BASELINE MONITORING PROJECT, EPA FISCAL YEARS 1998 - 2000
(July 1997 to June 2000)

TRIENNIAL SUMMARY REPORT, 2000

FOR THE

ENVIRONMENTAL EVALUALTION DIVISION

OF THE

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

PARTIAL FUNDING PROVIDED THROUGH CWA 106 GRANT

TRIENNIAL SUMMARY REPORT, 2000

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The Environmental Evaluation Division's (EED) Baseline Monitoring Project (the Project or BMP) owes its success to many people for their continual support through the years. Without this support, the Project could not exist.

The water well owners, who voluntarily participate in the BMP, are owed a debt of gratitude. Without access to private, corporate, and public property and wellheads, the Project could not operate.

The Louisiana Department of Environmental Quality (LDEQ) Water Laboratory continues to provide excellent analytical service in addition to continued advice and assistance in data interpretation.

Zahir "Bo" Bolourchi, P.E., Chief of the Water Resources Section of the Louisiana Department of Transportation and Development (LDOTD) provides counsel and water well data. The Water Well Registration data set that is provided to the LDEQ, and ultimately to the Environmental Evaluation Division, is used for multiple purposes in the execution of the BMP.

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The BMP is funded by the U.S. Environmental Protection Agency (EPA) through Section 106 of the Clean Water Act.

BACKGROUND

The BMP is conducted as a Clean Water Act, Section 106 activity. The Project was designed to determine and monitor the quality of ground water in the major freshwater aquifers across Louisiana. The data derived from this process is provided to the Ground Water Advisory Group for comments, and to LDEQ to aid in formulating and implementing the Ground Water Protection Strategy for the State. It is also available to the public through LDEQ's website and through the mail upon request. Also, the laboratory results from the sampling of each well are mailed to the well owner.

The BMP monitors 184 wells in fourteen major freshwater aquifers and aquifer systems throughout the state. Table 1 below lists these major aquifers and aquifer systems while Table 2 on the following page illustrates their stratigraphic occurrence. The number of wells assigned to each aquifer is based on the areal extent of each aquifer. Currently, the well density goal is approximately one well per 400 square miles. For example, an aquifer or aquifer system with an areal extent of 4,800 square miles would require a minimum of twelve project wells to be assigned to it, 4,800/400 = 12. An effort is made to distribute sample locations (wells) evenly within the areal extent of each aquifer so that a representative sampling of the aquifer as a whole can be accomplished. Table 1 illustrates the square mileage of each aquifer or aquifer system and the number of wells currently assigned to it.

Table 1
Aquifers and Aquifer Systems Monitored

AQUIFER OR SYSTEM	SQUARE MILES	NUMBER OF WELLS
Sparta Aquifer	6,923	13
Carrizo-Wilcox Aquifer	4,795	12
Red River Alluvial Aquifer	1,387	4
Evangeline Aquifer	4,547	8
Catahoula Aquifer	2,590	6
North Louisiana Terrace Aquifer	2,152	11
Carnahan Bayou Aquifer	3,640	7
Mississippi River Alluvial Aquifer	9,947	24
Cockfield Aquifer	5,161	12
Chicot Aquifer	9,949	26
Williamson Creek Aquifer	3,243	7
Chicot Equivalent Aquifer System	6,800	24
Evangeline Equivalent Aquifer System	6,252	15
Jasper Equivalent Aquifer System	6,051	15

The sampling process was designed so that each well is monitored every three years, and hence so that all fourteen aquifers and aquifer systems are monitored within a three-year period. The process is then repeated once a three-year cycle has been completed. Typically, five or more wells, each producing from the same aquifer, are sampled each month sampling is performed. An effort is made to sample all project wells of the aquifer in question within a month or set of months before moving to the next aquifer. Aquifers of small areal extent may have been completed in a single month, whereas larger aquifers may have required up to four months to complete. It should be noted that no regular sampling is undertaken in the months of June and December due to scheduling constraints.

Table 2
Hydrogeologic Column of Aquifers

SYSTEM	SERIES	Stratigraphic Unit	Hydrogeologic Unit: Northern Louisiana — Aquifer or confining unit	Central and southwestern Louisiana — Aquifer system or confining unit	Central and southwestern Louisiana — Aquifer or confining unit: Lake Charles area	Central and southwestern Louisiana — Aquifer or confining unit: Rice growing area	Southeastern Louisiana — Aquifer system or confining unit	Southeastern Louisiana — Aquifer[1] or confining unit: Baton Rouge area	Southeastern Louisiana — Aquifer[1] or confining unit: St. Tammany, Tangipahoa, and Washington Parishes	Southeastern Louisiana — Aquifer[1] or confining unit: New Orleans area and lower Mississippi River parishes
Quaternary	Pleistocene	Red River alluvial deposits Miss. River alluvial deposits Northern La. Terrace deposits Unnamed Pleistocene deposits	Red River alluvial aquifer or surficial confining unit Mississippi River alluvial aquifer or surficial confining unit Upland terrace aquifer or surficial confining unit	Chicot aquifer system or surficial confining unit	"200-foot" sand "500-foot" sand "700-foot" sand	Upper sand unit Lower sand unit	Chicot Equivalent aquifer system[2] or surficial confining unit	Mississippi River alluvial aquifer or surficial confining unit Shallow sand "400-foot" sand "600-foot" sand	Upland terrace aquifer Upper Ponchatoula aquifer	Gramercy aquifer[3] Norco aquifer[3] Gonzales-New Orleans Aquifer[3] "1,200-foot" sand[3]
Tertiary	Pliocene -----?-----	Fleming Formation: Blounts Creek Member	Pliocene-Miocene aquifers are absent in this area	Evangeline aquifer or surficial confining unit			Evangeline equivalent aquifer system[2] or surficial confining unit	"800-foot" sand "1,000-foot" sand "1,200-foot" sand "1,500-foot" sand "1,700-foot" sand	Lower Ponchatoula Aquifer Big Branch aquifer Kentwood aquifer Abita aquifer Covington aquifer Slidell aquifer	
	Miocene	Fleming Formation: Castor Creek Member		Castor Creek confining unit			Unnamed confining unit	"2,000-foot" sand "2,400-foot" sand "2,800-foot" sand	Tchefuncte aquifer Hammond aquifer Amite aquifer Ramsay aquifer Franklinton aquifer	
		Fleming Formation: Williamson Creek Member Dough Hills Member Carnahan Bayou Member		Jasper aquifer system or surficial confining unit	Williamson Creek aquifer Dough Hills confining unit Carnahan Bayou aquifer		Jasper equivalent aquifer system[2] or surficial confining unit			
		Fleming Formation: Lena Member		Lena confining unit			Unnamed confining unit			
	-----?----- Oligocene	Catahoula Formation		Catahoula aquifer			Catahoula equivalent aquifer system[2] or surficial confining unit			
		Vicksburg Group, undifferentiated	Vicksburg-Jackson confining unit	No fresh water occurs in older aquifers						
	Eocene	Jackson Group, undifferentiated								
		Claiborne Group: Cockfield Formation	Cockfield aquifer or surficial confining unit							
		Claiborne Group: Cook Mountain Formation	Cook Mountain aquifer or confining unit							
		Claiborne Group: Sparta Sand	Sparta aquifer or surficial confining unit							
		Claiborne Group: Cane River Forr ?	Cane River aquifer or confining unit							
		Claiborne Group: Carrizo Sand	Carrizo-Wilcox aquifer or surficial confining unit							
	Paleocene	Wilcox Group, undifferentiated								
		Midway Group, undifferentiated	Midway confining unit							

[1]Clay units separating aquifers in southeastern Louisiana are discontinuous and unnamed.
[2]Four aquifer systems as a group are called the Southern Hills aquifer system.
[3]Four aquifers as a group are called the New Orleans aquifer system.

Source: DOTD/USGS Water Resources Special Report No. 9, 1995

Each well is sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. The following tables, Table 3 through Table 7, list these sample parameters. The tables reflect the most recent sampling episodes since some of the items listed have changed over the last three years. For more specific lists, please refer to the aquifer summaries appended to this document. In addition to these parameters, the temperature, pH, conductivity, and salinity are recorded in the field.

Table 3
Water Quality, Metals, and Nutrients

PARAMETER	METHOD	PQL (practical quantitation limit)
BOTTLE A (Water Quality)		
Alkalinity	310.1	2 ppm
Chloride	300.0	1.25 ppm
Color	110.2	5 PCU
Conductivity	120.1	1 umho/cm @ 25ºC
Sulfate	300.0	1.25 ppm
T.D.S.	160.1	4.0 ppm
T.S.S.	160.2	4.0 ppm
Turbidity	180.1	1 NTU
BOTTLE B (Total Metals)		
Antimony	6010	5 ppb
Arsenic	6010	5 ppb
Barium	6010	5 ppb
Beryllium	6010	1 ppb
Cadmium	6010	1 ppb
Chromium	6010	5 ppb
Copper	6010	5 ppb
Iron	6010	20 ppb
Lead	6010	10 ppb
Mercury	7470A	0.05 ppb
Nickel	6010	5 ppb
Selenium	6010	5 ppb
Silver	6010	1 ppb
Thallium	6010	5 ppb
Zinc	6010	10 ppb
BOTTLE C (Nutrients)		
NH_3 – as N	350.3	0.1 ppm
Hardness	130.2	5 ppm
NO_2-NO_3 – as N	353.3	0.02 ppm
TKN	351.2	0.05 ppm
Total Phosphorus	365.4	0.05 ppm

Table 4
Volatile Organic Analysis
EPA METHOD 5030B, 8260B

PARAMETER	PQL (ppb)
Dichlorofluoromethane	5
Chlormethane	2
Vinyl chloride	2
Bromomethane	2
Chloroethane	2
Trichlorofluoromethane	5
1,1-Dichloroethene	2
Methylene chloride	2
trans-1,2-Dichloroethene	2
Methyl-t-butyl ether	2
1,1-Dichloroethane	2
2,2 Dichloropropane	2
cis-1,2 Dichloroethene	2
Bromochloromethane	2
Chloroform	2
1,1,1-Trichloroethane	2
1,1 Dichloropropene	2
Carbon tetrachloride	2
Benzene	2
1,2-Dichloroethane	2
Trichloroethene	2
1,2-Dichloropropane	2
Bromodichloromethane	2
Dibromomethane	2
cis-1,3-Dichloropropene	2
Toluene	2
trans-1,3-Dichloropropene	2
1,1,2-Trichloroethane	2
1,3--Dichloropropane	2
Tetrachloroethene	2
1,2-Dibromoethane	2
Dibromochloromethane	2
Chlorobenzene	2
Ethylbenzene	2
1,1,1,2-Tetrachloroethane	2
p&m Xylene	4
o-Xylene	2
Styrene	2
Bromoform	2

Table 4 (Cont'd)
Volatile Organic Analysis

PARAMETER	PQL (ppb)
Isopropylbenzene	2
1,1,2,2-Tetrachloromethane	2
1,2,3,-Trichloropropane	2
Bromobenzene	2
n-Propylbenzene	2
2-Chlorotoluene	2
4-Chlorotoluene	2
1,3,5-Trimethylbenzene	2
tert-Butylbenzene	2
1,2,4-Trimethylbenzene	2
sec-Butylbenzene	2
p-Isopropyltoluene	2
1,3-Dichlorobenzene	2
1,4-Dichlorobenzene	2
n-Butylbenzene	2
1,2-Dibromo-3-chloropropane	2
Naphthalene	2
1,2,4-Trichlorobenzene	2
Hexachlorobutadiene	2
1,2-Dichlorobenzene	2
1,2,3-Trichlorobenzene	2

Table 5
Semivolatile Organic Analysis
EPA METHOD 8270C

PARAMETER	PQL (ppb)
N-Nitrosodimethylamine	10
2-Picoline	10
Methyl methanesulfonate	10
Ethyl methanesulfonate	20
Phenol	10
Aniline	10
Bis(2-chloroethyl)ether	10
2-Chlorophenol	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
Benzyl alcohol	10
1,2-Dichlorobenzene	10
2-Methylphenol	10
Bis(2-chloroisopropyl)ether	10
4-Methylphenol	10
N-Nitroso-di-n-propylamine	10
Hexachloroethane	20
Acetophenone	10
Nitrobenzene	10
N-Nitrosopiperidine	20
Isophorone	10
2,4-Dimethylphenol	10
2-Nitrophenol	10
Benzoic acid	50
Bis(2-chloroethoxy)methane	10
2,4-Dichlorophenol	10
a,a-Dimethylphenethylamine	10
1,2,4-trichlorobenzene	10
Benzidine	50
Pyrene	10
p-Dimethylaminoazobenzene	10
Butylbenzylphthalate	10
Bis(2-ethylhexyl)phthalate	10

Table 5 (Cont'd)
Semivolatile Organic Analysis

PARAMETER	PQL (ppb)
3,3'-Dichlorobenzidine	20
Benzo(a)anthracene	10
Chrysene	10
Di-n-octylphthalate	10
7,12-Dimetnylbenz(a)anthracine	10
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	10
Benzo(a)pyrene	10
3-Methylcholanthrene	10
Dibenz(a,j)acridine	10
Indeno(1,2,3-cd)pyrene	10
Dibenz(a,h)anthracene	10
Benzo(g,h,i)perylene	10
Napthalene	10
4-Chloroaniline	10
2,6-Dichlorophenol	10
Hexachlorobutadiene	10
N-Nitrose-di-n-butylamine	10
4-Chloro-3-methylphenol	20
2-Methylnapthalene	10
Hexachlorocyclopentadiene	10
1,2,4,5-Tetrachlorobenzene	10
2,4,6-Trichlorophenol	10
2,4,5-Trichlorophenol	10
2-Chloronapthalene	10
1-Chloronapthalene	10
2-Nitroaniline	50
Dimethylphthalate	10
2,6-Dinitrotoluene	10
Acenaphthylene	10
3-Nitroaniline	50
4-Nitrophenol	50
2,4-Dinitrophenol	50
Acenaphthene	10

Table 5 (Cont'd)
Semivolatile Organic Analysis

PARAMETER	PQL (PPB)
2,4-Dinitrotoluene	10
Pentachlorobenzene	10
Dibenzofuran	10
1-Naphthylamine	10
Diethylphthalate	10
2,3,4,6-Tetrachlorophenol	10
2-Naphthylamine	10
4-Chlorophenyl phenyl ether	10
4-Nitroaniline	50
Fluorene	10
4,6-Dinitro-2-methylphenol	50
4-Aminobiphenyl	20
1,2-Diphenylhydrazine	10
Phenacetin	20
4-Bromophenyl phenyl ether	10
Hexachlorobenzene	10
Pronamide	10
N-Nitrosodiphenylamine/Diphenylamine	10
Pentachlorophenol	50
Pentachloronitrobenzene	20
Phenathrene	10
Anthracene	10
Di-n-butylphthalate	10
Fluoranthene	10

Table 6
Pesticides
EPA METHOD 8270C

PARAMETER	PQL (PPB)
Alpha BHC	2
Beta BHC	2
Gamma BHC	2
Delta BHC	2
Heptachlor	2
Aldrin	2
Heptachlor epoxide	2
Chlordane	2
Endosulfan I	2
4,4'-DDE	2
Dieldrin	2
4,4'DDD	2
Endrin	2
Toxaphene	2
Endosulfan II	2
Endrin Aldehyde	2
4,4'DDT	2
Endosulfan Sulfate	2
Methoxychlor	2
Endrin Ketone	2

Table 7
PCBs
EPA METHOD 8270C

PARAMETERS	PQL (PPB)
PCB 1221/ PCB 1232	10
PCB 1016/ PCB 1242	10
PCB 1254	10
PCB 1248	10
PCB 1260	10

SUMMARY OF FINDINGS

BACKGROUND

This report summarizes the BMP sampling that occurred from July 1997 up to June 2000. 184 wells completed in fourteen different aquifers or aquifer systems were monitored. Table 8 on page 14 lists the aquifers or aquifer systems that were sampled, the month or months in which they were sampled, and the number of wells that were sampled in the aquifer each month. Table 9 on pages 15-18 contains a listing of all the wells, each well's owner, completed depth, use of produced water, and the aquifers they produce from. In order to preserve privacy, "Private Owner" is all that is listed for the well owner when a well is owned by a private citizen.

Table 10 on pages 19-20 lists the minimum and maximum sample results for the samples from each aquifer and aquifer system for field parameters, water quality parameters, and nutrients, as well as an average of these sample results. Table 11 on pages 21-22 lists the minimum and maximum metals values from each aquifer and aquifer system, as well as an average of the sample results.

A discussion of the findings for each aquifer begins on page 23. For each aquifer or aquifer system, the geology and hydrogeology is discussed and an interpretation of the laboratory analyses is given. The lab analysis interpretation is accomplished by evaluating the general water quality and by comparing the historical data averages with the current data averages to detect changes in water quality over time. The general water quality is evaluated by comparing individual parameters to federal drinking water standards to assess the aquifer's use as a drinking water source, by taking into account whether or not volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were detected, and by taking into account the findings for pH, total dissolved solids (TDS), hardness, chloride, iron, and nitrite-nitrate.

It should be noted that all statements about hardness in the aquifer sections are based on the following scale.

Soft	<50 parts per million (ppm)
Moderately hard	50-150 ppm
Hard	150-300 ppm
Very hard	>300 ppm

A statewide summary of the findings and the summary statement begins on page 94.

Table 8
Aquifers and Number of Wells Sampled by Month

AQUIFER/SYSTEM	MONTH	NUMBER OF WELLS SAMPLED
State Fiscal Year 1998 (July 1997 – June 1998)		
Sparta	July	6
Sparta	August	7
Carrizo-Wilcox	September	6
Carrizo-Wilcox	October	6
Red River Alluvial	November	4
Evangeline	January	8
Catahoula	February	6
North Louisiana Terrace	March	6
North Louisiana Terrace	April	5
Carnahan Bayou	May	7
State Fiscal Year 1999 (July 1998 – June 1999)		
Mississippi River Alluvial	July	6
Mississippi River Alluvial	August	6
Mississippi River Alluvial	September	6
Mississippi River Alluvial	October	6
Cockfield	November	6
Cockfield	January	6
Chicot	February	8
Chicot	March	5
Chicot	April	6
Chicot	May	7
State Fiscal Year 2000 (July 1999 – June 2000)		
Williamson Creek	July	7
Chicot Equivalent	August	7
Chicot Equivalent	September	5
Chicot Equivalent	October	5
Chicot Equivalent	November	7
Evangeline Equivalent	January	7
Evangeline Equivalent	February	8
Jasper Equivalent	March	5
Jasper Equivalent	April	5
Jasper Equivalent	May	5

Table 9
Wells Sampled

WELL NUMBER	OWNER	DEPTH (FEET)	WELL USE	AQUIFER
BI-192	Lucky Water System	153	Public Supply	Sparta
BI-212	Stone Container Corp.	490	Industrial	Sparta
CA-105	Vixen Water System	525	Public Supply	Sparta
CL-171	Arcadia Refining Co.	559	Industrial	Sparta
L-31	City of Ruston	636	Public Supply	Sparta
L-32	City of Ruston	652	Public Supply	Sparta
MO-253	Village of Collinston	773	Public Supply	Sparta
OU-506	Angus Chemical	506	Industrial	Sparta
OU-597	Riverwood International	710	Industrial	Sparta
UN-205	D'Arbonne Water System	725	Public Supply	Sparta
W-165	Town of Winnfield	456	Public Supply	Sparta
WB-241	Town of Springhill	408	Public Supply	Sparta
WB-269	City of Minden	280	Public Supply	Sparta
BI-236	Alberta Water System	410	Public Supply	Carrizo-Wilcox
BO-233	Calumet Refinery	80	Industrial	Carrizo-Wilcox
BO-275	Village Water System	308	Public Supply	Carrizo-Wilcox
CD-453	City of Vivian	228	Public Supply	Carrizo-Wilcox
CD-630	Private Owner	240	Irrigation	Carrizo-Wilcox
CD-639	Box Company	200	Industrial	Carrizo-Wilcox
CD-642	Louisiana Lift	210	Industrial	Carrizo-Wilcox
DS-327	City of Mansfield	243	Public Supply	Carrizo-Wilcox
DS-363	City of Mansfield	280	Public Supply	Carrizo-Wilcox
RR-5070Z	Private Owner	105	Domestic	Carrizo-Wilcox
SA-502	Private Owner	213	Irrigation	Carrizo-Wilcox
SA-534	Boise Cascade	543	Industrial	Carrizo-Wilcox
CD-376	G. S. Roofing	80	Industrial	Red River Alluvial
CD-586	Private Owner	60	Irrigation	Red River Alluvial
G-79	Private Owner	110	Irrigation	Red River Alluvial
NA-47	Private Owner	80	Irrigation	Red River Alluvial
AL-120	City of Oakdale	910	Public Supply	Evangeline
AL-363	West Allen Parish Water Dist.	1715	Public Supply	Evangeline
AV-441	Town of Evergreen	319	Public Supply	Evangeline
BE-410	Boise Cascade	474	Industrial	Evangeline
BE-512	Singer Water District	918	Public Supply	Evangeline
EV-858	Savoy Swords Water System	472	Public Supply	Evangeline
R-1350	Private Owner	180	Irrigation	Evangeline
V-5065Z	Private Owner	170	Domestic	Evangeline
CT-119	City of Jonesville	800	Public Supply	Catahoula
G-295	Pollock Area Water System	188	Public Supply	Catahoula
G-WELLAN	Private Owner	Unknown	Domestic	Catahoula
LS-278	Rogers Water System	352	Public Supply	Catahoula
SA-442	Sabine River Authority	210	Public Supply	Catahoula
V-656	East Central Vernon Water Sys.	1477	Public Supply	Catahoula

WELL NUMBER	OWNER	DEPTH (FEET)	WELL USE	AQUIFER
BI-208	Private Owner	100	Domestic	N. La Terrace
BO-340	Village Water System	91	Public Supply	N. La Terrace
BO-434	Red Chute Utilities	94	Public Supply	N. La Terrace
BO-5382Z	Private Owner	95	Domestic	N. La Terrace
G-342	Farmland Ind., Inc.	49	Industrial	N. La Terrace
G-432	Central Grant Water System	158	Public Supply	N. La Terrace
LS-264	City of Jena	105	Public Supply	N. La Terrace
MO-124	Texas Gas	133	Industrial	N. La Terrace
MO-364	Peoples Water System	154	Public Supply	N. La Terrace
OU-184	Columbian Chemicals	105	Industrial	N. La Terrace
RR-254	East Cross Water System	93	Public Supply	N. La Terrace
BE-405	Boise Cascade	1016	Industrial	Carnahan Bayou
CO-71	Concordia W.W. Dist. No.1	305	Public Supply	Carnahan Bayou
G-5061Z	Private Owner	275	Domestic	Carnahan Bayou
R-1001	Gardner Water System	1080	Public Supply	Carnahan Bayou
R-1210	City of Alexandria	2036	Public Supply	Carnahan Bayou
V-496	U.S. Army/Fort Polk	1415	Public Supply	Carnahan Bayou
V-566	Hutton Volunteer Fire Dept.	143	Public Supply	Carnahan Bayou
AV-5135Z	Private Owner	110	Domestic	Miss. River Alluvial
AV-CHAT	Private Owner	75	Irrigation	Miss. River Alluvial
AV-DELTA	Private Owner	135	Irrigation	Miss. River Alluvial
CO-47	City of Vidalia	310	Public Supply	Miss. River Alluvial
CO-YAKEY	Private Owner	150	Domestic	Miss. River Alluvial
CT-241	Private Owner	134	Irrigation	Miss. River Alluvial
CT-DENNIS	Private Owner	30	Domestic	Miss. River Alluvial
EB-885	Private Owner	352	Irrigation	Miss. River Alluvial
EC-370	Private Owner	119	Irrigation	Miss. River Alluvial
FR-368	City of Winnsboro	79	Public Supply	Miss. River Alluvial
IB-289	Iberville Wtr. Dist. #2	209	Public Supply	Miss. River Alluvial
IB-5427Z	Private Owner	160	Domestic	Miss. River Alluvial
IB-COM	Private Owner	185	Domestic	Miss. River Alluvial
MA-28	Peoples Water Service	128	Public Supply	Miss. River Alluvial
MO-871	Private Owner	80	Irrigation	Miss. River Alluvial
OU-134	Private Owner	74	Irrigation	Miss. River Alluvial
RI-469	Liddieville Water System	90	Public Supply	Miss. River Alluvial
RI-48	Rayville Water Department	115	Public Supply	Miss. River Alluvial
SL-5477Z	Private Owner	110	Domestic	Miss. River Alluvial
SMN-33	LDOTD/Lafayette District	125	Public Supply	Miss. River Alluvial
TS-60	Town of St. Joseph	140	Public Supply	Miss. River Alluvial
TS-FORTENB	Private Owner	Unknown	Domestic	Miss. River Alluvial
WC-91	N.E.W. Carroll Wtr. Assn.	110	Public Supply	Miss. River Alluvial
WC-BRAN	Private Owner	80	Irrigation	Miss. River Alluvial
CA-129	City of Columbia	266	Public Supply	Cockfield
EC-233	Town of Lake Providence	371	Public Supply	Cockfield
JA-207	Private Owner	91	Irrigation	Cockfield

WELL NUMBER	OWNER	DEPTH (FEET)	WELL USE	AQUIFER
MO-479	Bayou Bonne Idee Water System	258	Public Supply	Cockfield
RI-127	Delhi Water Works	416	Public Supply	Cockfield
RI-246	Start Water System	190	Public Supply	Cockfield
SA-495	Glenwood Volunteer Fire Dept.	111	Public Supply	Cockfield
UN-167	Private Owner	110	Irrigation	Cockfield
W-192	Red Hill Water System	210	Public Supply	Cockfield
W-198	Atlanta Water System	445	Public Supply	Cockfield
W-5099Z	Private Owner	138	Domestic	Cockfield
WC-487	Town of Oak Grove	396	Public Supply	Cockfield
AC-539	City of Rayne	251	Public Supply	Chicot
AC-6919Z	Private Owner	Unknown	Irrigation	Chicot
AL-141	Town of Oberlin	155	Public Supply	Chicot
BE-378	Transcontinental Pipeline Gas	172	Industrial	Chicot
BE-412	Boise Cascade	202	Industrial	Chicot
BE-486	East Beauregard High School	150	Public Supply	Chicot
BE-488	Singer Water District	262	Public Supply	Chicot
CN-92	USGS	443	Observation	Chicot
CU-1023	PPG Industries	701	Industrial	Chicot
CU-1060	PPG Industries	200	Public Supply	Chicot
CU-1125	LDOTD	570	Public Supply	Chicot
CU-699	CITGO Petroleum Refining	530	Industrial	Chicot
CU-770	USGS	490	Observation	Chicot
CU-869	PPG Industries	526	Industrial	Chicot
EV-5314Z	Private Owner	180	Domestic	Chicot
I-5050Z	Private Owner	188	Domestic	Chicot
JD-363	City of Welsh	237	Public Supply	Chicot
LF-572	City of Lafayette	570	Public Supply	Chicot
R-5428Z	Private Owner	85	Domestic	Chicot
SL-392	USGS	126	Observation	Chicot
SMN-109	USGS	375	Observation	Chicot
V-535	Marlow Fire Station	66	Public Supply	Chicot
VE-650	USGS	205	Observation	Chicot
VE-6936Z	Private Owner	125	Domestic	Chicot
VE-862	Town of Gueydan	249	Public Supply	Chicot
VE-882	City of Kaplan	279	Public Supply	Chicot
BE-407	Boise Cascade	1657	Industrial	Williamson Creek
CO-163	U. S. Army Corps. Of Eng.	513	Public Supply	Williamson Creek
R-1172	CLECO-Rodemacher	298	Power Generation	Williamson Creek
R-867	International Paper Co.	385	Industrial	Williamson Creek
R-932	City of Alexandria	466	Public Supply	Williamson Creek
V-420	U.S. Army/Fort Polk	920	Public Supply	Williamson Creek
V-5858Z	Private Owner	248	Domestic	Williamson Creek
AN-266	City of Gonzales	548	Public Supply	Chicot Equivalent
AN-296	Uniroyal Chemical Co.	300	Industrial	Chicot Equivalent
AN-316	Borden Chemical and Plastics	478	Industrial	Chicot Equivalent

WELL NUMBER	OWNER	DEPTH (FEET)	WELL USE	AQUIFER
AN-321	Rubicon, Inc.	523	Industrial	Chicot Equivalent
AN-333	Capital Utilities	645	Public Supply	Chicot Equivalent
AN-337	BASF Corp.	459	Public Supply	Chicot Equivalent
AN-500	Uniroyal Chemical Co.	480	Industrial	Chicot Equivalent
AN-6297Z	Vulcan Chemical	294	Monitor	Chicot Equivalent
EB-1231	Georgia Pacific Corp.	280	Industrial	Chicot Equivalent
EB-34	Exxon USA	453	Industrial	Chicot Equivalent
EB-991B	Baton Rouge Water Works	565	Public Supply	Chicot Equivalent
EF-184	Private Owner	88	Domestic	Chicot Equivalent
JF-28	Entergy	807	Industrial	Chicot Equivalent
LI-5477Z	Private Owner	106	Domestic	Chicot Equivalent
LI-85	French Settlement Water Sys.	405	Public Supply	Chicot Equivalent
OR-61	Entergy (A.B. Patterson Sub-Sta.)	653	Power Generation	Chicot Equivalent
SC-179	Union Carbide	460	Industrial	Chicot Equivalent
SH-77	TRANSCO	170	Public Supply	Chicot Equivalent
SJ-226	La Roche Chemical	248	Industrial	Chicot Equivalent
SJB-175	E.I. Dupont	422	Industrial	Chicot Equivalent
ST-5245Z	Private Owner	90	Domestic	Chicot Equivalent
TA-520	Private Owner	135	Irrigation	Chicot Equivalent
WA-5295Z	Private Owner	100	Domestic	Chicot Equivalent
WA-5311Z	Private Owner	90	Domestic	Chicot Equivalent
AV-5304Z	Private Owner	547	Domestic	Evangeline Equivalent
EB-1003	Baton Rouge Water Works	1430	Public Supply	Evangeline Equivalent
EF-5045Z	Private Owner	160	Domestic	Evangeline Equivalent
LI-299	Ward 2 Water District	1417	Public Supply	Evangeline Equivalent
PC-325	Alma Plantation Ltd.	1252	Industrial	Evangeline Equivalent
SL-679	Valero Energy Corporation	1152	Industrial	Evangeline Equivalent
ST-532	SE Louisiana State Hospital	1520	Public Supply	Evangeline Equivalent
ST-6711Z	Private Owner	860	Domestic	Evangeline Equivalent
TA-284	City of Ponchatoula	608	Public Supply	Evangeline Equivalent
TA-286	Town of Kentwood	640	Public Supply	Evangeline Equivalent
TA-6677Z	Private Owner	495	Domestic	Evangeline Equivalent
WA-241	Private Owner	400	Irrigation	Evangeline Equivalent
WA-5210Z	Private Owner	752	Domestic	Evangeline Equivalent
WBR-181	Port of Greater Baton Rouge	1900	Industrial	Evangeline Equivalent
WF-DELEE	Private Owner	240	Domestic	Evangeline Equivalent
EB-630	Baton Rouge Water Co.	2253	Public Supply	Jasper Equivalent
EB-770	City of Zachary	2080	Public Supply	Jasper Equivalent
EF-272	La. War Vets Home	1325	Public Supply	Jasper Equivalent
LI-185	City of Denham Springs	2610	Public Supply	Jasper Equivalent
LI-229	Ward 2 Water District	1826	Public Supply	Jasper Equivalent
LI-257	Village of Albany	1842	Public Supply	Jasper Equivalent
PC-275	Private Owner	1912	Domestic	Jasper Equivalent
SH-104	Cal Maine Foods	1652	Industrial	Jasper Equivalent
ST-763	LDOTD	2230	Public Supply	Jasper Equivalent

WELL NUMBER	OWNER	DEPTH (FEET)	WELL USE	AQUIFER
ST-995	Private Owner	2290	Irrigation	Jasper Equivalent
ST-FOLSOM	Village of Folsom	2265	Public Supply	Jasper Equivalent
TA-560	Town of Roseland	2032	Public Supply	Jasper Equivalent
TA-826	City of Ponchatoula	2015	Public Supply	Jasper Equivalent
WA-248	Town of Franklinton	2700	Public Supply	Jasper Equivalent
WF-264	W. Feliciana Parish Utilities	960	Public Supply	Jasper Equivalent

Table 10
Field, Water Quality, & Nutrients Data Summary by Aquifer/Aquifer System

	FIELD PARAMETERS				LABORATORY PARAMETERS													
	pH SU	**Temp ^{0}C**	**Cond mmhos /cm**	**Salinity ppt**	**TSS ppm**	**TDS ppm**	**Alk ppm**	**Hardness ppm**	**Turbidity NTU**	**Cond umhos /cm**	**Color PCU**	**Chloride ppm**	**Sulfate ppm**	**Nitrite-Nitrate ppm**	**Phosphorus ppm**	**TKN ppm**	**TOC ppm**	**Ammonia ppm**
Laboratory Detection Limits					4	4	0.1	5	1	1	1	1.25	1.25	0.02	0.05	0.05	4	0.1
SPARTA AQUIFER																		
Min	5.24	20.56	0.031	0.01	<4	51.9	4.3	<5	<1	31.3	5.0	1.9	<1.25	0.02	<0.05	0.11	<4	<0.1
Max	8.89	26.74	2.000	1.01	<4	1142.0	566.0	48.7	4.90	2096.0	70.0	410.0	28.90	1.64	0.98	1.14	24.00	1.00
Avg	7.76	23.65	0.654	0.32	<4	442.7	203.2	10.0	2.21	687.7	21.7	89.0	8.21	0.32	0.31	0.52	5.54	0.46
CARRIZO-WILCOX AQUIFER																		
Min	6.23	18.78	0.192	0.09	<4	138.0	29.2	<5	<1	202.0	5.0	12.6	<1.25	0.02	<0.05	0.11	<4	<0.1
Max	8.49	23.71	1.203	0.60	36.0	702.0	614.0	138.0	45.00	1262.0	50.0	186.0	161.00	0.57	0.95	1.48	5.90	1.20
Avg	7.77	21.45	0.779	0.38	4.6	464.4	279.7	37.3	4.69	820.8	16.8	72.1	28.88	0.07	0.30	0.98	<4	0.66
RED RIVER ALLUVIAL AQUIFER																		
Min	6.64	19.39	0.808	0.40	6.0	526.0	446.0	385.0	50.00	834.0	5.0	14.2	<1.25	0.03	0.23	0.43	<4	0.30
Max	6.81	20.91	1.396	0.70	28.0	930.0	578.0	657.0	100.00	1424.0	5.0	75.5	189.00	0.03	0.71	2.21	5.60	1.00
Avg	6.72	20.08	1.168	0.58	17.2	759.6	516.4	581.8	64.00	1200.8	5.0	51.6	81.32	0.03	0.42	1.15	<4	0.73
EVANGELINE AQUIFER																		
Min	5.08	19.76	0.071	0.03	<4	126.0	24.0	<5	<1	76.5	<5	3.7	<1.25	<0.02	0.09	<0.05	<4	<0.1
Max	8.50	27.60	1.075	0.53	<4	704.0	433.0	42.4	1.20	1128.0	20.0	105.0	6.80	0.09	0.25	0.69	5.70	0.40
Avg	7.08	22.87	0.499	0.21	<4	324.8	192.8	11.1	<1	453.8	6.9	27.0	4.40	0.03	0.15	0.16	<4	0.16
CATAHOULA AQUIFER																		
Min	5.50	19.67	0.075	0.03	<4	176.0	27.3	<5	<1	85.4	5.0	3.9	<1.25	0.02	0.05	<0.05	<4	<0.1
Max	7.08	29.19	0.440	0.21	8.0	390.0	176.0	5.3	1.90	502.0	5.0	48.2	14.10	0.03	0.59	0.46	6.30	0.40
Avg	6.31	22.45	0.230	0.11	5.7	265.4	109.6	<5	<1	268.5	5.0	14.7	4.56	0.02	0.22	0.18	<4	0.16
NORTH LOUISIANA TERRACE AQUIFER																		
Min	4.98	16.65	0.042	0.02	<4	34.0	<0.1	5.0	<1	42.2	5.0	3.4	<1.25	<0.02	<0.05	0.12	<4	<0.1
Max	7.13	19.92	1.095	0.55	16.0	816.0	234.0	445.0	120.00	1124.0	10.0	83.9	390.00	5.34	0.58	1.09	<4	0.76
Avg	5.78	19.03	0.258	0.13	<4	190.2	61.5	68.1	10.18	261.4	6.5	21.9	34.85	1.20	0.13	0.36	<4	0.25
CARNAHAN BAYOU AQUIFER																		
Min	5.95	20.12	0.206	0.10	<4	190.0	60.6	<5	<1	218.0	5.0	4.4	<1.25	0.08	0.06	0.36	<4	<0.1
Max	7.88	29.65	0.675	0.33	<4	402.0	355.0	260.0	45.00	698.0	20.0	22.6	21.20	2.17	0.67	1.04	<4	0.82
Avg	7.21	25.43	0.379	0.18	<4	239.5	184.3	57.1	8.89	395.5	8.1	11.7	9.24	0.36	0.28	0.59	<4	0.35

	FIELD PARAMETERS				LABORATORY PARAMETERS													
	pH SU	Temp ^{0}C	Cond mmhos /cm	Salinity ppt	TSS ppm	TDS ppm	Alk ppm	Hardness ppm	Turbidity NTU	Cond umhos /cm	Color PCU	Chloride ppm	Sulfate ppm	Nitrite-Nitrate ppm	Phosphorus ppm	TKN ppm	TOC ppm	Ammonia ppm
Laboratory Detection Limits					4	4	0.1	5	1	1	1	1.25	1.25	0.02	0.05	0.05	4	0.1
MISSISSIPPI RIVER ALLUVIAL AQUIFER																		
Min	5.76	18.94	0.203	0.10	<4	175.0	57.7	69.5	<1	211.0	<5	<1.25	<1.25	<0.02	<0.05	<0.05	<4	0.10
Max	7.29	24.04	1.575	0.79	60.0	1073.0	542.0	550.0	250.00	1612.0	30.0	245.0	296.00	3.08	1.89	7.17	9.70	6.53
Avg	6.64	20.42	0.789	0.39	14.0	497.1	323.9	313.1	56.36	812.8	15.1	60.8	24.41	0.26	0.50	1.35	4.39	0.94
COCKFIELD AQUIFER																		
Min	5.37	16.76	0.091	0.04	<4	90.0	9.7	<5	1.30	93.8	5.0	7.6	<1.25	<0.02	<0.05	0.06	<4	<0.1
Max	8.44	22.13	0.939	0.47	10.5	648.0	376.0	246.0	39.00	1021.0	30.0	150.0	225.00	0.65	4.15	3.06	7.90	2.65
Avg	6.97	19.76	0.603	0.29	<4	420.6	222.2	85.3	9.64	607.9	11.7	49.9	34.14	0.07	0.55	0.67	<4	0.48
CHICOT AQUIFER																		
Min	6.48	20.82	0.322	0.15	<4	14.0	7.9	<5	<1	23.8	<5	3.1	<1.25	<0.02	0.05	<0.05	<4	<0.1
Max	7.76	28.83	1.725	0.87	32.0	1082.0	439.0	295.0	110.00	1744.0	50.0	415.0	30.60	0.07	0.45	3.01	8.50	2.07
Avg	7.02	23.12	0.631	0.32	5.2	346.2	184.4	120.6	13.40	541.9	12.7	58.9	2.64	0.02	0.25	0.64	<4	0.33
WILLIAMSON CREEK AQUIFER																		
Min	7.12	16.94	0.240	0.11	<4	226.1	101.0	6.4	<1	250.0	<5	7.7	<1.25	<0.02	0.15	<0.05	NS	<0.1
Max	8.57	30.97	0.630	0.31	5.5	390.0	210.0	147.0	27.00	599.0	5.0	93.2	17.40	0.51	0.27	0.71	NS	0.48
Avg	7.83	22.22	0.422	0.20	<4	282.8	150.1	33.7	4.93	414.1	<5	40.9	5.71	0.11	0.20	0.43	NS	0.23
CHICOT EQUIVALENT AQUIFER SYSTEM																		
Min	5.36	17.84	0.023	0.01	<4	38.0	3.1	<5	<1	21.5	<5	3.0	<1.25	<0.02	<0.05	<0.05	NS	<0.1
Max	9.26	26.13	2.457	0.87	5.0	1267.0	442.0	183.0	19.00	2615.0	200.0	729.0	27.70	1.29	0.64	3.18	NS	2.34
Avg	7.20	21.91	0.648	0.29	<4	406.6	166.9	45.8	2.09	689.9	26.4	118.2	2.68	0.18	0.21	0.71	NS	0.51
EVANGELINE EQUIVALENT AQUIFER SYSTEM																		
Min	6.31	17.60	0.044	0.02	<4	32.0	16.7	<5	<1	46.3	<5	2.7	<1.25	<0.02	0.10	<0.05	NS	<0.1
Max	9.20	27.83	0.657	0.32	16.3	392.0	336.0	35.8	10.40	672.0	55.0	63.9	11.70	0.64	0.53	0.85	NS	0.29
Avg	8.02	22.73	0.244	0.12	<4	162.6	110.3	11.9	1.71	249.7	7.6	8.3	6.34	0.09	0.27	0.26	NS	0.11
JASPER EQUIVALENT AQUIFER SYSTEM																		
Min	ID	24.08	0.185	0.09	<4	160.0	85.2	<5	<1	189.2	<5	2.5	4.60	<0.02	0.14	<0.05	NS	<0.1
Max	ID	34.14	0.711	0.34	66.3	428.0	289.0	9.1	1.90	727.6	17.0	87.9	9.30	0.03	0.48	1.25	NS	0.75
Avg	ID	28.84	0.381	0.18	7.3	251.4	167.2	<5	<1	394.0	5.9	17.9	7.30	<0.02	0.28	0.47	NS	0.26

NS = Not Sampled
ID = Invalid Data

Table 11
Inorganic (Total Metals) Data Summary by Aquifer/Aquifer System

	Antimony ppb	Arsenic ppb	Barium ppb	Beryllium ppb	Cadmiuim ppb	Chromium ppb	Copper ppb	Iron ppb	Lead ppb	Mercury ppb	Nickel ppb	Selenium ppb	Silver ppb	Thallium ppb	Zinc ppb
Detection Limits	5	5	10	2	2	5	5	10	10	0.05	5	5	1	5	10
SPARTA AQUIFER															
Min	<5	<5	<10	<2	<2	<5	<5	16.70	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	<5	110.60	<2	<2	6.40	41.40	2057.00	28.50	0.25	10.90	<5	2.50	<5	111.00
Avg	<5	<5	30.68	<2	<2	<5	10.21	283.69	<10	<0.05	<5	<5	1.17	<5	20.79
CARRIZO-WILCOX AQUIFER															
Min	<5	<5	<10	<2	<2	<5	<5	10.00	<10	<0.05	<5	<5	1.00	<5	<10
Max	5.40	5.60	201.40	<2	2.50	<5	83.50	19700.0	<10	<0.05	8.90	<5	2.50	<5	723.60
Avg	<5	<5	67.12	<2	<2	<5	23.99	1637.44	<10	<0.05	<5	<5	1.11	<5	144.17
RED RIVER ALLUVIAL AQUIFER															
Min	<5	<5	14.30	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	1.00	<5	<10
Max	<5	<5	239.00	<2	2.50	9.00	4746.00	8014.00	10.00	<0.05	5197.0	<5	9.60	<5	<10
Avg	<5	<5	125.30	<2	<2	<5	968.04	4652.14	<10	<0.05	1041.4	<5	3.20	<5	<10
EVANGELINE AQUIFER															
Min		<5	<10	<2	<2	<5	28.30	10.00	<10	<0.05	<5	<5	1.00	<5	22.30
Max		<5	232.60	<2	<2	5.40	136.00	318.00	40.00	<0.05	<5	<5	2.50	<5	533.00
Avg		<5	41.40	<2	<2	<5	48.56	104.53	<10	<0.05	<5	<5	1.17	<5	106.63
CATAHOULA AQUIFER															
Min	<5	<5	<10	<2	<2	<5	<5	35.00	<10	<0.05	<5	<5	1.00	<5	14.30
Max	6.00	<5	394.00	<2	3.10	7.90	<5	845.00	<10	0.28	<5	<5	1.00	<5	153.00
Avg	<5	<5	63.57	<2	2.07	<5	<5	412.67	<10	0.06	<5	<5	1.00	<5	42.17
NORTH LOUISIANA TERRACE AQUIFER															
Min	<5	<5	10.90	<2	<2	<5	<5	10.00	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	5.00	501.00	2.40	<2	<5	372.00	15260.0	16.20	<0.05	6.80	<5	2.00	<5	333.00
Avg	<5	<5	87.98	<2	<2	<5	53.54	1137.56	<10	<0.05	<5	<5	<1	<5	42.12
CARNAHAN BAYOU AQUIFER															
Min	<5	<5	<10	<2	<2	<5	<5	36.90	<10	<0.05	<5	<5	<1	<5	19.40
Max	<5	<5	1017.0	2.50	<2	<5	88.90	3732.00	<10	<0.05	6.80	<5	3.60	<5	3470.0
Avg	<5	<5	249.93	<2	<2	<5	17.36	1185.50	<10	<0.05	<5	<5	<1	<5	473.01

	Antimony ppb	Arsenic ppb	Barium ppb	Beryllium ppb	Cadmiuim ppb	Chromium ppb	Copper ppb	Iron ppb	Lead ppb	Mercury ppb	Nickel ppb	Selenium ppb	Silver ppb	Thallium ppb	Zinc ppb
Detection Limits	5	5	10	2	2	5	5	10	10	0.05	5	5	1	5	10
MISSISSIPPI RIVER ALLUVIAL AQUIFER															
Min	<5	<5	32.50	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	81.80	1091.0	<2	<2	8.50	56.00	21339.0	<10	0.07	8.00	<5	2.50	<5	1758.0
Avg	<5	12.88	432.31	<2	<2	<5	7.91	4146.86	<10	<0.05	<5	<5	<1	<5	161.18
COCKFIELD AQUIFER															
Min	<5	<5	<10	<2	<2	<5	<5	56.70	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	5.00	352.00	<2	2.80	7.30	21.50	8049.00	16.20	2.50	6.70	<5	<1	<5	163.80
Avg	<5	<5	124.54	<2	<2	<5	5.73	1478.14	<10	0.19	<5	<5	<1	<5	36.01
CHICOT AQUIFER															
Min	<5	<5	<10	<2	<2	<5	<5	53.30	<10	<0.05	<5	<5	<1	<5	<10
Max	5.70	5.00	1056.0	2.50	<2	63.00	281.00	16867.0	54.70	<0.05	15.30	<5	1.00	<5	980.00
Avg	<5	<5	310.81	<2	<2	<5	31.53	1853.98	<10	<0.05	<5	<5	<1	<5	165.42
WILLIAMSON CREEK AQUIFER															
Min	<5	<5	16.10	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	<5	337.80	<2	<2	18.30	7.90	271.80	<10	<0.05	16.50	<5	1.10	<5	1160.0
Avg	<5	<5	127.56	<2	<2	<5	<5	104.79	<10	<0.05	<5	<5	<1	<5	189.19
CHICOT EQUIVALENT AQUIFER SYSTEM															
Min	<5	<5	<10	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	<1	<5	<10
Max	5.00	10.80	341.90	<2	3.70	<5	79.60	2418.00	32.20	0.43	10.20	<5	2.50	<5	283.00
Avg	<5	<5	128.96	<2	<2	<5	11.17	398.30	<10	0.06	<5	<5	<1	<5	36.54
EVANGELINE EQUIVALENT AQUIFER SYSTEM															
Min	<5	<5	<10	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	<5	107.90	<2	3.60	<5	35.70	8517.00	<10	0.05	<5	<5	<1	<5	1268.0
Avg	<5	<5	40.58	<2	<2	<5	7.60	942.37	<10	<0.05	<5	<5	<1	<5	177.41
JASPER EQUIVALENT AQUIFER SYSTEM															
Min	<5	<5	<10	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	<1	<5	<10
Max	<5	<5	35.30	<2	2.70	<5	190.00	67.60	15.50	<0.05	<5	9.30	2.50	<5	80.30
Avg	<5	<5	11.65	<2	<2	<5	14.01	28.25	<10	<0.05	<5	<5	<1	<5	22.92

SPARTA AQUIFER

Background

From July 1997, through August 1997, thirteen wells that produce from the Sparta aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in nine parishes in the north central part of the state. Figure 1 on page 27 illustrates the areal extent of the Sparta and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

The Sparta aquifer is recharged through direct infiltration of rainfall, the movement of water through overlying terrace and alluvial deposits, and leakage from the Cockfield and Carrizo-Wilcox aquifers. The Sparta is pumped in a large area of north central Louisiana and in a narrow band through Natchitoches and Sabine parishes. The two areas are separated by a saltwater ridge below the Red River valley. Ground water movement is eastward toward the Mississippi River Valley and southward toward the Gulf of Mexico, except when altered by heavy pumping, and the hydraulic conductivity varies between 25 to 100 feet/day.

The maximum depths of occurrence of freshwater in the Sparta range from 200 feet above sea level, to 1,700 feet below sea level. The range of thickness of the fresh water interval in the Sparta is 50 to 700 feet. The depths of the Sparta wells that were monitored in conjunction with the BMP range from 153 to 773 feet.

Interpretation of Laboratory Analyses

Table I-2, page 6, in Appendix 1, Part I, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Sparta. Table I-3, page 7, in Appendix 1, Part I, lists the metals data that were found for each well sampled in the Sparta. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary maximum contaminant levels (MCL) for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met, except for the benzene concentration found in one project well. WB-269 exhibited a value of 6.0 parts per billion (ppb) for benzene, which exceeds the primary MCL of 5.0 ppb.

A review of the laboratory analyses show that federal secondary drinking water standards for pH, TDS, color, chloride, and iron were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 1, Part I. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: The only confirmed occurrence of these parameters from the Sparta is the benzene concentration found in project well WB-269 that was mentioned above.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 12 below lists the minimum and maximum values that were found in the Sparta for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Sparta project well for these parameters are listed in Appendix 1, Part I, pages 6 and 7. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 15-18. The average for hardness shows the ground water to be soft.

Table 12

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.24	8.89	7.76
TDS (ppm)	51.9	1142.0	442.7
Hardness (ppm)	<5	48.7	10.0
Chloride (ppm)	1.9	410.0	89.0
Iron (ppb)	16.70	2057.00	283.69
Nitrite-Nitrate (ppm)	0.02	1.64	0.32

<u>Comparison to Historical Data</u>

Table 13 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Sparta that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Sparta aquifer. The data show that the current averages are consistent for the most part with the historical averages.

Table 13

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.42	7.76
Temperature (°C)	23.69	23.65
Conductivity (mmhos/cm)	0.658	0.654
Salinity (ppt)	0.30	0.32
TSS (ppm)	<4	<4
TDS (ppm)	375.1	442.7
Alkalinity (ppm)	202.9	203.2
Hardness (ppm)	22.2	10.0
Turbidity (NTU)	1.49	2.21
Conductivity (umhos/cm)	662.1	687.7
Color (PCU)	27.7	21.7
Chloride (ppm)	89.4	89.0
Sulfate (ppm)	6.89	8.21
Nitrite-Nitrate (ppm)	0.19	0.32
Phosphorus (ppm)	0.40	0.31
TKN (ppm)	0.44	0.52
TOC (ppm)	<4	5.54
Ammonia (ppm)	0.35	0.46

Table 14 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Sparta. The data show that the current averages are consistent for the most part with the historical averages.

Table 14

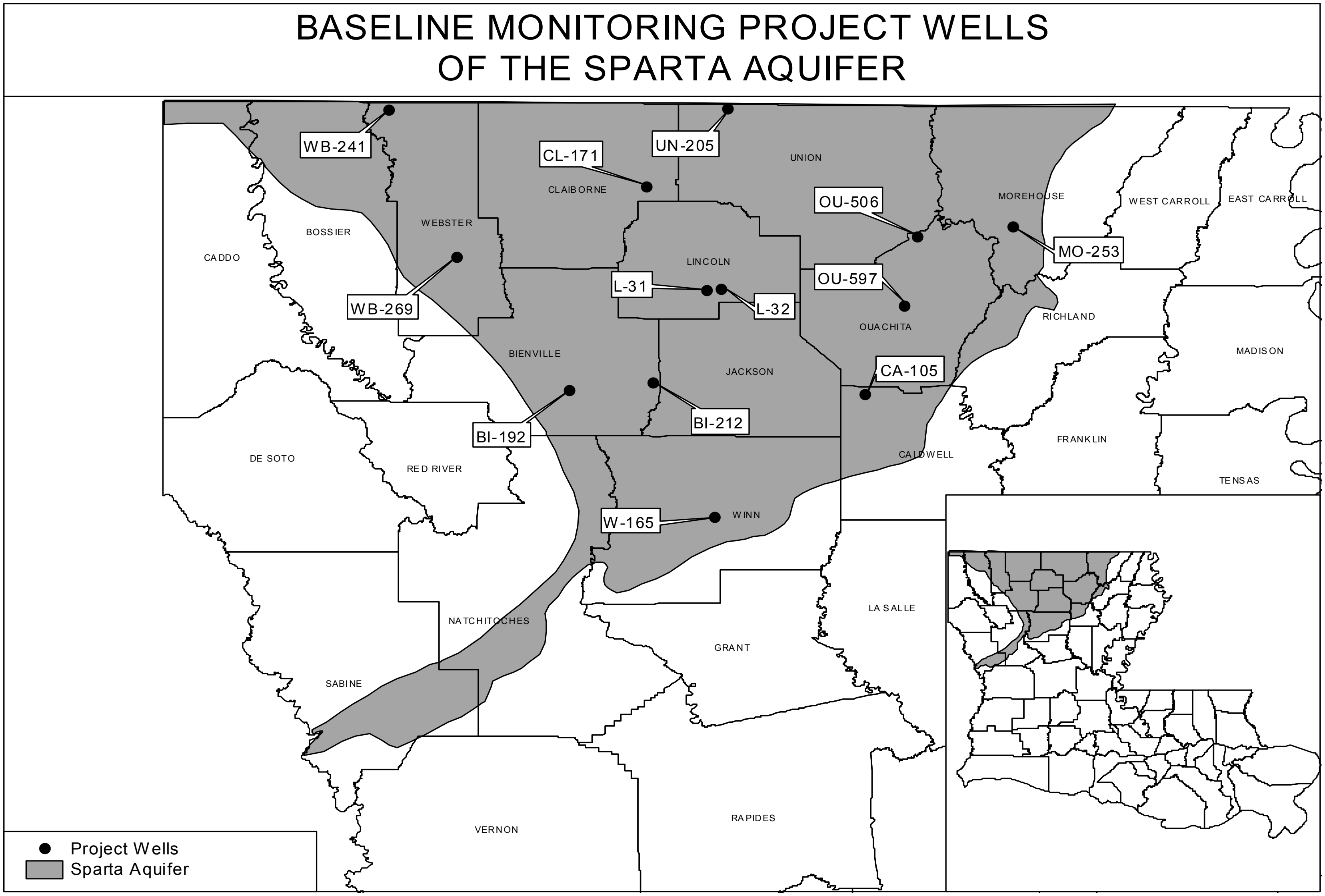
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	30.68	27.68
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	10.21	12.31
Iron (ppb)	283.69	242.1
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	5.49
Selenium (ppb)	<5	<5
Silver (ppb)	1.17	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	20.79	18.59

Summary and Conclusions

From July 1997, through August 1997, thirteen wells that produce from the Sparta aquifer were sampled as part of the regular BMP sampling rotation. One of the wells exhibited a benzene concentration of 6.0 ppb, which exceeds the primary MCL of 5.0 ppb. The well owner is aware of the benzene level and utilizes an air-stripper to treat the water prior to distribution. Additionally, the Remediation Services and Environmental Technology Divisions of LDEQ continue to address the situation. Federal secondary drinking water standards for pH, TDS, color, chloride, and iron were not met in certain wells, but no other secondary standard was exceeded. Benzene was the only volatile organic compound detected and no semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the current data averages with historical averages shows that the current averages are consistent for the most part with the historical averages.

The data from this sampling show that, with the exception of the benzene occurrence mentioned previously, water produced from the Sparta aquifer is of good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 1 Sparta Aquifer Map

CARRIZO-WILCOX AQUIFER

Background

From September through October 1997, twelve wells that produce from the Carrizo-Wilcox aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in six parishes in the northwest part of the state. Figure 2 on page 32 illustrates the areal extent of the Carrizo-Wilcox and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

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

The maximum depths of occurrence of freshwater in the Carrizo-Wilcox range from 200 feet above sea level, to 1,100 feet below sea level. The range of thickness of the fresh water interval in the Carrizo-Wilcox is 50 to 850 feet. The depths of the Carrizo-Wilcox wells that were monitored in conjunction with the BMP range from 80 to 543 feet.

Interpretation of Laboratory Analyses

Table II-2, page 5, in Appendix 1, Part II, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Carrizo-Wilcox. Table II-3, page 6, in Appendix 1, Part II, lists the metals data that were found for each well sampled in the Carrizo-Wilcox. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for pH, TDS, color, and iron were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 1, Part II. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: There was no confirmed occurrence of these parameters from the sampling of the Carrizo-Wilcox aquifer.

pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate: Table 15 below lists the minimum and maximum values that were found in the Carrizo-Wilcox for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Carrizo-Wilcox project well for these parameters are listed in Appendix 1, Part II, pages 5 and 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be soft.

Table 15

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	6.23	8.49	7.77
TDS (ppm)	138.0	702.0	464.4
Hardness (ppm)	<5	138.0	37.3
Chloride (ppm)	12.6	186.0	72.1
Iron (ppb)	10.00	19700.0	1637.44
Nitrite-Nitrate (ppm)	0.02	0.57	0.07

Comparison to Historical Data

Table 16 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Carrizo-Wilcox that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Carrizo-Wilcox aquifer. The data show that the current averages are consistent for the most part with the historical averages. Hardness decreased by 34.2 ppm, bringing the water from the moderately hard to the soft range. Chloride increased 4.6 ppm, which could account for some of the increase witnessed in the field conductivity (conductivity in mmhos/cm) and laboratory conductivity (conductivity in umhos/cm).

Table 16

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.73	7.77
Temperature (°C)	21.10	21.45
Conductivity (mmhos/cm)	0.730	0.779
Salinity (ppt)	0.37	0.38
TSS (ppm)	<4	4.6
TDS (ppm)	449.6	464.4
Alkalinity (ppm)	258.2	279.7
Hardness (ppm)	71.5	37.3
Turbidity (NTU)	2.95	4.69
Conductivity (umhos/cm)	777.5	820.8
Color (PCU)	23.7	16.8
Chloride (ppm)	67.5	72.1
Sulfate (ppm)	27.80	28.88
Nitrite-Nitrate (ppm)	0.06	0.07
Phosphorus (ppm)	0.33	0.30
TKN (ppm)	0.78	0.98
TOC (ppm)	<4	<4
Ammonia (ppm)	0.44	0.66

Table 17 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Carrizo-Wilcox. The data show that the current averages are consistent for the most part with the historical averages. Iron increased by 342.06 ppm, and zinc dropped 119.04 ppb from 144.17 ppb to 25.13 ppb.

Table 17

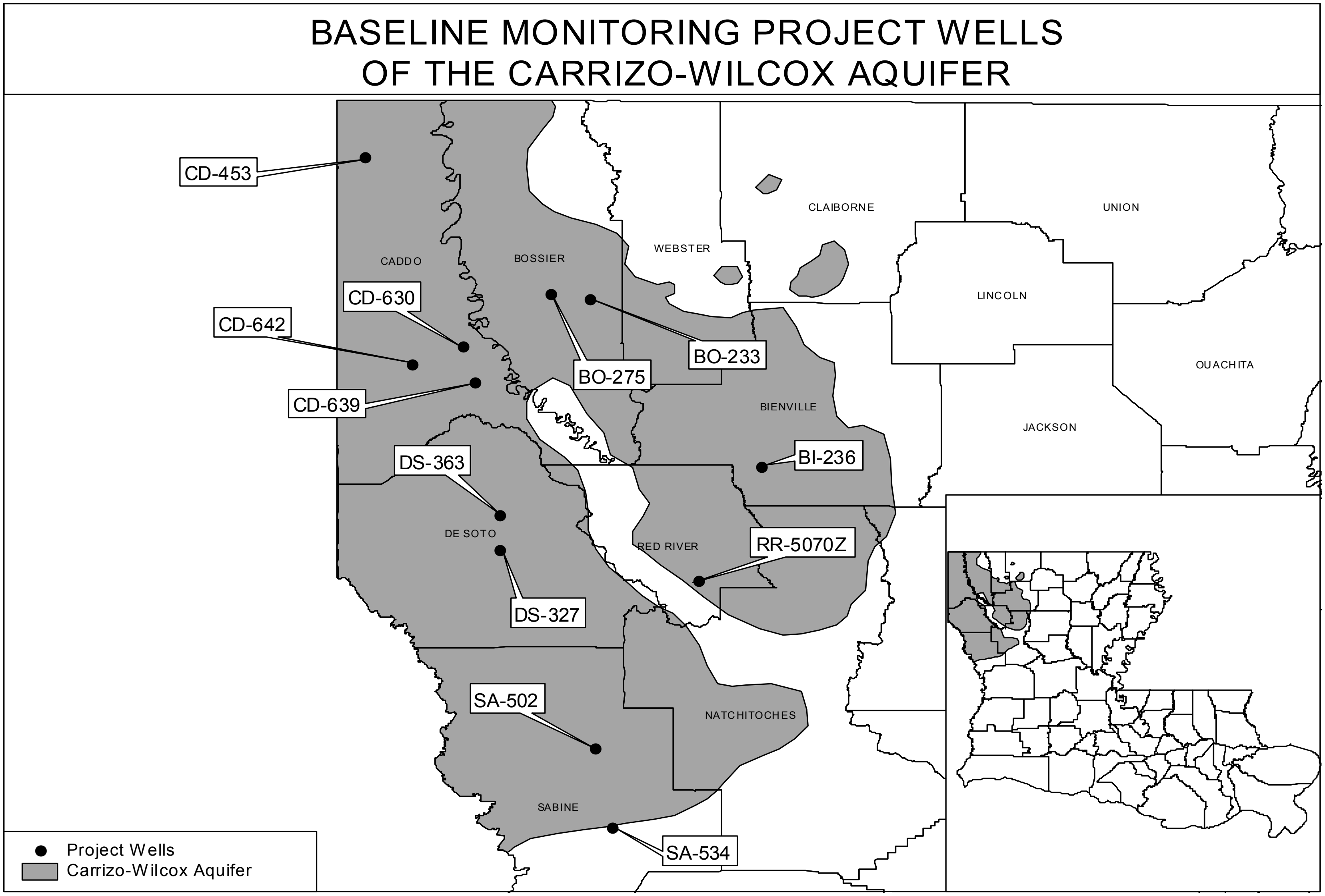
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	67.12	65.57
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	23.99	26.71
Iron (ppb)	1637.44	1979.50
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	11.89
Selenium (ppb)	<5	<5
Silver (ppb)	1.11	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	144.17	25.13

Summary and Conclusions

From September through October 1997, twelve wells that produce from the Carrizo-Wilcox aquifer were sampled as part of the regular BMP sampling rotation. None of the wells exceeded a federal primary standard. Federal secondary drinking water standards for pH, TDS, color, and iron were not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the current data averages with historical averages shows that the current averages are consistent for the most part with the historical averages. Hardness decreased by 34.2 ppm, bringing the water from the moderately hard to the soft range, and chloride increased by 4.6 ppm. Iron increased by 342.06 ppm, and zinc dropped 119.04 ppb from 144.17 ppb to 25.13 ppb.

The data from this sampling show that water produced from the Carrizo-Wilcox aquifer is of good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana. Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 2 Carrizo-Wilcox Aquifer Map

RED RIVER ALLUVIAL AQUIFER

Background

In November 1997, four wells that produce from the Red River Alluvial aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in four parishes from the central part of the state, following the Red River upstream to the northwest area of the state. Figure 3 on page 38 illustrates the areal extent of the Red River Alluvial and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

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

The maximum depths of occurrence of freshwater in the Red River Alluvial range from 20 feet above sea level, to 160 feet below sea level. The range of thickness of the fresh water interval in the Red River Alluvial is 50 to 200 feet. The depths of the Red River Alluvial wells that were monitored in conjunction with the BMP range from 60 to 110 feet.

Interpretation of Laboratory Analyses

Table III-2, page 6, in Appendix 1, Part III, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Red River Alluvial. Table III-3, page 7, in Appendix 1, Part III, lists the metals data that were found for each well sampled in the Red River Alluvial. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met, except for the nickel concentration found in one project well. At the time of sampling, nickel had a primary MCL of 100 ppb, and CD-586 exhibited a value of 5,197 ppb. However, the federal primary MCL for nickel has since been remanded.

A review of the laboratory analyses show that federal secondary drinking water standards for TDS, iron, and copper were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 1, Part III. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: There was no confirmed occurrence of these parameters from the sampling of the Red River Alluvial aquifer.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 18 below lists the minimum and maximum values that were found in the Red River Alluvial for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Red River Alluvial project well for these parameters are listed in Appendix 1, Part III, pages 6 and 7. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 15-18. The average for hardness shows the ground water to be very hard. It should be noted that the elevated levels of TDS and iron are characteristic of the ground water produced from the Red River Alluvial aquifer.

Table 18

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	6.64	6.81	6.72
TDS (ppm)	526.0	930.0	759.6
Hardness (ppm)	385.0	657.0	581.8
Chloride (ppm)	14.2	75.5	51.6
Iron (ppb)	<10	8014.00	4652.14
Nitrite-Nitrate (ppm)	0.03	0.03	0.03

<u>Comparison to Historical Data</u>

Table 19 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Red River Alluvial that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Red River Alluvial aquifer. The most notable changes are the 28.1 ppm decrease in sulfate and the 3.57 ppm decrease in TKN, otherwise the averages are consistent.

Table 19

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	6.65	6.72
Temperature (°C)	21.23	20.08
Conductivity (mmhos/cm)	1.201	1.168
Salinity (ppt)	0.58	0.58
TSS (ppm)	17.4	17.2
TDS (ppm)	787.6	759.6
Alkalinity (ppm)	510.8	516.4
Hardness (ppm)	550.4	581.8
Turbidity (NTU)	47.60	64.00
Conductivity (umhos/cm)	1200.2	1200.8
Color (PCU)	28.6	5.0
Chloride (ppm)	50.0	51.6
Sulfate (ppm)	109.42	81.32
Nitrite-Nitrate (ppm)	<0.02	0.03
Phosphorus (ppm)	0.67	0.42
TKN (ppm)	4.72	1.15
TOC (ppm)	<4	<4
Ammonia (ppm)	1.00	0.73

Table 20 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Red River Alluvial. The data show that barium decreased 222.48 ppb. Copper went from 22.76 ppb to 968.04 ppb, an increase which can be attributed to a high copper concentration found in project well NA-47. Nickel showed an increase of 997.56 ppb, an increase that can be attributed to a high nickel concentration found in project well CD-586. The high copper and nickel concentrations indicate bushing wear of the submersible pumps used in the two aforementioned wells, rather than copper and nickel contamination of the ground water. The copper concentration found in NA-47 also could indicate exposure and/or corrosion of the electrical wiring to the pump. Iron showed an increase in average of 1,648.46 ppb, while lead dropped from 33.30 ppb to below its quantifiable limit. Zinc also dropped below its quantifiable limit from an average of 180.10 ppb.

Table 20

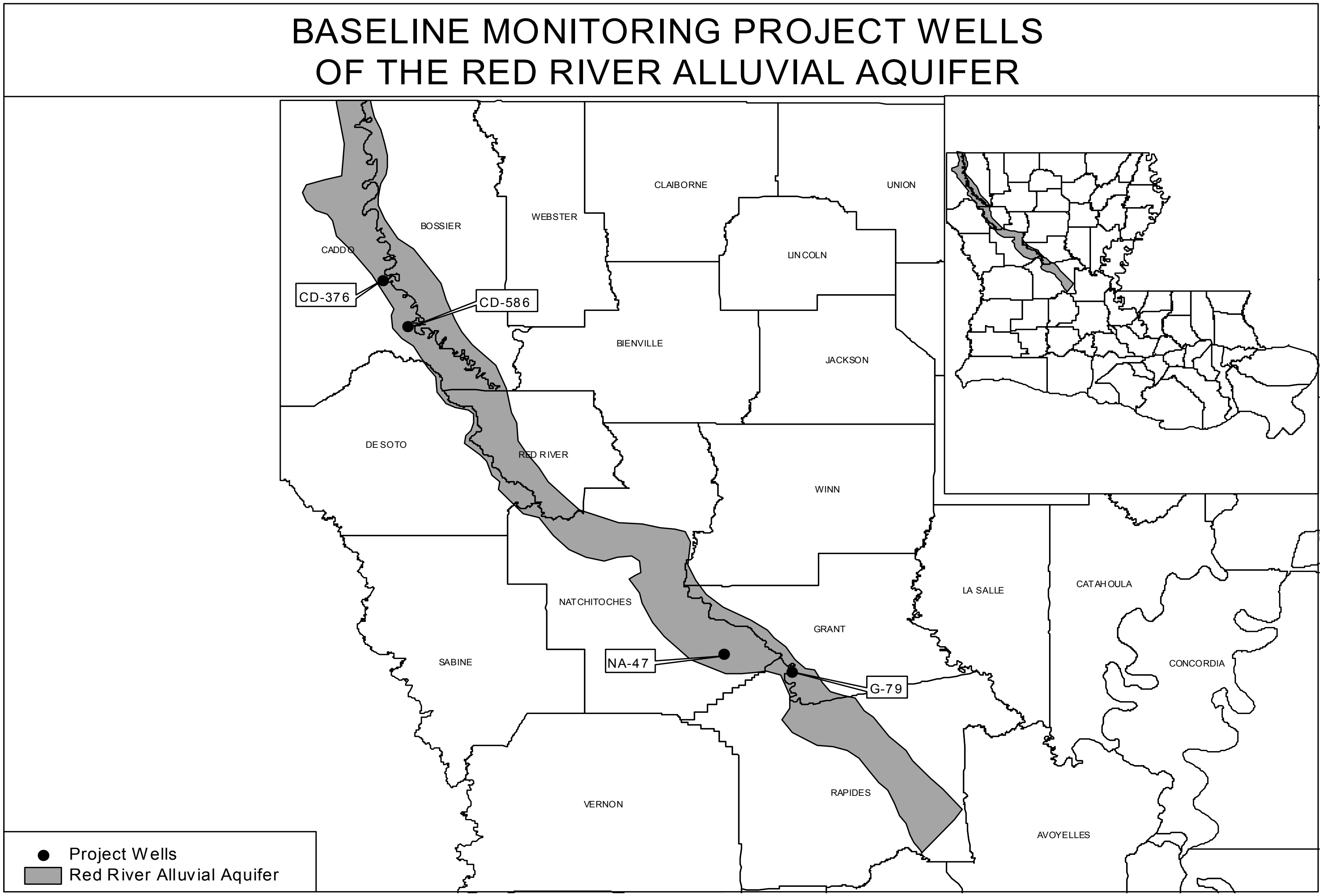
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	5.00	5.00
Barium (ppb)	347.78	125.30
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	12.40	<5
Copper (ppb)	22.76	968.04
Iron (ppb)	6300.60	4652.14
Lead (ppb)	33.30	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	43.84	1041.40
Selenium (ppb)	<5	<5
Silver (ppb)	<1	3.20
Thallium (ppb)	<5	<5
Zinc (ppb)	180.10	<10

Summary and Conclusions

In November 1997, five wells that produce from the Red River Alluvial aquifer were sampled as part of the regular BMP sampling rotation. One of the project wells exhibited a value of 5,197 ppb for nickel, which exceeded the primary MCL of 100 ppb that had been establish for nickel at that time. This MCL has since been remanded. Also, this high level of nickel tends to indicate a wear condition with the submersible pump in use for this well rather than nickel contamination of the aquifer at this location. Federal secondary drinking water standards for TDS, iron, and copper were not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The elevated levels found for TDS and iron are characteristic of the ground water produce from the Red River Alluvial aquifer. The average for hardness shows the ground water to be very hard.

A review of the historical and current averages for field parameters, water quality parameters, and nutrients shows the most notable changes to be the 28.1 ppm decrease in sulfate and the 3.57 ppm decrease in TKN, otherwise the averages are consistent. There were several changes noted in the comparison of the historical and current metals averages however. The data show that barium decreased 222.48 ppb, while copper and nickel increased 945.28 ppb and 997.56 ppb respectively. The copper increase can be attributed a high copper concentration found in project well NA-47. The nickel increase can be attributed to a high nickel concentration found in project well CD-586. These high copper and nickel concentrations indicate bushing wear of the submersible pumps used in the two aforementioned wells, rather than copper and nickel contamination of the ground water. The copper concentration found in NA-47 could also indicate exposure and/or corrosion of the electrical wiring to the pump. Iron showed an increase in average of 1,648.46 ppb, while lead dropped from 33.30 ppb to below its quantifiable limit. Zinc also dropped below its quantifiable limit from an average of 180.10 ppb.

The data from this sampling show that water produced from the Red River Alluvial aquifer is very hard and is of fair to good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 3 Red River Alluvial Aquifer Map

EVANGELINE AQUIFER

Background

In January 1998, eight wells that produce from the Evangeline aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in six parishes in the southwest and central part of the state. Figure 4 on page 43 illustrates the areal extent of the Evangeline aquifer and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

Recharge to the Evangeline aquifer occurs by the direct infiltration of rainfall in interstream, upland outcrop areas and the movement of water through overlying terrace deposits, as well as leakage from other aquifers. Fresh water in the Evangeline is separated from water in stratigraphically equivalent deposits in southeast Louisiana by a saltwater ridge in the Mississippi River valley. The hydraulic conductivity of the Evangeline varies between 20-100 feet/day.

The maximum depths of occurrence of freshwater in the Evangeline range from 150 feet above sea level, to 2,250 feet below sea level. The range of thickness of the fresh water interval in the Evangeline is 50 to 1,900 feet. The depths of the Evangeline wells that were monitored in conjunction with the BMP range from 170 to 1,715 feet.

Interpretation of Laboratory Analyses

Table IV-2, page 5, in Appendix 1, Part IV, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Evangeline. Table IV-3, page 6, in Appendix 1, Part IV, lists the metals data that were found for each well sampled in the Evangeline. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for TDS and iron were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 1, Part IV. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: There was no confirmed occurrence of these parameters from the sampling of the Evangeline aquifer.

pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate: Table 21 below lists the minimum and maximum values that were found in the Evangeline for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Evangeline project well for these parameters are listed in Appendix 1, Part IV, pages 5 and 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be soft.

Table 21

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.08	8.50	7.08
TDS (ppm)	126.0	704.0	324.8
Hardness (ppm)	<5	42.4	11.1
Chloride (ppm)	3.7	105.0	27.0
Iron (ppb)	10.00	318.00	104.53
Nitrite-Nitrate (ppm)	<0.02	0.09	0.03

Comparison to Historical Data

Table 22 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Evangeline that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Evangeline aquifer. For the most part the averages are consistent.

Table 22

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.14	7.08
Temperature (°C)	23.71	22.87
Conductivity (mmhos/cm)	0.504	0.499
Salinity (ppt)	0.22	0.21
TSS (ppm)	<4	<4
TDS (ppm)	308.4	324.8
Alkalinity (ppm)	205.8	192.8
Hardness (ppm)	16.1	11.1
Turbidity (NTU)	<1	<1
Conductivity (umhos/cm)	489.6	453.8
Color (PCU)	23.3	6.9
Chloride (ppm)	15.2	27.0
Sulfate (ppm)	4.71	4.40
Nitrite-Nitrate (ppm)	<0.02	0.03
Phosphorus (ppm)	0.16	0.15
TKN (ppm)	0.72	0.16
TOC (ppm)	<4	<4
Ammonia (ppm)	0.20	0.16

Table 23 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Evangeline. The data show that the averages are consistent.

Table 23

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	*
Arsenic (ppb)	5.06	<5
Barium (ppb)	62.73	41.40
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	25.07	48.56
Iron (ppb)	203.09	104.53
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	8.09	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	1.17
Thallium (ppb)	<5	<5
Zinc (ppb)	134.24	106.63

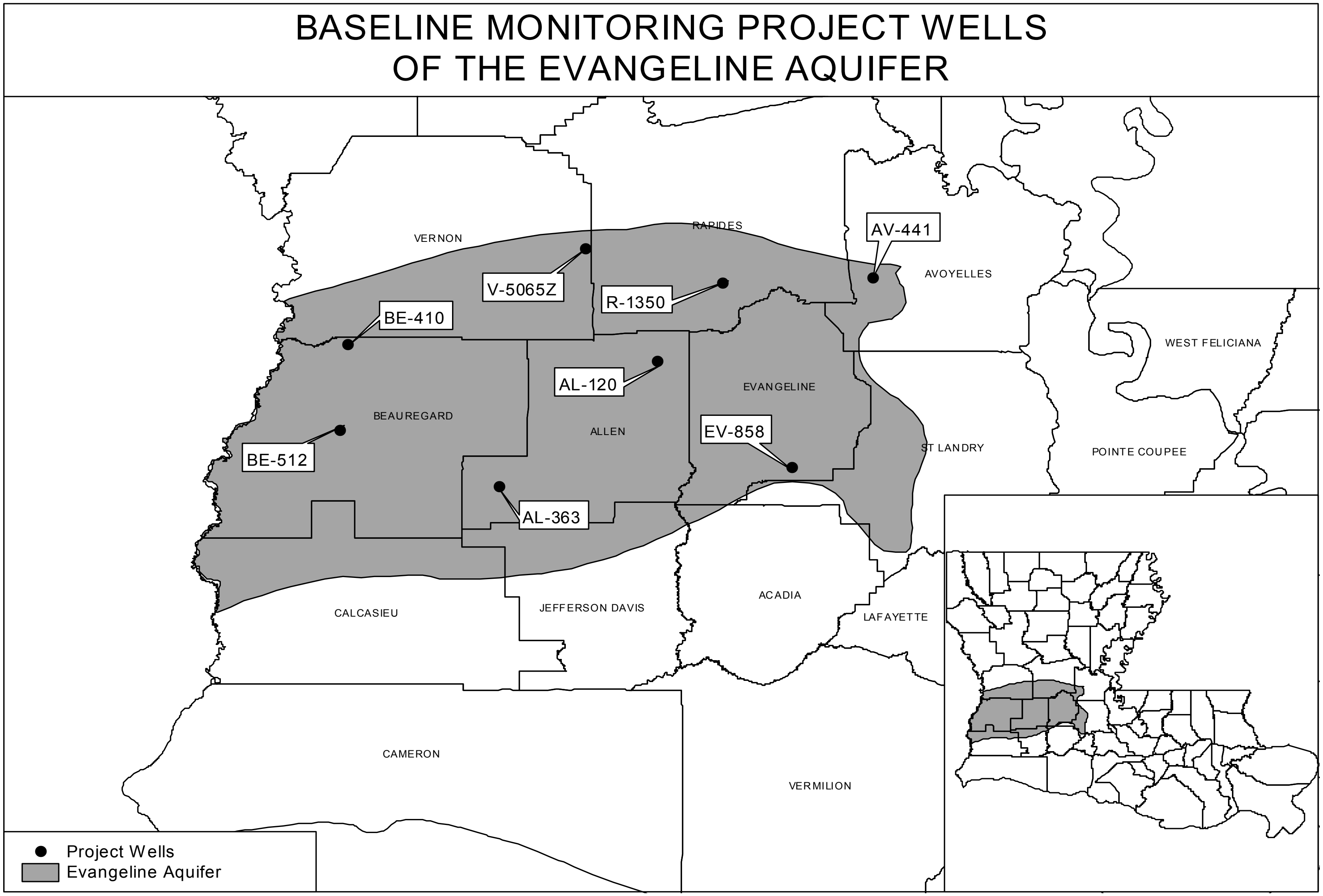
* Antimony data invalid.

Summary and Conclusions

In January 1998, eight wells that produce from the Evangeline aquifer were sampled as part of the regular BMP sampling rotation. None of the wells exceeded a federal primary standard. Federal secondary drinking water standards for TDS and iron were not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the current data averages with historical averages shows that for the most part the averages are consistent.

The data from this sampling show that water produced from the Evangeline aquifer is of good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 4 Evangeline Aquifer Map

CATAHOULA AQUIFER

Background

In February 1998, six wells that produce from the Catahoula aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in five parishes spread across the central part of the state. Figure 5 on page 48 illustrates the areal extent of the Catahoula aquifer and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

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

The maximum depths of occurrence of freshwater in the Catahoula range from 250 feet above sea level, to 2,200 feet below sea level. The range of thickness of the fresh water interval in the Catahoula is 50 to 450 feet. The depths of the Catahoula wells that were monitored in conjunction with the BMP range from <50 to 1,477 feet.

Interpretation of Laboratory Analyses

Table V-2, page 5, in Appendix 1, Part V, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Catahoula. Table V-3, page 6, in Appendix 1, Part V, lists the metals data that were found for each well sampled in the Catahoula. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that the federal secondary drinking water standard for iron was not met in certain wells; however, this secondary standard is an unenforceable guideline relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 1, Part V. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: There was no confirmed occurrence of these parameters from the sampling of the Catahoula aquifer.

pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate: Table 24 below lists the minimum and maximum values that were found in the Catahoula for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Catahoula project well for these parameters are listed in Appendix 1, Part V, pages 5 and 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be soft.

Table 24

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.50	7.08	6.31
TDS (ppm)	176.0	390.0	265.4
Hardness (ppm)	<5	5.3	<5
Chloride (ppm)	3.9	48.2	14.7
Iron (ppb)	35.00	845.00	412.67
Nitrite-Nitrate (ppm)	<0.02	0.03	0.02

Comparison to Historical Data

Table 25 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Catahoula that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Catahoula aquifer. The data show that the averages are consistent.

Table 25

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	*	6.31
Temperature (°C)	*	22.45
Conductivity (mmhos/cm)	*	0.230
Salinity (ppt)	*	0.11
TSS (ppm)	<4	5.7
TDS (ppm)	230.7	265.4
Alkalinity (ppm)	105.0	109.6
Hardness (ppm)	<5	<5
Turbidity (NTU)	<1	<1
Conductivity (umhos/cm)	249.2	268.5
Color (PCU)	7.5	5.0
Chloride (ppm)	14.7	14.7
Sulfate (ppm)	5.33	4.56
Nitrite-Nitrate (ppm)	<0.02	0.02
Phosphorus (ppm)	0.34	0.22
TKN (ppm)	0.64	0.18
TOC (ppm)	<4	<4
Ammonia (ppm)	0.20	0.16

*Data not acquired due to equipment malfunction.

Table 26 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Catahoula. Barium increased from below its quantifiable limit to 63.57 ppb, while copper decreased from 81.05 ppb to below its quantifiable limit and zinc decreased 208.71 ppb. Otherwise the data show that the averages are consistent.

Table 26

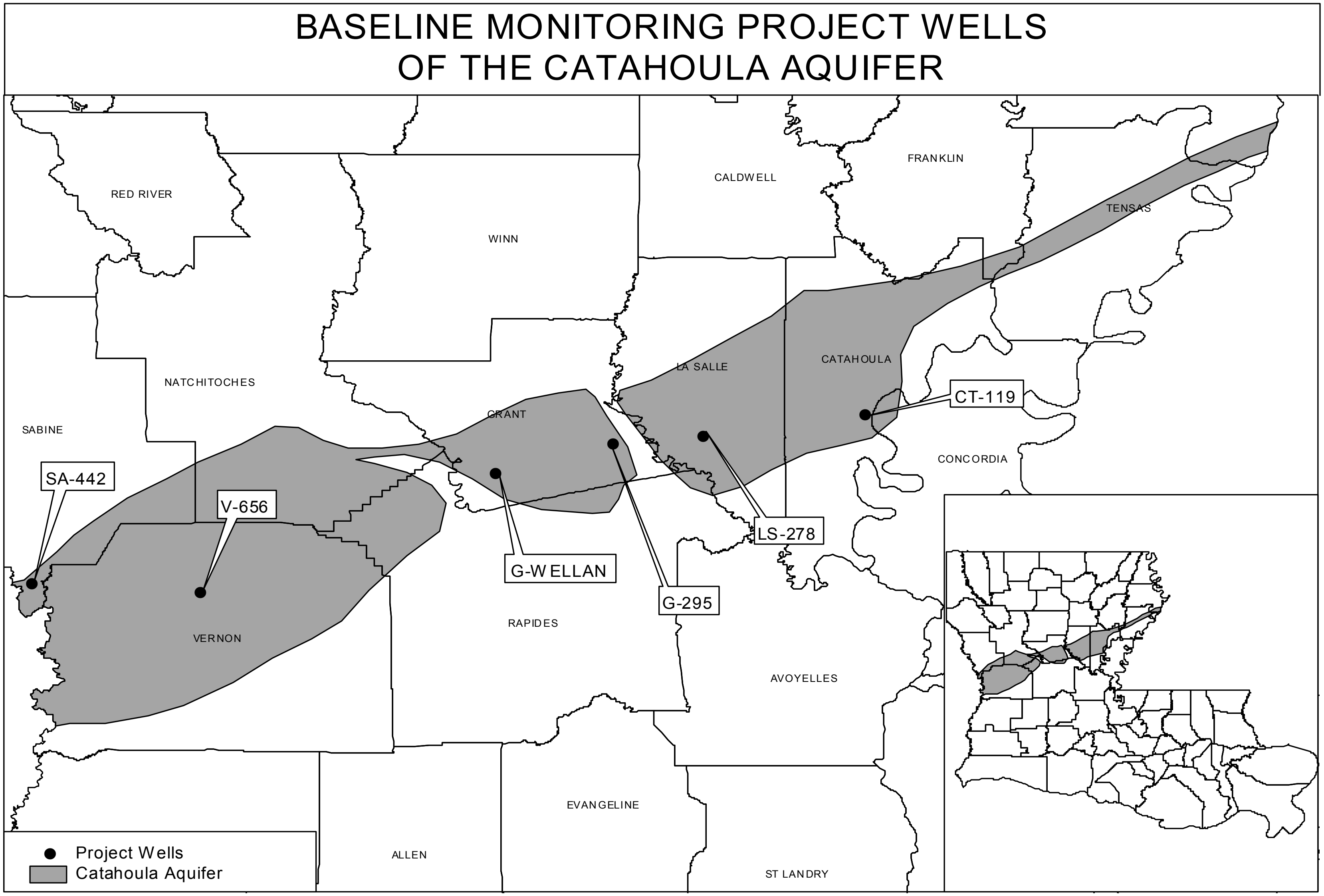
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	<10	63.57
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	2.07
Chromium (ppb)	<5	<5
Copper (ppb)	81.05	<5
Iron (ppb)	263.50	412.67
Lead (ppb)	32.17	<10
Mercury (ppb)	<0.05	0.06
Nickel (ppb)	6.72	<5
Selenium (ppb)	<5	<5
Silver (ppb)	1.38	1.00
Thallium (ppb)	<5	<5
Zinc (ppb)	250.88	42.17

Summary and Conclusions

In February 1998, six wells that produce from the Catahoula aquifer were sampled as part of the regular BMP sampling rotation. None of the wells exceeded a federal primary standard. The federal secondary drinking water standard for iron was not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the current data averages with historical averages shows that barium increased from below its quantifiable limit to 63.57 ppb, while copper decreased from 81.05 ppb to below its quantifiable limit and zinc decreased 208.71 ppb. Otherwise the data show that the averages are consistent.

The data from this sampling show that water produced from the Catahoula aquifer is of good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 5 Catahoula Aquifer Map

NORTH LOUISIANA TERRACE AQUIFER

Background

In March and April of 1998, eleven wells that produce from the North Louisiana Terrace aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in seven parishes from the central to the north part of the state. Figure 6 on page 53 illustrates the areal extent of the North Louisiana Terrace aquifer and also shows the locations of the water wells that were sampled.

Geology

The Pleistocene terrace aquifers that make up the North Louisiana Terrace aquifer occur as blanket terrace deposits in central Louisiana and as erosional remnants of dissected terraces northward. The Prairie, intermediate, and high terraces typically consist of unconsolidated, fining upward sequences of gravel, sand, silt, and clay and are overlain by Holocene alluvium in the valleys of the larger streams. The older terraces generally have a coarser texture and the fine-grained top stratum is often eroded. The aquifer deposits are typically poorly to well sorted and consist of coarse sand and gravel in the lower parts grading to fine sand toward the top. The North Louisiana Terrace is unconfined in most areas, but may be confined by silt and clay locally.

Hydrogeology

Recharge is primarily from the direct infiltration of rainfall in interstream, upland outcrop areas and can be relatively rapid where the overlying silts and clays are thin or missing. Water in the terrace aquifers moves downgradient and laterally and is discharged into streams that have eroded valleys into the aquifer units. Water levels typically reflect variations in precipitation and seasonal withdrawals by wells. The hydraulic conductivity of the North Louisiana Terrace varies between 150-270 feet/day.

The maximum depths of occurrence of freshwater in the North Louisiana Terrace range from 100 feet above sea level, to 100 feet below sea level. The range of thickness of the fresh water interval in the North Louisiana Terrace is 50 to 150 feet. The depths of the North Louisiana Terrace wells that were monitored in conjunction with the BMP range from 49 to 158 feet.

Interpretation of Laboratory Analyses

Table VI-2, page 6, in Appendix 1, Part VI, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the North Louisiana Terrace. Table VI-3, page 7, in Appendix 1, Part VI, lists the metals data that were found for each well sampled in the North Louisiana Terrace. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for iron, TDS, and sulfate were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 3 in Appendix 1, Part VI. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: Methyl Tertiary-Butyl Ether (MtBE) was detected in the laboratory analysis of the sample from well number MO-364 at a concentration of 16 ppb. A subsequent resample and its duplicate sample both revealed a concentration of 13 ppb. No other volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 27 below lists the minimum and maximum values that were found in the North Louisiana Terrace for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each North Louisiana Terrace project well for these parameters are listed in Appendix 1, Part VI, pages 6 and 7. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 15-18. The average for hardness shows the ground water to be moderately hard.

Table 27

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	4.98	7.13	5.78
TDS (ppm)	34.0	816.0	190.2
Hardness (ppm)	5.0	445.0	68.1
Chloride (ppm)	3.4	83.9	21.9
Iron (ppb)	10.00	15260.0	1137.56
Nitrite-Nitrate (ppm)	<0.02	5.34	1.20

<u>Comparison to Historical Data</u>

Table 28 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the North Louisiana Terrace that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the North Louisiana Terrace aquifer. The data show that the averages are, for the most part, consistent. Hardness did increase by 19.5 ppm to bring the average from the soft to the moderately hard range.

Table 28

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	6.27	5.78
Temperature (°C)	20.18	19.03
Conductivity (mmhos/cm)	0.283	0.258
Salinity (ppt)	0.12	0.13
TSS (ppm)	6.6	<4
TDS (ppm)	219.5	190.2
Alkalinity (ppm)	81.7	61.5
Hardness (ppm)	48.6	68.1
Turbidity (NTU)	11.08	10.18
Conductivity (umhos/cm)	278.0	261.4
Color (PCU)	17.7	6.5
Chloride (ppm)	22.7	21.9
Sulfate (ppm)	25.93	34.85
Nitrite-Nitrate (ppm)	0.67	1.20
Phosphorus (ppm)	0.24	0.13
TKN (ppm)	0.69	0.36
TOC (ppm)	<4	<4
Ammonia (ppm)	0.19	0.25

Table 29 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the North Louisiana Terrace. The data show that copper increased 46.97 ppb and iron decreased 1,106.36 ppb, otherwise the averages are consistent.

Table 29

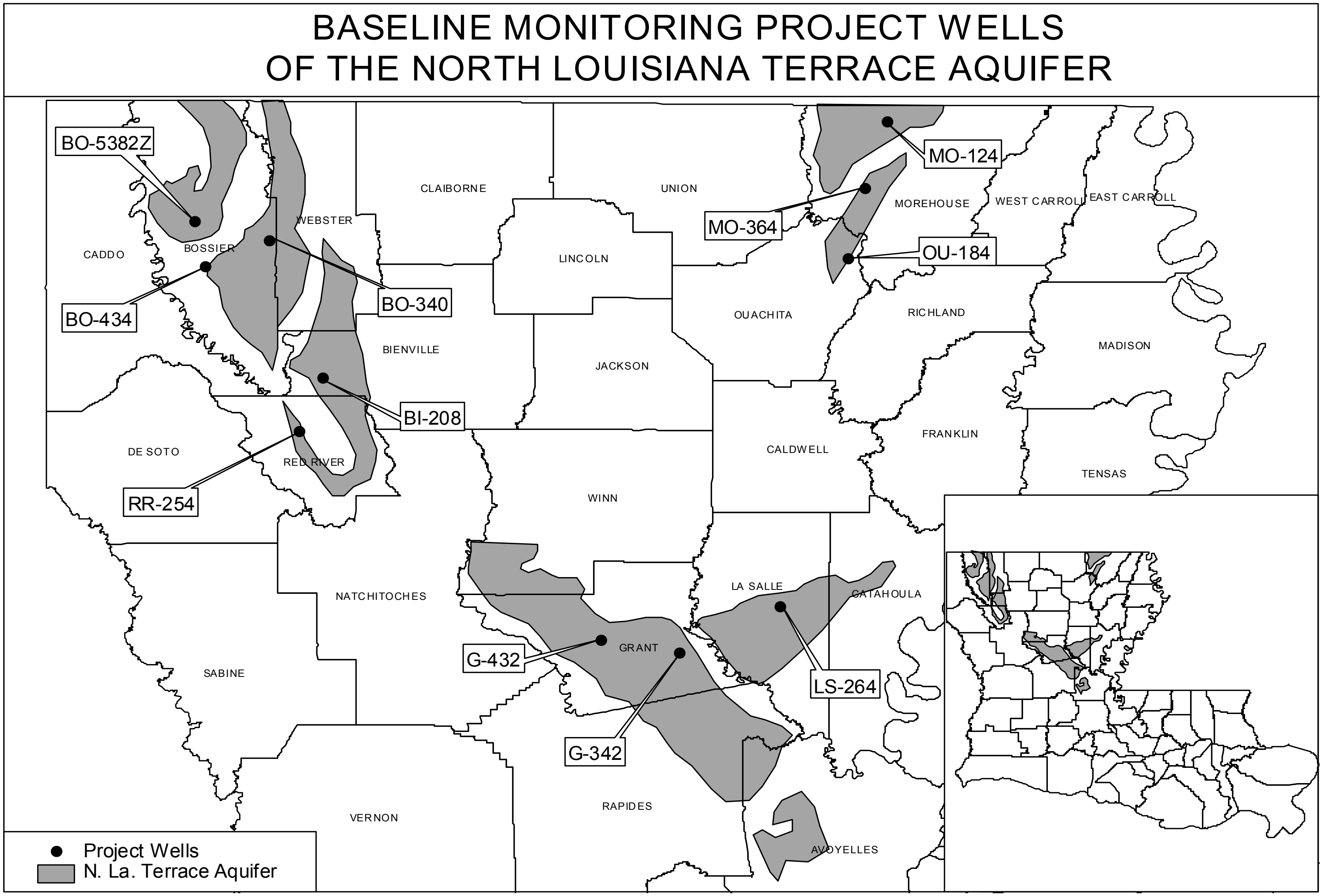
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	5.04	<5
Barium (ppb)	117.25	87.98
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	6.57	53.54
Iron (ppb)	2243.92	1137.56
Lead (ppb)	<10	<10
Mercury (ppb)	0.08	<0.05
Nickel (ppb)	7.18	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	25.03	42.12

Summary and Conclusions

In March and April of 1998, eleven wells that produce from the North Louisiana Terrace aquifer were sampled as part of the regular BMP sampling rotation. None of the wells exceeded a federal primary standard. The federal secondary drinking water standards for iron, TDS, and sulfate were not met in certain wells, but no other secondary standard was exceeded. MO-364 exhibited an MtBE concentration of 16 ppb. A subsequent resample and its duplicate sample both revealed a concentration of 13 ppb. MtBE is used as an octane enhancer in gasoline and no MCL has currently been established for it. However, an EPA drinking water advisory fact sheet entitled “Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MtBE)” explained that it is believed that keeping the concentrations in the range of 20 to 40 ppb or below will likely avert unpleasant taste and odor effects, although some may detect the chemical below this. Concentrations in this range are about 20,000 to 100,000 (or more) times lower than the range of exposure levels in which cancer or noncancer effects were observed in rodent tests. This margin of exposure is in the range of margins of exposure typically provided to protect against cancer effects by the National Primary Drinking Water Standards under the Federal Safe Drinking Water Act. The concentrations found in the samples from MO-364 were below this range. No other volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be moderately hard.

A comparison of the current data averages with historical averages shows that hardness increased by 19.5 ppm to bring the average from the soft to the moderately hard range, and that copper increased 46.97 ppb and iron decreased 1,106.36 ppb. Otherwise the averages are consistent.

The data from this sampling show that water produced from the North Louisiana Terrace aquifer is of good quality, with the exception of the MtBE concentration mentioned previously.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 6 North Louisiana Terrace Aquifer Map

CARNAHAN BAYOU AQUIFER

Background

In May of 1998, seven wells that produce from the Carnahan Bayou aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in five parishes from east central to the southwest part of the state. Figure 7 on page 58 illustrates the areal extent of the Carnahan Bayou aquifer and also shows the locations of the water wells that were sampled.

Geology

The Carnahan Bayou member consists of sands, silts, and clays, with some gravel. The Carnahan Bayou member, along with the Williamson Creek and Dough Hills, is grouped into the Jasper aquifer. The aquifer unit consists of fine to coarse sand, which may grade laterally and vertically to silt and clay.

Hydrogeology

Recharge takes place primarily as a result of the direct infiltration of rainfall in interstream, upland outcrop areas, movement of water through overlying terrace deposits, and leakage from other aquifers. The hydraulic conductivity of the Carnahan Bayou varies between 20-260 feet/day.

The maximum depths of occurrence of freshwater in the Carnahan Bayou range from 250 feet above sea level, to 3,300 feet below sea level. The range of thickness of the fresh water interval in the Carnahan Bayou is 100 to 1,100 feet. The depths of the Carnahan Bayou wells that were monitored in conjunction with the BMP range from 143 to 2,036 feet.

Interpretation of Laboratory Analyses

Table VII-2, page 6, in Appendix 1, Part VII, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Carnahan Bayou. Table VII-3, page 6, in Appendix 1, Part VII, lists the metals data that were found for each well sampled in the Carnahan Bayou. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for iron and color were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 1, Part VII. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: There was no confirmed occurrence of these parameters from the sampling of the Carnahan Bayou aquifer.

pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate: Table 30 below lists the minimum and maximum values that were found in the Carnahan Bayou aquifer for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Carnahan Bayou project well for these parameters are listed in Appendix 1, Part VII, page 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be moderately hard.

Table 30

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.95	7.88	7.21
TDS (ppm)	190.0	402.0	239.5
Hardness (ppm)	<5	260.0	57.1
Chloride (ppm)	4.4	22.6	11.7
Iron (ppb)	36.90	3732.00	1185.50
Nitrite-Nitrate (ppm)	0.08	2.17	0.36

Comparison to Historical Data

Table 31 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Carnahan Bayou aquifer that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Carnahan Bayou. The data show that the averages are, for the most part, consistent.

Table 31

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	6.80	7.21
Temperature (°C)	26.46	25.43
Conductivity (mmhos/cm)	0.460	0.379
Salinity (ppt)	0.21	0.18
TSS (ppm)	4.4	<4
TDS (ppm)	318.4	239.5
Alkalinity (ppm)	200.0	184.3
Hardness (ppm)	81.5	57.1
Turbidity (NTU)	6.53	8.89
Conductivity (umhos/cm)	474.6	395.5
Color (PCU)	15.0	8.1
Chloride (ppm)	31.9	11.7
Sulfate (ppm)	13.36	9.24
Nitrite-Nitrate (ppm)	<0.02	0.36
Phosphorus (ppm)	0.32	0.28
TKN (ppm)	0.29	0.59
TOC (ppm)	5.82	<4
Ammonia (ppm)	0.43	0.35

Table 32 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Carnahan Bayou aquifer. The data show that barium increased by 103.57 ppb, and that iron decreased by 305.64 ppb and zinc decreased by 318.49 ppb.

Table 32

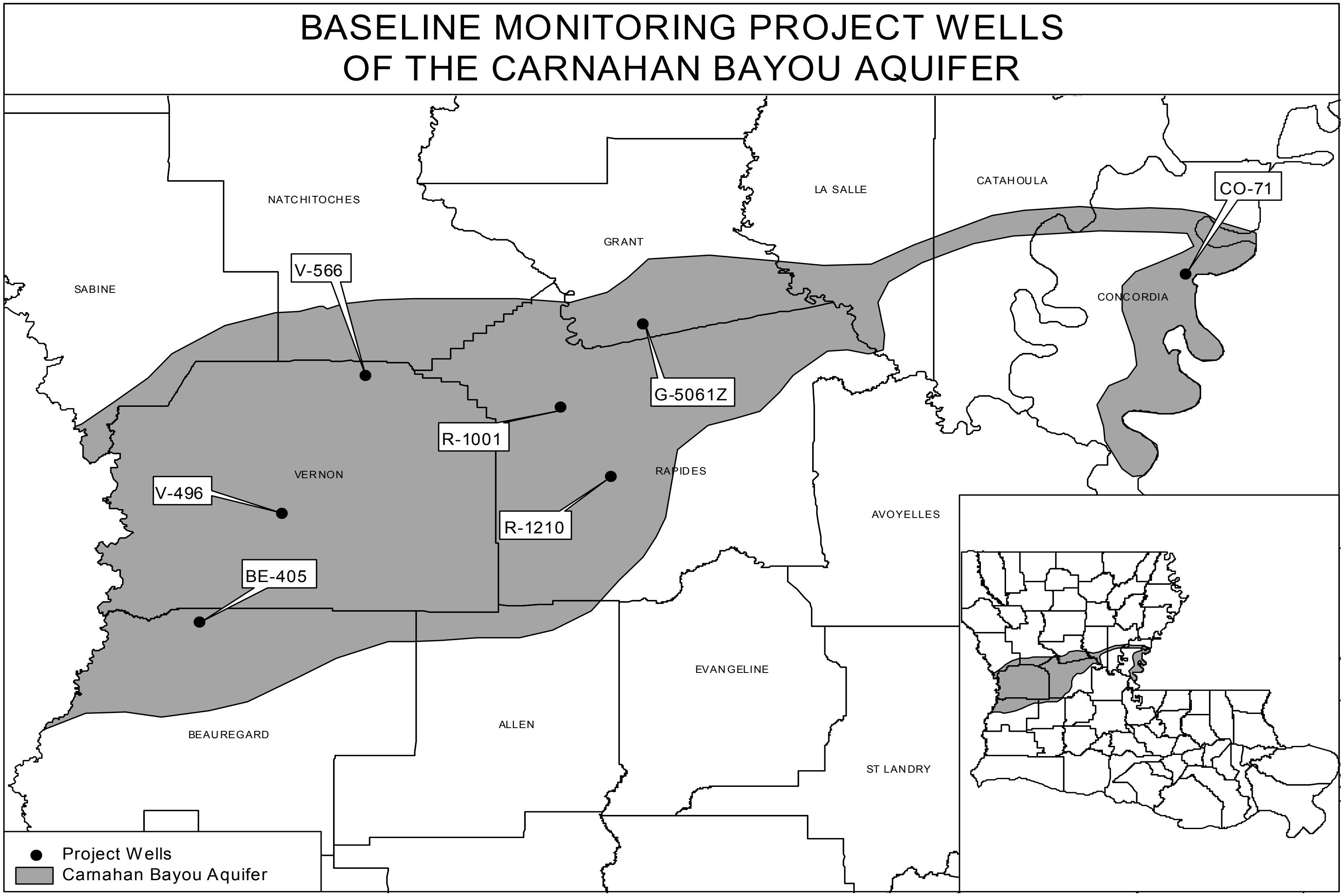
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	146.36	249.93
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	5.81	17.36
Iron (ppb)	1491.14	1185.50
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	791.50	473.01

Summary and Conclusions

In May of 1998, seven wells that produce from the Carnahan Bayou aquifer were sampled as part of the regular BMP sampling rotation. None of the wells exceeded a federal primary standard. The federal secondary drinking water standards for iron and color were not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be moderately hard.

A comparison of the current data averages with historical averages shows that barium increased by 103.57 ppb, and that iron decreased by 305.64 ppb and zinc decreased by 318.49 ppb. The other averages are, for the most part, consistent.

The data from this sampling show that water produced from the Carnahan Bayou aquifer is of good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 7 Carnahan Bayou Aquifer Map

MISSISSIPPI RIVER ALLUVIAL AQUIFER

Background

In July through October 1998, twenty-four wells that produce from the Mississippi River Alluvial aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in fifteen parishes that are situated along or near the Mississippi River in Louisiana. Figure 8 on page 63 illustrates the areal extent of the Mississippi River Alluvial aquifer and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

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

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

Interpretation of Laboratory Analyses

Table I-2, pages 6-7, in Appendix 2, Part I, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Mississippi River Alluvial. Table I-3, page 8-9, in Appendix 2, Part I, lists the metals data that were found for each well sampled in the Mississippi River Alluvial. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that two wells exceeded the federal primary MCL of 50 ppb for arsenic. SL-5477Z exhibited a value of 81.8 ppb and IB-5427Z exhibited a value of 56.5 ppb. No other primary standards were exceeded.

A review of the laboratory analyses show that federal secondary drinking water standards for iron, TDS, and color were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on pages 2 and 3 in Appendix 2, Part I. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: There was no confirmed occurrence of these parameters from the sampling of the Mississippi River Alluvial aquifer.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 33 below lists the minimum and maximum values that were found in the Mississippi River Alluvial aquifer for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Mississippi River Alluvial project well for these parameters are listed in Appendix 2, Part I, pages 6-9. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 18 – 21. The average for hardness shows the ground water to be very hard. It should be noted that the elevated levels of TDS and iron are characteristic of the ground water produced from the Mississippi River Alluvial aquifer.

Table 33

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.76	7.29	6.64
TDS (ppm)	175.0	1073.0	497.1
Hardness (ppm)	69.5	550.0	313.1
Chloride (ppm)	<1.25	245.0	60.8
Iron (ppb)	<10	21339.0	4146.86
Nitrite-Nitrate (ppm)	<0.02	3.08	0.26

<u>Comparison to Historical Data</u>

Table 34 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Mississippi River Alluvial aquifer that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Mississippi River Alluvial. The data show that the averages are consistent.

Table 34

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	6.67	6.64
Temperature (°C)	18.79	20.42
Conductivity (mmhos/cm)	0.771	0.789
Salinity (ppt)	0.36	0.39
TSS (ppm)	16.9	14.0
TDS (ppm)	448.5	497.1
Alkalinity (ppm)	320.7	323.9
Hardness (ppm)	302.1	313.1
Turbidity (NTU)	48.04	56.36
Conductivity (umhos/cm)	800.4	812.8
Color (PCU)	24.2	15.1
Chloride (ppm)	69.9	60.8
Sulfate (ppm)	8.37	24.41
Nitrite-Nitrate (ppm)	0.32	0.26
Phosphorus (ppm)	0.49	0.50
TKN (ppm)	1.31	1.35
TOC (ppm)	7.56	4.39
Ammonia (ppm)	1.06	0.94

Table 35 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Mississippi River Alluvial aquifer. The data show that iron decreased by 783.89 ppb, otherwise the averages are consistent.

Table 35

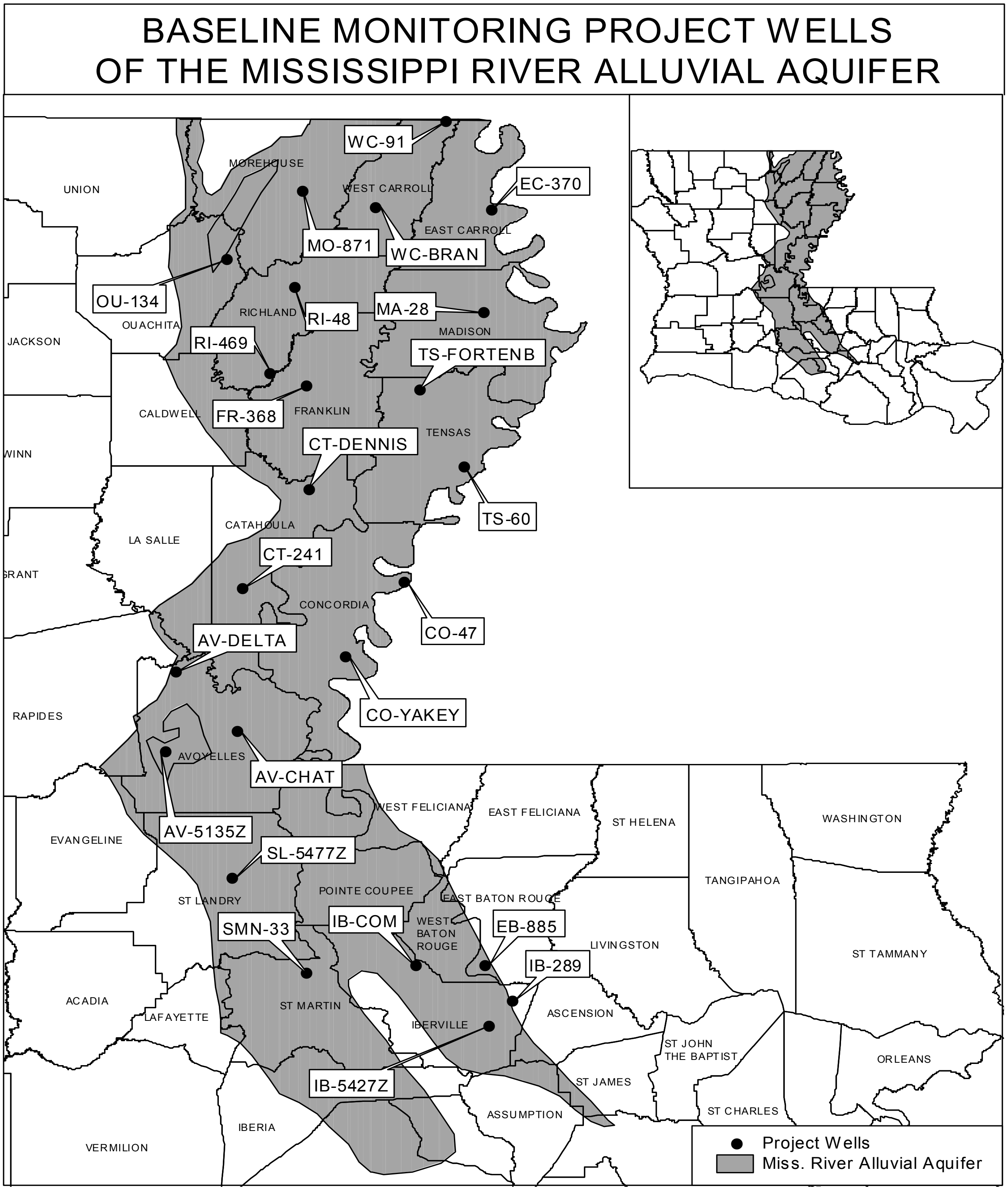
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	11.49	12.88
Barium (ppb)	488.17	432.31
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	8.86	7.91
Iron (ppb)	4930.75	4146.86
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	40.02	161.18

Summary and Conclusions

In July through October 1998, twenty-four wells that produce from the Mississippi River Alluvial aquifer were sampled as part of the regular BMP sampling rotation. Two of the wells exceeded the federal primary MCL of 50 ppb for arsenic. SL-5477Z exhibited a value of 81.8 ppb and IB-5427Z exhibited a value of 56.5 ppb. It is this Office's opinion that these concentrations are due to the existence of arsenic in the ground water at these two wells' locations. The BMP has historically found levels of arsenic from both of these wells. Both well owners are aware of this situation and have been given information and contacts that may help alleviate their problem. No other well exceeded a federal primary standard. The federal secondary drinking water standards for iron, TDS, and color were not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The elevated TDS and iron levels are characteristic of the ground water produce from the Mississippi River Alluvial aquifer. The average for hardness shows the ground water to be very hard.

A comparison of the current data averages with historical averages shows that iron decreased by 783.89 ppb, otherwise the averages are consistent.

The data from this sampling show that, with the exception of the arsenic concentrations found in project wells SL-5477Z and IB-5427Z, water produced from the Mississippi River Alluvial aquifer is of good quality when considering short-term or long-term health risks. However, this aquifer is of fair quality when considering taste, odor or appearance guidelines, due to the several exceedances of the secondary drinking water standards for iron, TDS, and color and due to the overall high averages for iron and TDS. Also, both the historic and current averages for hardness point to the Mississippi River Alluvial aquifer containing very hard water.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisian
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 8 Mississippi River Alluvial Map

COCKFIELD AQUIFER

Background

In November of 1998 and January of 1999, twelve wells that produce from the Cockfield aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in nine parishes from northeast to western Louisiana. Figure 9 on page 68 illustrates the areal extent of the Cockfield aquifer and also shows the locations of the water wells that were sampled.

Geology

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

Hydrogeology

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

The maximum depths of occurrence of freshwater in the Cockfield range from 200 feet above sea level, to 2,150 feet below sea level. The range of thickness of the fresh water interval in the Cockfield is 50 to 600 feet. The depths of the Cockfield wells that were monitored in conjunction with the BMP range from 91 to 445 feet.

Interpretation of Laboratory Analyses

Table II-2, page 5, in Appendix 2, Part II, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Cockfield. Table II-3, page 6, in Appendix 2, Part II, lists the metals data that were found for each well sampled in the Cockfield. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for iron, TDS, and color were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 2, Part II. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: Project well JA-207 exhibited the following volatile organic compounds with following values.

bromoform – 4.9 ppb, bromodichloromethane – 36.8 ppb, chloroform – 37.3 ppb,
dibromochloromethane – 30.1 ppb, dibromomethane – 1.8

These compounds do not have established MCLs. No other volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 36 below lists the minimum and maximum values that were found in the Cockfield aquifer for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Cockfield project well for these parameters are listed in Appendix 2, Part II, pages 5 and 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be moderately hard.

Table 36

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.37	8.44	6.97
TDS (ppm)	90.0	648.0	420.6
Hardness (ppm)	<5	246.0	85.3
Chloride (ppm)	7.6	150.0	49.9
Iron (ppb)	56.70	8049.00	1478.14
Nitrite-Nitrate (ppm)	<0.02	0.65	0.07

<u>Comparison to Historical Data</u>

Table 37 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Cockfield aquifer that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Cockfield. The data show that TOC decreased from 10.39 to below its quantifiable limit, otherwise the averages are consistent.

Table 37

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	6.81	6.97
Temperature (°C)	19.97	19.76
Conductivity (mmhos/cm)	0.595	0.603
Salinity (ppt)	0.29	0.29
TSS (ppm)	5.3	<4
TDS (ppm)	343.4	420.6
Alkalinity (ppm)	218.7	222.2
Hardness (ppm)	109.4	85.3
Turbidity (NTU)	7.04	9.64
Conductivity (umhos/cm)	595.4	607.9
Color (PCU)	41.5	11.7
Chloride (ppm)	37.4	49.9
Sulfate (ppm)	47.25	34.14
Nitrite-Nitrate (ppm)	0.10	0.07
Phosphorus (ppm)	0.31	0.55
TKN (ppm)	0.88	0.67
TOC (ppm)	10.39	<4
Ammonia (ppm)	0.80	0.48

Table 38 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Cockfield aquifer. The data show that iron decreased by 475.24 ppb and zinc decreased by 167.41 ppb. Otherwise the averages are consistent.

Table 38

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	5.39	<5
Barium (ppb)	94.54	124.54
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	7.64	5.73
Iron (ppb)	1953.38	1478.14
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	0.19
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	203.42	36.01

Summary and Conclusions

In November of 1998 and January of 1999, twelve wells that produce from the Cockfield aquifer were sampled as part of the regular BMP sampling rotation. A review of the laboratory analyses show that all federal primary drinking water standards were met. The federal secondary drinking water standards for iron, TDS, and color were not met in certain wells, but no other secondary standard was exceeded. Project well JA-207 exhibited concentrations of 4.9 ppb for bromoform, 36.8 ppb for bromodichloromethane, 37.3 ppb for chloroform, 30.1 ppb for dibromochloromethane, and 1.8 ppb for dibromomethane. These compounds do not have established MCLs. No other volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be moderately hard.

A comparison of the current data averages with historical averages shows that TOC decreased from 10.39 to below its quantifiable limit, iron decreased by 475.24 ppb, and zinc decreased by 167.41 ppb. Otherwise the averages are consistent.

The data from this sampling show that the ground water from this aquifer is of good quality when considering short-term or long-term health risks. However, this aquifer is of fair quality when considering taste, odor or appearance guidelines.

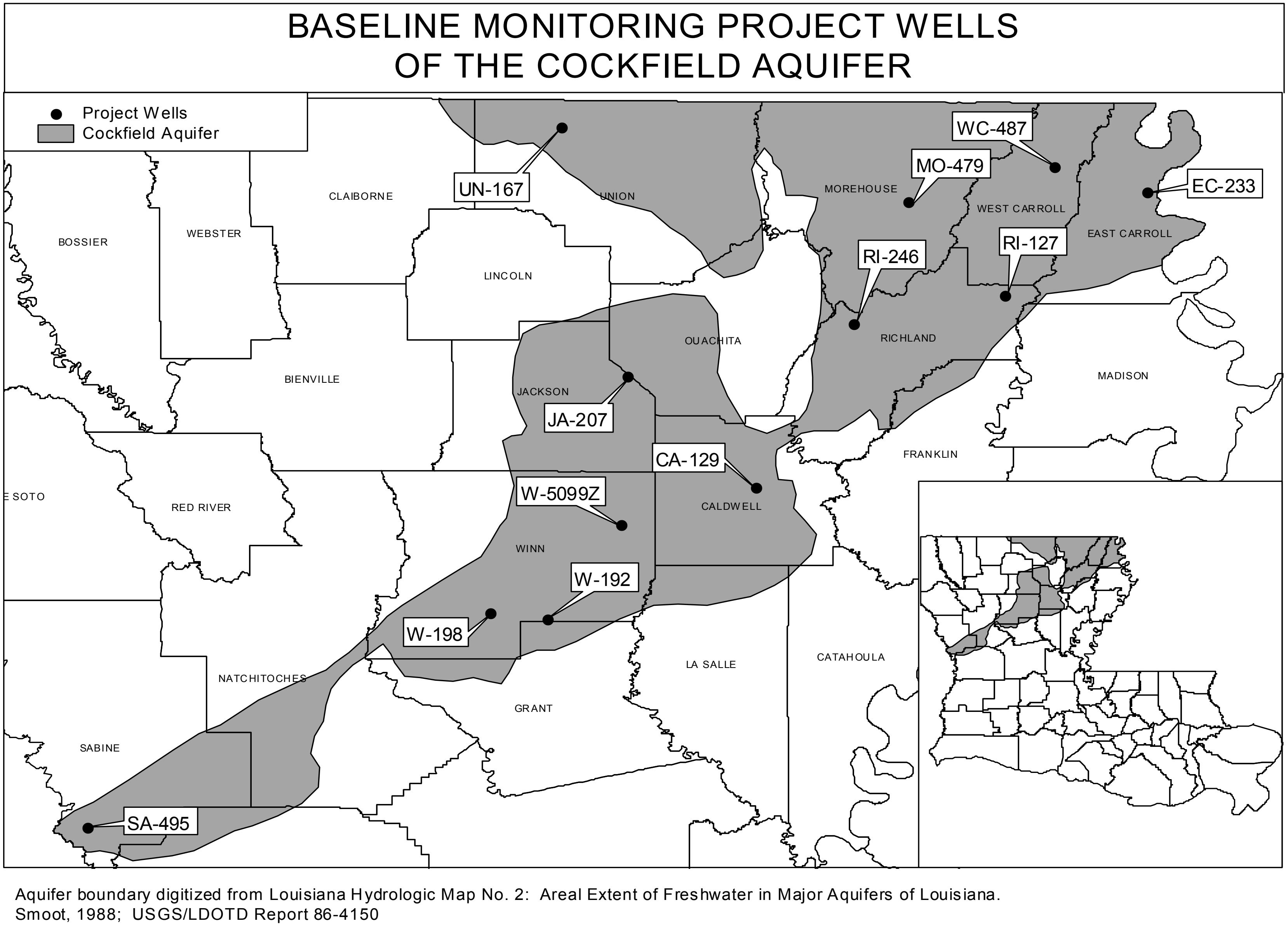


Figure 9 Cockfield Aquifer Map

CHICOT AQUIFER

Background

In February through May, and in August, of 1999, twenty-six wells that produce from the Chicot aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in fifteen parishes, mainly in southwest Louisiana. Figure 10 on page 73 illustrates the areal extent of the Chicot aquifer and also shows the locations of the water wells that were sampled.

Geology

The Chicot aquifer system consists of fining upward sequences of gravels, sands, silts, and clays of the Pleistocene Prairie, intermediate, and high terrace deposits of southwestern Louisiana. The medium to coarse-grained sand and gravel aquifer units dip and thicken toward the Gulf, thin slightly toward the west into Texas, and thicken toward the east where it is overlain by alluvium of the Atchafalaya and Mississippi rivers. The aquifers are confined, have a finer texture, and are increasingly subdivided by silts and clays southward from the northern limit of the outcrop area in southern Vernon and Rapides parishes.

In the Lake Charles area, the Chicot is divided into the shallow alluvial sands, the “200-foot” sand, the “500-foot” sand, and the “700-foot” sand. East of Calcasieu parish the Chicot is divided into the “upper sand” (in hydraulic connection to the Atchafalaya sand, Abbeville sand, and “200-foot” sand) and the “lower sand” (“700-foot” sand). The “500-foot” sand is largely isolated except where it merges with the “700-foot” sand north of Calcasieu Parish. Fresh water in the Chicot and other southwestern Louisiana aquifers is separated from fresh water in southeast Louisiana by a saltwater ridge along the western edge of the Mississippi River valley. Salt water occurs within the Chicot along the coast and in isolated bodies north of the coast.

Hydrogeology

Recharge to the Chicot occurs primarily through the direct infiltration of rainfall in the interstream, upland outcrop-subcrop areas. Recharge also occurs by water movement from the Atchafalaya alluvium, downward infiltration through the clays south of the primary recharge outcrop area, upward movement from the underlying Evangeline aquifer, and inflow from the Vermilion and Calcasieu rivers. Water movement is generally toward the pumping centers at Lake Charles and Eunice. There is little movement of water from the west because of pumping in the Orange, Texas area. The hydraulic conductivity varies between 40-220 feet/day.

The maximum depths of occurrence of freshwater in the Chicot range from 100 feet above sea level, to 1,000 feet below sea level. The range of thickness of the fresh water interval in the Chicot is 50 to 1,050 feet. The depths of the Chicot wells that were monitored in conjunction with the BMP range from 66 to 701 feet.

Interpretation of Laboratory Analyses

Table III-2, page 6, in Appendix 2, Part III, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Chicot. Table III-3, page 7, in Appendix 2, Part III, lists the metals data that were found for each well sampled in the Chicot. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for iron, TDS, and color were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 2, Part III. No other secondary standard was exceeded.

Two wells exceeded the federal lead action level of 15 ppb established to ensure that lead does not pose either a short-term or long-term health risk in public drinking water. Although not all wells sampled were public supply wells, this Office does use this action level as a benchmark for further evaluation. Concentrations of 54.7 ppb and 34.0 ppb were found in well CU-770, and a concentration of 28.7 ppb was found in well BE-378. However, since neither of these two wells produces water for consumption (CU-770 is an observation well and BE-378 is an industrial well) and neither is a public supply well, no further action was taken as a result of the lead values.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 39 below lists the minimum and maximum values that were found in the Chicot aquifer for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Chicot project well for these parameters are listed in Appendix 2, Part III, pages 6 and 7. Contour maps of the values for TDS, chloride, and iron are found in that appendix on pages 15-17. It should be noted that the field meter that measures pH was not functioning during the sampling of some wells, therefore a contour map was not made for pH and the values below do not reflect the pH from every well that was sampled. The average for hardness shows the ground water to be moderately hard.

Table 39

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	6.48	7.76	7.02
TDS (ppm)	14.0	1082.0	346.2
Hardness (ppm)	<5	295.0	120.6
Chloride (ppm)	3.1	415.0	58.9
Iron (ppb)	53.30	16867.0	1853.98
Nitrite-Nitrate (ppm)	<0.02	0.07	0.02

<u>Comparison to Historical Data</u>

Table 40 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Chicot aquifer that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Chicot. The data show that the averages are consistent.

Table 40

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.03	7.02
Temperature (°C)	22.88	23.12
Conductivity (mmhos/cm)	0.504	0.631
Salinity (ppt)	0.24	0.32
TSS (ppm)	10.1	5.2
TDS (ppm)	355.7	346.2
Alkalinity (ppm)	188.1	184.4
Hardness (ppm)	120.3	120.6
Turbidity (NTU)	8.92	13.40
Conductivity (umhos/cm)	545.1	541.9
Color (PCU)	21.9	12.7
Chloride (ppm)	66.6	58.9
Sulfate (ppm)	1.92	2.64
Nitrite-Nitrate (ppm)	0.02	0.02
Phosphorus (ppm)	0.25	0.25
TKN (ppm)	0.28	0.64
TOC (ppm)	4.02	<4
Ammonia (ppm)	0.36	0.33

Table 41 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Chicot aquifer. The data show that zinc decreased by 229.17 ppb. Otherwise the averages are consistent.

Table 41

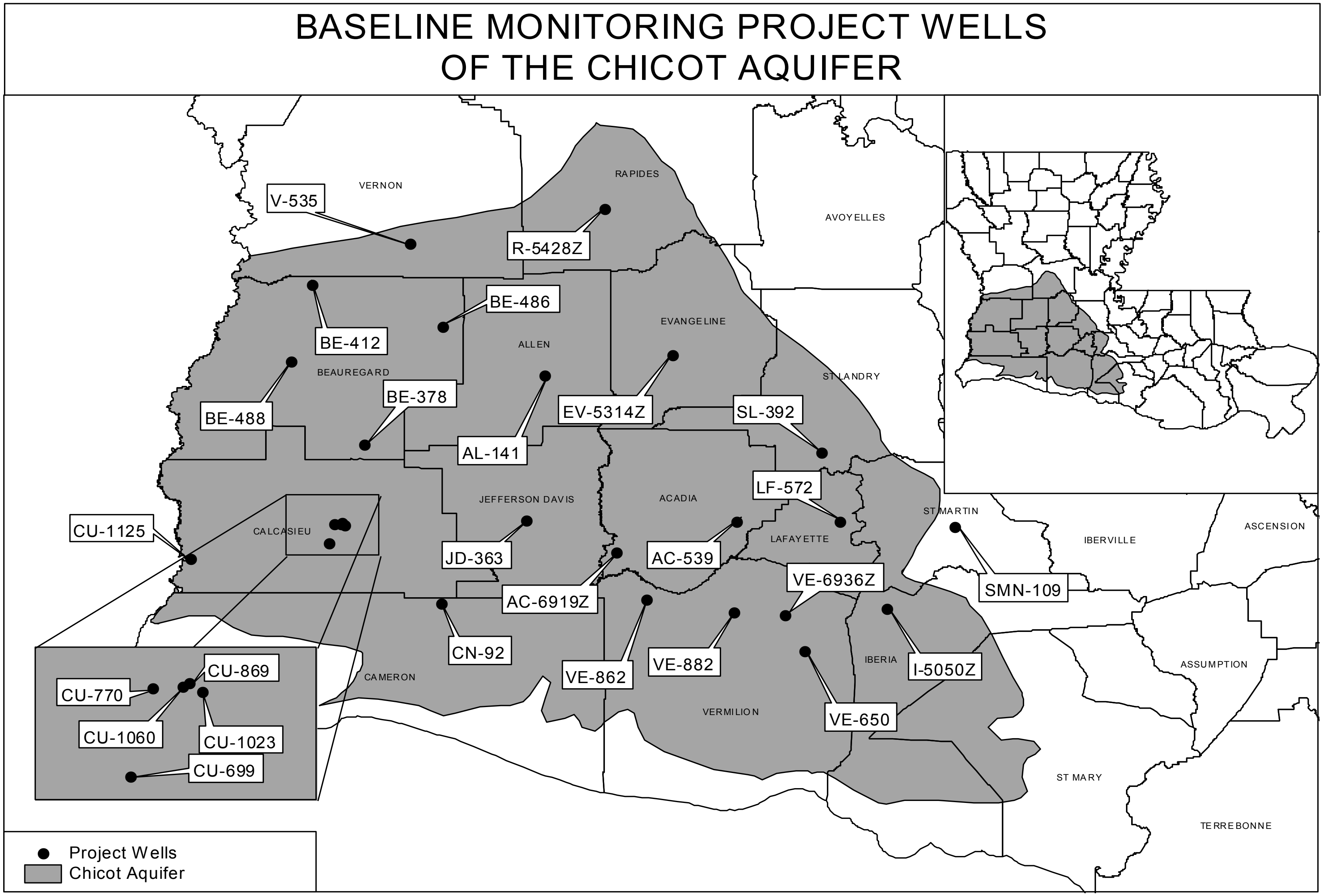
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	287.94	310.81
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	16.58	31.53
Iron (ppb)	1991.55	1853.98
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	394.59	165.42

Summary and Conclusions

In February through May, and in August, of 1999, twenty-six wells that produce from the Chicot aquifer were sampled as part of the regular BMP sampling rotation. A review of the laboratory analyses show that all federal primary drinking water standards were met. The federal secondary drinking water standards for iron, TDS, and color were not met in certain wells, but no other secondary standard was exceeded. Two wells exceeded the federal lead action level of 15 ppb. Concentrations of 54.7 ppb and 34.0 ppb were found in well CU-770, and a concentration of 28.7 ppb was found in well BE-378. However, since neither of these two wells produces water for consumption no further action was taken as a result of the lead values. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be moderately hard.

A comparison of the current data averages with historical averages shows that zinc decreased by 229.17 ppb. Otherwise the averages are consistent.

The data from this sampling show that the ground water from this aquifer is of good quality when considering short-term or long-term health risks. This is with the exception of the lead concentrations found in project wells CU-770 and BE-378, which do not pose a direct drinking water threat. However, this aquifer is of fair quality when considering taste, odor or appearance guidelines.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana. Smoot, 1988; USGS/LDOTD Report 86-4150

Project well SMN-109 is classified by the LDOTD Well Registry as being completed in the Chicot Aquifer.

Figure 10 Chicot Aquifer Map

WILLIAMSON CREEK AQUIFER

Background

In July and November of 1999, seven wells that produce from the Williamson Creek aquifer were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in four parishes, in central and southwest Louisiana. Figure 11 on page 78 illustrates the areal extent of the Williamson Creek aquifer and also shows the locations of the water wells that were sampled.

Geology

The Williamson Creek member consists of sands, silts, silty clays, and some gravel. The Williamson Creek member, along with the Carnahan Bayou and Dough Hills, is grouped into the Jasper aquifer. The aquifer unit consists of fine to coarse sand, which may grade laterally and vertically to silt and clay.

Hydrogeology

Recharge takes place primarily as a result of the direct infiltration of rainfall in interstream, upland outcrop areas, movement of water through overlying terrace deposits, and leakage from other aquifers. The hydraulic conductivity of the Williamson Creek varies between 20-260 feet/day.

The maximum depths of occurrence of freshwater in the Williamson Creek range from 175 feet above sea level, to 2,450 feet below sea level. The range of thickness of the fresh water interval in the Williamson Creek is 50 to 1,250 feet. The depths of the Williamson Creek wells that were monitored in conjunction with the BMP range from 248 to 1,657 feet.

Interpretation of Laboratory Analyses

Table I-2, page 5, in Appendix 3, Part I, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Williamson Creek. Table I-3, page 6, in Appendix 3, Part I, lists the metals data that were found for each well sampled in the Williamson Creek. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that the federal secondary drinking water standard for pH was not met in one well; however, this secondary standard is an unenforceable guideline relating primarily to the aesthetics of drinking water. Project well BE-407 exceeded the pH standard of 6.5-8.5 standard units (S.U.) with values of 8.56 S.U. and 8.57 S.U. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate: Table 42 below lists the minimum and maximum values that were found in the Williamson Creek aquifer for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Williamson Creek project well for these parameters are listed in Appendix 3, Part I, pages 5 and 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be soft.

Table 42

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	7.12	8.57	7.83
TDS (ppm)	226.1	390.0	282.8
Hardness (ppm)	6.4	147.0	33.7
Chloride (ppm)	7.7	93.2	40.9
Iron (ppb)	<10	271.80	104.79
Nitrite-Nitrate (ppm)	<0.02	0.51	0.11

Comparison to Historical Data

Table 43 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Williamson Creek aquifer that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Williamson Creek. The data show that the averages are consistent.

Table 43

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.15	7.83
Temperature (°C)	25.41	22.22
Conductivity (mmhos/cm)	0.418	0.422
Salinity (ppt)	0.20	0.20
TSS (ppm)	<4	<4
TDS (ppm)	218.0	282.8
Alkalinity (ppm)	159.3	150.1
Hardness (ppm)	34.1	33.7
Turbidity (NTU)	1.18	4.93
Conductivity (umhos/cm)	413.8	414.1
Color (PCU)	7.5	<5
Chloride (ppm)	35.6	40.9
Sulfate (ppm)	7.38	5.71
Nitrite-Nitrate (ppm)	0.04	0.11
Phosphorus (ppm)	0.53	0.20
TKN (ppm)	0.34	0.43
TOC (ppm)	4.20	*
Ammonia (ppm)	0.40	0.23

*As of July 1999, sampling for TOC was discontinued.

Table 44 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Williamson Creek aquifer. The data show that barium increased by 82.2 ppb. Copper decreased from 10.76 ppb to below its quantifiable limit, as did nickel, decreasing from 11.36 ppb. Also, zinc decreased by 101.94 ppb and iron decreased by 375.71 ppb. Otherwise the averages are consistent.

Table 44

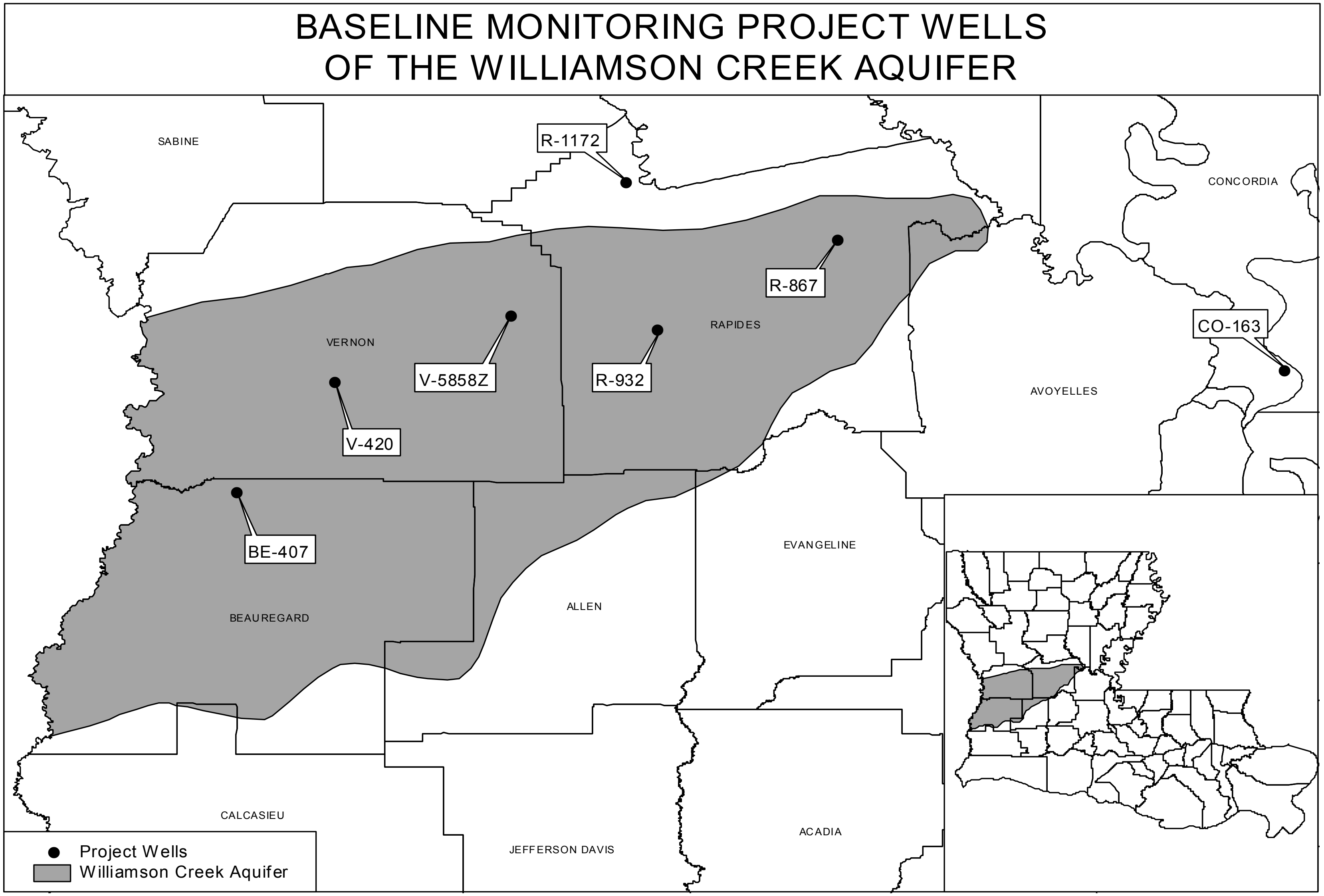
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	<5	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	45.36	127.56
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	10.76	<5
Iron (ppb)	480.50	104.79
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	11.36	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	291.13	189.19

Summary and Conclusions

In July and November of 1999, seven wells that produce from the Williamson Creek aquifer were sampled as part of the regular BMP sampling rotation. A review of the laboratory analyses show that all federal primary drinking water standards were met. The standard for pH was the only secondary drinking water standard that was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the current data averages with historical averages shows that barium increased by 82.2 ppb, and that copper decreased from 10.76 ppb to below its quantifiable limit, as did nickel, decreasing from 11.36 ppb. Also, zinc decreased by 101.94 ppb and iron decreased by 375.71 ppb. Otherwise the averages are consistent.

The data from this sampling show that the ground water from this aquifer is of very good quality.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Project wells R-1172 and CO-163 are classified by the LDOTD Well Registry as being completed in the Williamson Creek Aquifer.

Figure 11 Williamson Creek Aquifer Map

CHICOT EQUIVALENT AQUIFER SYSTEM

Background

In August through December of 1999, twenty-four wells that produce from the Chicot Equivalent aquifer system were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in thirteen parishes in southeast Louisiana. Figure 12 on page 83 illustrates the areal extent of the Chicot Equivalent aquifer system and also shows the locations of the water wells that were sampled.

Geology

The Chicot Equivalent aquifer system is composed of the Pleistocene aged aquifers of the New Orleans area, the Baton Rouge area, and St. Tammany, Tangipahoa, and Washington Parishes. The aquifers are in Pleistocene aged alluvial and terrace deposits. The sedimentary sequences that make up the aquifer system are subdivided into several aquifer units separated by confining beds. Northward within southeast Louisiana, fewer units are recognized because some younger units pinch out updip and some clay layers present to the south disappear. Where clay layers are discontinuous or disappear, aquifer units coalesce. The aquifers are moderately well, to well sorted, and consist of fine sand near the top, grading to coarse sand and gravel in lower parts and are generally confined by silt and clay layers.

Hydrogeology

The deposits that constitute the individual aquifers are not readily differentiated at the surface and act as one hydraulic system that can be subdivided into several hydrologic zones in the subsurface. The Mississippi River Valley is entrenched into the Pleistocene strata in the western part of the system, resulting in water movement between the river, the shallow sands, and the Pleistocene aquifers. Recharge occurs primarily by the direct infiltration of rainfall in interstream, upland outcrop areas, by the movement of water between aquifers, and between the aquifers and the Mississippi River. The hydraulic conductivity varies between 10-200 feet/day.

The maximum depths of occurrence of freshwater in the Chicot Equivalent range from 350 feet above sea level, to 1,100 feet below sea level. The range of thickness of the fresh water interval in the Chicot Equivalent is 50 to 1,100 feet. The depths of the Chicot Equivalent wells that were monitored in conjunction with the BMP range from 88 to 807 feet.

Interpretation of Laboratory Analyses

Table II-2, page 6, in Appendix 3, Part II, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Chicot Equivalent. Table II-3, page 7, in Appendix 3, Part II, lists the metals data that were found for each well sampled in the Chicot Equivalent. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

Laboratory data from the sampling of project well ST-5245Z revealed a concentration of 0.43 ppb for mercury. While this concentration did not exceed the federal primary MCL of 2 ppb established for mercury, it is a higher than expected concentration. Therefore the well was resampled for total metals and the results of the resampling showed concentrations of 0.20 ppb in the initial resample and in the duplicate resample. It is this Office's opinion that the resampling has confirmed the existence of mercury in the well.

A review of the laboratory analyses shows that federal secondary drinking water standards for pH, iron, TDS, chloride, and color were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 3, Part II. No other secondary standard was exceeded.

One well exceeded the federal lead action level of 15 ppb established to ensure that lead does not pose either a short-term or long-term health risk in public drinking water. Although not all wells sampled were public supply wells, this Office does use this action level as a benchmark for further evaluation.
ST-5245Z exceeded the action level with a concentration of 32.2 ppb. Even though this well is not a public supply well, it was resampled due to this concentration. The resampling revealed concentrations of 13.9 ppb and 15.9 ppb. It is this Office's opinion that the resampling has confirmed the existence of lead in the well.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 45 below lists the minimum and maximum values that were found in the Chicot Equivalent aquifer system for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Chicot Equivalent project well for these parameters are listed in Appendix 3, Part II, pages 6 and 7. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 15-18. The average for hardness shows the ground water to be soft.

Table 45

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	5.36	9.26	7.20
TDS (ppm)	38.0	1267.0	406.6
Hardness (ppm)	<5	183.0	45.8
Chloride (ppm)	3.0	729.0	118.2
Iron (ppb)	<10	2418.00	398.30
Nitrite-Nitrate (ppm)	<0.02	1.29	0.18

<u>Comparison to Historical Data</u>

Table 46 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Chicot Equivalent aquifer system that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Chicot Equivalent. The data show that the averages are consistent.

Table 46

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.03	7.20
Temperature (°C)	21.40	21.91
Conductivity (mmhos/cm)	0.666	0.648
Salinity (ppt)	0.35	0.29
TSS (ppm)	<4	<4
TDS (ppm)	427.9	406.6
Alkalinity (ppm)	153.3	166.9
Hardness (ppm)	42.4	45.8
Turbidity (NTU)	<1	2.09
Conductivity (umhos/cm)	674.2	689.9
Color (PCU)	16.5	26.4
Chloride (ppm)	126.1	118.2
Sulfate (ppm)	1.76	2.68
Nitrite-Nitrate (ppm)	0.18	0.18
Phosphorus (ppm)	0.20	0.21
TKN (ppm)	1.02	0.71
TOC (ppm)	<4	*
Ammonia (ppm)	0.53	0.51

*As of July 1999, sampling for TOC was discontinued.

Table 47 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Chicot Equivalent aquifer system. The data show that the averages are consistent.

Table 47

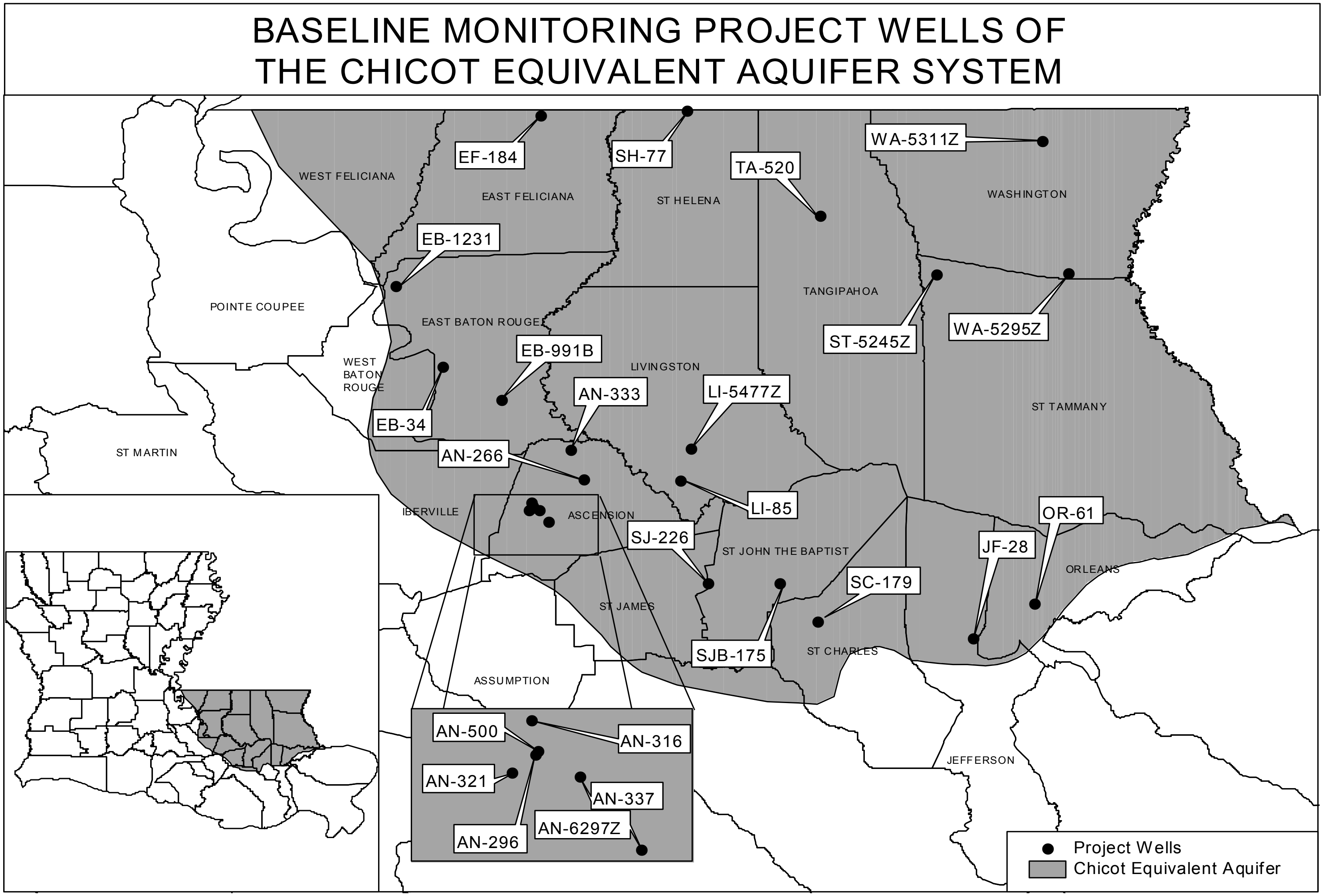
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	5.02	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	112.54	128.96
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	13.28	11.17
Iron (ppb)	224.59	398.30
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	0.06
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	82.98	36.54

Summary and Conclusions

In August through December of 1999, twenty-four wells that produce from the Chicot Equivalent aquifer system were sampled as part of the regular BMP sampling rotation. A review of the laboratory analyses show that all federal primary drinking water standards were met. However, laboratory data from the sampling of project well ST-5245Z revealed a concentration of 0.43 ppb for mercury, which is below mercury's primary MCL of 2 ppb but is a higher than expected concentration. Additionally, this well showed a lead value of 32.2 ppb, which is above the federal action level of 15 ppb. Subsequent resampling confirmed the existence of mercury and lead in the well. The owner of the well was made aware of this and was given information on lead and mercury contamination, and was informed of steps that can be taken to alleviate the problem. In addition to the owner, LDEQ's Mercury Contaminant Program, the Louisiana Department of Health and Hospitals, and the Louisiana Department of Agriculture and Forestry was also notified. The federal secondary drinking water standards for pH, iron, TDS, chloride, and color were not met in certain wells, but no other secondary standard was exceeded. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the current data averages with historical averages shows that the averages are consistent.

The data from this sampling show that the ground water from this aquifer is of fair quality when considering taste, odor or appearance guidelines. The data also show that this aquifer is of good quality as far as short-term or long-term health risks are concerned, with the exception of the lead and mercury values discussed above.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 12 Chicot Equivalent Aquifer System Map

EVANGELINE EQUIVALENT AQUIFER SYSTEM

Background

In January, February, and in April of 2000, fifteen wells that produce from the Evangeline Equivalent aquifer system were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in eleven parishes in southeast and south central Louisiana. Figure 13 on page 88 illustrates the areal extent of the Evangeline Equivalent aquifer system and also shows the locations of the water wells that were sampled.

Geology

The Evangeline Equivalent aquifer system is composed of the Pliocene aged aquifers of the Baton Rouge area and St. Tammany, Tangipahoa, and Washington Parishes. These Pliocene sediments outcrop in southwestern Mississippi. The sedimentary sequences that make up the aquifer system are subdivided into several aquifer units separated by confining beds. Northward within southeast Louisiana, fewer units are recognized because some younger units pinch out updip and some clay layers present to the south disappear. Where clay layers are discontinuous or disappear, aquifer units coalesce. The aquifers consist of moderately to well sorted, fine to medium grained sands, with interbedded coarse sand, silt, and clay.

Hydrogeology

The deposits that constitute the individual aquifers are not readily differentiated at the surface and act as one hydraulic system that can be subdivided into several hydrologic zones in the subsurface. A zone or ridge of saline water occurs within the Pliocene sediments beneath the Mississippi River alluvial valley. Recharge occurs primarily by the direct infiltration of rainfall in interstream, upland outcrop areas, and by the movement of water between aquifers. The hydraulic conductivity varies between 10-200 feet/day.

The maximum depths of occurrence of freshwater in the Evangeline Equivalent range from 0 to 2,500 feet below sea level. The range of thickness of the fresh water interval in the Evangeline Equivalent is 50 to 1,500 feet. The depths of the Evangeline Equivalent wells that were monitored in conjunction with the BMP range from 160 to 1900 feet.

Interpretation of Laboratory Analyses

Table III-2, page 5, in Appendix 3, Part III, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Evangeline Equivalent. Table III-3, page 6, in Appendix 3, Part III, lists the metals data that were found for each well sampled in the Evangeline Equivalent. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses show that federal secondary drinking water standards for pH, iron, and color were not met in certain wells; however, these secondary standards are unenforceable guidelines relating primarily to the aesthetics of drinking water. A complete listing of these exceedances can be found on page 2 in Appendix 3, Part III. No other secondary standard was exceeded.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: A review of the laboratory data shows that project well WBR-181 exhibited the following volatile organic compounds with the following values.

bromodichloromethane – 3.4 ppb, bromoform – 1.5 ppb, chloroform – 2.6 ppb,
dibromochloromethane – 4.5 ppb

These are byproducts of chlorination and do not have established MCLs. No other volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

<u>pH, TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 48 below lists the minimum and maximum values that were found in the Evangeline Equivalent aquifer system for pH, TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Evangeline Equivalent project well for these parameters are listed in Appendix 3, Part III, pages 5 and 6. Contour maps of the values for pH, TDS, chloride, and iron are found in that appendix on pages 14-17. The average for hardness shows the ground water to be soft.

Table 48

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	6.31	9.20	8.02
TDS (ppm)	32.0	392.0	162.6
Hardness (ppm)	<5	35.8	11.9
Chloride (ppm)	2.7	63.9	8.3
Iron (ppb)	<10	8517.00	942.37
Nitrite-Nitrate (ppm)	<0.02	0.64	0.09

<u>Comparison to Historical Data</u>

Table 49 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Evangeline Equivalent aquifer system that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Evangeline Equivalent. The data show that the averages are consistent.

Table 49

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.63	8.02
Temperature (°C)	25.27	22.73
Conductivity (mmhos/cm)	0.251	0.244
Salinity (ppt)	0.11	0.12
TSS (ppm)	<4	<4
TDS (ppm)	209.6	162.6
Alkalinity (ppm)	116.3	110.3
Hardness (ppm)	7.4	11.9
Turbidity (NTU)	<1	1.71
Conductivity (umhos/cm)	240.0	249.7
Color (PCU)	9.0	7.6
Chloride (ppm)	2.9	8.3
Sulfate (ppm)	9.08	6.34
Nitrite-Nitrate (ppm)	0.03	0.09
Phosphorus (ppm)	0.21	0.27
TKN (ppm)	0.39	0.26
TOC (ppm)	<4	*
Ammonia (ppm)	0.19	0.11

*As of July 1999, sampling for TOC was discontinued.

Table 50 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Evangeline Equivalent aquifer system. The data show that barium increased by 20.64 ppb, iron increased by 926.55 ppb, and zinc increased by 139.63 ppb, otherwise the averages are consistent.

Table 50

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	5.21	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	19.94	40.58
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	12.10	7.60
Iron (ppb)	15.82	942.37
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	37.78	177.41

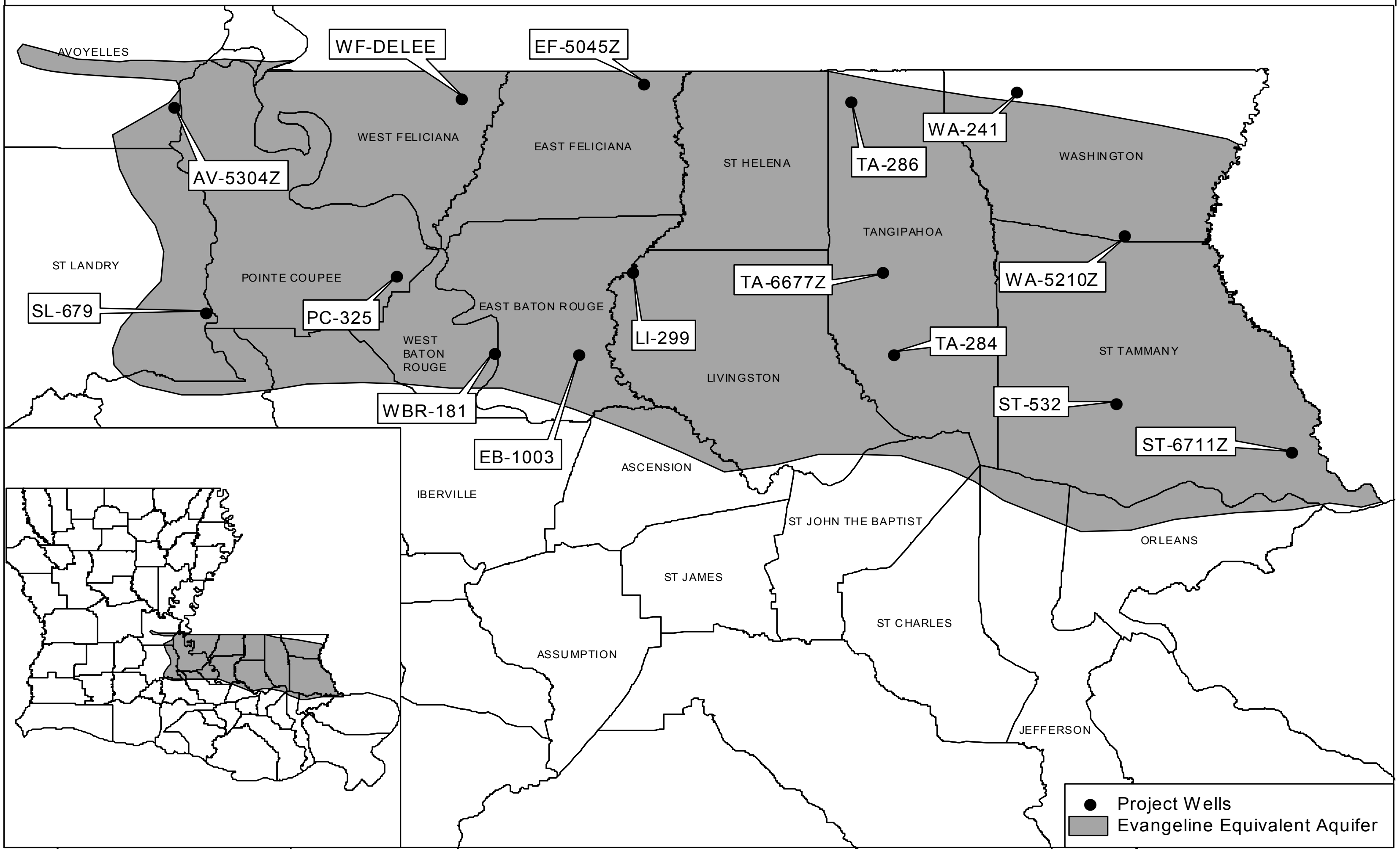
Summary and Conclusions

In January, February, and in April of 2000, fifteen wells that produce from the Evangeline Equivalent aquifer system were sampled as part of the regular BMP sampling rotation. A review of the laboratory analyses show that all federal primary drinking water standards were met. The federal secondary drinking water standards for pH, iron, and color were not met in certain wells, but no other secondary standard was exceeded. A review of the laboratory data shows that project well WBR-181 exhibited a value of 3.4 ppb for bromodichloromethane, 1.5 ppb for bromoform, 2.6 ppb for chloroform, and 4.5 ppb for dibromochloromethane. These are byproducts of chlorination and do not have established MCLs. No other volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the historical data averages with the current averages data shows that barium increased by 20.64 ppb, iron increased by 926.55 ppb, and zinc increased by 139.63 ppb, otherwise the averages are consistent.

The data from this sampling show that the ground water from this aquifer is of good quality when considering short-term or long-term health risk guidelines and taste, odor or appearance guidelines.

BASELINE MONITORING PROJECT WELLS OF THE EVANGELINE EQUIVALENT AQUIFER SYSTEM



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 13 Evangeline Equivalent Aquifer System

JASPER EQUIVALENT AQUIFER SYSTEM

Background

In March, April, and May of 2000, fifteen wells that produce from the Jasper Equivalent aquifer system were sampled for water quality parameters, metals, nutrients, volatile organic compounds, semi-volatile organic compounds, pesticides, and PCBs. These wells are located in nine parishes in southeast Louisiana. Figure 14 on page 93 illustrates the areal extent of the Jasper Equivalent aquifer system and also shows the locations of the water wells that were sampled.

Geology

The Jasper Equivalent aquifer system is composed of the Miocene aged aquifers of the Baton Rouge area and St. Tammany, Tangipahoa, and Washington Parishes. These Miocene sediments outcrop in southwestern Mississippi. The sedimentary sequences that make up the aquifer system are subdivided into several aquifer units separated by confining beds. Northward within southeast Louisiana, fewer units are recognized because some younger units pinch out updip and some clay layers present to the south disappear. Where clay layers are discontinuous or disappear, aquifer units coalesce. The aquifers consist of fine to coarse sand and gravel, with grain size increasing and sorting decreasing with depth.

Hydrogeology

The deposits that constitute the individual aquifers are not readily differentiated at the surface and act as one hydraulic system that can be subdivided into several hydrologic zones in the subsurface. A zone or ridge of saline water occurs within the Miocene sediments beneath the Mississippi River alluvial valley. Recharge occurs primarily by the direct infiltration of rainfall in interstream, upland outcrop areas, and by the movement of water between aquifers. The hydraulic conductivity varies between 10-200 feet/day.

The maximum depths of occurrence of freshwater in the Jasper Equivalent range from 500 to 3,200 feet below sea level. The range of thickness of the fresh water interval in the Jasper Equivalent is 1,600 to 2,350 feet. The depths of the Jasper Equivalent wells that were monitored in conjunction with the BMP range from 960 to 2,700 feet.

Interpretation of Laboratory Analyses

Table IV-2, page 5, in Appendix 3, Part IV, lists the field parameters, water quality parameters, and nutrients data that were found for each well sampled in the Jasper Equivalent. Table IV-3, page 6, in Appendix 3, Part IV, lists the metals data that were found for each well sampled in the Jasper Equivalent. In addition to these parameters, a list of project analytical parameters that were sampled for, which includes volatiles, semi-volatiles, pesticides, and PCBs, is included. Due to the large number of analytes in these categories, tables showing the values for each well were not prepared. However, the confirmed detection of any of these analytes would be noted under the "Discussion Of Water Quality Data" section of the appendix and in this section of this report.

General Water Quality

Federal Drinking Water Standards: Under the Federal Safe Drinking Water Act, EPA has established primary MCLs for pollutants that may pose a health risk in public drinking water. Primary MCLs ensure that drinking water does not pose either a short-term or long-term health risk. Secondary MCLs have been established as non-enforceable taste, odor or appearance guidelines. While not all wells sampled were public supply wells, MCLs are used as a benchmark for further evaluation and are used to evaluate the general water quality for use as a drinking water source.

A review of the laboratory analyses show that all federal primary drinking water standards were met.

A review of the laboratory analyses shows that well ST-995 exceeded color's secondary standard of 15 color units with a measure of 17 color units; however, this secondary standard is an unenforceable guideline relating primarily to the aesthetics of drinking water.

One well exceeded the federal lead action level of 15 ppb established to ensure that lead does not pose either a short-term or long-term health risk in public drinking water. Although not all wells sampled were public supply wells, this Office does use this action level as a benchmark for further evaluation. ST-995 exceeded the action level with a concentration of 15.5 ppb.

Volatile Organic Compounds, Semi-Volatile Organic Compounds, Pesticides, PCBs: No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found.

<u>TDS, Hardness, Chloride, Iron, Nitrite-Nitrate:</u> Table 51 below lists the minimum and maximum values that were found in the Jasper Equivalent aquifer system for TDS, hardness, chloride, iron, and nitrite-nitrate, as well as an average of these values. Results from the sampling of each Jasper Equivalent project well for these parameters are listed in Appendix 3, Part IV, pages 5 and 6. Contour maps of the values for TDS, chloride, and iron are found in that appendix on pages 14-16. Please note that the pH values are excluded from this report due to a malfunction of the sampling equipment. For a discussion of this, see Page 2 in Appendix 3, Part IV. The average for hardness shows the ground water to be soft.

Table 51

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
TDS (ppm)	160.0	428.0	251.4
Hardness (ppm)	<5	9.1	<5
Chloride (ppm)	2.5	87.9	17.9
Iron (ppb)	<10	67.60	28.25
Nitrite-Nitrate (ppm)	<0.02	0.03	<0.02

<u>Comparison to Historical Data</u>

Table 52 lists the historical averages for field parameters, water quality parameters, and nutrients from the regular BMP sampling of the Jasper Equivalent aquifer system that occurred within the July 1994 to June 1997 sampling rotation. Alongside the historical averages are the averages for these parameters from the current sampling of the Jasper Equivalent. The data show that the averages are consistent.

Table 52

PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
pH (SU)	7.64	*
Temperature (°C)	29.00	28.84
Conductivity (mmhos/cm)	0.354	0.381
Salinity (ppt)	0.17	0.18
TSS (ppm)	<4	7.3
TDS (ppm)	258.3	251.4
Alkalinity (ppm)	137.3	167.2
Hardness (ppm)	6.9	<5
Turbidity (NTU)	<1	<1
Conductivity (umhos/cm)	335.0	394.0
Color (PCU)	8.1	5.9
Chloride (ppm)	12.1	17.9
Sulfate (ppm)	8.80	7.30
Nitrite-Nitrate (ppm)	0.04	<0.02
Phosphorus (ppm)	0.20	0.28
TKN (ppm)	0.19	0.47
TOC (ppm)	<4	**
Ammonia (ppm)	0.22	0.26

*pH data unavailable due to malfunction in sampling equipment.

**As of July 1999, sampling for TOC was discontinued.

Table 53 lists the historical averages for metals from the same sampling events as the previous table, alongside the averages for these parameters from the current sampling of the Jasper Equivalent aquifer system. The data show that antimony decreased to below its quantification limit from 7.78 ppb, copper increased from below its quantification limit from <5 ppb to 14.01 ppb, and zinc went from <10 ppb to 22.92 ppb. Otherwise the averages are consistent.

Table 53

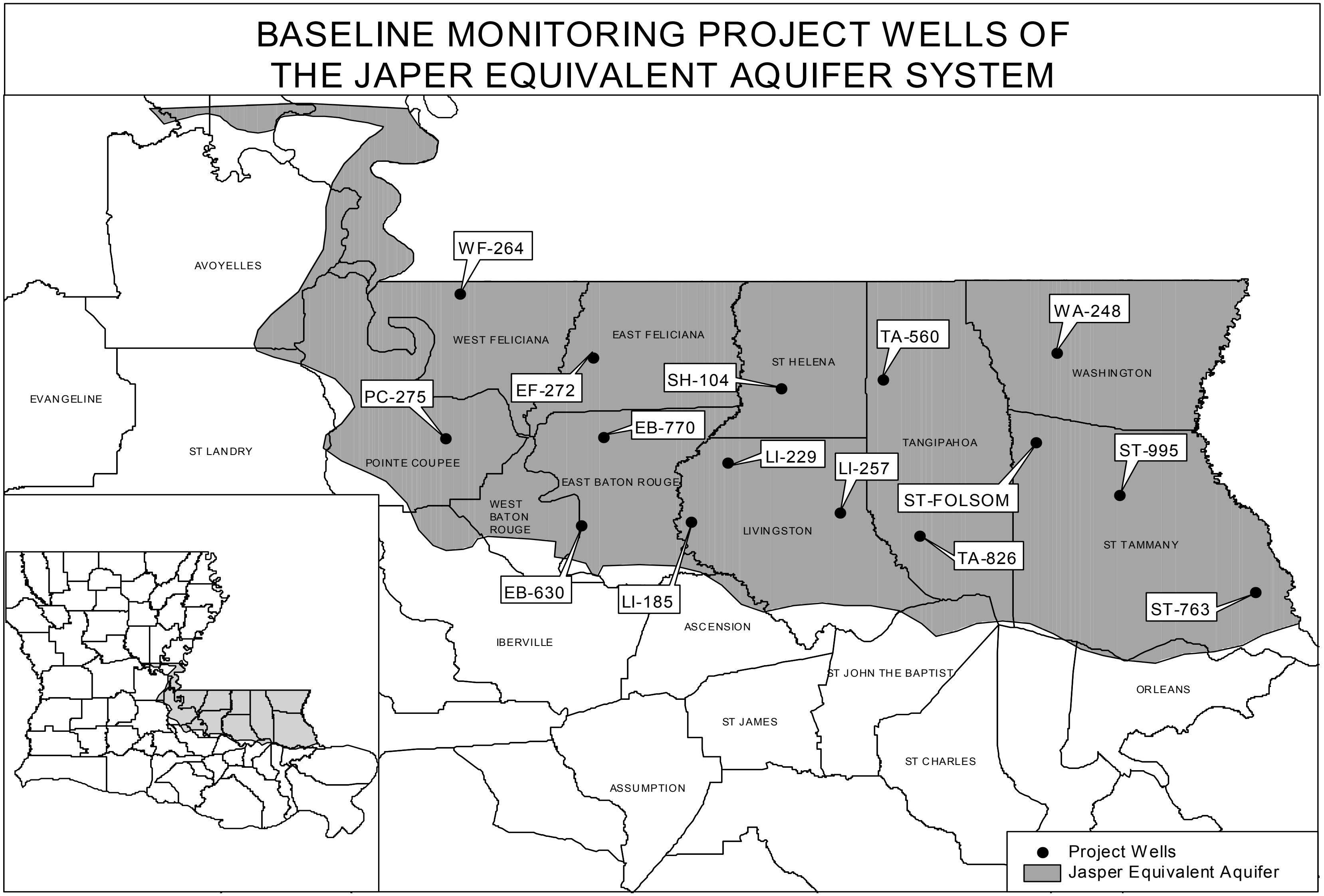
PARAMETER	HISTORICAL AVERAGE	CURRENT AVERAGE
Antimony (ppb)	7.78	<5
Arsenic (ppb)	<5	<5
Barium (ppb)	24.20	11.65
Beryllium (ppb)	<2	<2
Cadmium (ppb)	<2	<2
Chromium (ppb)	<5	<5
Copper (ppb)	<5	14.01
Iron (ppb)	27.46	28.25
Lead (ppb)	<10	<10
Mercury (ppb)	<0.05	<0.05
Nickel (ppb)	<5	<5
Selenium (ppb)	<5	<5
Silver (ppb)	<1	<1
Thallium (ppb)	<5	<5
Zinc (ppb)	<10	22.92

Summary and Conclusions

In March, April, and May of 2000, fifteen wells that produce from the Jasper Equivalent aquifer system were sampled as part of the regular BMP sampling rotation. A review of the laboratory analyses show that all federal primary drinking water standards were met. A review of the laboratory analyses shows that well ST-995 exceeded color's secondary standard of 15 color units with a measure of 17 color units; however, this secondary standard is an unenforceable guideline relating primarily to the aesthetics of drinking water. One well exceeded the federal lead action level of 15 ppb established to ensure that lead does not pose either a short-term or long-term health risk in public drinking water. ST-995 exceeded the action level with a concentration of 15.5 ppb. The owner of this well was notified of this level. No further action has been taken as a result of this lead level since the well is classified as an irrigation well and not a drinking water supply well. No volatile organic compounds, semi-volatile organic compounds, pesticides, or PCBs were found. The average for hardness shows the ground water to be soft.

A comparison of the historical data averages with the current averages data shows that antimony decreased to below its quantification limit from 7.78 ppb, copper increased from below its quantification limit from <5 ppb to 14.01 ppb, and zinc went from <10 ppb to 22.92 ppb. Otherwise the averages are consistent.

The data from this sampling show that the ground water from this aquifer is of good quality when considering short-term or long-term health risk guidelines and taste, odor or appearance guidelines.



Aquifer boundary digitized from Louisiana Hydrologic Map No. 2: Areal Extent of Freshwater in Major Aquifers of Louisiana.
Smoot, 1988; USGS/LDOTD Report 86-4150

Figure 14 Jasper Equivalent Aquifer System

STATEWIDE SUMMARY OF FINDINGS

Combined Aquifer Data

Table 55 on page 95 shows the minimum and maximum sample results, out of all the results from every aquifer and aquifer system that was sampled, for field parameters, water quality parameters, nutrients, and metals, as well as an average of all these sample results. Table 54 below highlights the pH, TDS, hardness, chloride, iron, and nitrite-nitrate values shown in Table 55. It should be noted that the only average listed in Table 54 that does not meet a federal drinking water standard is the iron average of 1,431.25 ppb.

Table 54

PARAMETER	MINIMUM	MAXIMUM	AVERAGE
pH (SU)	4.98	9.26	7.14
TDS (ppm)	14.0	1267.0	359.7
Hardness (ppm)	<5	657.0	95.2
Chloride (ppm)	<1.25	729.0	54.0
Iron (ppb)	<10	21339.0	1431.25
Nitrite-Nitrate (ppm)	<0.02	5.34	0.20

Federal Primary MCL and Action Level Exceedances

A review of the laboratory data from all the aquifers sampled shows that there were two exceedances of the primary MCL for arsenic and one exceedance of the primary MCL for benzene. There was also one exceedance of the primary MCL for nickel, however that MCL has since been remanded. Also, one of the wells sampled exhibited a mercury level that was below mercury's MCL, but was still a higher than expected concentration.

A review of the laboratory data from all the aquifers sampled shows that there were four exceedances of the federal action level for lead.

The instances mentioned above are the only confirmed exceedances of primary MCLs and the only exceedances of a federal action level. Considering the fact that the BMP sampled 184 wells completed in fourteen different aquifers or aquifer systems, these numbers show that the overall quality of the ground water in the state of Louisiana is good, when considering short-term or long-term health risk guidelines.

SUMMARY STATEMENT

In conclusion, a few of the aquifers exhibited localized concentrations of certain analytes and some exhibited fair water quality when considering taste, odor or appearance guidelines, but for the most part they exhibited overall good water quality. Considering this, and taking into consideration the quality of the ground water as far as short-term or long-term health risk guidelines, it is this Office's opinion that the overall quality of the ground water in Louisiana is good.

Table 55
Data Summary of All Aquifers/Aquifer Systems

Water Quality Parameters

	FIELD PARAMETERS				LABORATORY PARAMETERS													
	pH SU	**Temp ^{0} C**	**Cond mmhos /cm**	**Salinity ppt**	**TSS ppm**	**TDS ppm**	**Alk ppm**	**Hardness ppm**	**Turbidity NTU**	**Cond umhos /cm**	**Color PCU**	**Chloride ppm**	**Sulfate ppm**	**Nitrite-Nitrate ppm**	**Phosphorus ppm**	**TKN ppm**	**TOC ppm**	**Ammonia ppm**
Laboratory Detection Limits					4	4	0.1	5	1	1	1	1.25	1.25	0.02	0.05	0.05	4	0.1
Min	4.98	16.65	0.023	0.01	<4	14.0	<0.1	<5	<1	21.5	<5	<1.25	<1.25	<0.02	<0.05	<0.05	<4	<0.1
Max	9.26	34.14	2.457	1.01	66.3	1267.0	614.0	657.0	250.00	2615.0	200.0	729.0	390.00	5.34	4.15	7.17	24.00	6.53
Avg	7.14	22.45	0.559	0.27	5.4	359.7	199.4	95.2	13.47	567.6	13.1	54.0	14.54	0.20	0.30	0.66	<4	0.43

Inorganic (Total Metals) Parameters

	Antimony ppb	**Arsenic ppb**	**Barium ppb**	**Beryllium ppb**	**Cadmiuim ppb**	**Chromium ppb**	**Copper ppb**	**Iron ppb**	**Lead ppb**	**Mercury ppb**	**Nickel ppb**	**Selenium ppb**	**Silver ppb**	**Thallium ppb**	**Zinc ppb**
Detection Limits	5	5	10	2	2	5	5	10	10	0.05	5	5	1	5	10
Min	<5	<5	<10	<2	<2	<5	<5	<10	<10	<0.05	<5	<5	<1	<5	<10
Max	6.00	81.80	1091.0	2.50	3.70	63.00	4746.00	21339.0	54.70	2.50	5197.0	9.30	9.60	<5	3470.0
Avg	<5	<5	164.89	<2	<2	<5	39.38	1431.25	<10	<0.05	26.67	<5	<1	<5	111.32

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