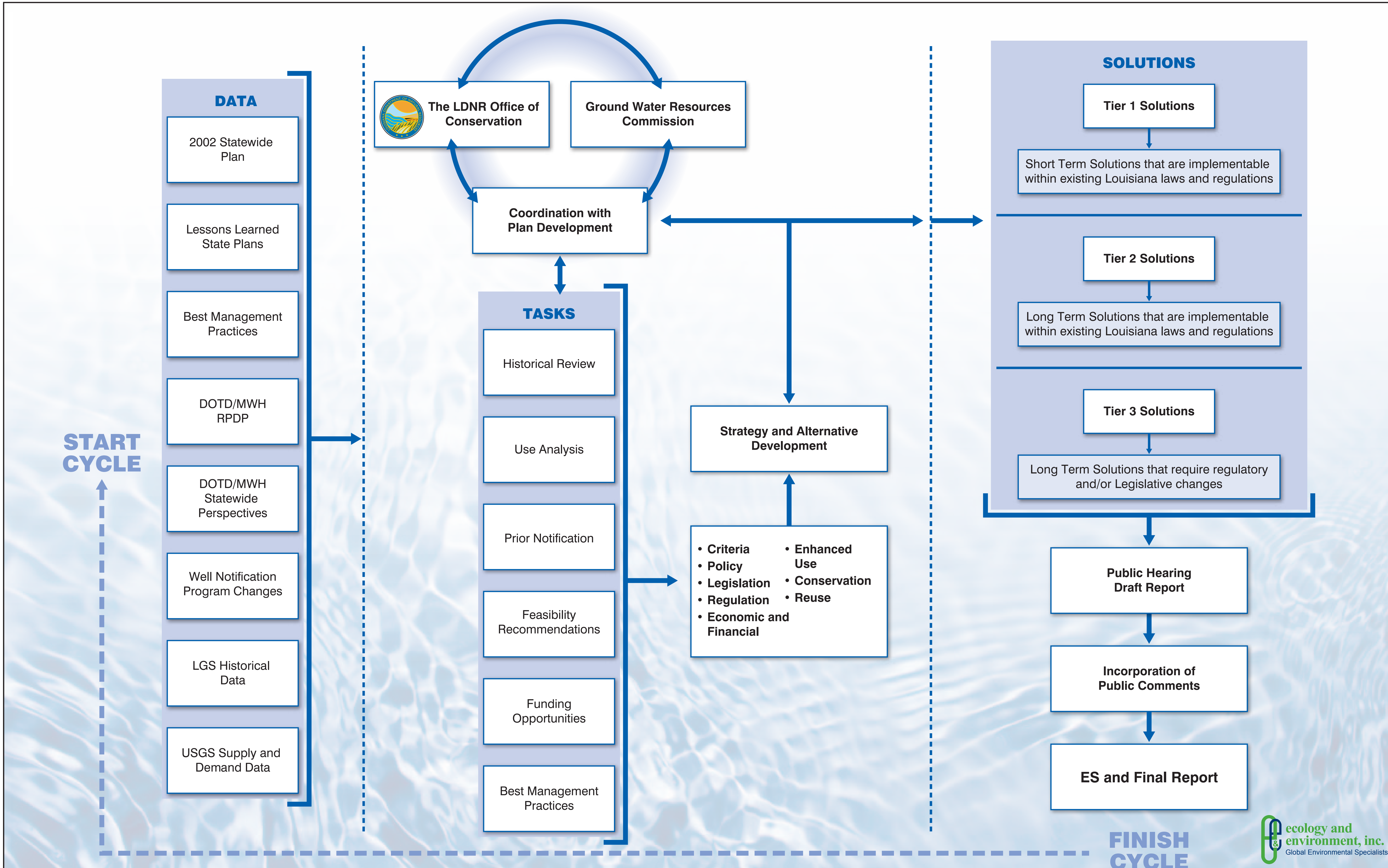

Preliminary Draft Statewide Groundwater Management Planning Process

Preliminary Draft Statewide Groundwater Management Planning Process

Historical Review → **Use Analysis** → **Review of Groundwater with Prior Notification Procedures** → **Feasibility Recommendations** → **Funding Opportunities** → **Best Management Practices**

Historical Review

Review of Historical Data from:

- LGS Data Review
- 2002 Statewide Water Management Plan
- LDNR Well Notification Program
- DOTD RPDP
- DOTD Perspectives on Water Resources Report
- BMP's
- State's Water Resources Management Plans
- Journals
- Standards of Practice
- Water Use Data

Use Analysis

- Analyze historic and current transfer population growth and movement.
- Analyze historic and predicted water demands by population, industries, agriculture, energy production, and other uses including developing industries such as aquaculture, biofuel production, enhanced gas recovery methods, solution mining, and Other demands.
- Compare collected data with USGS aggregate water use Data for data gaps.
- Identify parishes where there is a need to expand or update lists where water usage is known to have changed and/or usage has been missed by earlier publication.

Review of Groundwater with Prior Notification Procedures

- Collect data on the reception, review, and comment phases to determine ways of streamlining the reporting process.
- Review analytical data, methods, models, and estimates used to determine current demand of the aquifers to be impacted by new wells.
- Evaluate the accuracy and recommend evaluation criteria improvements, based on sustainability, including best management practices as a basis for decision-making as necessary.
- Analyze ways to streamline reporting requirements for both the prior well notification and for nonexempt wells and post-completion reporting requirements for all wells prior to his transition from DOTD to LDNR.

Feasibility Recommendations

- Identification, evaluation, and recommendations of groundwater management plan components, regulations, and guidance, development grants and financing, and interim corrective measures.
- Identification and evaluation of areas of declining groundwater in major aquifers and minor aquifers as permitted using existing documentation and available data.
- Production of region or aquifer scale maps showing areas of water level decline, areas of recharge, areas of saltwater intrusion, and potential sources of surface and groundwater.
- Identification and evaluation availability of alternative sources of supply.
- Review and evaluation of previous recommendations for conservation in the Sparta aquifer.
- Development of recommendations with consideration of existing groundwater availability models.
- Planning component development: potential components may include water reduction strategies, water and wastewater development projects, and mitigation measures.
- Identification of water conservation measures.
- Identification of water reuse measures.
- Identification of BMPs for agricultural water uses.
- Identification of wastewater reuse measures.
- Identification of recharge measures.
- Identification of additional interim corrective measures.
- Conduct demand analysis and demand forecasting.
- Estimate gap between future demand and supply from existing sources.
- Identify alternatives to fill the supply gap.
- Conduct financial and economic feasibility analysis.
- Conduct uncertainty analysis.
- Conduct cost-benefit analysis of alternatives.
- Consider other factors.
- Identify potential progressive and regressive stimulus measures to optimize water use.
- Stimulus measures may include development grants and financing, crop subsidies, tariffs, market assistance, water conservation and education programs, incentives, monitoring, auditing, and enforcement
- Groundwater level monitoring and water quality and Monitoring recommendations.
- Financial feasibility analysis.
- Recommend and prioritize short and long-term alternatives.

Funding Opportunities

- Identification of relevant federal state and local funding sources for alternatives to reduce groundwater depletion.
- Review of appropriation sources for water resources development water treatment, transmission, distribution, storage for surface water supplies, and funding available for reclaimed water processing and reuse.
- Identification of funding sources and incentives for water conservation and water reuse.
- Evaluation of local funding sources such as tax increment financing, development impact fees, ad valorem taxes, and in criminal sales taxes, and groundwater depletion taxes.
- Prioritization of funding sources And development of funding source recommendations based on a lease cost framework to state taxpayers.
- Identification of special-purpose funding vehicles And their constraints based on requirements for regulatory authority and organizational Structure.
- Evaluation of innovative programs being implemented across the nation for applicability to the issues and opportunities facing the state.
- Compilation of relevant funding sources.

Best Management Practices

Identification and Evaluation of Best Management Practices for:

- Tax credit programs
- Tax incentives
- Low-interest loan programs
- Grant programs
- Rebate programs
- Surface and groundwater conservation programs.
- Water reuse programs
- Lessons learned

Early Input and Guidance from the Ground Water Resources Commission and the Office of Conservation

Public Hearing Draft Report

ES and Final Report

ecology and environment, inc.
Global Environmental Specialists

Statewide Ground Water Management Plan

Preliminary Draft

Date

September 2, 2010

Prepared for:

Louisiana Department of Natural Resources
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List of Abbreviations and Acronyms

(edits needed)

%	Percent
~	approximately
°F	Degrees Fahrenheit
AWUDS	Aggregate Water-Use Data System
AGC	Area of Ground water concern
AIC	Average Incremental Cost
ANRC	Arkansas Natural Resources Commission
AWEP	Agriculture Water Enhancement Program
BaB	Build America Bonds
BMP	Best Management Practices
CIP	Capital Improvement Plan
DED	Department of Economic Development
DEQ	Department of Environmental Quality
DHH	Department of Health and Hospitals
DOE	Department of Energy
E & E	Ecology and Environment, Inc.
EIA	Energy Information Administration
EPA	Environmental Protection Agency
FIPS	Federal Information Processing Standard
FIRR	Rinancial Internal Rate of Return
GEOREF	GeoRef Database
GIS	Geographic Information System
gpm	Gallons per minute
GWRD	Ground Water Resources Division
HP	Horse Power
ID	Identification
IMPLAN	Impact Analysis for Planning
in	Inches
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Develop-ment
LGS	Louisiana Geological Survey
LRPD	Louisiana Reservoir Priority and Development Program
MGD	Million gallons per day
N/A	Not Available
NASS	National Agricultural Statistics Service
NRCS	Natural Resource Conservation Service
NWRC	National Wetland Research Center
NWUDB	National Water Use Database
O & M	Operation and Maintenance
OC	Office of Conservation
OPH	Office of Public Health
OWR	Office of Water Resources
P&A	Plug and abandonment

List of Abbreviations and Acronyms (cont.)

SDWIS	Safe Drinking Water Information System
SHAS	Southern Hills Aquifer System
SONRIS	Strategic Online Natural Resources Information System
SWAP	
TWDB	Texas Water Development Board
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WACC	Weighted Average Cost of Capital
WIN	Water Independence Now
WRC	Water Resource Commission
WWC	Water Well Contractor

List of Abbreviations and Acronyms (cont.)

Executive Summary

In 2002, a report titled "Assistance in Developing the Statewide Water Management Plan" was developed for the Louisiana Ground Water Management Commission and the Ground Water Management Advisory Task Force along with the Commissioner of Conservation. This was necessitated by the need for developing rules and regulations for the determination of critical ground water sources, emergency situation responses, conservation of water resources, and related matters. The report became the basis for promulgating Act 49 of 2003 regarding surface and ground water management and conservation. Act 49 of the 2003 Legislative Session directed the Commissioner of Conservation and Louisiana to develop a statewide ground water resource management program to evaluate current and projected demands, water use conservation program, alternatives to ground water use, incentives for conservation, alternative technologies, and education and conservation programs.

Conservation and sustainability of ground and surface water resources are the focal points of this current project, with recent increases in water demand, especially for the northern region of the state, triggering the effort. A comprehensive approach from updating the baseline conditions to looking into possible cost-effective water resources alternatives is necessary to ensure that water resources are utilized judiciously and in a sustainable manner. We understand that there is a need for compiling and reviewing statewide database on water uses. The state's current system of water use reporting from various users needs to be reviewed and potentially modified to ensure adequate monitoring of this precious resource. Efforts will concentrate on developing more stringent and discrete ground water well permitting processes to ensure that conservation and sustainability of water resources is achieved. Conservative use of water resources needs to be developed and incentives made available to the users. Awareness should be developed among the water users regarding the value of this resource and adequate fees should be charged for the usage. Cost-effective alternatives to ground water and use of ground water from healthy aquifers will be explored in addition to considering non-potable ground and surface water for industrial purposes. A mechanism that will help the state to forecast ground water and surface water demands for short- and long-term needs also will be developed. Innovative funding mechanisms will be explored in addition to utilizing existing funding sources. Innovative ways of conserving and reusing surface and ground water resources assume paramount importance for this project. Interstate cooperation for surface recharges into various aquifers will be explored and need to be made part of the recommendations. An appropriate Geographic Information System (GIS)-based database development will help the state to monitor and adaptively manage the resources. Louisiana State's Comprehensive Master Plan envisions utilizing freshwater for the coastal restoration and protection measures; therefore, any action towards utilizing surface water will have to be be consistent with the Master Plan since a sustainable landscape, which is the main focus of the master plan that ensures sustainability to the state's coastal areas and related economy.

1 Historical Review of Groundwater and Surface Water Sources

1.1 Background

A broad cursory review was performed on historical information from various sources regarding Louisiana's ground water and surface water management and conservation goals. The search included a review of published material from the following sources: (1) 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 (DOTD); (6) Louisiana Department of Natural Resources (DNR); (7) Louisiana Department of Environmental Quality (DEQ); (8) Louisiana Department of Health and Hospitals (DHH); (9) other published literature gathered through a American Geological Institute's GeoRef Database (GEOREF) search. A database of published works was compiled using Endnote software.

Additional sources were researched, including U.S. Environmental Protection Agency (EPA), 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), 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 *Assistance in Developing the Statewide Water Management Plan*; *Water System Master Plan*; as well as studies on major aquifers, i.e., the Sparta, Chicot aquifer, and Southern Hills aquifer were reviewed.

The literature search was compiled, organized by region and water sources such as groundwater or surface water. A bibliography and index was prepared and is available on CD.

In addition to the condition and capacity of surface and groundwater sources, the review examined available data on impacts of climate conditions on surface waters and recharge potentials of groundwater, such as through interaction between the various aquifers and overlying surface water bodies, such as major streams, rivers, bayous and lakes, through direct infiltration of rainfall on the top unit and infiltration downwards either into the focus aquifer directly (if it's subcropping), or through other associated aquifers. Some aquifers of concern, such as the Sparta, have experienced a decline in water level that has been nearly continuous over the past 100 years. This aquifer, as most in Louisiana, is a shared resource between states, so it was critical that the data review look and the system as a whole and not confine the investigation to State boundaries.

The findings from this task will serve as the foundation for other tasks in this project. Information from this task was used to complete Task 2 and Task 4 through the identification of water usage trends and the development of recommendations for five-year and 25-year periods.

1.2 Historical Review of Ground Water and Surface Water Sources

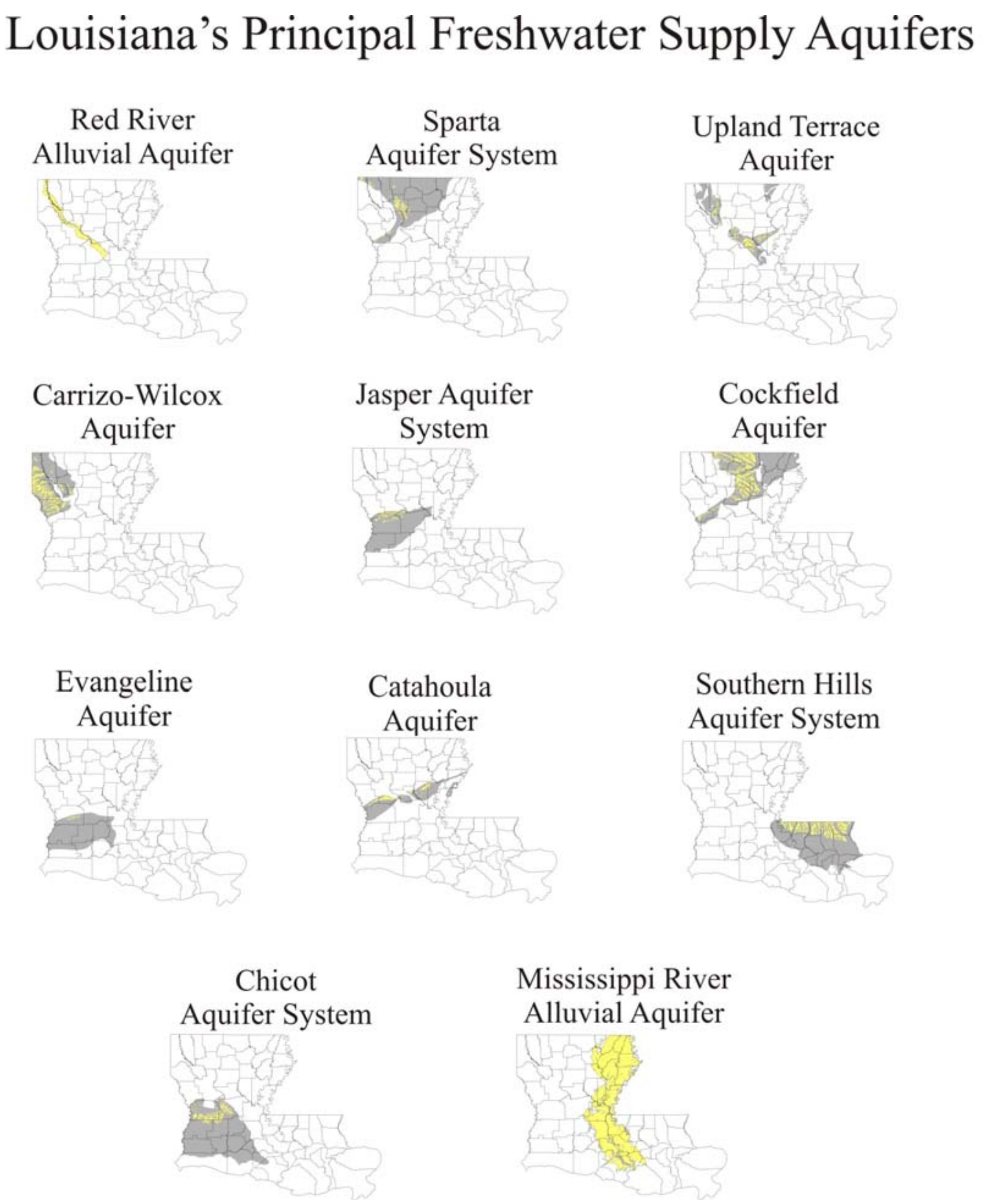
The Louisiana Geological Survey (LGS) conducted a review of surface and ground water resources for this plan. Their draft report - *Summary of Surface and Ground Water Resources Publications and Readily Available Data for Louisiana* is included in Attachment 1-1.

1.2.1 Groundwater

As noted in the LGS report –

> 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 northeast Louisiana. In addition to those four dominant aquifers, the Upland Terrace, Catahoula and Cockfield aquifers are local secondary groundwater sources. In Southwestern Louisiana, the Chicot Aquifer System is dominant with the Evangeline Aquifer, Jasper Aquifer System and Catahoula Aquifer as secondary source. 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.

Figure 1-1 depects the general recharge areas and subsurface extent of each of these 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 1-1: Louisiana Principal Fresh Water Aquifers

.

The LGS report details following the 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 historic 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

1.2.2 Surface Water

As noted in the LGS report –

> 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.

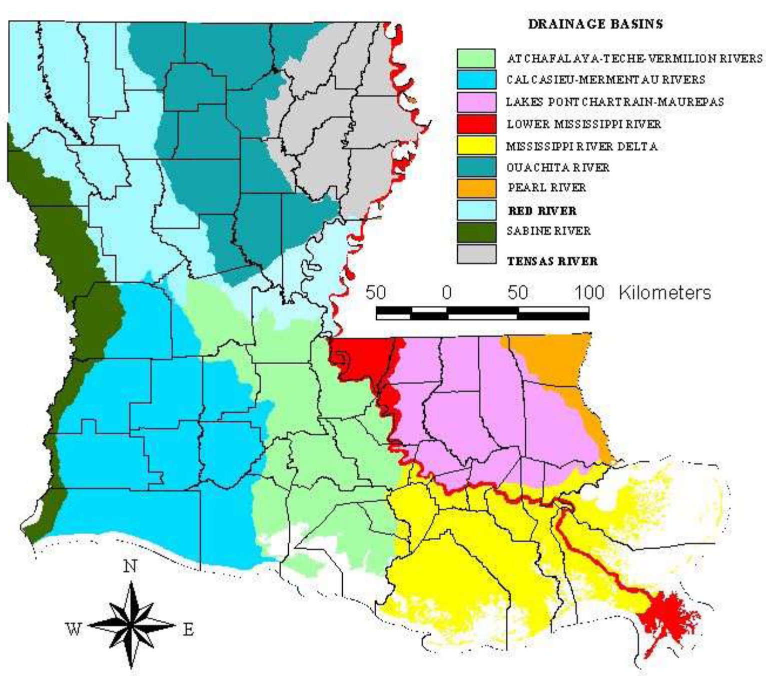


Figure 1-2: Principal drainage basins of Louisiana (from LGS -2010)

In addition the bibliography, the LGS report details the extent of each basin as well as the location of each USGS and USACE gauging station located within each drainage basin.

(TMDL / impaired watershed data?)

1.2.3 Climate Data

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.

LGS collected average monthly precipitation data, average monthly temperature data, average monthly Palmer Drought Severity Index data that covers the covers the period of 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 (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 relatively evenly distributed during the year.
>
> **Temperature** - 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 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.

Variations in climate in and around Louisiana can not only impact surface waters, but can affect aquifers in the areas of recharge (see Figure 1-3).

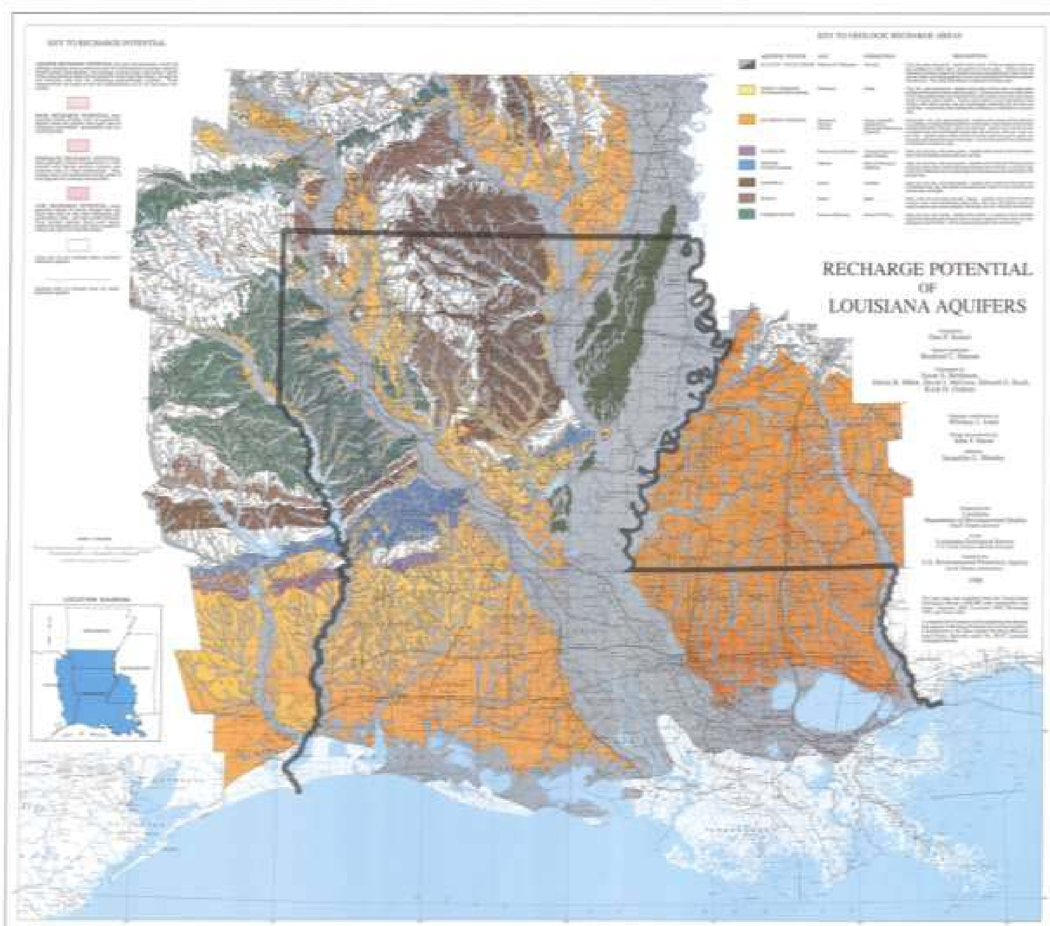


Figure 1-3: Recharge potential map (from Boniol and Hanson, 1988)

2 Water Resource Use Analysis

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

- EPA 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;
- U.S. DOE 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;
- DNR Ground Water Resources Division (GWRD);
- Louisiana DEQ groundwater monitoring programs;
- Louisiana DHH select ground water well data and drinking water monitoring programs; and
- Various area surface and ground water conservation data.

An analysis of historic and current trends for population growth and movement, historic and projected water demands by population, industries, agriculture, energy production, and other uses, including developing industries such as aquaculture, biofuel production, enhanced gas recovery methods, solution mining, and other demands; and determined the quality, as well as, the current and projected quantity required by each user group. Data collected was compared to the USGS Aggregate Water-Use Data System (AWUDS) for data gaps. We identified parishes where there is a need to expand/update lists where water usage is known to have changed and/or usage has been missed by earlier publication. These need to be included to yield more accurate accounting of water demand.

At present, GWR Division receives monthly usage only for non-exempt wells located in the three areas of concern of the Sparta Aquifer, as designated by Order No. AGC-1-05. The usage data for these areas, and others, was compared to usage estimates projected by other available databases for additional water demand corrections.

2.1 Water Usage

The LGS also conducted a review of surface and ground water resource data for this plan, as detailed in their report in Attachment 1-1. As summarized in their report-

> 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.

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 Spring 2011. (Insert discussion of major user information once received Sept 2010- 175 public supply, industrial, or power generation facilities that withdraw greater than 1 million gallons per day, annual totals for 2005 through 2009 grouped by category of use, industrial subcategory, county, major aquifer, and surface-water basin. This subset accounts for roughly 60 percent of public supply withdrawals, 80 percent of industrial withdrawals, and 100 percent of fossil-fueled power generation withdrawals. The annual totals could provide a sense of the overall trend in these categories since 2005.)

2.1.1 Water Use Data

Water use information is derived from a wide variety of sources, 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). Livestock 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. (Note- Mining source water is being tracked post 2005 - discussion needed)

2.2 Water Use by Regions

To be consistent with the “Assistance in Developing the Statewide Water Management Plan” (LGWMC 2002) water use will be discussed by the three regions (Region I-North Louisiana, Region II-Southwest Louisiana, and Region III-Southeast Louisiana) that were established in that report (Figure 2-1)

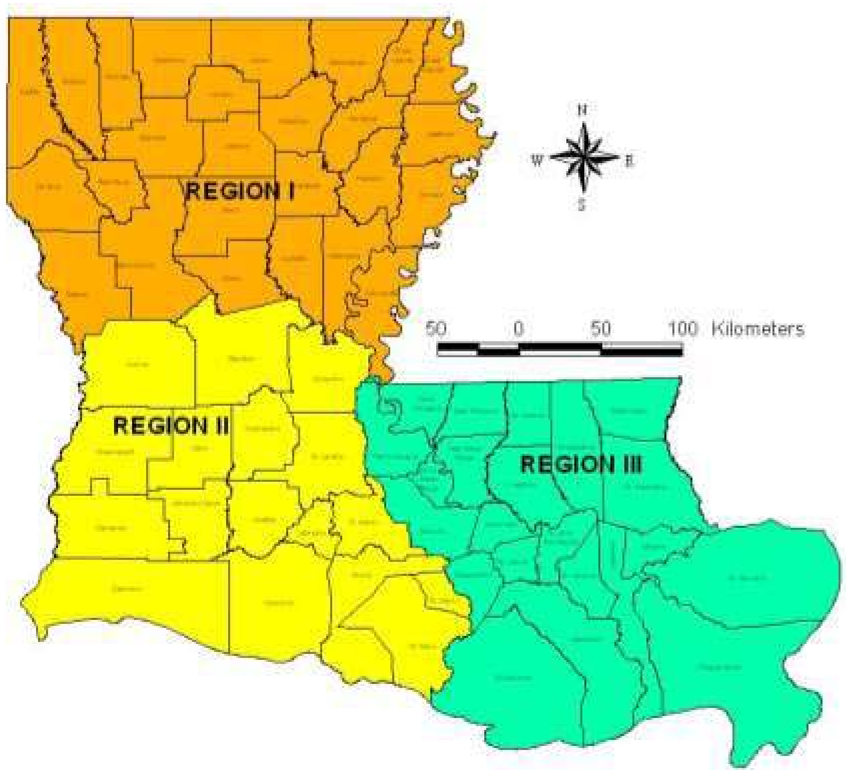


Figure 2-1: Water Use Regions

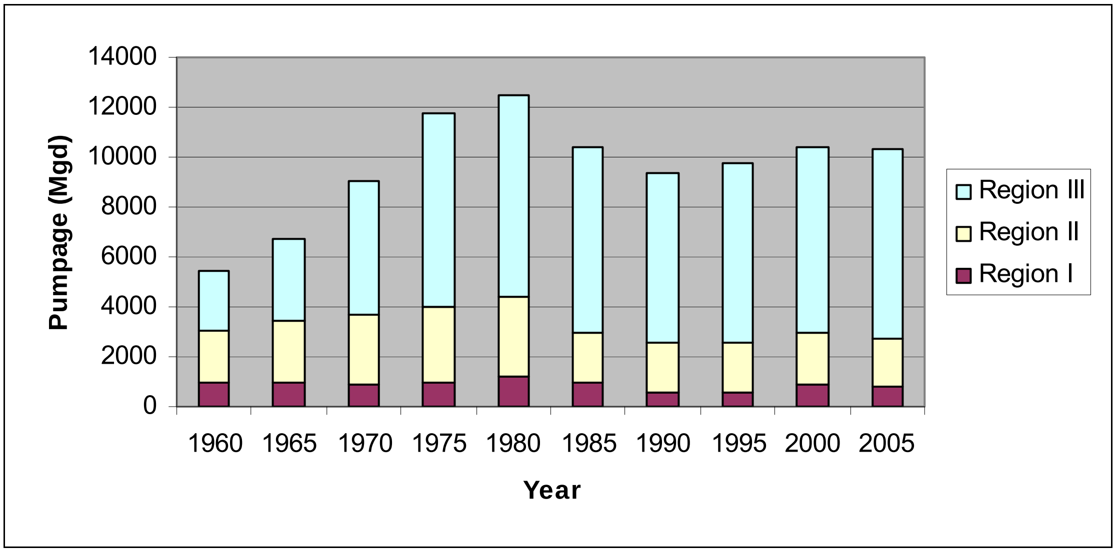
Total water use in Louisiana increased from 5,400 million gallons per day (MGD) in 1960 to a peak value of 12,500 MGD in 1980, but decreased by 3,000 MGD by 1990 (Table 2-1 and Figure 2-1). Water use in the three regions of Louisiana generally followed this trend, except for Region I that saw a decrease in water use between 1965 and 1970 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 has accounted for most of the pumpage ranging from 40% in 1960 to 75% in 2005 (Figure 2-2) in large part due to the majority of Louisiana' population and industry in the cities of New Orleans and Baton Rouge. Region II has accounted for between 30% of and 40% of the pumpage and Region I has accounted for between 5% and 20% of the pumpage over the past 45years. Average water use over this 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. Water use in both Region I and II are currently below their average and Region III is using water at a rate above it average.

Table 2-1: Total Water Use by Region in Louisiana (1960 - 2005) (MGD)

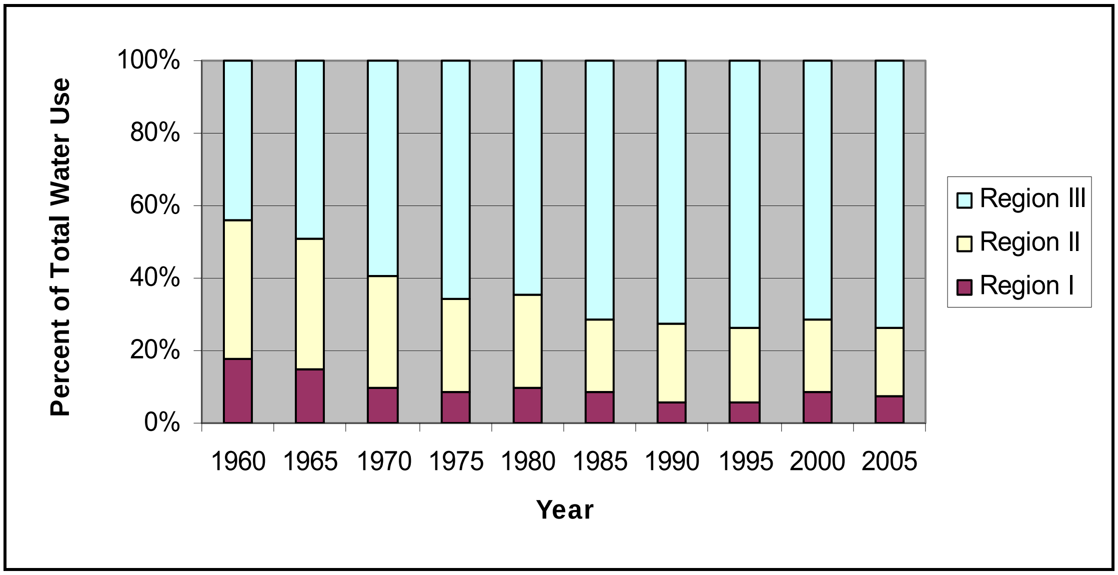
Region	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
I	970	979	886	983	1,184	920	551	579	877	762
II	2,072	2,433	2,812	3,022	3,192	2,037	2,036	1,960	2,106	1,935
III	2,372	3,288	5,367	7,724	8,068	7,449	6,767	7,224	7,394	7,602
Total	5,415	6,700	9,066	11,730	12,444	10,408	9,354	9,763	10,377	10,299

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-2: Total Water Use by Region in Louisiana (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-3: Distribution of Water Use by Region in Louisiana (1960 -2005)

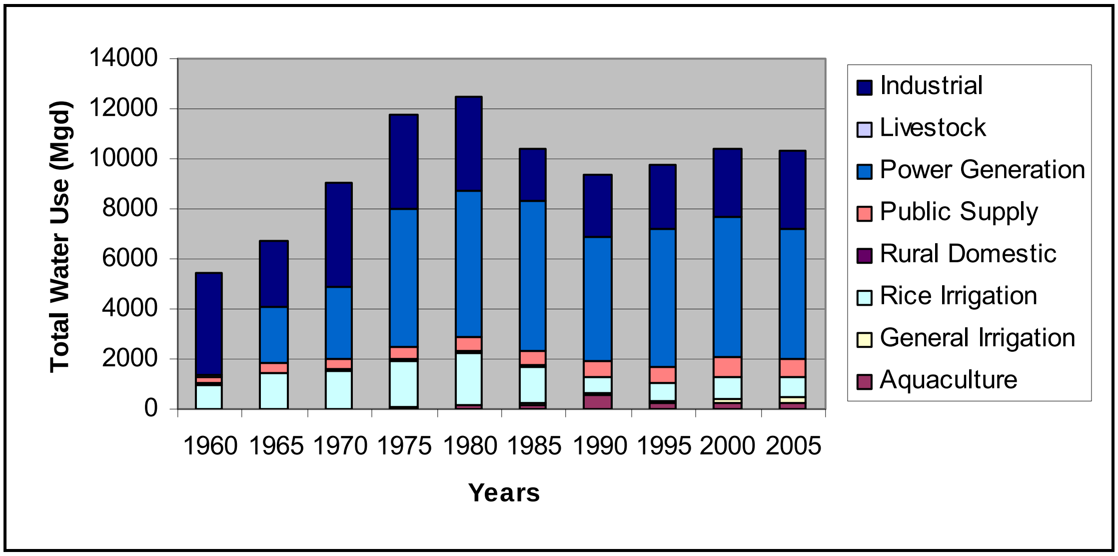
2.3 Water Use by User

Water use was analyzed by the following user groups: Aquaculture; General Irrigation; Rice Irrigation; Rural Domestic; Public Supply; Power Generation; Livestock; and Industrial. (Note- Mining source water is being tracked post 2005 - discussion needed) The two primary user groups in Louisiana are power generation and industrial use, accounting for over 80% of total water use in the State in 2005 (Table 2-2, Figure 2-4, and Figure 2-5). Power generation passed 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. Water use for public supply consumer has increased during each of the USGS/LDOTD's water use surveys.

Table 2-2: Water Use by Consumer (1960 -2005) (MGD)

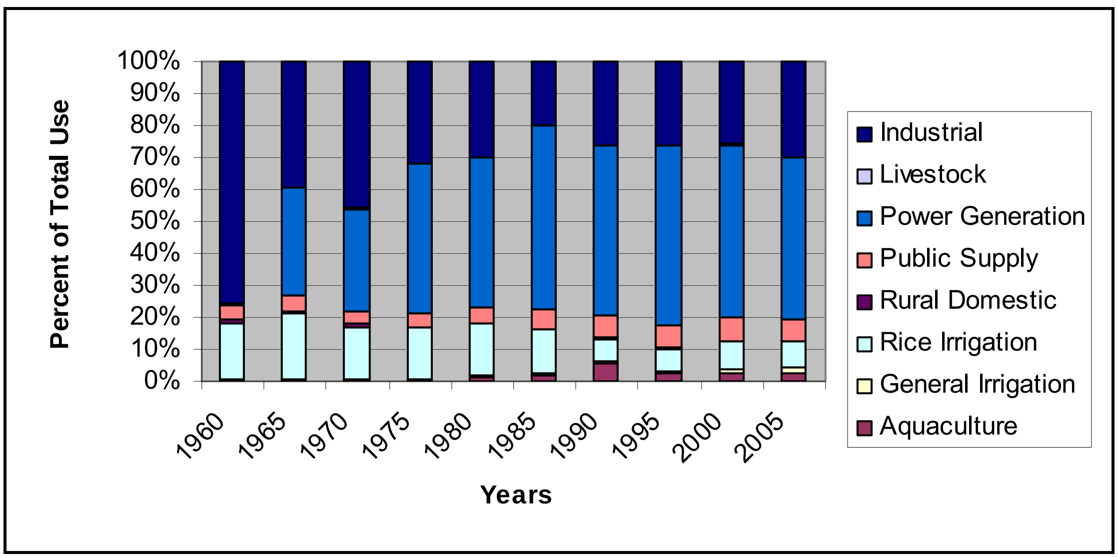
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture[1]	0	0	0	0	151	192	541	234	243	271
General Irrigation	27	29	30	77	44	43	62	61	135	205
Rice Irrigation	967	1,379	1,526	1,865	2,031	1,441	646	708	888	787
Rural Domestic	41	42	67	42	54	46	50	39	41	44
Public Supply	267	357	384	502	602	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-4: Total Water Use by User Group (1960 -2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

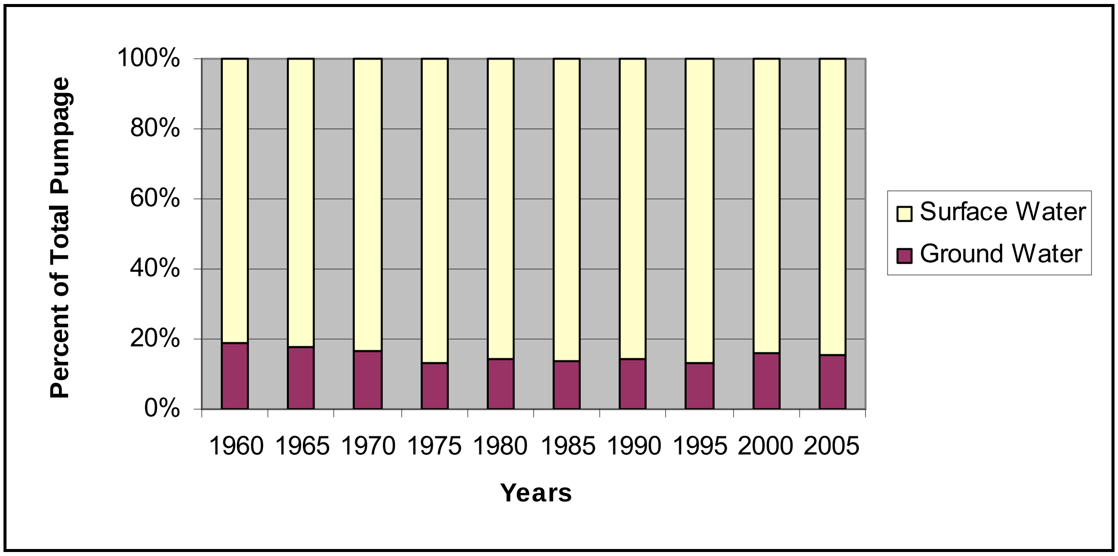
Figure 2-5: Distribution of Water Use by User Group (1960 – 2005)

Surface water accounts for over 80% of the source of water for the eight primary user groups (Table 2-3 and Figure 2-6). Over this time frame total pumpage reached a peak 12,444 MGD in 1980. Ground water and surface water use decreased in 1985 and 1990 reporting periods. Since 1995, both surface and ground water use show modest increases, returning to 1985 levels (Figure 2-4).

Table 2-3: Total Water Use by Source (1960 - 2005)

Source	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Ground Water	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-6: Distribution of Water Use by Source (1960 – 2005)

Of the total water use (10, 298 MGD) in 2005, approximately 15% was pumped from groundwater and 85% was pumped from surface waters (Table 2-4). When examined by source, for 2005 the primary groundwater users are: Rice Irrigation (33%); Public Supply (22%), Industry (17%), Aquaculture (13%) and General Irrigation (10%).

Table 2-4: 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%	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	100%	8,727.4	100%	10,299.40	100%
	15%		85%		100%	

Source: LGS 2010 from Sargent, 2007

(Note – need discussion on use vs. consumption. Pass through vs evaporation/infiltration vs true consumption)

2.4 Surface Water Use

2.4.1 Surface Water Use by User Group

Power generation and industrial are the primary surface water users in Louisiana. (Table 2-5 and Figure 2-7). 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 sharply to 248 MGD by 1990 (78% or 870 MGD). Since 1990 rice irrigation surface water use has flattened out in the 250 – 280 MGD range, except for a moderate decline in 2000 to 206 MGD its lowest surface water use. The public supply user group surpassed the rice irrigation user groups 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 between 80% and 90% of the surface water use in the state since 1960 (Figure 2-8). The rice irrigation user group was the primary pumper of the remaining 10 % to 20% of surface water used in the state between 1960 and 1985. Since 1985 the public supply user and rice irrigation user groups have pumped a roughly equal percentage (50%) of the remaining 10% of surface water use in the state.

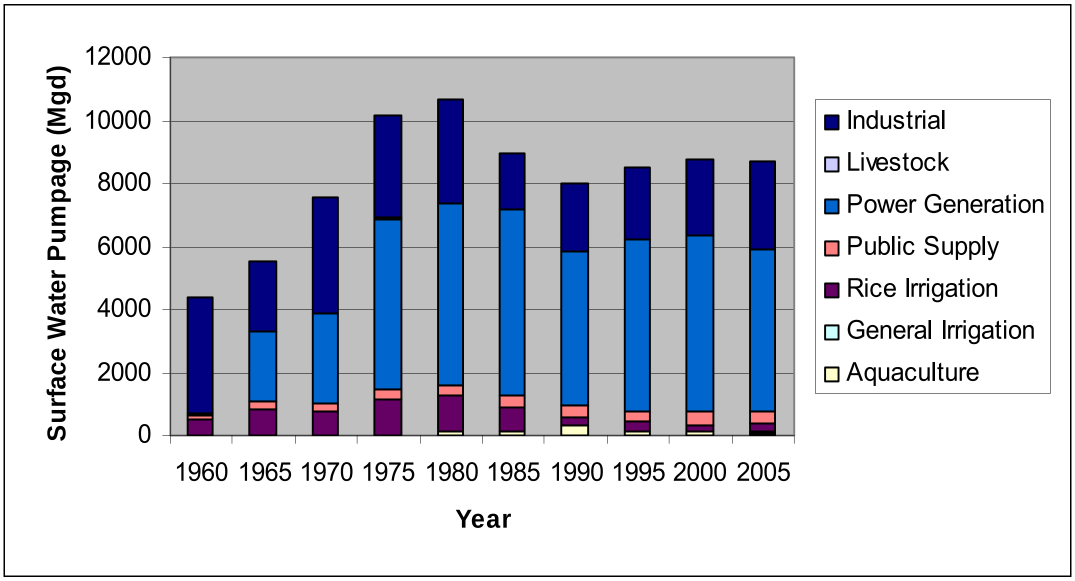
Table 2-5: Surface Water Use by User Group (1960 - 2005) (MGD)

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.

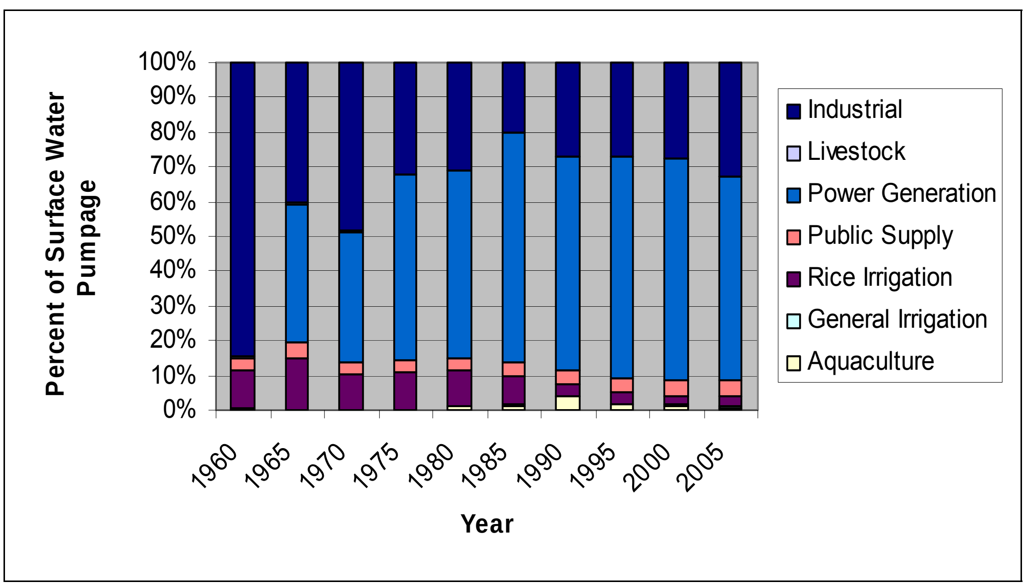
Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 1: Surface Water Use by User Group in Louisiana (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-7: Surface Water Use by User Group (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-8: Distribution of Surface Water use by User Group (1960 - 2005)

2.4.2 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) (Table 2-6 and Figure 2-

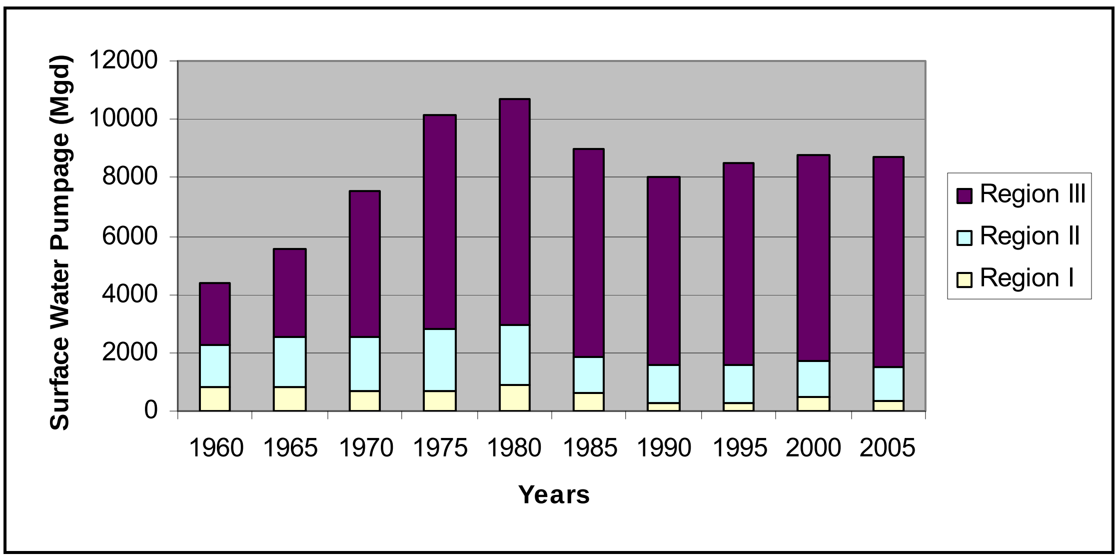
9). Between the 1980 and 1990 reporting periods surface water use in the state decreased by 25% (roughly 2,600 MGD) with Region I water use decreasing by 66% (577 MGD), Region II water use decreasing by 40% (833 MGD), and Region III water use decreasing by 16% (1,241 MGD). Surface water use has increased 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 a large percentage of the surface water in the state then the 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 (Figure 2-810). Since 1985 the distribution of surface water pumpage has remained fairly constant between Regions I, II, and III.

Table 2-6: Surface Water Use by Region (1960 - 2005) (MGD)

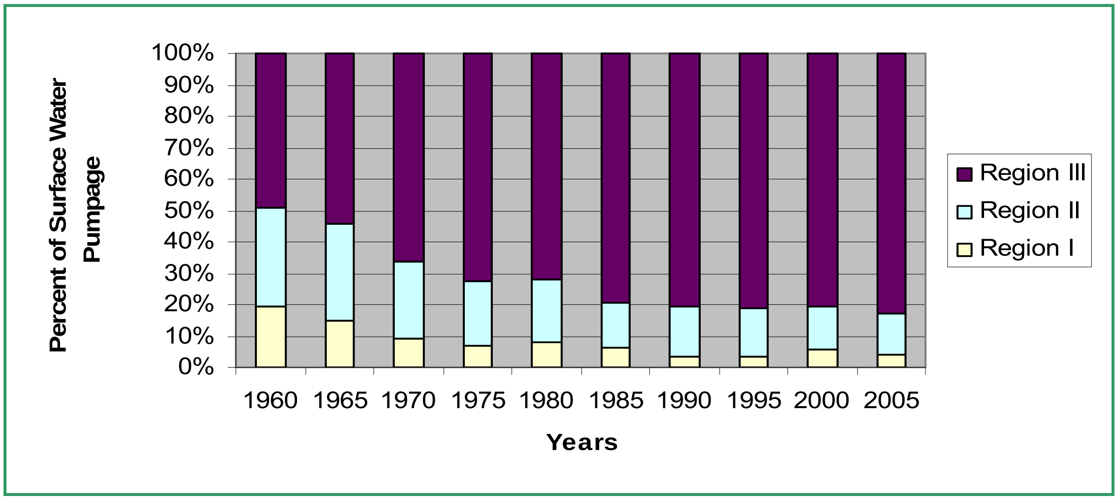
Region	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
I	851	835	700	692	871	587	294	294	507	362
II	1,382	1,681	1,827	2,096	2,108	1,255	1,275	1,304	1,189	1,155
III	2,151	3,013	5,015	7,378	7,684	7,128	6,443	6,907	7,047	7,211
Total	4,385	5,530	7,542	10,167	10,664	8,971	8,012	8,506	8,743	8,727

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-9: Surface Water Use by Region (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-10: Distribution of Surface Water use by Region (1960 - 2005)

2.4.2.1 Surface Water Use – Region I

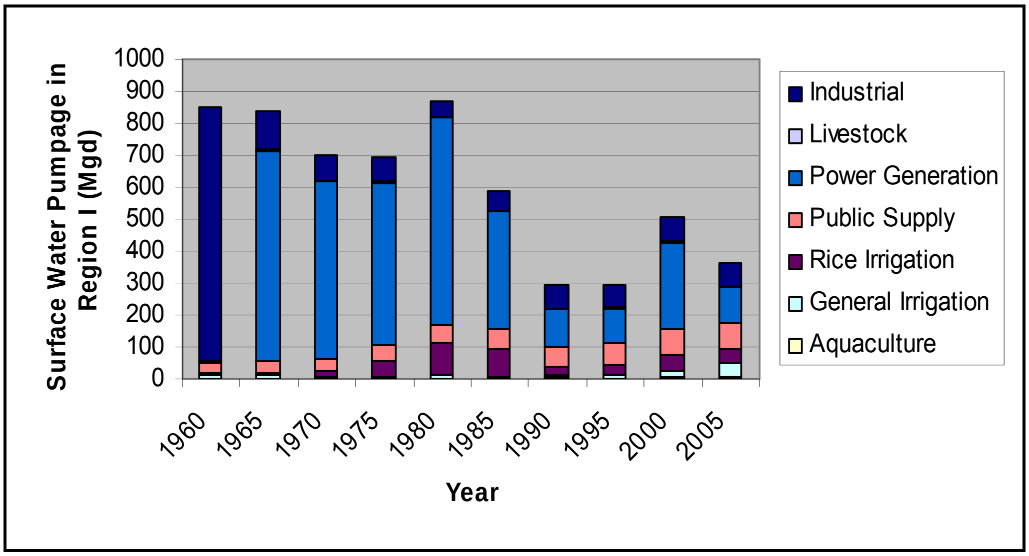
All user groups except for the rural domestic user group (supplied by ground water) in Region I rely on surface water (Table 2-7 and Figure 2-11). Surface water use in this Region has been concentrated in the power generation user group since it was reported separately from the industrial user group 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 has seen a fairly stable surface water use since 1970. Public supply has been the third largest user group of surface water in this region 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 has reached a surface water use of 84 MGD at the time of the 2005 LDOTD/USGS

Industrial with the power generation user group included accounted for roughly 95% of the pumpage of surface water in this region in 1960 (Figure 2-12). 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)

Table 2-7: Surface Water Use by User Group in Region I (1960 - 2005) (MGD)

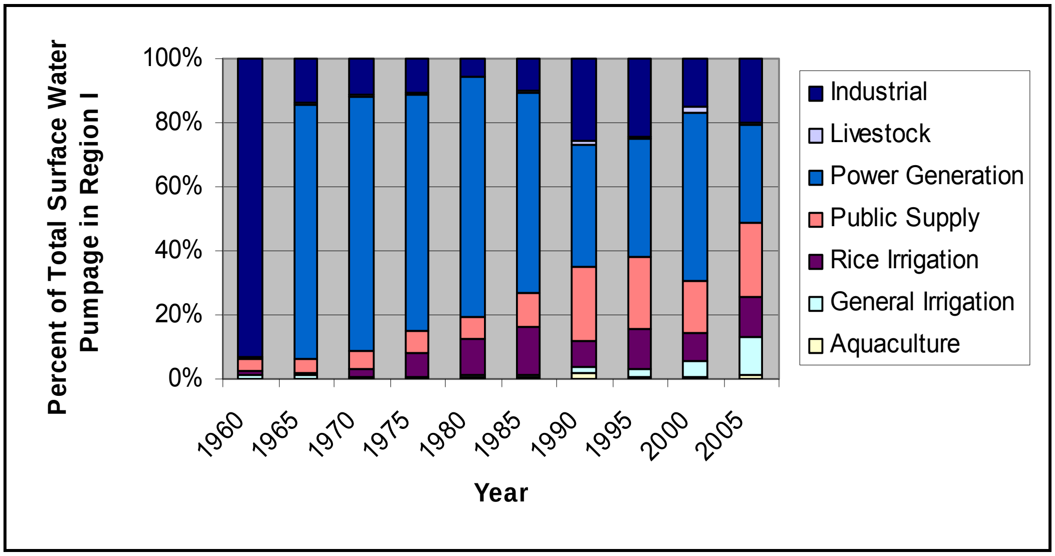
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture[1]	0	0	0	0	3	3	6	1	3	4
General Irrigation	11	12	5	3	10	6	5	8	24	44
Rice Irrigation	10	5	18	54	97	85	24	37	46	43
Public Supply	32	36	40	49	61	62	67	66	82	84
Power Generation[2]	0	660	555	509	648	370	114	108	267	111
Livestock	6	6	4	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-11: Surface Water Use by User Group in Region I (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-12: Distribution of Surface Water Use by User Group in Region I (1960 - 2005)

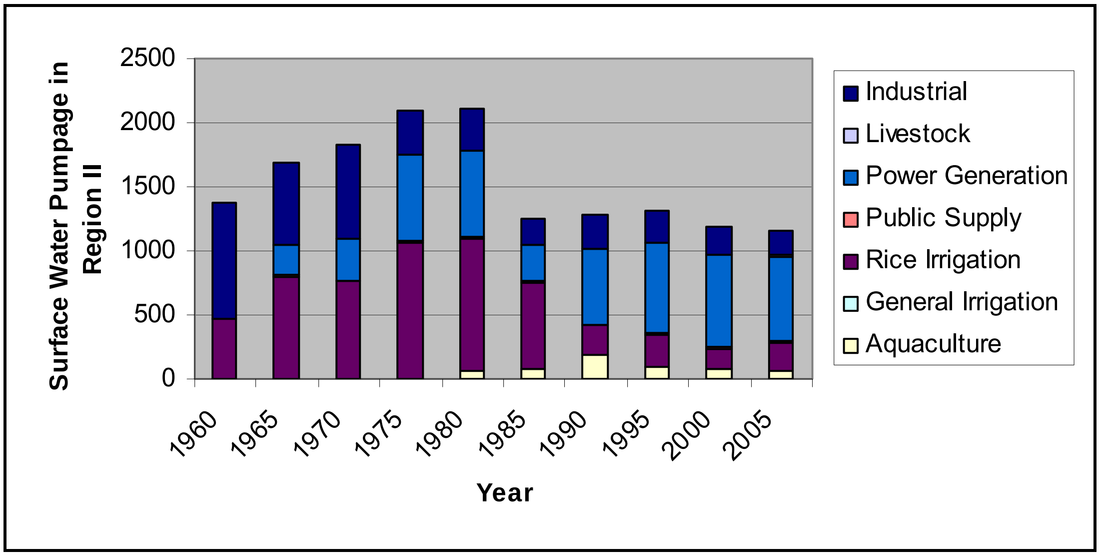
2.4.2.2 Surface Water Use – Region II

(Region II synopsis needed)

Table 2-8: Surface Water Use by User Group in Region II (1960 - 2005) (MGD)

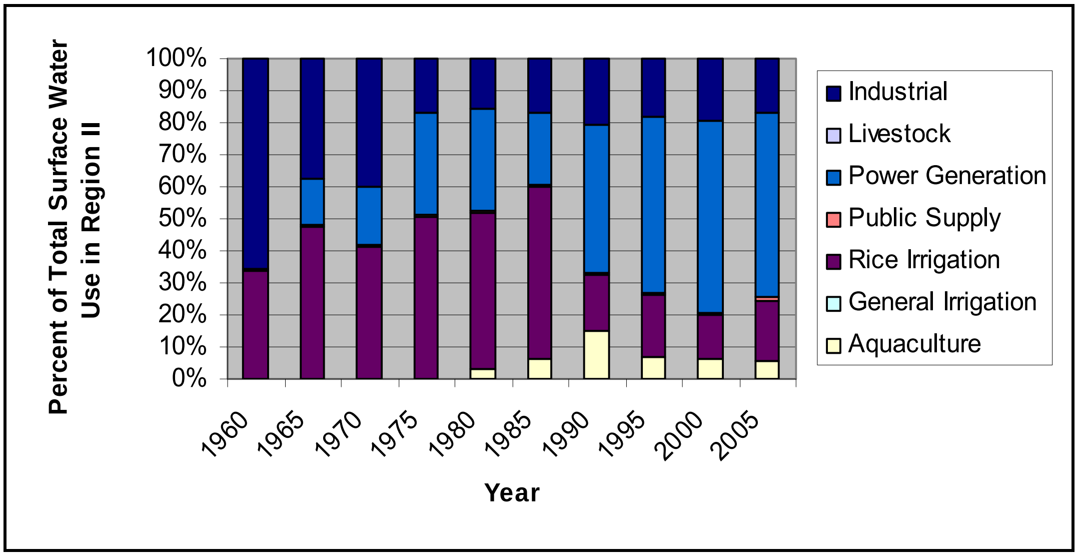
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture	0	0	0	0	62	78	189	92	74	64
General Irrigation	2	0.2	0.1	6	4	2	2	0.2	1	2
Rice Irrigation	463	801	759	1061	1026	672	224	248	161	217
Public Supply	6	7	7	11	9	10	8	13	12	11
Power Generation	0	239	328	665	678	279	584	712	715	665
Livestock	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-13: Surface Water Use by User Group in Region II (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-14: Distribution of Surface Water Use by User Group in Region II (1960 - 2005)

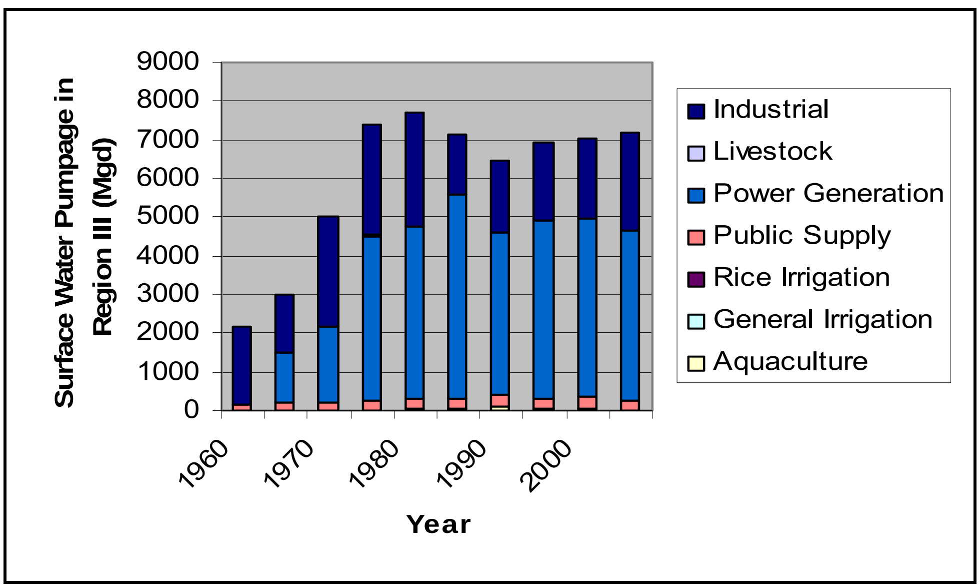
2.4.2.3 Surface Water Use – Region III

(Region III synopsis needed)

Table 2-9: Surface Water Use by User Group in Region III (MGD)

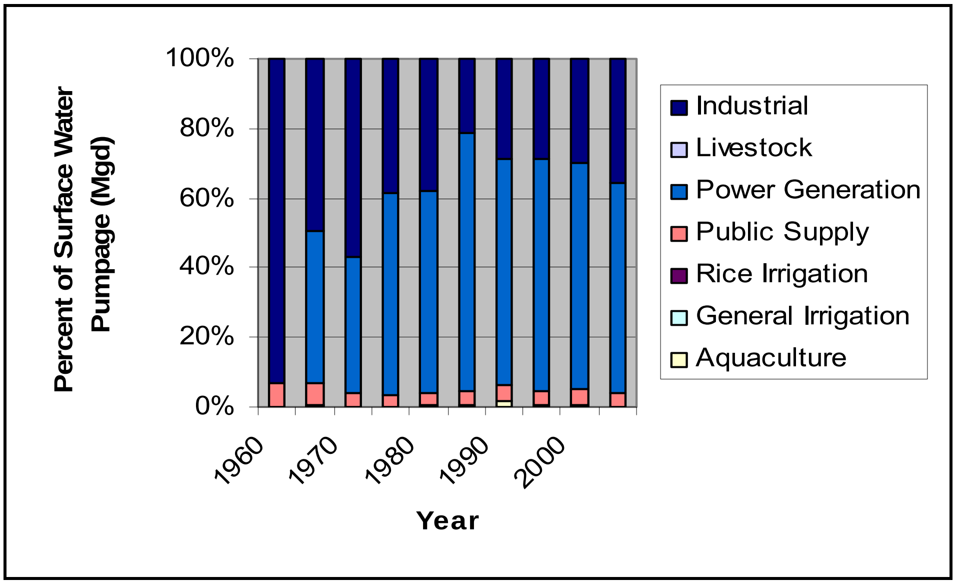
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture	0	0	0	0	36	44	128	37	38	0
General Irrigation	6	2	1	12	0.3	1	1	1	1	0.4
Rice Irrigation	0	8	0	0	0.3	1	0	0.1	0	0
Public Supply	137	193	195	240	267	280	268	266	311	271
Power Generation	0	1318	1,964	4,271	4,476	5,282	4,212	4,634	4,600	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-15: Surface Water Use by User Group in Region III (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-16: Distribution of Surface Water Use by User Group in Region III (1960 - 2005)

2.5 Ground Water Use

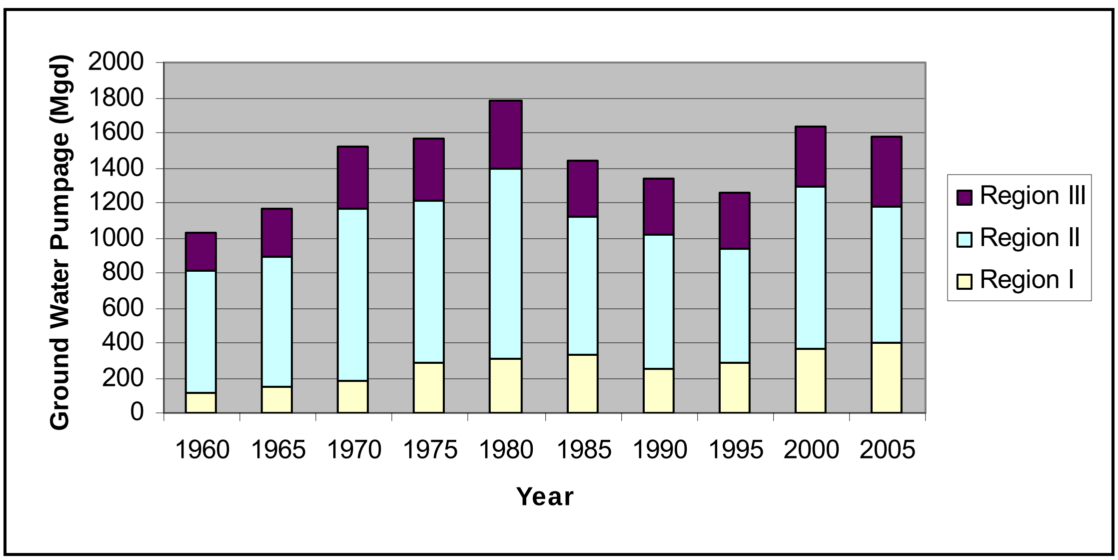
Ground water use in Louisiana follows the trend of surface water use in Louisiana by reaching its peak use in 1980 at 1,780 MGD (Table 2-10 and Figure 2-17). However, unlike surface water use only Region II reached its peak ground water use in 1980 (1,084 MGD). The 2005 USGS/LDOTD study has found that Regions I and III have continued their increase in water use since the study conducted in 1990 eclipsing their previous peak values in 2000 and established new peak water use values in 2005 at 400 MGD an d 391 MGD respectively. As of the 2005 study Region I continues to be the primary user of ground water. Region I passed Region III as the second largest user of ground water in 1985 and again in 2000.

Region II accounts for nearly 60% of the ground water pumpage in the state (Figure 2-18). Approximately 20% of the pumpage is contained in Regions I and III. Since 1980 Regions I and III have roughly the same percentage of ground water. Overall the percentage of water use by Region I, II, and III has remained relatively stable since 1985.

Table 2-10: Ground Water Use by Region (1960 - 2005) (MGD)

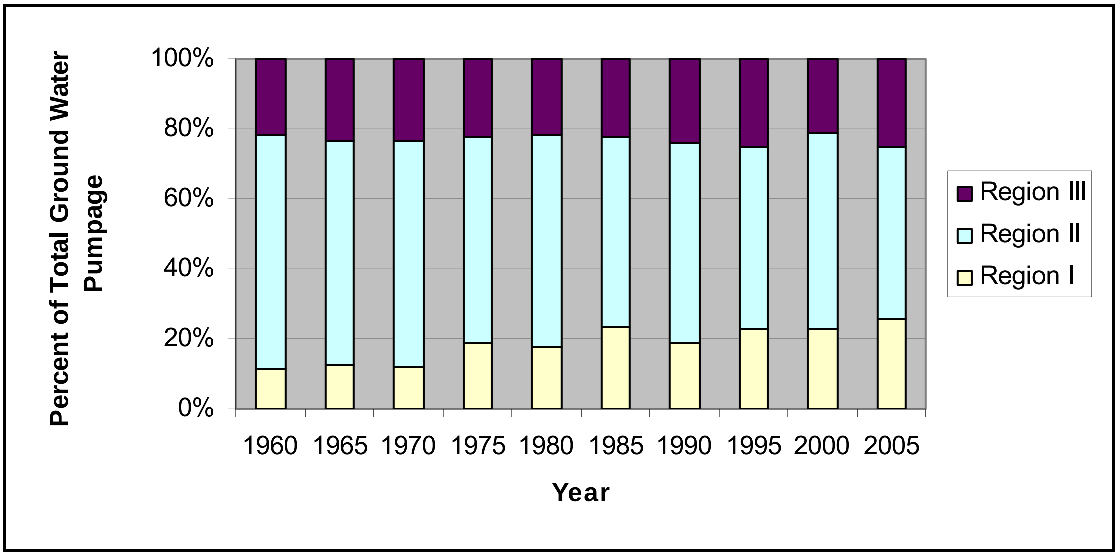
Region	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
I	119	144	186	290	313	333	257	286	370	400
II	689	751	985	926	1,084	782	761	656	917	780
III	221	275	353	347	383	321	324	317	347	391
Total	1,029	1,170	1,524	1,563	1,780	1,436	1,341	1,258	1,634	1,572

Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-17: **Ground Water Use by Region (1960 - 2005)**



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-18: Distribution of Ground Water Use by Region (1960 - 2005)

2.5.1 Ground Water Use by User Group

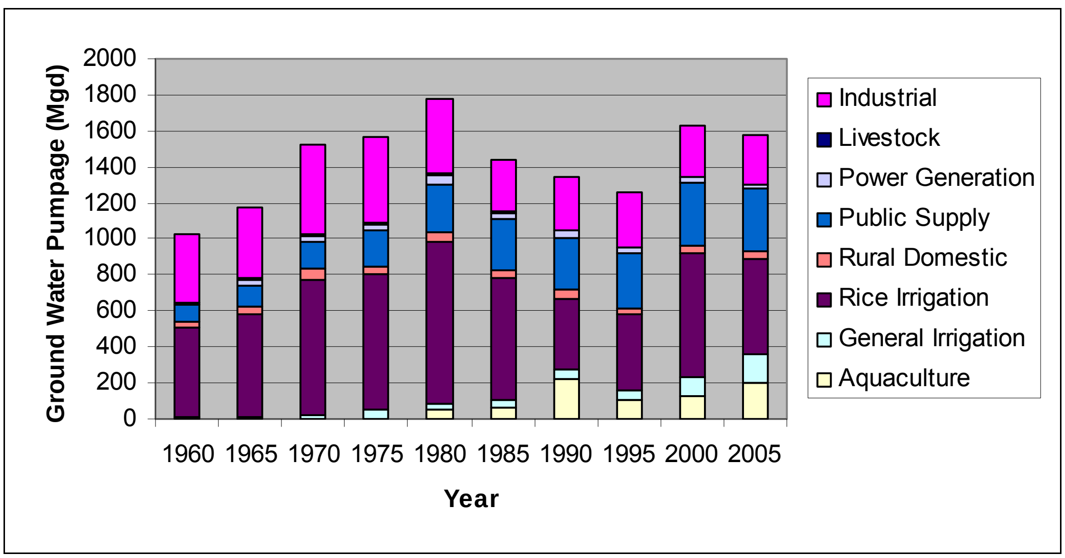
The rice irrigation user group is the leading user of ground water in the state reaching a peak of 907 MGD in 1980 (Table 2-10 and Figure 2-18). It then decreased by 56% (500 MGD) during the 1980s to a lower water use of 398 MGD in 1990. Since then it has steadily increased in the 1990s.The industrial and public supply groups represent the other large users of ground water in the state. The industrial user groups' ground water 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' ground water use peaked at 354 MGD in 2000 and has remained stable through 2005. The public supply user groups' ground water use has increased moderately during each one of the LDOTD/USGS studies since 1960.

Over 65% of the ground water 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 2-19). Rice irrigation ground water pumpage decreased to roughly 30% of the pumpage in 1990 while the public supply and aquaculture user groups ground water pumpage increased to 20% and 15% respectively. Since 2000 general irrigation user groups percentage of ground water pumpage has been increasing. As of 2005 it is responsible for nearly 10% of the ground water pumpage while rice irrigation water pumpage has declined.

Table 2-11: Ground Water Use by User Group (1960 - 2005) (MGD)

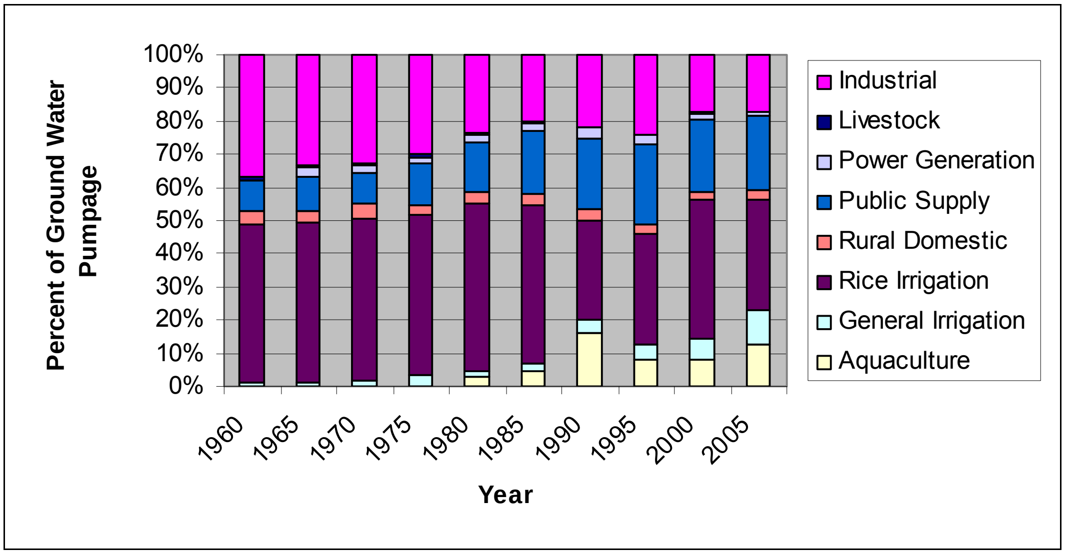
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aqua-culture	0	0	0	0	51	67	219	104	128	203
General Irrigation	9	15	24	57	29	34	53	52	109	158
Rice Irrigation	494	565	750	750	907	682	398	423	682	526
Rural Domestic	41	42	67	42	54	46	50	39	41	44
Public Supply	93	121	141	201	265	276	285	303	354	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-19: Ground Water Use by User Group (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-20: Distribution of Ground Water Use by User Group (1960 - 2005)

2.5.2 Ground Water Use by Region

2.5.2.1 Ground Water - Region I

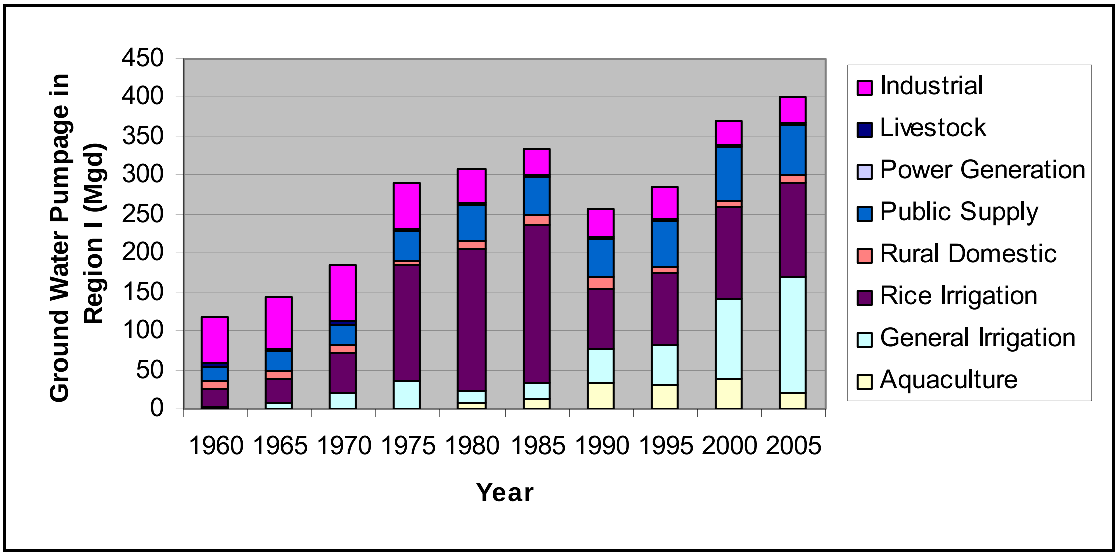
Ground water use in this Region is centered around the rice irrigation user group since it passed the industrial user group in 1975 as the leading user group in this region (Table 2-12 and Figure 2-21). Rice irrigation ground water use peaked at 204 MGD in 1985 it then saw a decrease of ground water use of 60% (130 MGD). Since then this user group has shown a moderate increase in ground water use. According to the 2005 LDOTD/USGS study the general irrigation group has over taken the rice user group as the largest user group of ground water in this region reaching a ground water use of 149 MGD. The industrial user group peak water use occurred at 74 MGD in 1970 and it was the leading user of ground water 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 ground water 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 ground water in this region.

The industrial user group accounted for 40 - 50% of the ground water pumpage in this region from1960 – 1970 (Figure 2-22). Its pumpage then decreased to 20% of the ground water pumpage in 1975. At about that time rice irrigation ground water pumpage increased from 30% in 1970 to 50% of the ground water pumpage in 1975 This was represented by this group tripling its water use between 1970 and 1975. The rice irrigation group returned to being responsible for 30% of the ground water pumpage in this region in 1990. Since 2000 irrigation (general and rice) has been responsible for nearly 70% of ground water pumpage in this region.

Table 2-12: Ground Water Use by User Group in Region I (1960 - 2005) (MGD)

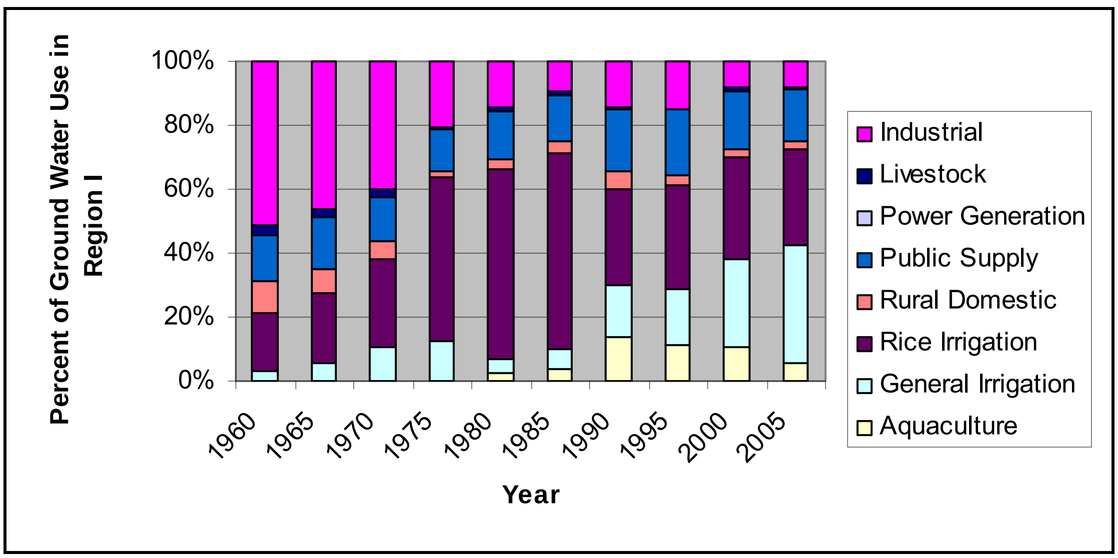
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	0	0	0	0	7	13	35	31	39	22
General Irrigation	4	8	19	37	15	20	42	50	101	149
Rice Irrigation	22	31	52	149	183	204	77	93	119	120
Rural Domestic	12	11	11	5	10	14	15	9	9	9
Public Supply	17	23	25	37	46	47	50	58	68	66
Power Generation	0	0.2	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-21: Ground Water Use by User Group in Region I (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-22: Distribution of Ground Water Use by User Group in Region I (1960 - 2005)

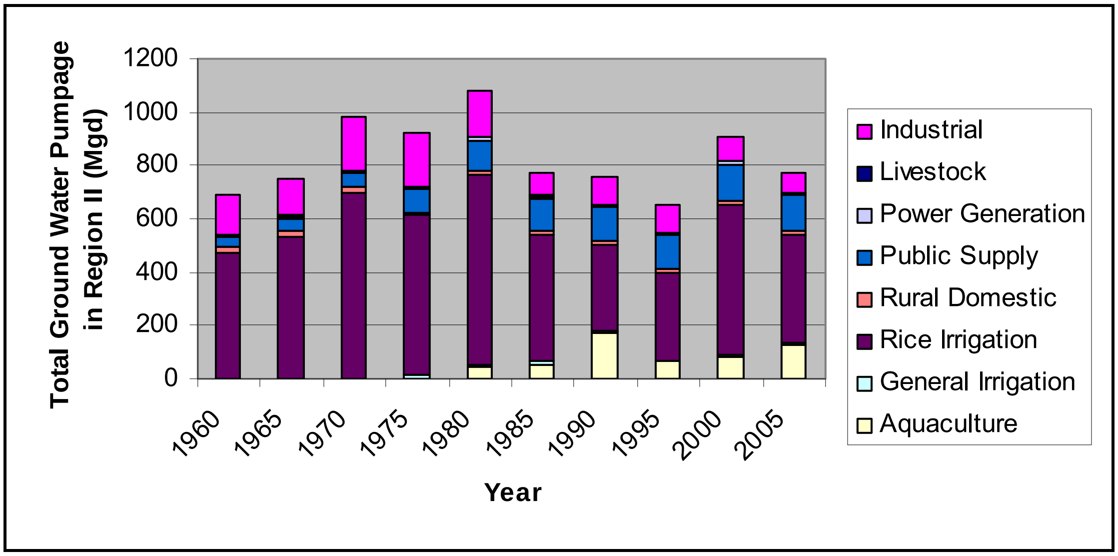
2.5.2.2 Ground Water - Region II

(Region II synopsis needed)

Table 2-13: Ground Water Use by User Group in Region II (1960 - 2005)

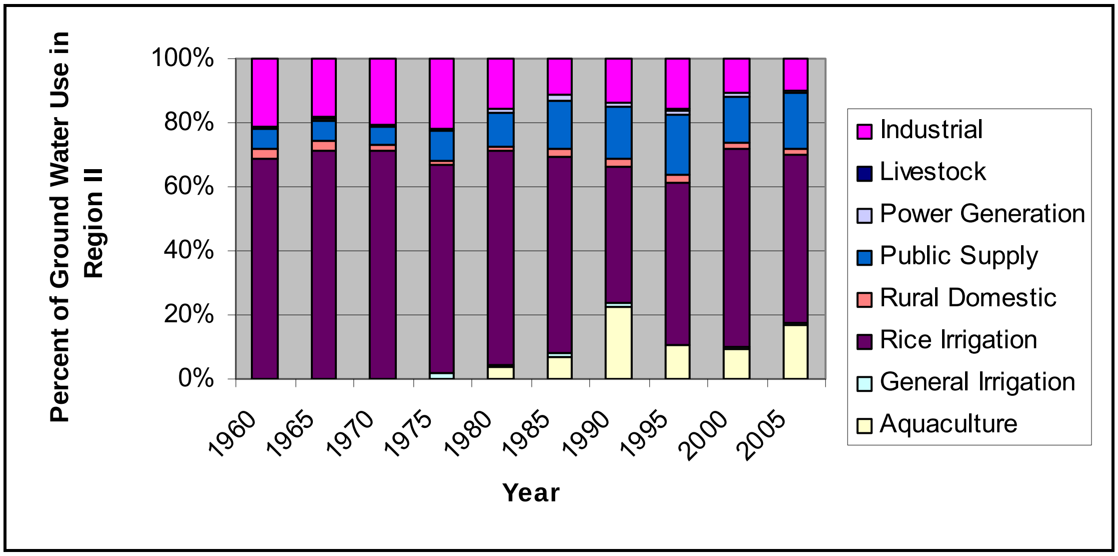
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	0	0	0	0	42.71	54	171	69	86	131
General Irrigation	2	1	0.05	15	7	11	9	0.4	6	6
Rice Irrigation	472	533	697	600	718	473	319	329	561	404
Rural Domestic	21	20	19	9	12	18	19	14	15	16
Public Supply	41	47	55	88	116	117	124	122	133	134
Power 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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-23: Ground Water Use by User Group in Region II (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-24: Distribution of Ground Water Use by User Group in Region II (1960 - 2005)

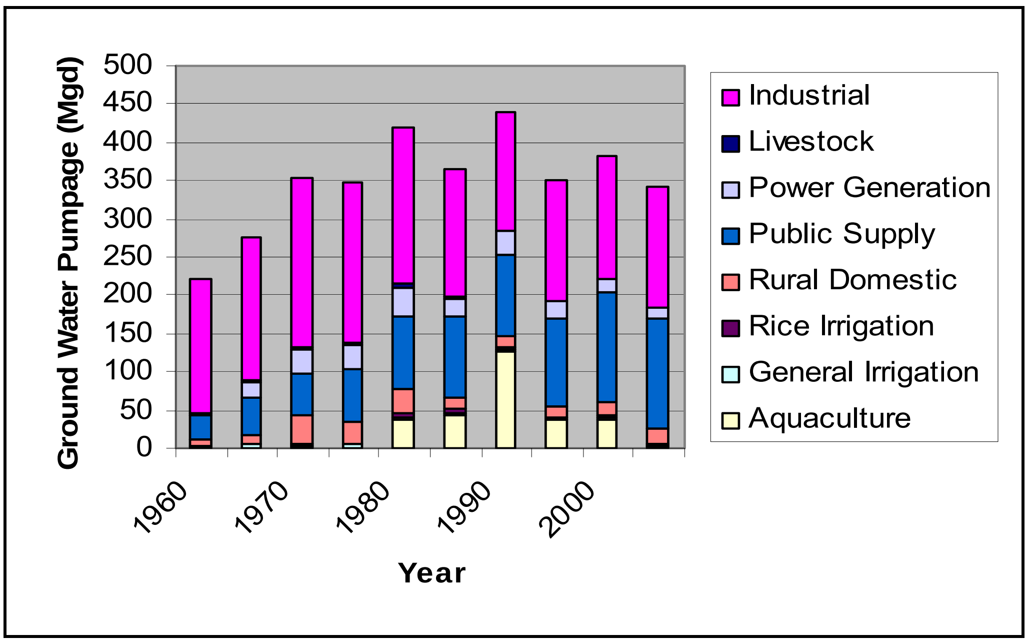
2.5.2.3 Ground Water - Region III

(Region III synopsis needed)

Table 2-14: Ground Water Use by User Group in Region III (MGD)

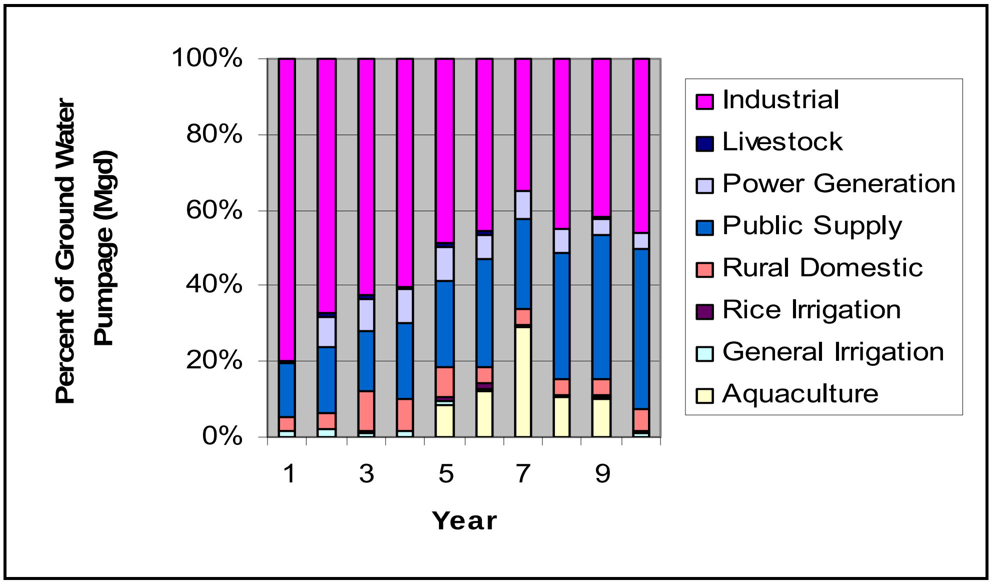
Category	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Aquaculture	0	0	0	0	34	44	128	37	38	0
General Irrigation	4	5	4	5	3	3	2	2	2	3
Rice Irrigation	0	1	1	1	6	5	1	1	2	3
Rural Domestic	7	11	37	29	32	14	17	15	17	19
Public Supply	32	48	57	70	96	105	106	116	145	146
Power Generation	0	22	30	31	37	23	31	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.



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2-25: Ground Water Use by User Group in Region III (1960 - 2005)



Source: LDOTD Water Use in Louisiana Reports, 1965, 1970, 1975, 1980, 1985, 1990, 1995, 2000, and 2005.

Figure 2- 26: Distribution of Ground Water Use by User Group in Region III (1960 - 2005)

2.5.3 Ground Water Use by Aquifer

(Synopsis per aquifer w/ specific issues is needed)

2.5.3.1 Carrizo-Wilcox Aquifer

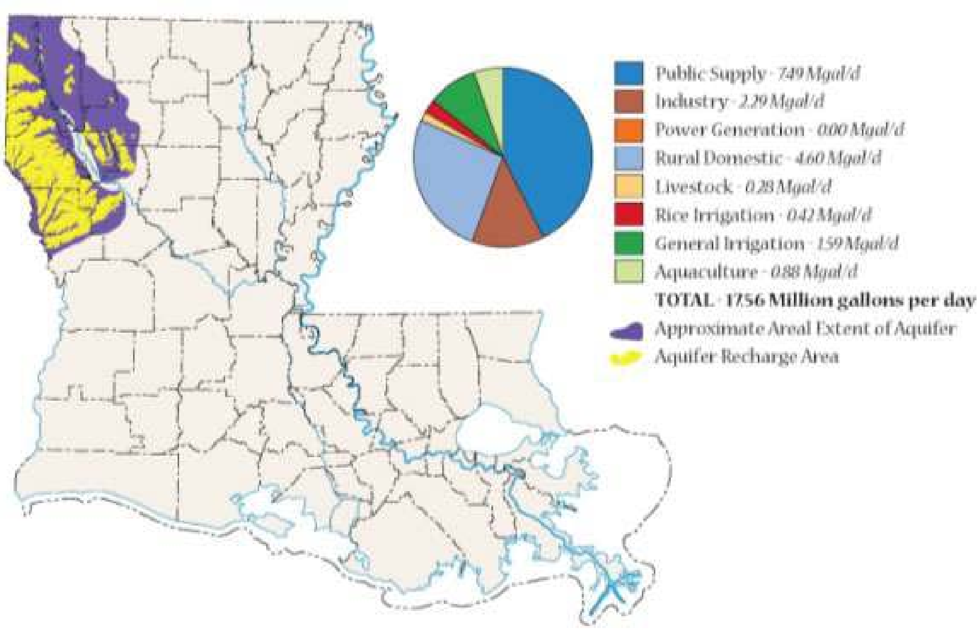


Figure 2- 27: Extent of the CWA in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010)

2.5.3.2 Catahoula Aquifer

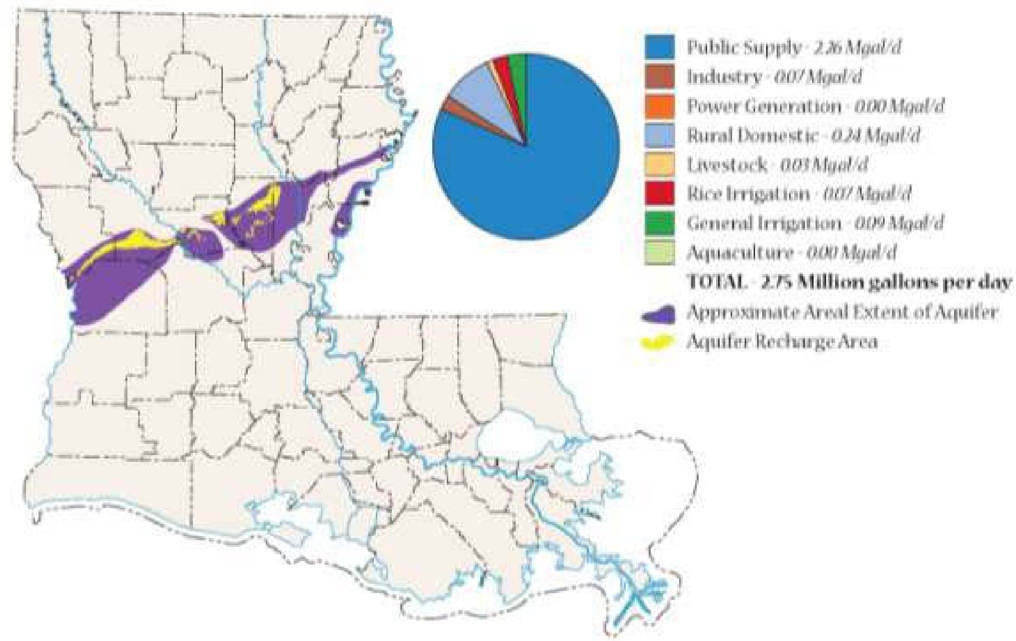


Figure 2- 28: Extent of the Catahoula Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.3 Cockfield Aquifer

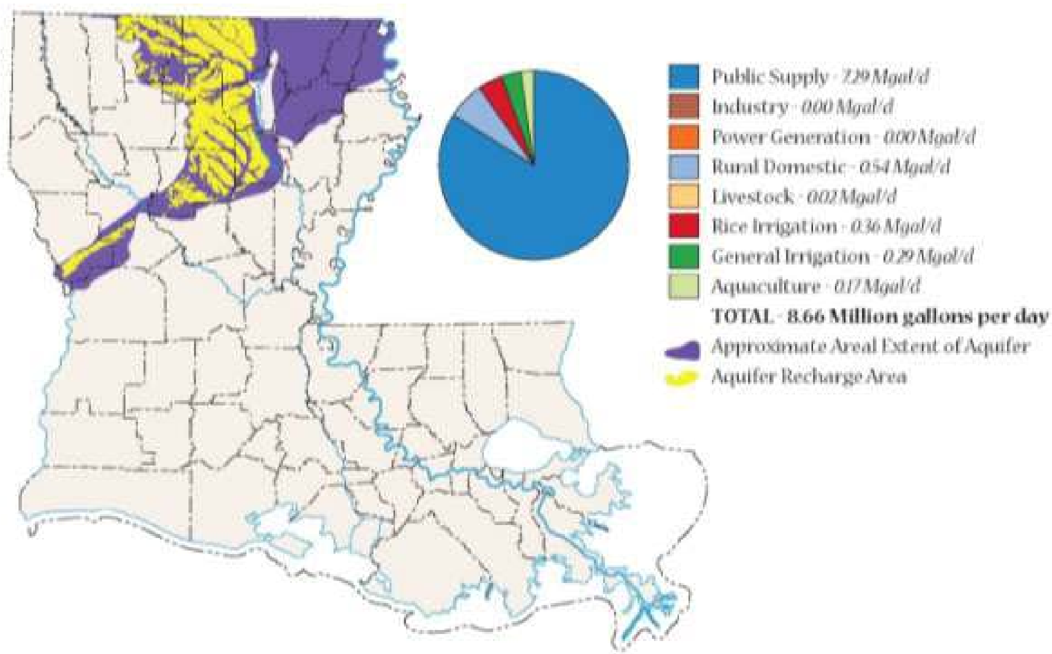


Figure 2-29: Extent of the Cockfield Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.4 Mississippi River Alluvial Aquifer (northern portion)

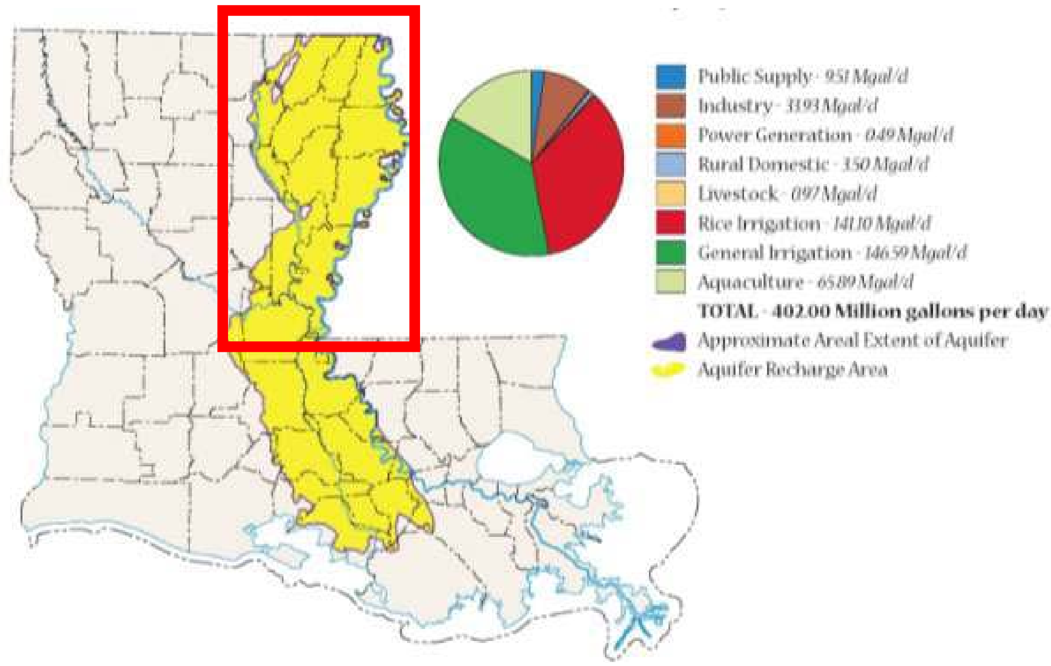


Figure 2-30: Extent of the Mississippi River Alluvial Aquifer in Louisiana. The 2005 estimated water usage for the whole MRAA (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.5 Red River Alluvial Aquifer

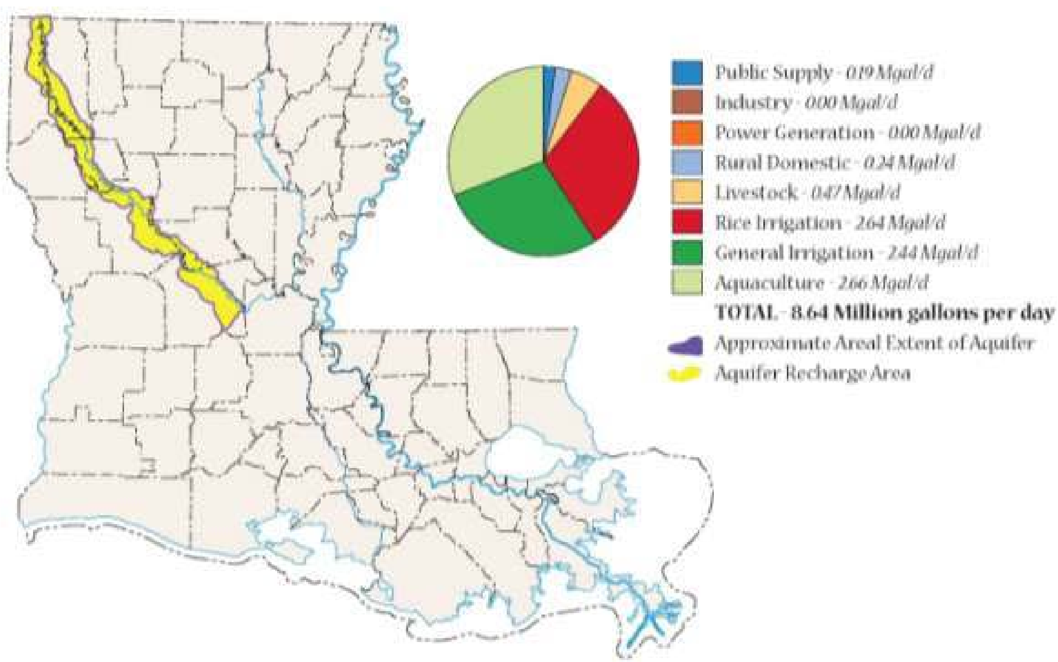


Figure 2-31: Extent of the Red River Alluvial Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.6 Sparta Aquifer System

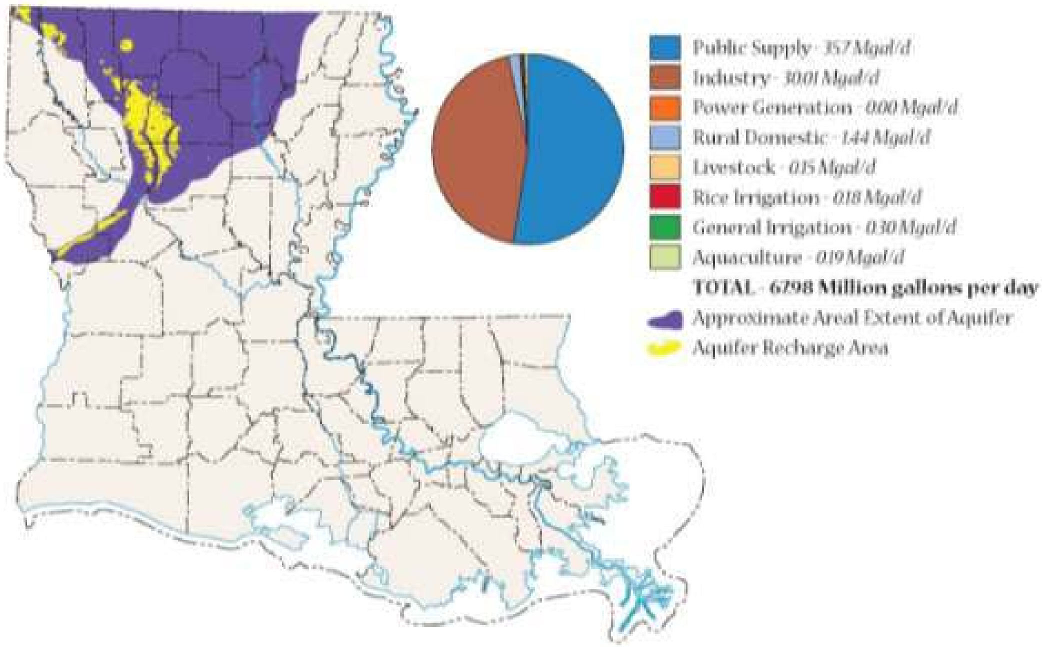


Figure 2-32: Extent of the Sparta Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.7 Upland Terrace Aquifer

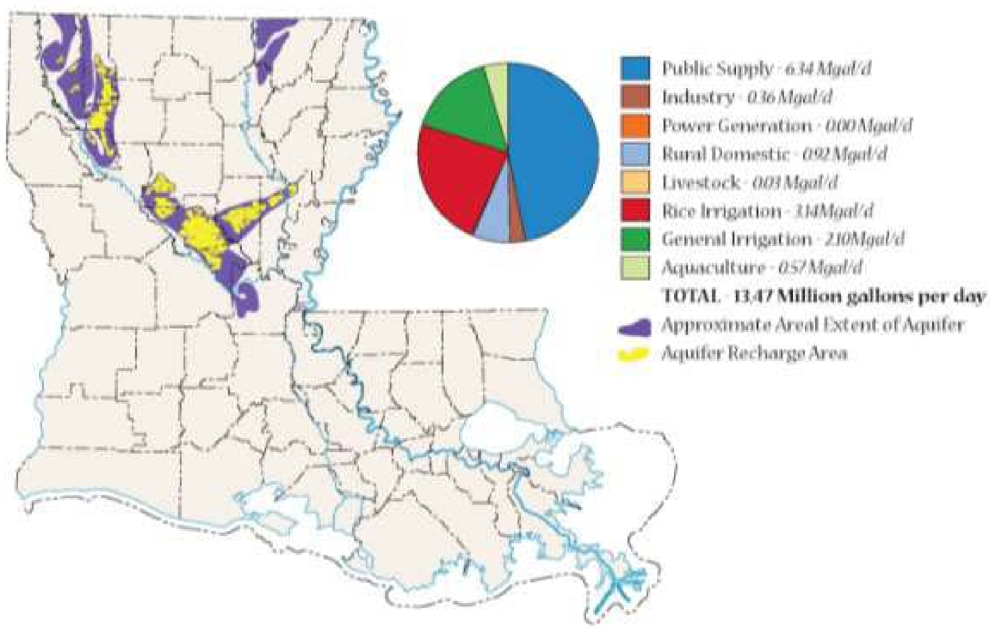


Figure 2-33: Extent of the Upland Terrace Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.8 Chicot Aquifer System

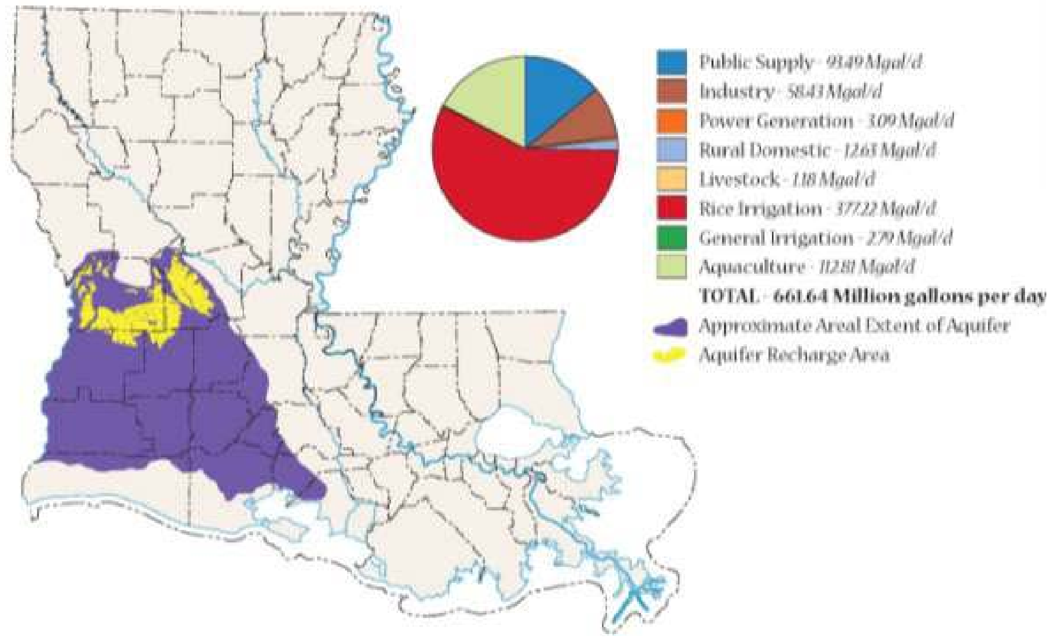


Figure 2-34: Extent of the Chicot Aquifer System in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.9 Evangeline Aquifer

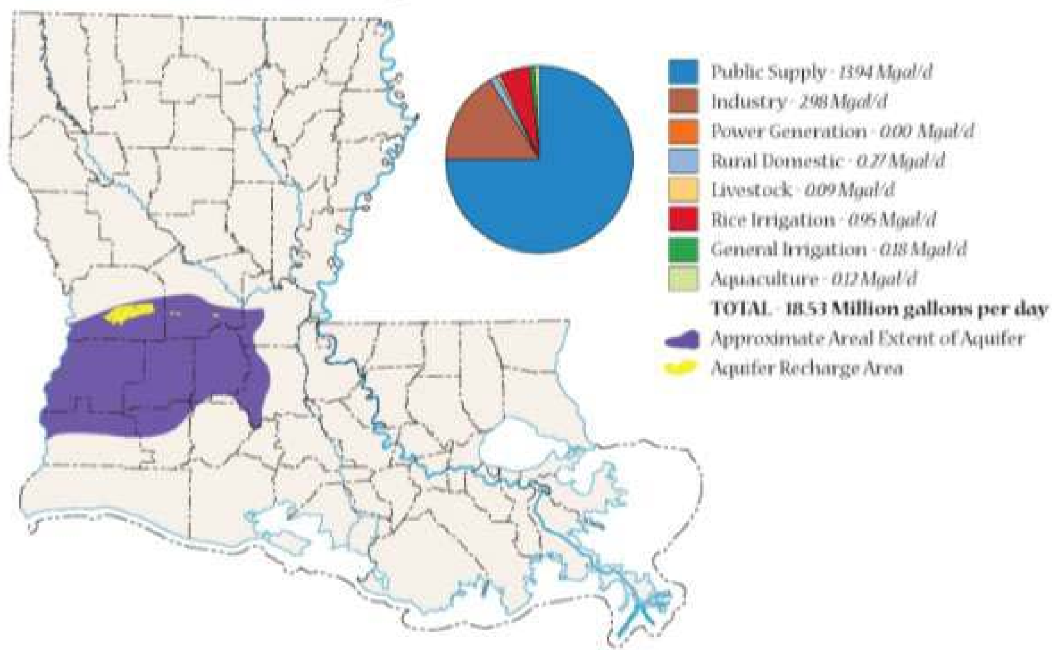


Figure 2-35: Extent of the Evangeline Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.10 Jasper Aquifer System

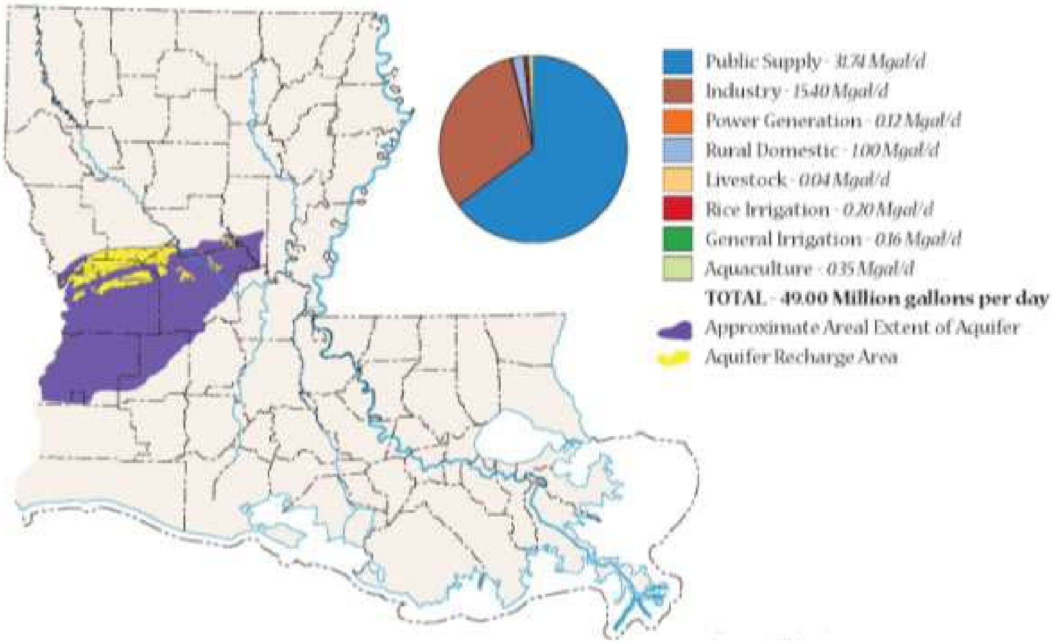


Figure 2-36: Extent of the Jasper Aquifer in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.11 Southern Hills Aquifer System

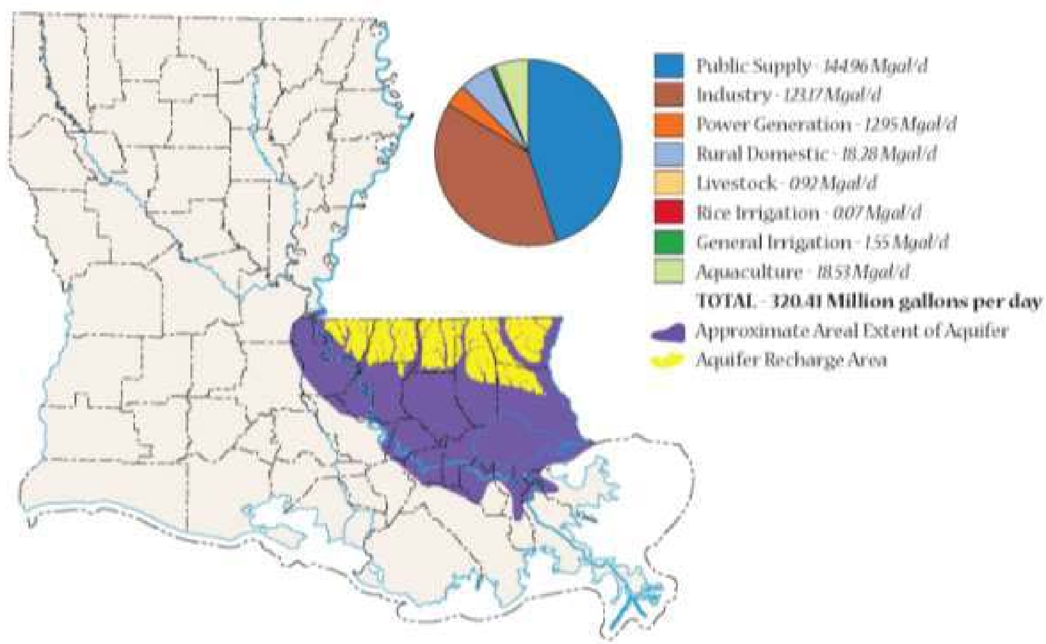


Figure 2-37: Extent of the Southern Hills Aquifer System in Louisiana. The 2005 estimated water usage (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

2.5.3.12 Mississippi River Alluvial Aquifer (southern portion)

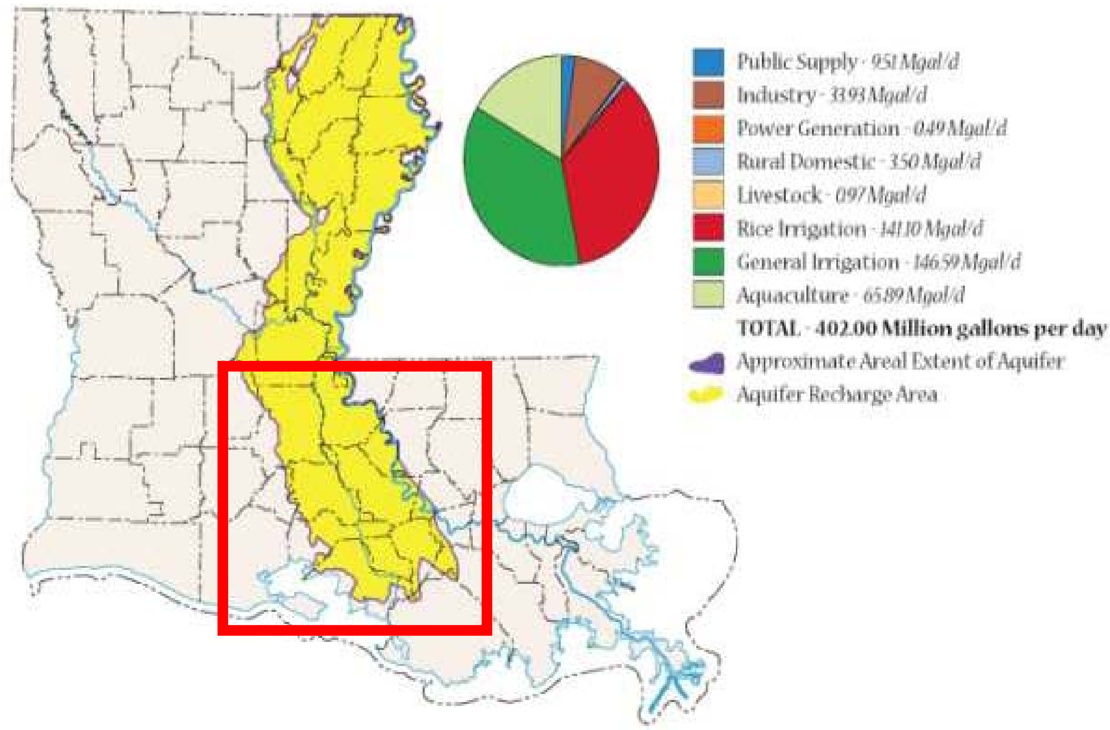


Figure 2-38: Extent of the MRAA in Louisiana. The 2005 estimated water usage of the whole MRAA (Sargent, 2007) is displayed on the pie chart (from Van Biersel and Milner, 2010).

3 Review of Ground Water Well Prior Notification Procedures

A review was performed on the GWR divisions procedures and recommendations compiled to streamline the reporting process for improvements to current procedures used by the Environmental Division technical staff to use in their review of ground water well prior notification form submittals for new non-exempt ground water wells (e.g., public supply, industrial, irrigation, and frac water supply wells).
At present, with the exception of exempt wells, which include domestic wells, replacement wells, drought relief wells, and drilling rig supply wells, a Water Well Notification form (GWR-01) must be submitted to the Commissioner of Conversation 60 days prior to drilling for all new water wells. In addition to the owner, driller, well location, and construction details, the form must detail the anticipated pumping rate and the number of days per year that the well will be pumped.

All analytical data, methods, models, and estimates used to determine the current demands of the aquifer(s) that could be impacted by new wells were reviewed to evaluate their accuracy and evaluation criteria. Improvements and recommendations are provided, based on sustainability, including Best Management Practices (BMPs). An analysis of ways to streamline reporting requirements for both the prior well notification for non-exempt wells and post completion reporting requirements for all wells was performed prior to its transition from DOTD to DNR.

3.1 Water Well Notification Requirements

Louisiana Revised Statute (R.S.) 38:3097.3.C(4)(a) requires that advance notification of intent to drill a water well shall be submitted by the well owner to the Commissioner of Conservation (Commissioner) at least 60 days prior to drilling the well. The purpose is to assist the Commissioner in the management of the State's ground water resources. The Water Well Notification form (GWR-01) provides the Commissioner with the basic information necessary to document new water wells and pumping rates of wells installed in each aquifer. All new water wells are also required to be registered with DOTD within 30 days after completion pursuant to Louisiana Administrative Code (LAC) 57:I. et seq. LAC 43:VI.701.A.

All new water wells, except for except those types specifically listed in 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) require that a water well notification form be submitted at least 60 days prior to installation. Per LAC 43:VI. §701.D, there shall be no just cause exceptions granted for large volume wells (a well with an 8 inch or greater diameter screen size; or well or well group capable producing ground water at a rate of 1,500 gallons per minute to be used for hydraulic fracturing for natural gas production).

Included are wells used for Dewatering, Power Generation, Irrigation, Industrial, Public Supply, and Frac Water Supply. Converting a drilling rig supply well to a Frac Water Supply well or other well use except for domestic use also requires 60 days prior notification. Additionally, if a 60 day prior notification is required for a Frac Water Supply well or other well use (except for Domestic use) that is also to be used for Drilling Rig Supply purposes, the owner must provide in a separate attachment to this form the projected pumping rate (gallons per day), number of days used, and the date drilled or anticipated drill date for the additional use as a drilling rig supply well.

3.2 Ground Water Resources Review Procedures

3.2.1 Water Well Notification Form

The water well notification data is submitted to Louisiana Office of Conservation, Environmental Division, Ground Water Resources (GWR) via a Water Well Notification (GWR-01) form (Attachment 3-1).

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 –

    - LDOTD 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 LDNR Strategic Online Natural Resources Information System (SONRIS). LDNR is working to integrate the GWR-ID Number as a subset to the LDOTD Well Number so the well will have one number from pre-permitting to plug and abandonment (P&A).

3.2.2 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. Area of Groundwater Concern (AGC) and/orcritical AGC as desiginated 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 LDOTD registered monitoring wells within ¼ mile of the proposed well or published 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 LDNR-OC/LDOTD 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, LDNR 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.

3.2.3 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 3-1 - Hydraulic Characteristics of the Aquifers in Louisiana.

Table 3-1: 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.

LDNR 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:

$$\int_u^{\infty} \frac{e^{-u} du}{u} = W(u) = \left[-0.5772 - \ln u + u - \frac{u^2}{2x2!} + \frac{u^3}{3x3!} - \frac{u^4}{4x4!} \ldots \right]$$

Cooper-Jacobs found that when $u < 0.01$, $W(u)$ reduces to:

$$W(u) = -0.5772 - \ln u \text{ or,}$$
$$W(u) = -0.5772 - \ln \frac{r^2 S}{4Tt}$$

Drawdown is calculated as

$$s = \frac{Q}{4\pi T} W(u)$$

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 dependant 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 (which ever 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.

With the migration of the State's Registered Water Well database into the SONRIS system, the drawdown calculation could feasibly be integrated into a GIS macro to automate this process and even select and export potentially impacted wells for further analysis.

In addition, regularly updated static water level gradient 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.

3.3 Well Registration Forms

Louisiana utilizes three separate water well registration forms: the Water Well Registration Long Form (DOTD-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 (DOTD-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 (DOTD-GW-2) used to document the plugging and abandonment procedures utilized when abandoning any of the above listed wells.

3.3.1 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.

3.3.2 Data Specific to the Long Water Well Registration Form

The Long Water Well Registration Form request 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)

3.3.3 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)

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

(Form evaluation needs completion, comment on electronic data entry- SONRIS)

Adjustments needed:

- Well Location-
  - Distance from landmark needs direction.
  - Well location coordinates (Latitude and Longitude) should be added to all of the forms
  - Address of property on which the well is located could also be added

Since the Water Well Notification form (GRW-01), Water Well Registration Long Form (DOTD-GW-1), Water Well Registration Short Form (DOTD-GW-1S), and the even the Well Plugging and Abandonment Form (LDOTD-GW-2) 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.

3.4 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.

3.4.1 Water Well Notification Review

3.4.1.1 Drawdown Calculations

Drawdown calculation should include not only the well nearest to the proposed well location the shallowest wells within the ¼ mile radius (or greater dependant on the calculated cone of depression) to ensure that potential impacts are not missed. Drawdown curves over distance from the proposed well should be compared to the well screen depths at increasing distances from the proposed well location. The drawdown calculation could feasibly be integrated into a GIS macro within the SONRIS system macro to automate the review.

3.4.1.2 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.

(Need Form evaluation, comment on electronic data entry- SONRIS)

4 Feasibility and Recommendations for Short Term and Long Term Study to Enhance the Sustainability and Quality of Ground Water Resources Throughout the State

E & E assisted in the identification, evaluation, and recommendation of groundwater management planning components, regulations and guidance, development grants and financing, and interim corrective measures. E & E identified areas of declining groundwater in major aquifers, and minor aquifers, using existing documentation and available data obtained in Tasks 1 and 2, and evaluated the causative behaviors. This task includes the review of existing groundwater availability models. Region or aquifer scale maps were produced showing the areas of water level decline, areas of recharge, areas of salt water intrusion, and potential alternative sources surface and groundwater (i.e., minor aquifers). Based on water use trends identified in Task 2, the data was used to identify and evaluate the availability of alternate sources of supply.

Recommendations were developed with consideration of existing groundwater availability models. Specifically, E & E reviewed and evaluated previous recommendations for aquifer conservation in the Sparta aquifer. The 2002 Sparta Groundwater Study recommended that current pumpage rates be reduced by 18 million gallons per day between 2005 and 2025 to obtain significant restoration of the aquifer. The study identified alternate sources of water, including four lakes and the Ouachita River, and recommended the construction of pump stations, transmission lines, booster pump stations, ground storage tanks, and water treatment plants. The specific recommendations were based on the criteria of 1) areas of greatest stress in the aquifer, 2) water use trends in proposed service areas, 3) demographic projections, 4) inhibition of salt water intrusion on the eastern side of the aquifer, 5) unit cost for water treatment, and 6) preservation of the aquifer.

Water conservation measures include:

- Public education and making available information to each retail customer,
- Plumbing codes to promote conservation,
- Retrofit of existing plumbing devices where warranted,
- Conservation-oriented rate structure,

- Universal metering and meter repair and replacement,
- Water conservation landscaping practices,
- Irrigation practices,
- Water audits and leak detections,
- Recycling and reuse of treated wastewater wherever practical,
- Assumption of water supply corporations that are located within corporate limits and conversion to surface water supply,
- Pressure control,
- Encourage water conservation by owners of private water wells, and
- Surface water recharges (rain harvesting, water conservation practices during spring high river, etc.) opportunities for various aquifers and recommendations on developing mechanisms for potential inter-state cooperation.

In urban areas, water use can be reduced by constructing gray water collection, treatment, and distribution systems that allow the reuse of wastewater for irrigation of parks, golf courses, and additional irrigation areas. Agricultural water use may be reduced through the promotion of more efficient irrigation methods and selection of lower water and more drought tolerant crops, and aquaculture water demand may be reduced through best management practices.

Water and wastewater development projects for the Sparta acquifer includes recommendations from the 2002 Sparta Aquifer Study, and may include additional ideas. Water allocation was addressed for when increasing the draw from surface water supplies. Surface water replacement required the development and/or expansion of existing and additional reservoirs. Wastewater may be beneficially used to recharge the aquifer, but would impact the water allocation balance for water users in the state. Municipal wastewater may be land applied to recharge the aquifer. Land application may be performed as tertiary treatment of municipal wastewater through active farming practices, or wastewater may be direct injected through infiltration galleries and wells after tertiary treatment. Recharge may be focused in areas of rapid decline, to inhibit salt water intrusion, in accessible areas for local agriculture, or in available areas near the treatment system. Additional corrective measures identified, includes the development of surface water recharge basins in depleting areas of the aquifer, pumping and transmitting groundwater from available areas of the aquifer into depleting areas of the aquifer, and pumping water between formations.

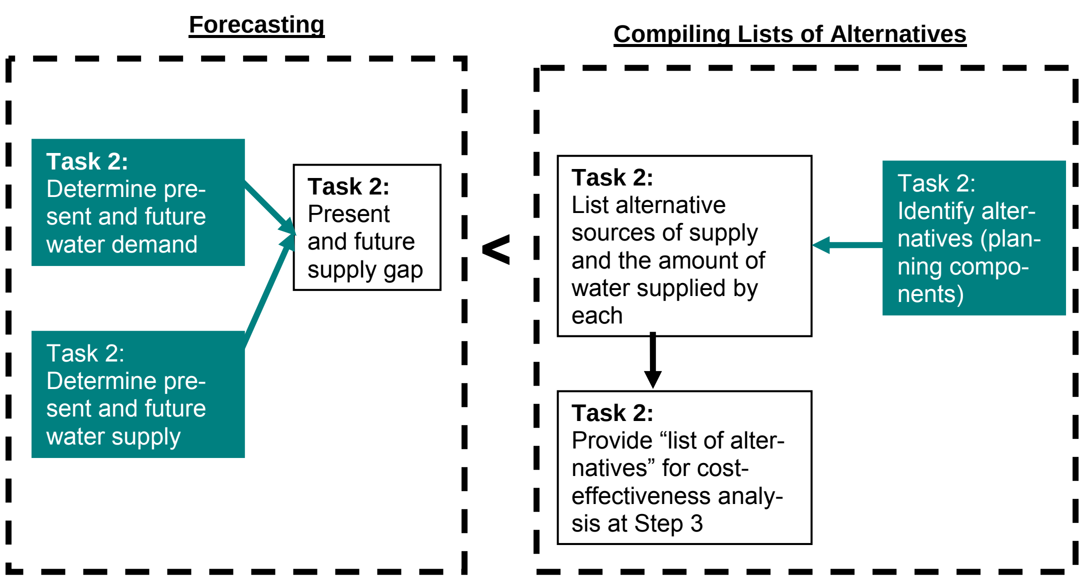
This Statewide Ground Water Management Plan addresses short (five-year) and long-term (25-year) recommendations to enhance the sustainability and quality of Louisiana's groundwater resources. This plan recommends the development or modification of existing groundwater availability models to more accurately quantify the availability of groundwater supply. Where feasible, the plan provides a cost-benefit analysis of the proposed remedies, which are consistent with applicable Department of Economic Development methods, to identify viable alternatives. This plan also identifies potential progressive and regressive stimulus measures to optimize water use. The stimulus measures include development grants and financing; crop subsidies, tariffs, and market assistance; and water conservation education programs, incentives, monitoring, auditing, and enforcement.

This comprehensive Statewide Groundwater Management Plan recommends the development of a groundwater level and water quality monitoring program. The recommended monitoring program is consistent with recommendations in the National Framework for Ground-Water Monitoring in the United States report prepared by the Subcommittee on Ground Water of the Advisory Committee on Water Information, which included implementing the SECURE Water Act directive, as passed by Congress as part of the Omnibus Public Land Management Act of 2009. The proposed monitoring plan takes into consideration collaborative activities among local, state, and federal agencies, in addition to other potential stakeholders. Additionally, the plan recommends a program to update the short- and long-term accounting of water usage in Louisiana.

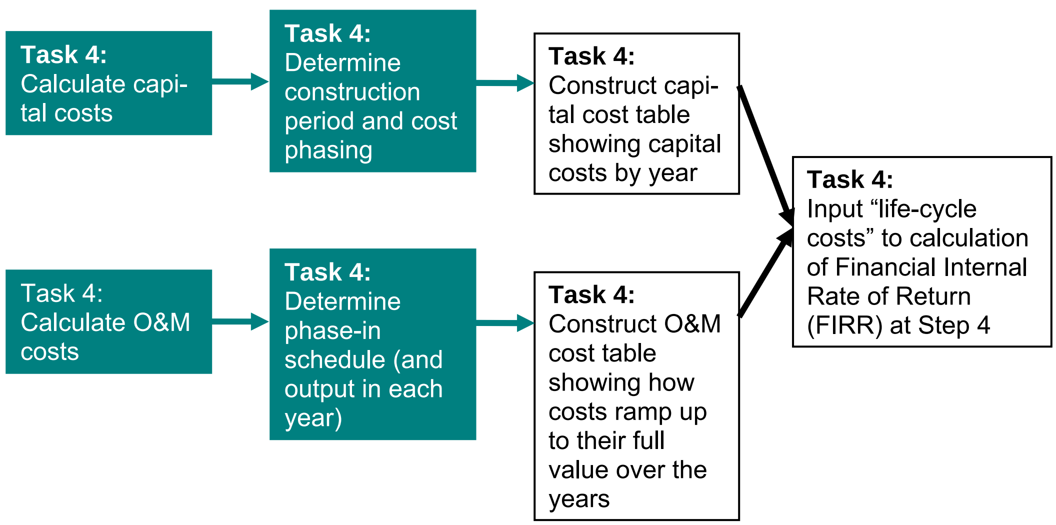
4.1 Conduct Financial Feasibility Analysis

E&E will conducted a financial feasibility analysis. Steps 1-11 below shows the procedures that will be followed in assessing the financial feasibility of alternatives to ground water extraction, computing their cost/benefit ratios, and in recommending and prioritizing short and long term alternatives:

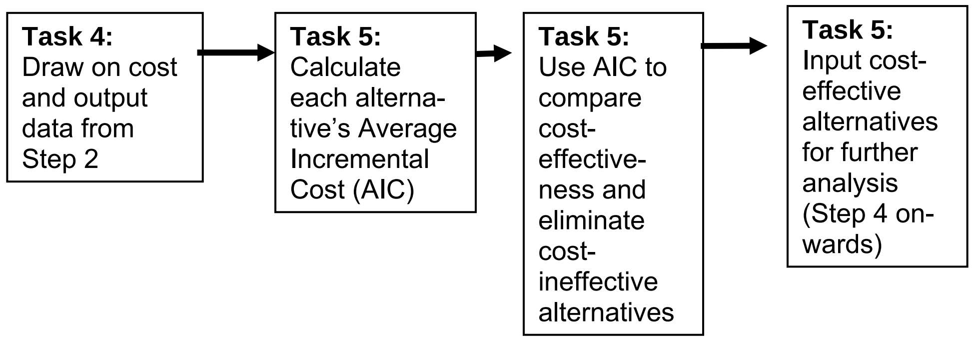
Step 1: Forecast the Supply Gaps in 5 and 20 Years' Time and Compile Lists of Alternatives to Fill Them



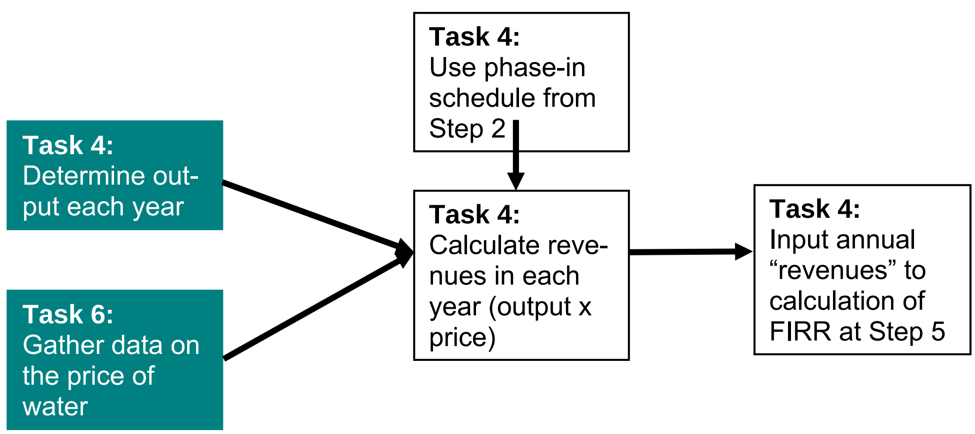
Step 2: Calculate the Life-Cycle Costs for Each Alternative



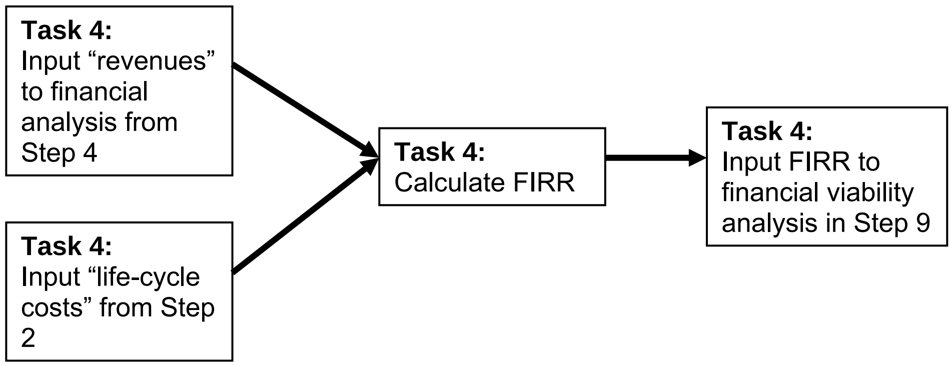
Step 3: Conduct Cost-Effectiveness Analysis for Each Alternative and Eliminate Cost-Ineffective Alternatives



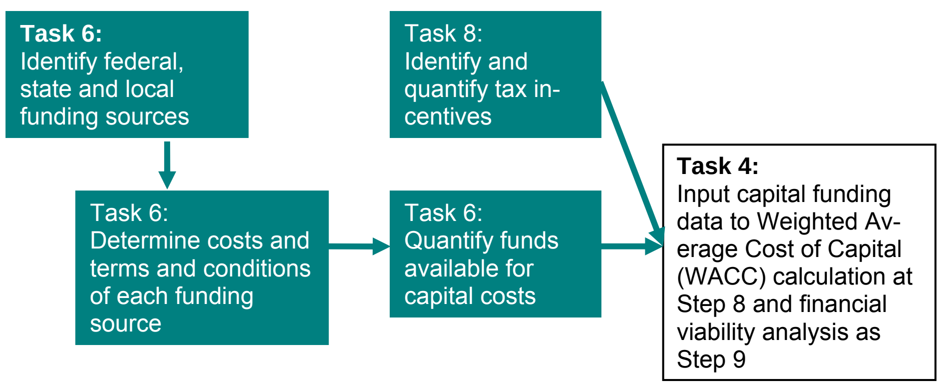
Step 4: Calculate Annual Revenues for Each Alternative



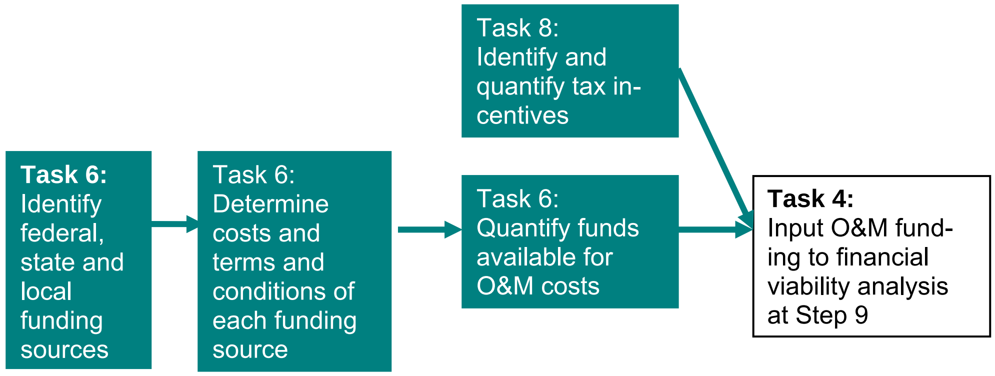
Step 5: Calculate the Financial Internal Rate of Return for Each Alternative



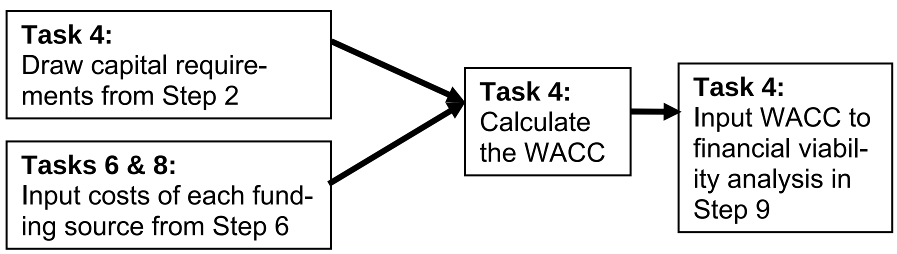
Step 6: Identify Sources, Amounts and Cost of Funding for Capital Costs for Each Alternative



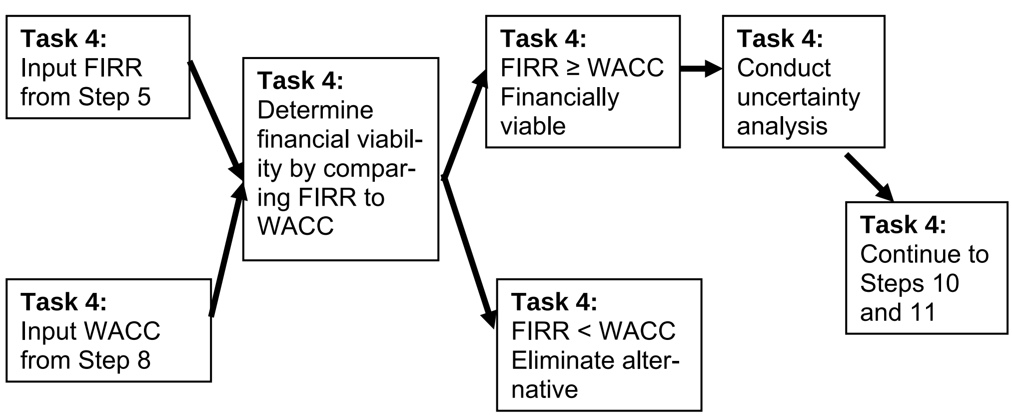
Step 7: Identify Sources, Amounts and Cost of Funding for O&M Costs for Each Alternative



Step 8: Calculate the Weighted Average Cost of Capital for Each Alternative

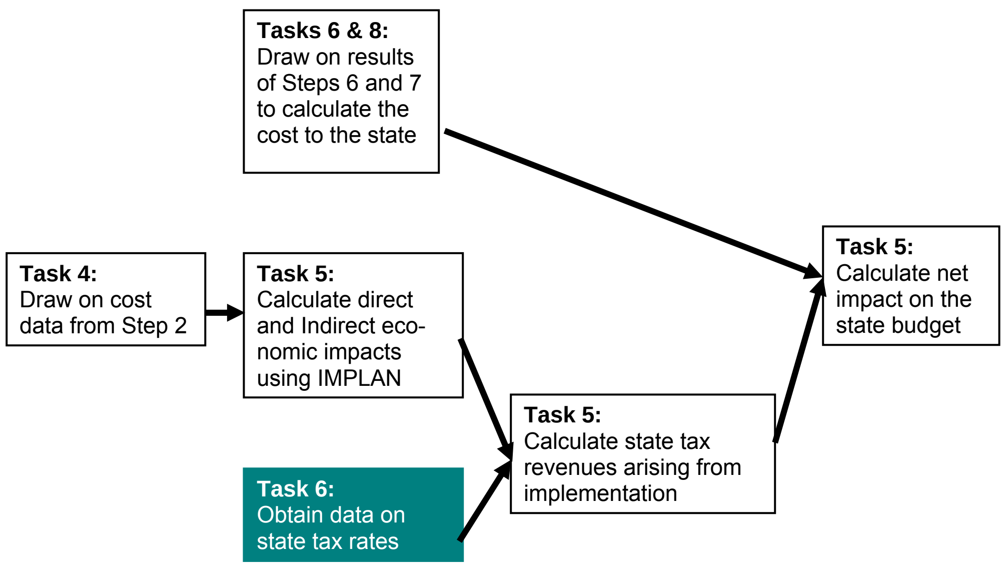


Step 9: Determine The Financial Viability of Each Alternative

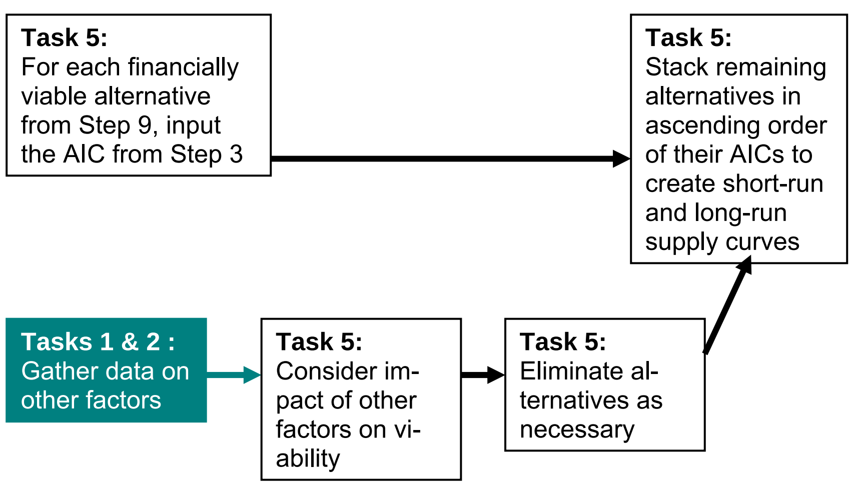


Steps 1-9 above feed data into Task 5- Cost Benefit Analysis and Prioritization. Steps 10 and 11 are shown below for continuity.

Step 10: Estimate Economic Impacts of Each Alternative and Calculate State Budget Impacts



Step 11: Construct Short-Run (5 Years) and Long-Run (20 Years) Supply Curves



In conducting the financial feasibility analysis, we calculated the complete life-cycle costs of each alternative. Life-cycle costs include initial capital costs, the future operations and maintenance (O&M), and replacement costs. The complete costs includes those directly associated with construction of the alternative and indirect costs arising from the construction of any secondary infrastructure (e.g., extra storage). The costs and revenues of the alternative were calculated by comparing the situation and the alternative to the situation without the alternative.

Following the financial feasibility analysis, an analysis on each of the alternatives using the information on costs developed earlier under this task (see Steps 1-11 above) and the information on potential local, state, and federal sources of funds developed under Task 6 was conducted. To assess the financial feasibility of each alternative, we compared the financial internal rate of return (FIRR) to the weighted average cost of capital (WACC), as explained below. All financial analyses were conducted in real (i.e., inflation adjusted) terms, in line with standard practice for such analyses.

The profitability of an alternative is indicated by its FIRR, namely the discount rate at which the present value of the alternative's net revenues becomes zero. Table 4-1 illustrates how the calculations of the FIRR for a hypothetical alternative are achieved.

Table 4-1: Example of the Calculation of the FIRR for a Hypothetical Alternative

Project Year	Output (Cubic Yards per Day)	Capital Costs	Operations and Maintenance Costs	Total Costs	Revenues	Net Revenues
1	0	$5,000,000		$5,000,000	$0	$5,000,000
2	0	$5,000,000		$5,000,000	$0	$5,000,000
3	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
4	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
5	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
6	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
7	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
8	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
9	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
10	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
11	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
12	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
13	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
14	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
15	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
16	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
17	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
18	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
19	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
20	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
21	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
22	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
23	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
24	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
25	3,000,000		$1,000,000	$1,000,000	$1,650,000	$650,000
Financial Internal Rate of Return:						**3.5%**

The capital and O&M costs and output for the alternatives developed under this task, while the sources of revenue for the alternatives (e.g. user fees, groundwater extraction fees, etc,) are developed under Task 6. For the hypothetical alternative, we have assumed that the revenues amount to $0.55 per cubic yard.

The financing costs for the alternatives are accounted for in the calculation of their WACC. Table 4-2 shows the calculation of the hypothetical alternative's WACC.

Table 4-2: Hypothetical Real Weighted Average Cost of Capital Calculation

Source of Funds	Amount of Funds	Share of Total Funds	Nominal Cost	Nominal Cost After Tax (1)	Contribution to WACC
Bank Loan	$5,000,000	50%	6.0%	3.7%	1.8%
Internally Generated Funds	$3,000,000	30%	10.0%	10.0%	3.0%
Grant from Federal Government	$2,000,000	20%	0.0%	0.0%	0.0%
Total:	$10,000,000	100%			
		Nominal Weighted Average Cost of Capital:			4.8%
		Inflation Rate:			2.0%
		Real Weighted Average Cost of Capital:			2.8%

Note: (1) The combined corporate federal and state income tax rate is assumed to be 39%.

The sources, amounts, and the nominal costs for financing to be used to cover the capital costs of each alternative and will be identified in Task 6.

In the case of the hypothetical example, it is assumed that a combination of a bank loan, funds provided by the entity responsible for operating the alternative, and a federal grant will be used to cover $10 million in construction costs. The assumed nominal cost of each is shown in the fourth column of the Table 4-2. The assumed interest rate on the bank loan is 6% per year and the operating entity is assumed to require a 10% return on its equity contribution to the alternative. Since the interest on the bank loan is tax-deductible, the after-tax cost of the loan to the alternative is 3.7%. Weighting the nominal cost of each funding source by its contribution to the capital costs and summing the result yields the alternative's nominal WACC. Adjusting the nominal WACC by the assumed rate of future price inflation yields the alternative's real WACC, which is the real (weighted) cost of the funds required to construct the alternative.

As noted above, a comparison of each alternative's FIRR to its real WACC are documented. If the FIRR exceeds the WACC, the alternative is financially feasible on a stand-alone basis. If the FIRR is below the WACC, the alternative is not financially feasible in the absence of a government subsidy. In the hypothetical example, the FIRR is 3.5% and the WACC is 2.8%, indicating that the alternative is financially feasible without a subsidy. It is possible, however, that the State of Louisiana will have to contribute funds for some alternatives either due to insufficient funds to finance the construction of the alternatives or due to a revenue shortfall. If so, the need for such funding will identified during the financial feasibility analysis.

4.2 Conduct Uncertainty Analyses

The analysis of the feasibility of the hypothetical alternative shown above relates to what is known as the "base case" analysis. The base case analysis represents the results of applying our anticipated likely values for the major quantifiable variables (e.g., costs, revenues) that affect the alternative's feasibility. However, it is to be expected that their actual values will differ from our assumed values. To determine the impact of such differences on each alternative's financial feasibility and to assess the probabilities of different values an uncertainty analysis was conducted for each alternative through undertaking sensitivity and risk analyses. Sensitivity analysis involves calculating measures of the extent to which the feasibility of an alternative is affected by changes in the values of major quantifiable variables (e.g., a decline in the amount of water supplied). Risk analyses examine the probabilities of changes in values of major quantifiable variables.

Starting with sensitivity analysis, Table 4-3 shows a sensitivity analysis for the hypothetical alternative:

Table 4-3: The Results of Sensitivity Analysis for the Hypothetical Alternative

Assumed Change	Financial Internal Rate of Return	Sensitivity Index	Switching Value
Base Case	3.5%	-	
Volume - 10%	0.9%	36.7	2.7%
Capital Costs + 10%	2.6%	12.4	8.0%
O&M Costs + 10%	2.0%	21.5	4.7%
One Year Delay	2.9%	-	

Notes: 1. The sensitivity index shows the percentage change in the amount by which Financial Internal Rate of Return exceeds the Weighted Average Cost of Capital divided by the percentage change in the parameter of interest (e.g., volume)
2. The switching value is the reciprocal of the sensitivity index.

The first column shows the assumed change in a major quantifiable variable (e.g., 10% decline in the volume of water supplied by the alternative). The second column shows the alternative's FIRR given the changes. The third column shows the sensitivity index, which is a measure of sensitivity of the margin by which the alternative's FIRR exceeds its WACC (i.e., 3.5% - 2.8% = 0.7%, in the base case) to the various changes. The final column shows the percentage change in each variable (apart from a delayed start to the construction work) that would be sufficient to reduce the alternative's FIRR to equality with its WACC. Any larger increase in that variable would require a subsidy.

It can be concluded from Table 4-3 (above) that a 1% increase in capital costs of the hypothetical example will reduce the amount by which its FIRR exceeds its WACC by 36.7% (i.e., 36.7 x 1%) and that a 2.7% increase in capital costs is sufficient to reduce its FIRR to equality with its WACC. An increase in capital costs of more than 2.7% will therefore require a subsidy to be provided to the alternative.

Having identified the major quantifiable variables to which each alternative's financial feasibility is sensitive, we then conducted a risk analyses by examining the likely sources of changes in these variables, assessing the likelihood (in a qualitative sense) that such variations will occur, and discussed the measures that might be taken to eliminate, reduce or mitigate risk.

5 Cost Benefit Analysis and Prioritization

5.1 Conduct Benefit Analysis

In conducting this task, each alternative replaced or reduced differing amounts of groundwater and will differ in their estimated costs. We combined the estimate of each alternative's costs with its estimated output (i.e., millions of cubic yards per day of groundwater replaced or reduced) to calculate its Average Incremental Cost (AIC). The AIC is the present value of the sum of an alternative's complete life-cycle costs divided by the present value of the quantity of water it supplies, and is calculated using the following formula:

$$AIC = \left(\sum_{t=0}^{n}(C_t / (1+d)^t)\right) / \left(\sum_{t=0}^{n} (O_t / (1+d)^t)\right)$$

Where:

	C_t	=	Capital and O&M cost in year t
	O_t	=	Water supplied in year t
	n	=	Lifetime of the alternative in years
	d	=	Discount rate (weighted average cost of capital)

An example showing the calculation of a hypothetical alternative's AIC is provided in Table 5-1:

Table 5-1: The Calculation of the Average Incremental Cost of the Hypothetical Alternative

WACC: 2.8% per year

Project Year	Capital Costs	Operations and Maintenance Costs	Total Costs	Output (Cubic Yards per Day)
1	$5,000,000		$5,000,000	0
2	$5,000,000		$5,000,000	0
3		$1,000,000	$1,000,000	3,000,000
4		$1,000,000	$1,000,000	3,000,000
5		$1,000,000	$1,000,000	3,000,000
6		$1,000,000	$1,000,000	3,000,000
7		$1,000,000	$1,000,000	3,000,000
8		$1,000,000	$1,000,000	3,000,000
9		$1,000,000	$1,000,000	3,000,000

Table 5-1: The Calculation of the Average Incremental Cost of the Hypothetical Alternative

WACC: 2.8% per year

Project Year	Capital Costs	Operations and Maintenance Costs	Total Costs	Output (Cubic Yards per Day)
10		$1,000,000	$1,000,000	3,000,000
11		$1,000,000	$1,000,000	3,000,000
12		$1,000,000	$1,000,000	3,000,000
13		$1,000,000	$1,000,000	3,000,000
14		$1,000,000	$1,000,000	3,000,000
15		$1,000,000	$1,000,000	3,000,000
16		$1,000,000	$1,000,000	3,000,000
17		$1,000,000	$1,000,000	3,000,000
18		$1,000,000	$1,000,000	3,000,000
19		$1,000,000	$1,000,000	3,000,000
20		$1,000,000	$1,000,000	3,000,000
21		$1,000,000	$1,000,000	3,000,000
22		$1,000,000	$1,000,000	3,000,000
23		$1,000,000	$1,000,000	3,000,000
24		$1,000,000	$1,000,000	3,000,000
25		$1,000,000	$1,000,000	3,000,000
Present Value of Costs:			$25,537,827	
Present Value of Output:				47,817,373
Average Incremental Cost ($/Cubic Yard):				**$0.53**

Using the results, a supply curve will be created showing the amounts and costs of water supplied by alternative sources. Figure 5-1 illustrates this approach.

The colored blocks show the AIC and quantity of water supplied by each of the four alternatives. The alternatives are arranged in ascending order of AIC. In 2010, the supply gap (i.e., the demand for water minus the maximum allowable extraction from groundwater sources) is such that the first three alternative sources are called upon to supply water. By 2030, the demand for water is assumed to have increased so that all four alternative sources will be required to supply water to both replace groundwater extractions and accommodate the increase in water usage.

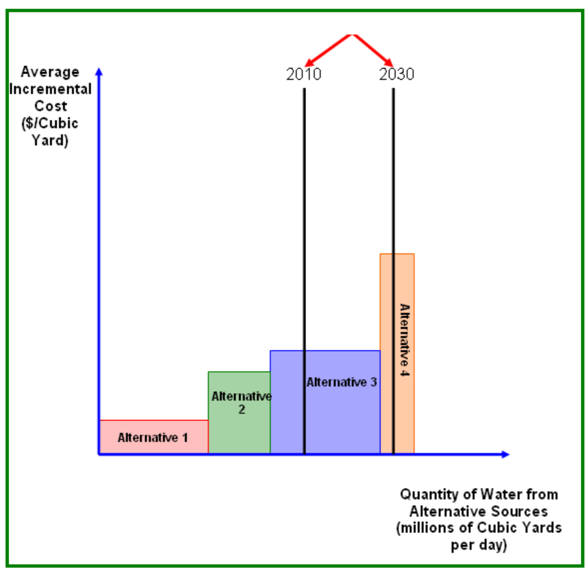


Figure 5-1: Water Use Curve

5.1.1 XXXX

5.2 Consider Other Factors

Factors taken into consideration in assessing the ability of alternatives to meet short and/or long-term needs include the following:

- Applicable Department of Economic cost recovery Development methods;
- The quality of the water supplied by the alternative;
- The dependability of the water supply;
- The time required to implement the alternative;
- The suitability of the water for alternative uses (e.g., for agriculture and aquaculture or for hydrofracturing of natural gas wells);
- The length of the period over which the alternative will likely produce/contribute to improved water supplies;
- The technical and administrative feasibility of implementing the alternative;
- The location of the alternative (i.e., alternatives will be preferred if they are located in an area of high need/low water availability);
- The level of completeness of the planning and design process; and
- The availability of Federal grants to cover construction costs.

With regard to applicable Department of Economic Development methods, the Department's main concern is the net impact of each alternative on the state budget. As a result, the DED will be able to see a comparison of each alternative's cost to the state with the revenues it will generate for that state.

With regard to the revenues accruing to the state, the DED is most interested in the direct and indirect employment generated by the construction and operation of the alternative; this can be attributed to the fact that every dollar paid to the workers on the alternative results in seven cents of additional revenue for the state. An economic input-output model called IMPLAN (Impact Analysis for Planning, MIG, Inc.) was used to estimate the direct employee compensation arising from the alternative and the indirect employee compensation arising from related, linked economic activity throughout the state (i.e., the multiplier effects generated by the direct spending stimulus attributable to the alternative).

If a fatal flaw was identified by using the factors such as those listed above, the alternative was eliminated from consideration.

5.3 Recommend and Prioritize Short and Long Term Alternatives

Having identified potential alternatives to groundwater extraction; assessed their financial feasibility, sensitivity, and risk; assessed their cost-benefit ratios; considered other factors including DED methods, a list of both short-term and long-term alternatives was developed. The results are listed as prioritized, recommended alternatives to meet short-term and long-term needs, respectively.

5.3.1 Short Term Alternatives

5.3.2 Long Term Alternatives

6 Funding Opportunities

The objective of this task was to identify and prioritize federal, state, and local funding sources that could be applied to fund the water infrastructure alternatives necessary to reduce groundwater depletion in the state through:

- Water Conservation
- Water treatment
- Transmission
- Distribution
- Reclaimed water processing and reuse.

Many of the sources identified require appropriations to fund surface and groundwater resource development.

Funding Source Priority System

The funding source recommendations will be based on a priority ranking system that has been developed based on the identified projects. The particular criteria for funding eligibility into the system is designed to evaluate the potential funding source alternatives ***relative to effectiveness of the program*** and ***relative to the State's program goals and objectives***. The priority system has been designed to ensure that the cost of implementing the recommendations proceeds in a ***least cost framework*** to the state taxpayers.

To ensure that the funding requirements are raised at the least cost to the State, priority rankings will be developed by matching identified projects that relate directly to the recommendations proposed in Task 4 to the eligibility criteria for each of the available funding sources. Some funding sources apply directly to the capital costs of infrastructure and others apply to long-term operational and maintenance costs. The funding recommendations that are being developed will consider existing capital improvement plans (CIPs) at the state, parish, and municipal level. Some CIPs are contingent upon water demand projections that are being developed as a part of this study. Demand management recommendations that are targeted to achieve conservation goals may result in the postponement, deferrement or downsizing of existing capital projects which address water infrastructure development. Where this is deemed likely to occur, the benefits from deferred costs and cost savings will be considered in the funding recommendations and financing plans. Available funds that were formerly targeted for CIP projects (without the implementation of the statewide groundwater management plan) could be tapped if budgets and appropriations are not exhausted, and can also be optimized and shifted to other projects and uses necessary to implement the groundwater plan.

Many potential funding sources were evaluated including;

- Build America Bonds (BABs)
- Water Resources Development Act of 1992 funds (Environmental Infrastructure)
- State Revolving Funds
- USDA
  - Rural Utility Service grants
  - NRCS programs implementing the Watershed Protection and Flood Prevention Act
- Louisiana Department of Environmental Quality
- Water Resources Development Act
- Louisiana Capital Outlay Program
- Louisiana Community Development Block Grant Program
- Cooperative programs with various state agencies involved in conservation in Louisiana, including: Cooperative Extension Service, Department of Agriculture and Forestry, Geological Survey and Farm Bureau
- Federal Clean Water State Revolving Fund
- Drinking Water State Revolving Fund
- Clean Water Act Section 319 Funding for Groundwater
- US Department of Energy Smart Communities Network
- US Fish and Wildlife Service wetland conservation matching grants program
- Grant programs that focus on public and industry education of groundwater issues, sustainable water management, and efficiency opportunities
- Groundwater Advocacy Grants available from the National Ground Water Association.

Local funding sources could potentially relate to:

- user charges for water withdrawals from surface water supplies (alternative sources)
- local fees
- tax increment financing
- development impact fees,
- ad valorem taxes
- sales tax increases (incremental rate increases earmarked towards water resource development infrastructure)

Local groundwater depletion taxes (groundwater extraction charges) will also be studied as one way to raise funds and to discourage or arrest the current rate of groundwater depletion from aquifers.

The particular blend of funding sources will be selected by determining the feasibility of alternatives within the State's capability at the federal state, parish, and municipal level, as well as regulatory and public authority for raising such funds.

Special Purpose Funding Vehicles

Special purpose funding vehicles were researched and evaluated to maximize funding source availability and flexibility; while at the same time attempting to minimize cost to the taxpayers. These funding vehicles were first evaluated by matching the groundwater management recommendations to a particular funding vehicle based on grant eligibility, availability of low interest loans, and tax exempt financing capability. Next we evaluated how these funding vehicles could be applied at different stages of the groundwater management plan program formulation to maximize the use of the particular vehicle. Special purpose funding vehicles are often dependant on regulatory authority or legislation. During the evaluation process each vehicle will be reviewed to determine if new statutory authority or new organizational structures will be required to implement the vehicle. This information was included as a component of the recommendations.

Examples of Special Purpose Funding Vehicles Include:

- California's Water Independence Now (WIN) program, focused on water conservation and water recycling/reuse;
- Orange County, California's award-winning groundwater replenishment program;
- California's Local Groundwater Management Assistance Act of 2000, small community groundwater grants program, and integrated regional water management program;
- New South Wales, Australia, State Groundwater Policy, including integration of surface water and groundwater management;
- Texas groundwater conservation district rules and permit requirements;
- Various state water quality improvement programs which incorporate groundwater management into the overall water quality programs;
- Grant programs for sustainable water use training to individuals and industry that can be applied to groundwater management; and
- Regional strategies for meeting water demand, such as North Carolina's use of Capacity Use Areas to manage groundwater use.

6.1 Federal Mechanisms

The federal funding mechanisms are generally in the form of project or formula grants; cooperative agreements; direct, guaranteed or insured loans and/or direct project payments. Grants and formula grants are a form financial aid that does not have to be repaid. Federal formula grants have a precise set of rules or factors that determine the amount of the financial aid. A cooperative agreement is a legal instrument used principally for transferring money, property, or service to a recipient in order to accomplish a public purpose of support or stimulation.

6.1.1 Economic Development Program

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.

6.1.2 United States Department of Agriculture

United States Department of Agriculture (USDA)
www.rurdev.usda.gov

USDA Rural Development's Water and Environmental Program (WEP) - http://www.rurdev.usda.gov/tx
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.
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.

Technical Assistance and Training Grants
www.usda.gov/rus/water/tatg.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 the applications 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 area not in a city or town with a population in excess of 10,000, according to the latest decennial census of the US. Entities eligible must be private non-profit organizations.

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.

Watershed Operations Authorized by Public Law 566
The Watershed Protection and Flood Prevention Act of 1954 provides 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.

6.1.3 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 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.

6.1.4 United States Environmental Protection Agency

Clean Water Act, Section 319
Grant 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 ground water quality protection activities which the Administrator determines are part of a comprehensive nonpoint source pollution control program including research, planning, ground water assessments, demonstration programs, enforcement, technical assistance, education, and training to protect ground water quality from nonpoint sources of pollution.

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.

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 biosolids (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.

Water Quality Management Planning (66.454)
Public Law 97-117
www.federalgrantswire.com/water-quality-management-planning.html

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. EPA strongly encourages 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.

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 ground water 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.

6.2 State Funding Sources

6.2.1 State Funding Sources

Louisiana Community Development Authority – Environmental Facilities Bonds

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".

http://www.louisianacda.com/index.htm
http://www.louisianacda.com/assets/
http://www.louisianacda.com/assets/lcda-rules.pdf

Division of Administration (DOA), Facility Planning and Control,
www.doa.louisiana.gov/fpc/qualifications.htm

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.

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 co-operative 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.

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.

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).

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.

Louisiana's federal allocation for the FY 2010 CDBG Program is $30,533,587. Five program areas were established for the distribution of these funds. Public Facilities, Housing, Demonstrated Needs, Economic Development and LaSTEP. Applications for FY 2010 Economic Development, Demonstrated Needs and LaSTEP funds will be accepted through March 31, 2011.

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.

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.

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.

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.

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.

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.

6.3 Special Interest

Ground Water 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%.

6.4 Conceptual Financing Plan

In general, in formulating the conceptual financing plan, “user pays” or “polluter pays” principles are followed. These principles ensure that local users pay for the long-term sustainability of the groundwater resource by ensuring that abstraction, withdrawal/depletion and pollution assimilation charges are tied to regional consumption and discharge. Specific funding sources and financial instruments can relate to these demand charge concepts. Where the principles are followed, demand management practices and conservation-oriented user fees can also be applied and linked to areas of concern where water budgets are out of balance and existing resources are not achieving sustainable yield.

While the “Funding Uses” for the financing plan are not now defined (this will come later on in the Study), it is known that the costs for water supply and conveyance infrastructure will likely be identified and therefore the likely funding sources can be conceptually profiled now. Later in the project it will be determined how much each “Funding Source” would contribute to the financing plan, this is currently at the level of a conceptual financing plan. The table below indicates how how federal funds or available state grants (the “Sources”) which could be used to fund project capital costs and other revenue sources will be applied to fund long-term operations and maintenance costs (O&M).

Even though the project implementation cost for the management plan alternatives have not yet been identified it is still possible to provide a conceptual financing plan table, using information from the Sparta Aquifer as an example.

Funding Uses:	Funding %	Funding %
(Uses to be defined later in process)		
Funding Sources	Capital Costs	Operations & Maintenance (O&M)
Federal Grants / Low Interest Loans	√	
State Grants/Appropriations	√	
State Bonds (GO, Environmental Facilities)	√	
Regional / Locally Originated		
Sales tax	√	√
Ad valorem tax	√	√
User Fees		√
Ground water extraction/depletion fee		√
Surface water sales		√
	100%	100%

The conceptual financing plan will be more fully developed into defined funding sources and defined contribution levels as the project is finalized.

7 Best Management Practices

Groundwater and surface water Best Management Practices (BMP) were surveyed from a myriad of sources including Federal, State, Local plans, guidelines, standards of practice, and tax structures to identify ***BMP Incentives*** that reduce the cost of implementing management measures to reduce groundwater depletion.

Each incentive that was identified will be matched to specific measure that is chosen. For example, demand management incentives will be 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, will be 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 (i.e., such as control structures or impoundment measures and utilizing surface water in place of groundwater supplies) that could be stimulated and aided by tax incentives will also be described and related back to the alternative measures and short and long-term recommendations from Tasks 4 and 5.

In addition, tax incentives related to promoting ***conservation*** and ***water reuse*** have also been 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 will be described and evaluated so that the appropriate tax incentives can be applied within Louisiana. The survey of state practices will also provide information on any lessons learned or shortfalls that have been encountered in meeting the broad based participation goals of the tax incentive programs.

7.1 Nationwide and State Regional Identification of Relevant BMP's

The regions with similar ***groundwater depletion issues***, ***land use practices***, ***climates***, and ***geology*** with active incentives in place has been surveyed and profiled first, but the research to identify the BMPs will continue and will be national and international in scope. Particular attention has been paid to those states which have implemented programs with strong participation and public support, as well as programs noted for innovative approaches that could be feasible in Louisiana. The focus will be on incentives that balance ***fiscal considerations***, ***efficiency***, and ***environmental concerns***. Programs in Arkansas, Georgia, Texas and Alabama were evaluated with regard to shared groundwater resources and are summarized in the following sections. In addition, Tables 7-1, 7-2, and 7-3 describe further summaries of state and federal BMPs that have been evaluated to date.

7.1.1 Arkansas

- First developed plan in 1969 and was published in 1975
  - Gave Arkansas Soil and Water Conservation Commission responsibility for water resource planning.
  - Included five appendices addressing specific problems and needs in the State.
- In 1985 Commissions planning responsibilities were broadened:
  - Inventory of the State's water resources, including areas of groundwater concern then and in 30 years time, determination of current needs and projected future needs, determination if any excess surface water exists
- Commission revised water management plan in 1986.
  - Divide the State by watersheds to most easily develop management policies and practices.
  - Establish minimum stream flows (Act. 1051) to maintain fish and wildlife habitat.
  - Determine the Safe Yield of surface and groundwater to assure sustainability of water resources.
  - Establish Critical Surface and Groundwater Areas that do not meet the safe yield criterion.
  - Favored mitigation is to convert to surface water in areas of ground water concern and to augment surface water supply with any surface water excess.
- Arkansas Groundwater Management Act of 1991.
  - Produced annually by the Arkansas Natural Resources Commission (ANRC).
    - Provides the State with a comprehensive water-quantity and water-quality document to be utilized in accordance with the State Water Plan.
    - A guide for water resources and conservation programs
  - Current 2009 report finds that the State is withdrawing ground water from the Sparta and alluvial aquifers at far above sustainable

rates and recommends that ANRC should continue to promote conservation, education, and the conjunctive use of ground- and surface-water at rates that are sustainable now and in the future.

7.1.2 Texas

The Texas Water Development Board (TWDB) established the regional water planning process in 1977. Key elements of this process are:

- Demonstrated a shift in policy from a top-down approach to a bottom-up approach/
- Resulted in 16 regional water planning areas that are designated by river basin and aquifer delineations, water utility development patterns, socio-economic characteristics, existing regional water planning areas, political subdivision boundaries, and public comment.
- Consists of seven tasks:
    1. Describing the regional water planning area (i.e. major water providers, current water use, sources of groundwater and surface water);
    2. Quantifying current and projected population and water demand
    3. Evaluating and quantifying current water supplies (To estimate the existing water supplies, the planning groups use surface water and groundwater availability models when available)
    4. Identifying surpluses and needs;
    5. Evaluating water management strategies and preparing plans to meet the needs (examples of recommended water management strategies include advanced conservation of existing water supplies, new reservoir and groundwater development, conveyance facilities to move available or newly developed water supplies to areas of need, water reuse, water rights subordination agreements, and others);
    6. Recommending regulatory, administrative, and legislative changes; and
    7. Adopting the plan, including the required level of public participation.

Senate Bill 2 of 2001 Session of the Texas Legislature

- Requires TWDB to develop groundwater availability models for all of Texas' aquifers.
- Requires each of the 16 regional water planning groups to examine the financing for their proposed water management strategies.
- Creates a Water Infrastructure Fund.

7.1.3 Alabama

Office of Water Resources (OWR) and Water Resource Commission (WRC) are in charge of water resource management, as established by the Alabama Water Resources Act of 1993.

- OWR is responsible for coordinating with other state agencies to manage the state's water resources (Primary function has been towards basin management)
- WRC has the rule and policy making authority
- Major planning focuses of Alabama's Planning Program
    - Drought Management
        - Created a drought planning task force.
    - Development of the Water Use Reporting Program
        - Published every five years
        - The only comprehensive water use database in the State.

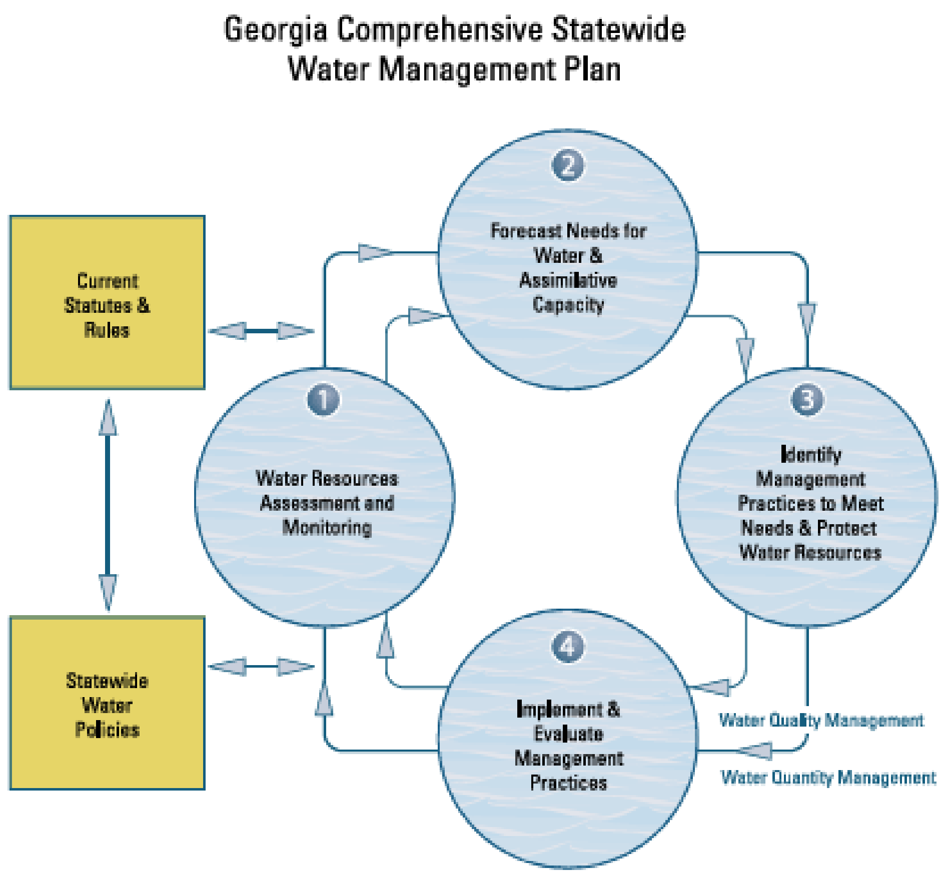
7.1.4 Georgia

Georgia's Environmental Protection Division under guidance of the Water Council developed a comprehensive statewide water management plan in 2008.

- Provides for a Water Resource Assessment
    - To conduct a consumptive use and assimilative capacity assessment of the State's ground- and surface waters.
        - Process will begin with the identification of hydrologic boundaries of watersheds and aquifers.
        - Will drive the selection of appropriate water management strategies.
    - Support revisions of water quality standards
    - Require the compilation of a significant information base, a comprehensive monitoring program, and a well coordinated system for information management.
- Development of regional forecasts of water supply and assimilative capacity demands.
    - Developed for the planning regions. These regions are defined by jurisdictional boundaries, economic interdependencies, as well as hydrologic boundaries.
- Develop regional water development and conservation plans.
    - Use water resource assessments as well as regional forecasts to identify water quantity management practices.
        - Address management of consumptive use of water.
    - Management practices identified by the plans for each region will be supported by statewide guidance.
    - Once adopted will serve as a basis for making permitting decisions as well as decisions regarding States grants and loans from the State's Environmental Facilities.

- Will not conflict with state laws during an emergency period of water shortage.
- Establish water conservation goals and requiring water withdrawal permit holders to demonstrate progress towards those goals.
- Proposed Water Supply Management Practices:
  - Additional surface water storage, interbasin transfers, intrabasin transfers, and aquifer storage and recovery.
- Enhanced Pollution Management Practices

Based on a review of state plans within a similar region, there is a similarity in the approaches used by each state in developing and implementing a successful state-wide water management plan. This is best illustrated in Georgia's approach to state-side water management.



Source: Georgia Comprehensive State-wide Water Management Plan, 1/8/2008

Figure 7- 1: Georgia Comprehensive Statewide Water Management Plan

The Georgia plan has four basic management components:

- Integrated water policies govern water management decisions
- Provisions for assessment of the capacities of water resources
- A 'toolbox' of water quantity and water quality management practices
- Provisions for regional planning to select the management practices that best fit the resource conditions and uses in different regions throughout the state.

7.1.5 Louisiana Reservoir Priority and Development Program Issues, Concerns and Recommendations

The 2010 Louisiana Reservoir Priority and Development Program (LRPD Program) (MWH, 2010) 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 resources 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*. While 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 demands water*. Throughout the state of Louisiana, agricultural uses 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. While 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 ground water 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 resources 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 resources 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 resources 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 resources 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, 2010). 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 resources 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.

7.2 Water Use Sector Targeting

The most groundwater intensive or demanding sectors of the state will be targeted for applicable tax incentives in a priority system ranking. The recommendations will examine national BMPs that have resulted in the greatest success in arresting depletion rates and leading to sustainable aquifer recovery and replenishment. Earlier tasks will guide the prioritization of incentives that identify the most water intensive sectors in the State. From this ranking process a mix of public and private tax incentives can be recommended that will result in the greatest “bang for the buck.” Applicable tax incentives that encourage and enable oil and gas operators to effectively use available surface water resources or other acceptable alternative water sources in northwest Louisiana will be researched since this sector is currently placing pressure on groundwater resources. Tables 7-1, 7-2, and 7-3 describe the state and federal BMPs that have been evaluated to date.

Table 7-1: Best Management Practices: Tax, Grant, Rebate, and Funding Incentives

Best Management Practices: *Tax, Grant, Rebate and Funding Incentives*															
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 per year	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 ground water use to surface water use outside/within a critical ground water 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

Table 7-1. Best Management Practices: Tax, Grant, Rebate, and Funding Incentives (cont.)

Best Management Practices: *Tax, Grant, Rebate and Funding Incentives*														
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	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
Florida	Florida Water Star Gold (Incentives	Not yet in Effect	Increasing water efficiency in Landscapes, irrigation systems, and indoor fixtures	Yes	Yes	N/A	High	High	Unknown	Yes	No	No	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	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	Unknown	4
Texas	Municipal Rebates and Discounts	2001	Rainwater and Condensate Recovery Systems	Yes	Yes	N/A	High	High	Be a 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 7-1. Best Management Practices: Conservation and Water Reuse Incentives (cont).

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
Best Management Practices: *Conservation Incentives*														
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, Forestal 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
California	California Ground and Surface Water Conservation (GSWC) Initiative		Improvements to irrigation systems; Improving water storage capability; The 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
California	Agricultural Water Enhancement Program (AWEP) (part of the 2008 Farm Bill)	2008	Any BMP regarding that help 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
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

8 Public Hearing

E & E will coordinate and facilitate up to four public hearings, during a 30 day period , at times and locations determined by DNR Office of Conservation, with all interested parties to introduce the project findings and project components under consideration for implementation. We assume that the presentation will focus on both the technical and scientific background surrounding groundwater management in Louisiana, as well as the financial and regulatory options being considered for program implementation and long-term management. E & E will meet with DNR Office of Conservation to discuss roles and presentation process for the public hearings. In our experience the goals of these public hearings are to formally introduce the project and process; build relationships laying the foundation for future conflict resolution; and identify stakeholder issues, concerns, and opportunities.

In preparation for the meeting, E & E will create materials to support the meeting discussions as required, including graphic materials, pamphlets, a PowerPoint presentation, and/or story boards, dependent upon Office of Conservation's guidance, to best present the program findings and proposed actions. E & E will discuss potential stakeholders, industry groups, business interests, and non-governmental organization representation that might be expected at each of the meetings, and will assist DNR in identifying potential issues of particular interests to these groups and individuals as part of meeting preparation. E & E will work with DNR to refine the project description, develop a project timeline, prepare a presentation and talking points, and develop and produce factsheets and sign-in sheets.

Two E & E staff will attend the hearings: the project manager will address technical issues and financial considerations. E & E's project manager has a great deal of experience facilitating discussion and review of statewide program initiatives at public hearings. We have assumed that a DNR Office of Conservation representative will commence the meeting introducing the program mission and describing the project. E & E will assist DNR Office of Conservation in preparing the key messages and talking points.

Public comments made during the hearing will be documented by a recorder in accordance with state law. E&E will assemble, review, and present results to DNR Office of Conservation. Results of the public meeting will be used to guide finalization of proposed approaches. Public comments and comments from DNR Office of Conservation will be incorporated into the Final Comprehensive Report, as directed by DNR.

8.1 Plan Input and Review

The purpose of this study is to develop a comprehensive Statewide Ground Water Management Plan that provides implementable short (five year) and long-term (25 year) recommendations to enhance the sustainability and quality of Louisiana's groundwater resources.

As seen in the attached diagram, data from various sources will be reviewed, synthesized and processed via a collaborative and iterative effort between stakeholders, the State of Louisiana Groundwater Commission, and Office of Conservation using the tasks outlined in this report and repeated below for convenience:

Task 1: Historical Review
Task 2: Water Resource Use Analysis
Task 3: Review of Ground Water Well Prior Notification Procedures
Task 4: Feasibility and Cost-Benefit Analysis
Task 5: Funding Opportunities
Task 6: Best Management Practices

Data will include a combination of information from the following sources:

1. Key water management documents, including:
   a. *Assistance in Developing the Statewide Water Management Plan,* prepared for the LA Ground Water Management Commission, 2002
   b. *Louisiana Reservoir Priority and Development Program, Louisiana Statewide Perspective on Water Resources,* prepared for the LDOTD, 2010
   c. Aquifer Studies and other Water Management historical data prepared by the Louisiana Geological Survey
2. Federal, State and local BMPs and Incentive programs
3. Existing State programs such as the Well Notification Program, and
4. Supply and Demand Data

From this iterative process, a combination of recommendations and/or solutions to water management in the State of LA will be developed for short-term and long-term implementation. The final recommendations will be categorized into tiers based on their estimated time frame for implementation and on whether or not regulatory or legislative changes may be required to successfully implement them.

The Tiers are defined as follows:

Tier 1 Solution: Short Term Recommendations that are implementable with existing Louisiana Laws and Regulations.

Tier 2 Solution: Long Term Recommendations that are implementable with existing Louisiana Laws and Regulations.

Tier 3 Solution: Long Term Recommendations that require Legislative Changes to be implemented.

Recommendations formulated through this process and other project findings will be introduced at Public Hearings. This will formally introduce the project and process; build relationships laying the foundation for future conflict resolution; and identify stakeholder issues, concerns and opportunities. Public Comments made during the hearings will be documented for further review by the Office of Conservation and results of the public meeting and review will be used to guide the finalization of proposed solutions.

9 References

A

Appendix A

B

Appendix B

C Appendix C