	($77.09)	($72.79)	($66.71)	($60.33)	($53.94)	($47.56)	($41.18)	($34.80)	($28.42)	($22.04)	($15.66)	($9.28)	($2.90)	$3.48	$9.86	$16.25	$22.63	$29.01	$35.39	$41.77	$53.01
V. Cost Stream	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	($1.72)	($4.16)	($6.61)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($6.31)	($1.45)

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.0%
Net Present Value of Net Cash Flows (at 5%)	($8)
Net Present Value of Revenue Flows (at 5%)	$124
Net Present Value of Cost Flows (at 5%)	($133)
Net Present Value of Output Stream (at 5%)	94,906

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.40
Levelized Revenue	$1.31
	($0.09)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: PIPELINE CONVEYANCE OF OUACHITA RIVER WATER ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Pipeline Conveyance of Ouachita River Water

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.31	Per Thousand Gallons
Total Capital Costs:	$87.57	<= Increased by 10% compared to base case
Total O&M Costs:	$3.98	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($17.51)	($17.51)	($17.51)	($17.51)	($17.51)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$4.70	$9.40	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($1.33)	($2.65)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$3.37*	*$6.75*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.71)	($1.65)	($1.59)	($1.53)	($1.46)	($1.39)	($1.32)	($1.25)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($1.25)*	*$2.18*	*$5.62*	*$5.68*	*$5.74*	*$5.81*	*$5.88*	*$5.95*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.48	($0.84)	($2.16)	($2.19)	($2.21)	($2.24)	($2.26)	($2.29)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.77)*	*$1.34*	*$3.45*	*$3.49*	*$3.53*	*$3.57*	*$3.62*	*$3.66*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$1.05	$1.01	$0.98	$0.94	$0.90	$0.86	$0.81	$0.77
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.39)	($0.77)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.11	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.66)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$2.87	$4.94	$7.02	$7.35	$7.35	$7.35	$7.35	$7.35
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($17.51)	($17.51)	($17.51)	($17.51)	($17.51)	$2.87	$4.94	$7.02	$7.35	$7.35	$7.35	$7.35	$7.35
Cumulative Cash Flows	($17.51)	($35.03)	($52.54)	($70.06)	($87.57)	($84.70)	($79.76)	($72.74)	($65.39)	($58.04)	($50.69)	($43.34)	($35.99)
V. Cost Stream	($17.51)	($17.51)	($17.51)	($17.51)	($17.51)	($1.83)	($4.46)	($7.09)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*
Depreciation	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)	($2.92)
Debt Interest Payment	($1.18)	($1.10)	($1.02)	($0.93)	($0.84)	($0.75)	($0.65)	($0.56)	($0.45)	($0.35)	($0.24)	($0.12)	$0.00
Taxable Income	*$6.03*	*$6.11*	*$6.19*	*$6.28*	*$6.36*	*$6.46*	*$6.55*	*$6.65*	*$6.75*	*$6.86*	*$6.97*	*$7.09*	*$7.21*
Income Tax	($2.32)	($2.35)	($2.38)	($2.42)	($2.45)	($2.49)	($2.52)	($2.56)	($2.60)	($2.64)	($2.68)	($2.73)	($2.77)
Net Operating Income	*$3.71*	*$3.76*	*$3.81*	*$3.86*	*$3.91*	*$3.97*	*$4.03*	*$4.09*	*$4.15*	*$4.22*	*$4.29*	*$4.36*	*$4.43*
B. Add Back Items													
Depreciation	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92	$2.92
After Tax Interest on Debt	$0.72	$0.67	$0.62	$0.57	$0.52	$0.46	$0.40	$0.34	$0.28	$0.21	$0.14	$0.07	$0.00
C. Change in Net Working Capital													
Receivables	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35
III. Terminal Year Cash Flows													
Salvage Value													$4.38
Recovery of Net Working Capital													$1.00
Total Termination Cash Flows													$5.37
IV. Net Cash Flows	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$7.35	$12.72
Cumulative Cash Flows	($28.64)	($21.29)	($13.94)	($6.59)	$0.76	$8.11	$15.46	$22.82	$30.17	$37.52	$44.87	$52.22	$64.94
V. Cost Stream	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($6.75)	($1.38)

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($6)
Net Present Value of Revenue Flows (at 5%)	$138
Net Present Value of Cost Flows (at 5%)	($144)
Net Present Value of Output Stream (at 5%)	105,451

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.37
Levelized Revenue	$1.31
Levelized Profit	($0.06)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: PIPELINE CONVEYANCE OF OUACHITA RIVER WATER ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Pipeline Conveyance of Ouachita River Water

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.31	Per Thousand Gallons
Total Capital Costs:	$79.61	
Total O&M Costs:	$4.38	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$4.70	$9.40	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($1.46)	($2.92)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$3.24*	*$6.48*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.55)	($1.50)	($1.44)	($1.39)	($1.33)	($1.27)	($1.20)	($1.14)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.96)*	*$2.33*	*$5.63*	*$5.68*	*$5.74*	*$5.81*	*$5.87*	*$5.94*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.37	($0.90)	($2.17)	($2.19)	($2.21)	($2.24)	($2.26)	($2.29)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.59)*	*$1.43*	*$3.46*	*$3.50*	*$3.53*	*$3.57*	*$3.61*	*$3.65*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.95	$0.92	$0.89	$0.85	$0.82	$0.78	$0.74	$0.70
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.39)	($0.77)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.06	$0.12	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.65)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$2.69	$4.68	$6.68	$7.00	$7.00	$7.00	$7.00	$7.00
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	$2.69	$4.68	$6.68	$7.00	$7.00	$7.00	$7.00	$7.00
Cumulative Cash Flows	($15.92)	($31.84)	($47.77)	($63.69)	($79.61)	($76.92)	($72.24)	($65.56)	($58.56)	($51.55)	($44.55)	($37.55)	($30.54)
V. Cost Stream	($15.92)	($15.92)	($15.92)	($15.92)	($15.92)	($2.01)	($4.72)	($7.43)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)	($4.38)
Earnings Before Depreciation and Tax	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*	*$9.73*
Depreciation	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	($1.07)	($1.00)	($0.92)	($0.85)	($0.77)	($0.68)	($0.60)	($0.51)	($0.41)	($0.31)	($0.21)	($0.11)	$0.00
Taxable Income	*$6.00*	*$6.08*	*$6.15*	*$6.23*	*$6.31*	*$6.39*	*$6.48*	*$6.57*	*$6.66*	*$6.76*	*$6.86*	*$6.96*	*$7.07*
Income Tax	($2.31)	($2.34)	($2.37)	($2.40)	($2.43)	($2.46)	($2.49)	($2.53)	($2.56)	($2.60)	($2.64)	($2.68)	($2.72)
Net Operating Income	*$3.69*	*$3.74*	*$3.78*	*$3.83*	*$3.88*	*$3.93*	*$3.98*	*$4.04*	*$4.10*	*$4.16*	*$4.22*	*$4.28*	*$4.35*
B. Add Back Items													
Depreciation	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.66	$0.61	$0.57	$0.52	$0.47	$0.42	$0.37	$0.31	$0.25	$0.19	$0.13	$0.07	$0.00
C. Change in Net Working Capital													
Receivables	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18	$0.18
Net Working Capital	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)	($0.98)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00
III. Terminal Year Cash Flows													
Salvage Value													$3.98
Recovery of Net Working Capital													$0.98
Total Termination Cash Flows													$4.96
IV. Net Cash Flows	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$7.00	$11.96
Cumulative Cash Flows	($23.54)	($16.54)	($9.53)	($2.53)	$4.48	$11.48	$18.48	$25.49	$32.49	$39.49	$46.50	$53.50	$65.46
V. Cost Stream	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($7.10)	($2.14)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.7%
Net Present Value of Net Cash Flows (at 5%)	($2)
Net Present Value of Revenue Flows (at 5%)	$138
Net Present Value of Cost Flows (at 5%)	($140)
Net Present Value of Output Stream (at 5%)	105,451
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.33
Levelized Revenue	$1.31
Levelized Profit	($0.02)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR SPARTA AQUIFER: PIPELINE CONVEYANCE OF OUACHITA RIVER WATER ALTERNATIVE

Aquifer: Sparta Aquifer
Alternative: Pipeline Conveyance of Ouachita River Water

Parameters:

Water Supplied:	10,786	Million Gallons per Year
Water Price:	$1.31	Per Thousand Gallons
Total Capital Costs:	$79.61	
Total O&M Costs:	$3.98	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	3,595	7,191	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($13.27)	($13.27)	($13.27)	($13.27)	($13.27)	($13.27)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4.70	$9.40	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.33)	($2.65)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$3.37*	*$6.75*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.55)	($1.50)	($1.44)	($1.39)	($1.33)	($1.27)	($1.20)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.83)*	*$2.60*	*$6.03*	*$6.08*	*$6.14*	*$6.20*	*$6.27*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.32	($1.00)	($2.32)	($2.34)	($2.36)	($2.39)	($2.41)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.51)*	*$1.60*	*$3.71*	*$3.74*	*$3.78*	*$3.82*	*$3.85*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.95	$0.92	$0.89	$0.85	$0.82	$0.78	$0.74
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.39)	($0.77)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.05	$0.11	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.66)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.33)	($0.33)	($0.33)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.77	$4.84	$6.92	$7.25	$7.25	$7.25	$7.25
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($13.27)	($13.27)	($13.27)	($13.27)	($13.27)	($13.27)	$2.77	$4.84	$6.92	$7.25	$7.25	$7.25	$7.25
Cumulative Cash Flows	($13.27)	($26.54)	($39.80)	($53.07)	($66.34)	($79.61)	($76.84)	($72.00)	($65.09)	($57.84)	($50.59)	($43.34)	($36.09)
V. Cost Stream	($13.27)	($13.27)	($13.27)	($13.27)	($13.27)	($13.27)	($1.94)	($4.56)	($7.19)	($6.86)	($6.86)	($6.86)	($6.86)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786	10,786
Water Sales Price ($/Thousand Gallons)	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31	$1.31
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11	$14.11
Operating Expenses	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)	($3.98)
Earnings Before Depreciation and Tax	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*	*$10.12*
Depreciation	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)	($2.65)
Debt Interest Payment	($1.14)	($1.07)	($1.00)	($0.92)	($0.85)	($0.77)	($0.68)	($0.60)	($0.51)	($0.41)	($0.31)	($0.21)	($0.11)
Taxable Income	*$6.33*	*$6.40*	*$6.47*	*$6.55*	*$6.63*	*$6.71*	*$6.79*	*$6.88*	*$6.97*	*$7.06*	*$7.16*	*$7.26*	*$7.36*
Income Tax	($2.44)	($2.46)	($2.49)	($2.52)	($2.55)	($2.58)	($2.61)	($2.65)	($2.68)	($2.72)	($2.76)	($2.79)	($2.83)
Net Operating Income	*$3.90*	*$3.94*	*$3.98*	*$4.03*	*$4.07*	*$4.12*	*$4.18*	*$4.23*	*$4.28*	*$4.34*	*$4.40*	*$4.46*	*$4.53*
B. Add Back Items													
Depreciation	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65	$2.65
After Tax Interest on Debt	$0.70	$0.66	$0.61	$0.57	$0.52	$0.47	$0.42	$0.37	$0.31	$0.25	$0.19	$0.13	$0.07
C. Change in Net Working Capital													
Receivables	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)	($1.16)
Payables	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16	$0.16
Net Working Capital	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)	($1.00)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25
III. Terminal Year Cash Flows													
Salvage Value													$3.98
Recovery of Net Working Capital													$1.00
Total Termination Cash Flows													$4.98
IV. Net Cash Flows	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$7.25	$12.22
Cumulative Cash Flows	($28.85)	($21.60)	($14.35)	($7.10)	$0.15	$7.40	$14.65	$21.89	$29.14	$36.39	$43.64	$50.89	$63.11
V. Cost Stream	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($6.86)	($1.88)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($4)
Net Present Value of Revenue Flows (at 5%)	$127
Net Present Value of Cost Flows (at 5%)	($131)
Net Present Value of Output Stream (at 5%)	97,396

VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.35
Levelized Revenue	$1.31
Levelized Profit	($0.04)

SUMMARY AND SENSITIVITY ANALYSIS FOR SPARTA AQUIFER: PIPELINE CONVEYANCE OF OUACI

Aquifer: **Sparta Aquifer**
Alternative: **Pipeline Conveyance of Ouachita River**

Table x: The Results of Sensitivity Analysis for theSparta Aquifer: Pipeline Conveyance of Ouachita River

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.0%	2.1
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.7%	0.6
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

HITA RIVER WATER ALTERNATIVE

Water

Water Alternative

BASE CASE - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RED RIVER/USE RED RIVER ALLUVIAL AQUIFER ALTERNATIVE

Aquifer:	**Carrizo-Wilcox**
Alternative:	**Red River/Use Red River Alluvial Aquifer**

Parameters:

Water Supplied:	3,197	Million Gallons per Year
Water Price:	**$1.47**	Per Thousand Gallons
Total Capital Costs:	$23.78	
Total O&M Costs:	$1.66	
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$3.13	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.55)	($1.11)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$1.01*	*$2.02*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.46)	($0.45)	($0.43)	($0.41)	($0.40)	($0.38)	($0.36)	($0.34)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.25)*	*$0.78*	*$1.80*	*$1.82*	*$1.84*	*$1.85*	*$1.87*	*$1.89*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	($0.30)	($0.69)	($0.70)	($0.71)	($0.71)	($0.72)	($0.73)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.15)*	*$0.48*	*$1.11*	*$1.12*	*$1.13*	*$1.14*	*$1.15*	*$1.16*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.29	$0.28	$0.27	$0.25	$0.24	$0.23	$0.22	$0.21
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.13)	($0.26)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.05	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.11)	($0.21)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.11)	($0.11)	($0.11)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.82	$1.44	$2.06	$2.17	$2.17	$2.17	$2.17	$2.17
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	$0.82	$1.44	$2.06	$2.17	$2.17	$2.17	$2.17	$2.17
Cumulative Cash Flows	($4.76)	($9.51)	($14.27)	($19.02)	($23.78)	($22.96)	($21.52)	($19.46)	($17.29)	($15.12)	($12.96)	($10.79)	($8.63)
V. Cost Stream	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	($0.74)	($1.69)	($2.63)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69
Operating Expenses	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*
Depreciation	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	($0.32)	($0.30)	($0.28)	($0.25)	($0.23)	($0.20)	($0.18)	($0.15)	($0.12)	($0.09)	($0.06)	($0.03)	$0.00
Taxable Income	*$1.91*	*$1.93*	*$1.96*	*$1.98*	*$2.00*	*$2.03*	*$2.05*	*$2.08*	*$2.11*	*$2.14*	*$2.17*	*$2.20*	*$2.23*
Income Tax	($0.74)	($0.74)	($0.75)	($0.76)	($0.77)	($0.78)	($0.79)	($0.80)	($0.81)	($0.82)	($0.84)	($0.85)	($0.86)
Net Operating Income	*$1.18*	*$1.19*	*$1.20*	*$1.22*	*$1.23*	*$1.25*	*$1.26*	*$1.28*	*$1.30*	*$1.32*	*$1.33*	*$1.35*	*$1.37*
B. Add Back Items													
Depreciation	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.20	$0.18	$0.17	$0.16	$0.14	$0.13	$0.11	$0.09	$0.08	$0.06	$0.04	$0.02	$0.00
C. Change in Net Working Capital													
Receivables	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)
Payables	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
III. Terminal Year Cash Flows													
Salvage Value													$1.19
Recovery of Net Working Capital													$0.32
Total Termination Cash Flows													$1.51
IV. Net Cash Flows	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$3.67
Cumulative Cash Flows	($6.46)	($4.30)	($2.13)	$0.03	$2.20	$4.37	$6.53	$8.70	$10.86	$13.03	$15.19	$17.36	$21.03
V. Cost Stream	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($1.02)

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$46
Net Present Value of Cost Flows (at 5%)	($46)
Net Present Value of Output Stream (at 5%)	31,261

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.47
Levelized Revenue	$1.47
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RED RIVER/USE RED RIVER ALLUVIAL AQUIFER ALTERNATIVE

Aquifer:	**Carrizo-Wilcox**
Alternative:	**Red River/Use Red River Alluvial Aquifer**

Parameters:

Water Supplied:	2,878	Million Gallons per Year	**<= Reduced by 10% compared to base case**
Water Price:	$1.47	Per Thousand Gallons	
Total Capital Costs:	$23.78		
Total O&M Costs:	$1.66		
Years to Construct	5		
Years Required to Reach 100%			
Capacity	2		

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	959	1,918	2,878	2,878	2,878	2,878	2,878	2,878
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$1.41	$2.81	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.55)	($1.11)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.85*	*$1.70*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.46)	($0.45)	($0.43)	($0.41)	($0.40)	($0.38)	($0.36)	($0.34)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.40)*	*$0.46*	*$1.33*	*$1.35*	*$1.37*	*$1.39*	*$1.40*	*$1.42*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.16	($0.18)	($0.51)	($0.52)	($0.53)	($0.53)	($0.54)	($0.55)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.25)*	*$0.29*	*$0.82*	*$0.83*	*$0.84*	*$0.85*	*$0.86*	*$0.88*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.29	$0.28	$0.27	$0.25	$0.24	$0.23	$0.22	$0.21
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.12)	($0.23)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.05	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.09)	($0.19)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.09)	($0.09)	($0.09)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.74	$1.26	$1.78	$1.88	$1.88	$1.88	$1.88	$1.88
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	$0.74	$1.26	$1.78	$1.88	$1.88	$1.88	$1.88	$1.88
Cumulative Cash Flows	($4.76)	($9.51)	($14.27)	($19.02)	($23.78)	($23.04)	($21.78)	($19.99)	($18.12)	($16.24)	($14.36)	($12.49)	($10.61)
V. Cost Stream	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	($0.67)	($1.55)	($2.44)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22	$4.22
Operating Expenses	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*	*$2.56*
Depreciation	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	($0.32)	($0.30)	($0.28)	($0.25)	($0.23)	($0.20)	($0.18)	($0.15)	($0.12)	($0.09)	($0.06)	($0.03)	$0.00
Taxable Income	*$1.44*	*$1.47*	*$1.49*	*$1.51*	*$1.54*	*$1.56*	*$1.59*	*$1.61*	*$1.64*	*$1.67*	*$1.70*	*$1.73*	*$1.76*
Income Tax	($0.56)	($0.56)	($0.57)	($0.58)	($0.59)	($0.60)	($0.61)	($0.62)	($0.63)	($0.64)	($0.65)	($0.67)	($0.68)
Net Operating Income	*$0.89*	*$0.90*	*$0.92*	*$0.93*	*$0.94*	*$0.96*	*$0.98*	*$0.99*	*$1.01*	*$1.03*	*$1.05*	*$1.06*	*$1.08*
B. Add Back Items													
Depreciation	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.20	$0.18	$0.17	$0.16	$0.14	$0.13	$0.11	$0.09	$0.08	$0.06	$0.04	$0.02	$0.00
C. Change in Net Working Capital													
Receivables	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)	($0.35)
Payables	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)	($0.28)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88
III. Terminal Year Cash Flows													
Salvage Value													$1.19
Recovery of Net Working Capital													$0.28
Total Termination Cash Flows													$1.47
IV. Net Cash Flows	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$1.88	$3.34
Cumulative Cash Flows	($8.73)	($6.85)	($4.98)	($3.10)	($1.22)	$0.66	$2.53	$4.41	$6.29	$8.16	$10.04	$11.92	$15.26
V. Cost Stream	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($2.34)	($0.88)

VI. Financial Results

Payback Period	19
Internal Rate of Return	3.8%
Net Present Value of Net Cash Flows (at 5%)	($3)
Net Present Value of Revenue Flows (at 5%)	$41
Net Present Value of Cost Flows (at 5%)	($44)
Net Present Value of Output Stream (at 5%)	28,135

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.57
Levelized Revenue	$1.47
Levelized Profit	($0.10)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RED RIVER/USE RED RIVER ALLUVIAL AQUIFER ALTERNATIVE

Aquifer: Carrizo-Wilcox
Alternative: Red River/Use Red River Alluvial Aquifer

Parameters:

Water Supplied:	3,197	Million Gallons per Year
Water Price:	$1.47	Per Thousand Gallons
Total Capital Costs:	$26.15	<= Increased by 10% compared to base case
Total O&M Costs:	$1.66	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($5.23)	($5.23)	($5.23)	($5.23)	($5.23)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$3.13	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.55)	($1.11)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$1.01*	*$2.02*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)	($0.87)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.51)	($0.49)	($0.47)	($0.46)	($0.44)	($0.42)	($0.40)	($0.37)	($0.35)	($0.33)	($0.30)	($0.28)	($0.25)	($0.22)	($0.20)	($0.17)	($0.14)	($0.10)	($0.07)	($0.04)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.37)*	*$0.65*	*$1.68*	*$1.70*	*$1.72*	*$1.74*	*$1.76*	*$1.78*	*$1.80*	*$1.83*	*$1.85*	*$1.88*	*$1.90*	*$1.93*	*$1.96*	*$1.99*	*$2.02*	*$2.05*	*$2.08*	*$2.12*	*$2.15*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.14	($0.25)	($0.65)	($0.65)	($0.66)	($0.67)	($0.68)	($0.69)	($0.69)	($0.70)	($0.71)	($0.72)	($0.73)	($0.74)	($0.75)	($0.77)	($0.78)	($0.79)	($0.80)	($0.82)	($0.83)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.23)*	*$0.40*	*$1.03*	*$1.04*	*$1.06*	*$1.07*	*$1.08*	*$1.09*	*$1.11*	*$1.12*	*$1.14*	*$1.15*	*$1.17*	*$1.19*	*$1.20*	*$1.22*	*$1.24*	*$1.26*	*$1.28*	*$1.30*	*$1.32*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87	$0.87
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.31	$0.30	$0.29	$0.28	$0.27	$0.26	$0.24	$0.23	$0.22	$0.20	$0.19	$0.17	$0.15	$0.14	$0.12	$0.10	$0.08	$0.06	$0.04	$0.02	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.13)	($0.26)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.05	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.11)	($0.21)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.11)	($0.11)	($0.11)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.85	$1.47	$2.09	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20
III. Terminal Year Cash Flows																										
Salvage Value																										$1.31
Recovery of Net Working Capital																										$0.32
Total Termination Cash Flows																										$1.62
IV. Net Cash Flows	($5.23)	($5.23)	($5.23)	($5.23)	($5.23)	$0.85	$1.47	$2.09	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$2.20	$3.82
Cumulative Cash Flows	($5.23)	($10.46)	($15.69)	($20.92)	($26.15)	($25.30)	($23.83)	($21.74)	($19.55)	($17.35)	($15.15)	($12.96)	($10.76)	($8.57)	($6.37)	($4.17)	($1.98)	$0.22	$2.42	$4.61	$6.81	$9.00	$11.20	$13.40	$15.59	$19.41
V. Cost Stream	($5.23)	($5.23)	($5.23)	($5.23)	($5.23)	($0.71)	($1.66)	($2.60)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($2.49)	($0.87)

VI. Financial Results	
Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($2)
Net Present Value of Revenue Flows (at 5%)	$46
Net Present Value of Cost Flows (at 5%)	($48)
Net Present Value of Output Stream (at 5%)	31,261
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.52
Levelized Revenue	$1.47
Levelized Profit	($0.06)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RED RIVER/USE RED RIVER ALLUVIAL AQUIFER ALTERNATIVE

Aquifer: Carrizo-Wilcox
Alternative: Red River/Use Red River Alluvial Aquifer

Parameters:

Water Supplied:	3,197	Million Gallons per Year
Water Price:	$1.47	Per Thousand Gallons
Total Capital Costs:	$23.78	
Total O&M Costs:	$1.83	**<= Increased by 10% compared to base case**
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$3.13	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.61)	($1.22)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.95*	*$1.91*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*	*$2.86*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.46)	($0.45)	($0.43)	($0.41)	($0.40)	($0.38)	($0.36)	($0.34)	($0.32)	($0.30)	($0.28)	($0.25)	($0.23)	($0.20)	($0.18)	($0.15)	($0.12)	($0.09)	($0.06)	($0.03)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.30)*	*$0.67*	*$1.63*	*$1.65*	*$1.67*	*$1.69*	*$1.71*	*$1.73*	*$1.75*	*$1.77*	*$1.79*	*$1.81*	*$1.84*	*$1.86*	*$1.89*	*$1.92*	*$1.94*	*$1.97*	*$2.00*	*$2.03*	*$2.07*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.12	($0.26)	($0.63)	($0.64)	($0.64)	($0.65)	($0.66)	($0.66)	($0.67)	($0.68)	($0.69)	($0.70)	($0.71)	($0.72)	($0.73)	($0.74)	($0.75)	($0.76)	($0.77)	($0.78)	($0.80)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.19)*	*$0.41*	*$1.01*	*$1.02*	*$1.03*	*$1.04*	*$1.05*	*$1.06*	*$1.07*	*$1.09*	*$1.10*	*$1.12*	*$1.13*	*$1.15*	*$1.16*	*$1.18*	*$1.20*	*$1.21*	*$1.23*	*$1.25*	*$1.27*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.29	$0.28	$0.27	$0.25	$0.24	$0.23	$0.22	$0.21	$0.20	$0.18	$0.17	$0.16	$0.14	$0.13	$0.11	$0.09	$0.08	$0.06	$0.04	$0.02	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.13)	($0.26)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.03	$0.05	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08	$0.08
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.10)	($0.21)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)	($0.31)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.10)	($0.10)	($0.10)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.79	$1.37	$1.96	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06
III. Terminal Year Cash Flows																										
Salvage Value																										$1.19
Recovery of Net Working Capital																										$0.31
Total Termination Cash Flows																										$1.50
IV. Net Cash Flows	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	$0.79	$1.37	$1.96	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$2.06	$3.56
Cumulative Cash Flows	($4.76)	($9.51)	($14.27)	($19.02)	($23.78)	($22.99)	($21.61)	($19.65)	($17.59)	($15.53)	($13.46)	($11.40)	($9.34)	($7.27)	($5.21)	($3.15)	($1.08)	$0.98	$3.04	$5.11	$7.17	$9.23	$11.30	$13.36	$15.42	$18.98
V. Cost Stream	($4.76)	($4.76)	($4.76)	($4.76)	($4.76)	($0.78)	($1.75)	($2.73)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($2.63)	($1.13)

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.6%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$46
Net Present Value of Cost Flows (at 5%)	($47)
Net Present Value of Output Stream (at 5%)	31,261

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.50
Levelized Revenue	$1.47
Levelized Profit	($0.03)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RED RIVER/USE RED RIVER ALLUVIAL AQUIFER ALTERNATIVE

Aquifer: Carrizo-Wilcox
Alternative: Red River/Use Red River Alluvial Aquifer

Parameters:

Water Supplied:	3,197	Million Gallons per Year
Water Price:	$1.47	Per Thousand Gallons
Total Capital Costs:	$23.78	
Total O&M Costs:	$1.66	
Years to Construct	6	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($3.96)	($3.96)	($3.96)	($3.96)	($3.96)	($3.96)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$3.13	$4.69	$4.69	$4.69	$4.69	$4.69
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.55)	($1.11)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$1.01*	*$2.02*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.46)	($0.45)	($0.43)	($0.41)	($0.40)	($0.38)	($0.36)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.25)*	*$0.78*	*$1.80*	*$1.82*	*$1.84*	*$1.85*	*$1.87*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.10	($0.30)	($0.69)	($0.70)	($0.71)	($0.71)	($0.72)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.15)*	*$0.48*	*$1.11*	*$1.12*	*$1.13*	*$1.14*	*$1.15*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.29	$0.28	$0.27	$0.25	$0.24	$0.23	$0.22
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.13)	($0.26)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.02	$0.05	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.11)	($0.21)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.11)	($0.11)	($0.11)	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.82	$1.44	$2.06	$2.17	$2.17	$2.17	$2.17
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($3.96)	($3.96)	($3.96)	($3.96)	($3.96)	($3.96)	$0.82	$1.44	$2.06	$2.17	$2.17	$2.17	$2.17
Cumulative Cash Flows	($3.96)	($7.93)	($11.89)	($15.85)	($19.81)	($23.78)	($22.96)	($21.52)	($19.46)	($17.29)	($15.12)	($12.96)	($10.79)
V. Cost Stream	($3.96)	($3.96)	($3.96)	($3.96)	($3.96)	($3.96)	($0.74)	($1.69)	($2.63)	($2.52)	($2.52)	($2.52)	($2.52)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47	$1.47
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69	$4.69
Operating Expenses	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)	($1.66)
Earnings Before Depreciation and Tax	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*	*$3.03*
Depreciation	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)	($0.79)
Debt Interest Payment	($0.34)	($0.32)	($0.30)	($0.28)	($0.25)	($0.23)	($0.20)	($0.18)	($0.15)	($0.12)	($0.09)	($0.06)	($0.03)
Taxable Income	*$1.89*	*$1.91*	*$1.93*	*$1.96*	*$1.98*	*$2.00*	*$2.03*	*$2.05*	*$2.08*	*$2.11*	*$2.14*	*$2.17*	*$2.20*
Income Tax	($0.73)	($0.74)	($0.74)	($0.75)	($0.76)	($0.77)	($0.78)	($0.79)	($0.80)	($0.81)	($0.82)	($0.84)	($0.85)
Net Operating Income	*$1.16*	*$1.18*	*$1.19*	*$1.20*	*$1.22*	*$1.23*	*$1.25*	*$1.26*	*$1.28*	*$1.30*	*$1.32*	*$1.33*	*$1.35*
B. Add Back Items													
Depreciation	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79	$0.79
After Tax Interest on Debt	$0.21	$0.20	$0.18	$0.17	$0.16	$0.14	$0.13	$0.11	$0.09	$0.08	$0.06	$0.04	$0.02
C. Change in Net Working Capital													
Receivables	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)	($0.39)
Payables	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07	$0.07
Net Working Capital	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)	($0.32)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17
III. Terminal Year Cash Flows													
Salvage Value													$1.19
Recovery of Net Working Capital													$0.32
Total Termination Cash Flows													$1.51
IV. Net Cash Flows	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$2.17	$3.67
Cumulative Cash Flows	($8.63)	($6.46)	($4.30)	($2.13)	$0.03	$2.20	$4.37	$6.53	$8.70	$10.86	$13.03	$15.19	$18.87
V. Cost Stream	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($2.52)	($1.02)

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($1)
Net Present Value of Revenue Flows (at 5%)	$42
Net Present Value of Cost Flows (at 5%)	($43)
Net Present Value of Output Stream (at 5%)	28,873

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.51
Levelized Revenue	$1.47
Levelized Profit	($0.04)

SUMMARY AND SENSITIVITY ANALYSIS FOR CARRIZO-WILCOX: RED RIVER/USE RE

Aquifer: Carrizo-Wilcox
Alternative: Red River/Use Red River Alluvial Aquife

Table x: The Results of Sensitivity Analysis for theCarrizo-Wilcox: Red River/Use Red River Alluvial Aquife

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	3.8%	2.3
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	4.6%	0.8
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

ED RIVER ALLUVIAL AQUIFER ALTERNATIVE

er

er Alternative

BASE CASE - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Carrizo-Wilcox**	
Alternative:	**Reservoirs for Rainharvesting**	
Parameters:		
Water Supplied:	3,197	Million Gallons per Year
Water Price:	**$1.92**	Per Thousand Gallons
Total Capital Costs:	$47.16	
Total O&M Costs:	$0.13	
Years to Construct	5	
Years Required to Reach 100%		
Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$2.04	$4.08	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.04)	($0.09)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.00*	*$3.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.89)	($0.86)	($0.82)	($0.79)	($0.75)	($0.71)	($0.67)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.49)*	*$1.53*	*$3.56*	*$3.60*	*$3.63*	*$3.67*	*$3.71*	*$3.75*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.19	($0.59)	($1.37)	($1.38)	($1.40)	($1.41)	($1.43)	($1.44)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.30)*	*$0.94*	*$2.19*	*$2.21*	*$2.23*	*$2.26*	*$2.28*	*$2.30*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.57	$0.55	$0.53	$0.51	$0.48	$0.46	$0.44	$0.41
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.34)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.33)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.17)	($0.17)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$1.67	$2.90	$4.12	$4.29	$4.29	$4.29	$4.29	$4.29
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	$1.67	$2.90	$4.12	$4.29	$4.29	$4.29	$4.29	$4.29
Cumulative Cash Flows	($9.43)	($18.86)	($28.30)	($37.73)	($47.16)	($45.49)	($42.60)	($38.47)	($34.18)	($29.90)	($25.61)	($21.32)	($17.03)
V. Cost Stream	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	($0.37)	($1.19)	($2.00)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12
Operating Expenses	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)
Earnings Before Depreciation and Tax	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*
Depreciation	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	($0.63)	($0.59)	($0.55)	($0.50)	($0.45)	($0.40)	($0.35)	($0.30)	($0.24)	($0.19)	($0.13)	($0.06)	$0.00
Taxable Income	*$3.79*	*$3.83*	*$3.87*	*$3.92*	*$3.97*	*$4.01*	*$4.07*	*$4.12*	*$4.18*	*$4.23*	*$4.29*	*$4.35*	*$4.42*
Income Tax	($1.46)	($1.47)	($1.49)	($1.51)	($1.53)	($1.55)	($1.57)	($1.59)	($1.61)	($1.63)	($1.65)	($1.68)	($1.70)
Net Operating Income	*$2.33*	*$2.35*	*$2.38*	*$2.41*	*$2.44*	*$2.47*	*$2.50*	*$2.53*	*$2.57*	*$2.60*	*$2.64*	*$2.68*	*$2.72*
B. Add Back Items													
Depreciation	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.39	$0.36	$0.34	$0.31	$0.28	$0.25	$0.22	$0.18	$0.15	$0.11	$0.08	$0.04	$0.00
C. Change in Net Working Capital													
Receivables	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Payables	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29
III. Terminal Year Cash Flows													
Salvage Value													$2.36
Recovery of Net Working Capital													$0.50
Total Termination Cash Flows													$2.86
IV. Net Cash Flows	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$7.15
Cumulative Cash Flows	($12.74)	($8.45)	($4.16)	$0.13	$4.42	$8.71	$13.00	$17.29	$21.58	$25.87	$30.16	$34.45	$41.60
V. Cost Stream	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	$1.02

VI. Financial Results	
Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	$0
Net Present Value of Revenue Flows (at 5%)	$60
Net Present Value of Cost Flows (at 5%)	($60)
Net Present Value of Output Stream (at 5%)	31,261
VII. Levelized Calculations (Per Thousand Gallons)	
Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	$0.00

10% REDUCED VOLUME - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer:	**Carrizo-Wilcox**	
Alternative:	**Reservoirs for Rainharvesting**	

Parameters:

Water Supplied:	**2,878** Million Gallons per Year	**<= Reduced by 10% compared to base case**
Water Price:	**$1.92** Per Thousand Gallons	
Total Capital Costs:	$47.16	
Total O&M Costs:	$0.13	
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	959	1,918	2,878	2,878	2,878	2,878	2,878	2,878
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$1.84	$3.67	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.04)	($0.09)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$1.79*	*$3.59*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.89)	($0.86)	($0.82)	($0.79)	($0.75)	($0.71)	($0.67)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.70)*	*$1.13*	*$2.95*	*$2.98*	*$3.02*	*$3.06*	*$3.09*	*$3.13*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.27	($0.43)	($1.14)	($1.15)	($1.16)	($1.18)	($1.19)	($1.21)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.43)*	*$0.69*	*$1.81*	*$1.84*	*$1.86*	*$1.88*	*$1.90*	*$1.93*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.57	$0.55	$0.53	$0.51	$0.48	$0.46	$0.44	$0.41
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.30)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.30)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.15)	($0.15)	($0.15)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$1.56	$2.66	$3.76	$3.91	$3.91	$3.91	$3.91	$3.91
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	$1.56	$2.66	$3.76	$3.91	$3.91	$3.91	$3.91	$3.91
Cumulative Cash Flows	($9.43)	($18.86)	($28.30)	($37.73)	($47.16)	($45.60)	($42.94)	($39.18)	($35.26)	($31.35)	($27.44)	($23.52)	($19.61)
V. Cost Stream	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	($0.28)	($1.01)	($1.75)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878	2,878
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51	$5.51
Operating Expenses	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)
Earnings Before Depreciation and Tax	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*	*$5.38*
Depreciation	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	($0.63)	($0.59)	($0.55)	($0.50)	($0.45)	($0.40)	($0.35)	($0.30)	($0.24)	($0.19)	($0.13)	($0.06)	$0.00
Taxable Income	*$3.17*	*$3.22*	*$3.26*	*$3.31*	*$3.35*	*$3.40*	*$3.45*	*$3.51*	*$3.56*	*$3.62*	*$3.68*	*$3.74*	*$3.81*
Income Tax	($1.22)	($1.24)	($1.26)	($1.27)	($1.29)	($1.31)	($1.33)	($1.35)	($1.37)	($1.39)	($1.42)	($1.44)	($1.47)
Net Operating Income	*$1.95*	*$1.98*	*$2.00*	*$2.03*	*$2.06*	*$2.09*	*$2.12*	*$2.16*	*$2.19*	*$2.23*	*$2.26*	*$2.30*	*$2.34*
B. Add Back Items													
Depreciation	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.39	$0.36	$0.34	$0.31	$0.28	$0.25	$0.22	$0.18	$0.15	$0.11	$0.08	$0.04	$0.00
C. Change in Net Working Capital													
Receivables	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Payables	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)	($0.45)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91
III. Terminal Year Cash Flows													
Salvage Value													$2.36
Recovery of Net Working Capital													$0.45
Total Termination Cash Flows													$2.81
IV. Net Cash Flows	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$3.91	$6.72
Cumulative Cash Flows	($15.70)	($11.79)	($7.87)	($3.96)	($0.05)	$3.87	$7.78	$11.69	$15.61	$19.52	$23.43	$27.35	$34.07
V. Cost Stream	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	($1.60)	$1.21

VI. Financial Results

Payback Period	19
Internal Rate of Return	4.2%
Net Present Value of Net Cash Flows (at 5%)	($4)
Net Present Value of Revenue Flows (at 5%)	$54
Net Present Value of Cost Flows (at 5%)	($58)
Net Present Value of Output Stream (at 5%)	28,135

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$2.05
Levelized Revenue	$1.92
Levelized Profit	($0.13)

10% INCREASED CAPITAL COST - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Carrizo-Wilcox**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	3,197	Million Gallons per Year	
Water Price:	$1.92	Per Thousand Gallons	
Total Capital Costs:	$51.88		**<= Increased by 10% compared to base case**
Total O&M Costs:	$0.13		
Years to Construct	5		
Years Required to Reach 100% Capacity	2		

All Monetary Amounts in Millions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($10.38)	($10.38)	($10.38)	($10.38)	($10.38)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$2.04	$4.08	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.04)	($0.09)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.00*	*$3.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)	($1.73)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($1.01)	($0.98)	($0.94)	($0.90)	($0.87)	($0.83)	($0.78)	($0.74)	($0.70)	($0.65)	($0.60)	($0.55)	($0.50)	($0.44)	($0.39)	($0.33)	($0.27)	($0.21)	($0.14)	($0.07)	$0.00
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.74)*	*$1.29*	*$3.32*	*$3.36*	*$3.40*	*$3.44*	*$3.48*	*$3.52*	*$3.57*	*$3.61*	*$3.66*	*$3.71*	*$3.76*	*$3.82*	*$3.87*	*$3.93*	*$3.99*	*$4.06*	*$4.12*	*$4.19*	*$4.26*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.29	($0.50)	($1.28)	($1.29)	($1.31)	($1.32)	($1.34)	($1.36)	($1.37)	($1.39)	($1.41)	($1.43)	($1.45)	($1.47)	($1.49)	($1.51)	($1.54)	($1.56)	($1.59)	($1.61)	($1.64)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.46)*	*$0.79*	*$2.04*	*$2.06*	*$2.09*	*$2.11*	*$2.14*	*$2.17*	*$2.19*	*$2.22*	*$2.25*	*$2.28*	*$2.31*	*$2.35*	*$2.38*	*$2.42*	*$2.46*	*$2.49*	*$2.54*	*$2.58*	*$2.62*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73	$1.73
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.62	$0.60	$0.58	$0.56	$0.53	$0.51	$0.48	$0.46	$0.43	$0.40	$0.37	$0.34	$0.31	$0.27	$0.24	$0.20	$0.17	$0.13	$0.09	$0.04	$0.00
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.34)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.33)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.17)	($0.17)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$1.73	$2.96	$4.18	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35
III. Terminal Year Cash Flows																										
Salvage Value																										$2.59
Recovery of Net Working Capital																										$0.50
Total Termination Cash Flows																										$3.09
IV. Net Cash Flows	($10.38)	($10.38)	($10.38)	($10.38)	($10.38)	$1.73	$2.96	$4.18	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$4.35	$7.44
Cumulative Cash Flows	($10.38)	($20.75)	($31.13)	($41.50)	($51.88)	($50.15)	($47.19)	($43.01)	($38.66)	($34.31)	($29.96)	($25.61)	($21.26)	($16.91)	($12.56)	($8.21)	($3.86)	$0.49	$4.84	$9.19	$13.54	$17.89	$22.25	$26.60	$30.95	$38.39
V. Cost Stream	($10.38)	($10.38)	($10.38)	($10.38)	($10.38)	($0.31)	($1.13)	($1.94)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	($1.77)	$1.32

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.3%
Net Present Value of Net Cash Flows (at 5%)	($4)
Net Present Value of Revenue Flows (at 5%)	$60
Net Present Value of Cost Flows (at 5%)	($63)
Net Present Value of Output Stream (at 5%)	31,261

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$2.03
Levelized Revenue	$1.92
Levelized Profit	($0.11)

10% INCREASED O&M COSTS - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: Carrizo-Wilcox
Alternative: Reservoirs for Rainharvesting

Parameters:

Water Supplied:	3,197	Million Gallons per Year
Water Price:	$1.92	Per Thousand Gallons
Total Capital Costs:	$47.16	
Total O&M Costs:	$0.15	<= Increased by 10% compared to base case
Years to Construct	5	
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$2.04	$4.08	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	($0.05)	($0.10)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$1.99*	*$3.99*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.89)	($0.86)	($0.82)	($0.79)	($0.75)	($0.71)	($0.67)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.50)*	*$1.52*	*$3.55*	*$3.58*	*$3.62*	*$3.65*	*$3.69*	*$3.73*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.19	($0.59)	($1.37)	($1.38)	($1.39)	($1.41)	($1.42)	($1.44)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.31)*	*$0.94*	*$2.18*	*$2.20*	*$2.23*	*$2.25*	*$2.27*	*$2.30*
B. Add Back Items													
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.57	$0.55	$0.53	$0.51	$0.48	$0.46	$0.44	$0.41
C. Change in Net Working Capital													
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.34)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.33)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.17)	($0.17)	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$1.66	$2.89	$4.12	$4.28	$4.28	$4.28	$4.28	$4.28
III. Terminal Year Cash Flows													
Salvage Value													
Recovery of Net Working Capital													
Total Termination Cash Flows													
IV. Net Cash Flows	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	$1.66	$2.89	$4.12	$4.28	$4.28	$4.28	$4.28	$4.28
Cumulative Cash Flows	($9.43)	($18.86)	($28.30)	($37.73)	($47.16)	($45.50)	($42.61)	($38.49)	($34.21)	($29.93)	($25.65)	($21.36)	($17.08)
V. Cost Stream	($9.43)	($9.43)	($9.43)	($9.43)	($9.43)	($0.38)	($1.19)	($2.01)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)

Calendar Year	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made													
% Constructed	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life													
A. Net Operating Income													
Operating Revenues	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12
Operating Expenses	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)	($0.15)
Earnings Before Depreciation and Tax	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*	*$5.98*
Depreciation	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	($0.63)	($0.59)	($0.55)	($0.50)	($0.45)	($0.40)	($0.35)	($0.30)	($0.24)	($0.19)	($0.13)	($0.06)	$0.00
Taxable Income	*$3.77*	*$3.82*	*$3.86*	*$3.90*	*$3.95*	*$4.00*	*$4.05*	*$4.11*	*$4.16*	*$4.22*	*$4.28*	*$4.34*	*$4.41*
Income Tax	($1.45)	($1.47)	($1.49)	($1.50)	($1.52)	($1.54)	($1.56)	($1.58)	($1.60)	($1.62)	($1.65)	($1.67)	($1.70)
Net Operating Income	*$2.32*	*$2.35*	*$2.37*	*$2.40*	*$2.43*	*$2.46*	*$2.49*	*$2.53*	*$2.56*	*$2.59*	*$2.63*	*$2.67*	*$2.71*
B. Add Back Items													
Depreciation	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.39	$0.36	$0.34	$0.31	$0.28	$0.25	$0.22	$0.18	$0.15	$0.11	$0.08	$0.04	$0.00
C. Change in Net Working Capital													
Receivables	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Payables	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28
III. Terminal Year Cash Flows													
Salvage Value													$2.36
Recovery of Net Working Capital													$0.50
Total Termination Cash Flows													$2.86
IV. Net Cash Flows	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$4.28	$7.14
Cumulative Cash Flows	($12.80)	($8.52)	($4.24)	$0.04	$4.33	$8.61	$12.89	$17.17	$21.45	$25.73	$30.02	$34.30	$41.43
V. Cost Stream	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	($1.84)	$1.01

VI. Financial Results

Payback Period	17
Internal Rate of Return	5.0%
Net Present Value of Net Cash Flows (at 5%)	($0)
Net Present Value of Revenue Flows (at 5%)	$60
Net Present Value of Cost Flows (at 5%)	($60)
Net Present Value of Output Stream (at 5%)	31,261

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.92
Levelized Revenue	$1.92
Levelized Profit	($0.00)

ONE YEAR CONSTRUCTION DELAY - FINANCIAL ANALYSIS FOR CARRIZO-WILCOX: RESERVOIRS FOR RAINHARVESTING ALTERNATIVE

Aquifer: **Carrizo-Wilcox**
Alternative: **Reservoirs for Rainharvesting**

Parameters:

Water Supplied:	3,197	Million Gallons per Year
Water Price:	**$1.92**	Per Thousand Gallons
Total Capital Costs:	$47.16	
Total O&M Costs:	$0.13	
Years to Construct	**6**	**<= Added One Yeat to Construction Time**
Years Required to Reach 100% Capacity	2	

All Monetary Amounts in Millions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Calendar Year	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Project Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
% of Full Production	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	33.33%	66.67%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Production (Millions of Gallons)	0	0	0	0	0	0	1,066	2,132	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197	3,197
Water Sales Price ($/Thousand Gallons)	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92	$1.92
I. Net Cash Flows a the Time the Invesment is Made																										
% Constructed	16.7%	33.3%	50.0%	66.7%	83.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Built Cost	($7.86)	($7.86)	($7.86)	($7.86)	($7.86)	($7.86)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
II. Operating Inflows Over the Project's Life																										
A. Net Operating Income																										
Operating Revenues	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2.04	$4.08	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12	$6.12
Operating Expenses	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.04)	($0.09)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)	($0.13)
Earnings Before Depreciation and Tax	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$2.00*	*$3.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*	*$5.99*
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)	($1.57)
Debt Interest Payment	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.92)	($0.89)	($0.86)	($0.82)	($0.79)	($0.75)	($0.71)	($0.67)	($0.63)	($0.59)	($0.55)	($0.50)	($0.45)	($0.40)	($0.35)	($0.30)	($0.24)	($0.19)	($0.13)	($0.06)
Taxable Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.49)*	*$1.53*	*$3.56*	*$3.60*	*$3.63*	*$3.67*	*$3.71*	*$3.75*	*$3.79*	*$3.83*	*$3.87*	*$3.92*	*$3.97*	*$4.01*	*$4.07*	*$4.12*	*$4.18*	*$4.23*	*$4.29*	*$4.35*
Income Tax	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.19	($0.59)	($1.37)	($1.38)	($1.40)	($1.41)	($1.43)	($1.44)	($1.46)	($1.47)	($1.49)	($1.51)	($1.53)	($1.55)	($1.57)	($1.59)	($1.61)	($1.63)	($1.65)	($1.68)
Net Operating Income	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*($0.30)*	*$0.94*	*$2.19*	*$2.21*	*$2.23*	*$2.26*	*$2.28*	*$2.30*	*$2.33*	*$2.35*	*$2.38*	*$2.41*	*$2.44*	*$2.47*	*$2.50*	*$2.53*	*$2.57*	*$2.60*	*$2.64*	*$2.68*
B. Add Back Items																										
Depreciation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57	$1.57
After Tax Interest on Debt	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.57	$0.55	$0.53	$0.51	$0.48	$0.46	$0.44	$0.41	$0.39	$0.36	$0.34	$0.31	$0.28	$0.25	$0.22	$0.18	$0.15	$0.11	$0.08	$0.04
C. Change in Net Working Capital																										
Receivables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.34)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Payables	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01	$0.01
Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.33)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)	($0.50)
Change in Net Working Capital	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	($0.17)	($0.17)	($0.17)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
D. Net Operating Cash Flows	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1.67	$2.90	$4.12	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29
III. Terminal Year Cash Flows																										
Salvage Value																										$2.36
Recovery of Net Working Capital																										$0.50
Total Termination Cash Flows																										$2.86
IV. Net Cash Flows	($7.86)	($7.86)	($7.86)	($7.86)	($7.86)	($7.86)	$1.67	$2.90	$4.12	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$4.29	$7.15
Cumulative Cash Flows	($7.86)	($15.72)	($23.58)	($31.44)	($39.30)	($47.16)	($45.49)	($42.60)	($38.47)	($34.18)	($29.90)	($25.61)	($21.32)	($17.03)	($12.74)	($8.45)	($4.16)	$0.13	$4.42	$8.71	$13.00	$17.29	$21.58	$25.87	$30.16	$37.31
V. Cost Stream	($7.86)	($7.86)	($7.86)	($7.86)	($7.86)	($7.86)	($0.37)	($1.19)	($2.00)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	($1.83)	$1.02

VI. Financial Results

Payback Period	18
Internal Rate of Return	4.5%
Net Present Value of Net Cash Flows (at 5%)	($2)
Net Present Value of Revenue Flows (at 5%)	$55
Net Present Value of Cost Flows (at 5%)	($58)
Net Present Value of Output Stream (at 5%)	28,873

VII. Levelized Calculations (Per Thousand Gallons)

Levelized Cost	$1.99
Levelized Revenue	$1.92
Levelized Profit	($0.08)

SUMMARY AND SENSITIVITY ANALYSIS FOR CARRIZO-WILCOX: RESERVOIRS FOR R

Aquifer: **Carrizo-Wilcox**
Alternative: **Reservoirs for Rainharvesting**

Table x: The Results of Sensitivity Analysis for theCarrizo-Wilcox: Reservoirs for Rainharvesting Alternati

Assumed Change	Financial Internal Rate of Return	Sensitivity Index
Base Case	5.0%	-
Volume - 10%	4.2%	1.5
Capital Costs + 10%	4.3%	1.3
O&M Costs + 10%	5.0%	0.0
One Year Delay (= 20% Increase in Construction Period)	4.5%	0.5

Notes: 1. The sensitivity index shows the percentage change in the internal rate of return divided by the percentage change in the parameter of interest (e.g., volume).

Appendix 6 Financial Viability Analysis and Cost Comparison of Alternatives

GRAND SUMMARY

Aquifer	Alternative	Net Present Value of Costs ($ Millions)	Water Price ($ per 1,000 Gallons)
Chicot Aquifer System	Waste Water Recycling	$1,811	$1.49
	Reservoirs for Rainharvesting	**$917**	**$0.75**
Jasper Aquifer System	Waste Water Recycling	$442	$1.49
	Reservoirs for Rainharvesting	$569	$1.92
	Pipeline Conveyance of Red River Water	**$388**	**$1.31**
Cockfield Aquifer	Waste Water Recycling	**$17**	**$1.49**
	Reservoirs for Rainharvesting	$21	$1.92
Sparta Aquifer	Waste Water Recycling	$157	$1.49
	Reservoirs for Rainharvesting	$202	$1.92
	Pipeline Conveyance of Ouachita River Water	**$138**	**$1.31**
Carrizo-Wilcox	Red River/Use Red River Alluvial Aquifer	**$46**	**$1.47**
	Reservoirs for Rainharvesting	$60	$1.92

Internal Rates of Return (Sensitivity Indices)

Aquifer	Alternative	Base Case	10% Lower Volume	10% Higher Capital Costs	10% Higher Operations and Maintenance Costs	One Year Construction Delay
Chicot Aquifer System	Waste Water Recycling	5.0%	3.4% (3.2)	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rainharvesting	5.0%	4.2% (1.5)	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
Jasper Aquifer System	Waste Water Recycling	5.0%	3.4% (3.2)	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rainharvesting	5.0%	4.2% (1.5)	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
	Pipeline Conveyance of Red River Water	5.0%	4.0% (2.1)	4.3% (1.3)	4.7% (0.6)	4.5% (0.5)
Cockfield Aquifer	Waste Water Recycling	5.0%	3.4% (3.2)	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rainharvesting	5.0%	4.2% (1.5)	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
Sparta Aquifer	Waste Water Recycling	5.0%	3.4% (3.2)	4.3% (1.3)	4.2% (1.6)	4.5% (0.5)
	Reservoirs for Rainharvesting	5.0%	4.2% (1.5)	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)
	Pipeline Conveyance of Ouachita River Water	5.0%	4.0% (2.1)	4.3% (1.3)	4.7% (0.6)	4.5% (0.5)
Carrizo-Wilcox	Red River/Use Red River Alluvial Aquifer	5.0%	3.8% (2.3)	4.3% (1.3)	4.6% (0.8)	4.5% (0.5)
	Reservoirs for Rainharvesting	5.0%	4.2% (1.5)	4.3% (1.3)	5.0% (0.0)	4.5% (0.5)