Louisiana Water Quality Standards Ecoregions:

For Use in Ecologically-Driven Water Quality Standards

Revision 1

May 1, 2014

Municipal, Biosolids, and Water Quality Section
Water Permits Division, Office of Environmental Services

Louisiana Department of Environmental Quality
Baton Rouge, Louisiana

The Louisiana Department of Environmental Quality (LDEQ) is utilizing an ecoregional approach to water quality management, specifically in water quality standards development and refinement. Historical information was synthesized with information gleaned from additional, more recent sources and pertinent literature as well as with chemical, physical, and biological data collected within water bodies of Louisiana thus providing the basis for describing the ecological characteristics within the state of Louisiana, and ultimately, refining ecoregion delineations. This report also represents a compilation of the historical ecoregional delineations developed by LDEQ.

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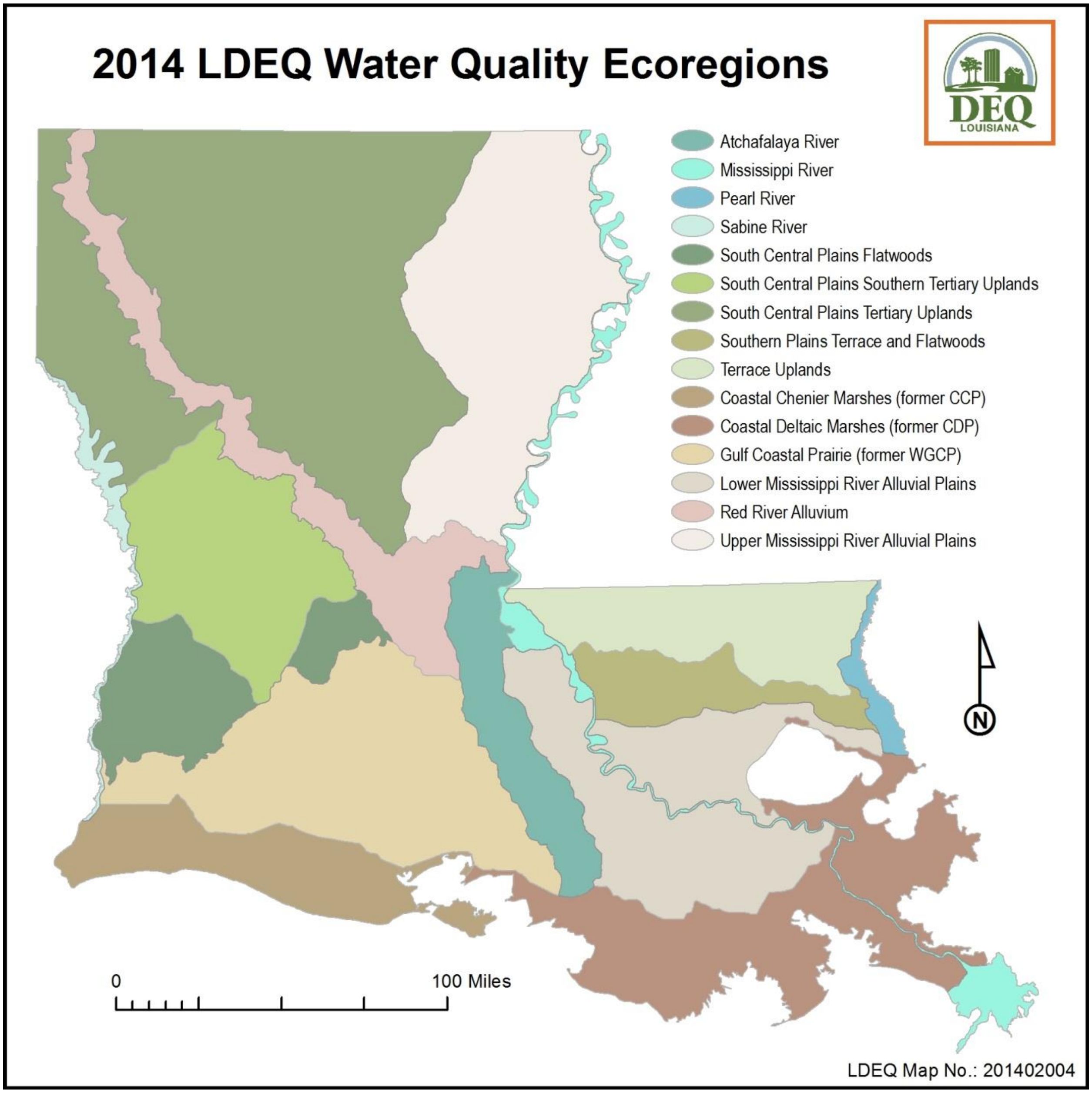
I. ABSTRACT

The Louisiana Department of Environmental Quality (LDEQ) is utilizing an ecoregional approach in the development and refinement of Louisiana state water quality standards and criteria. The LDEQ delineated water quality standards ecoregions are presented below. GIS-based maps and sources as well as physical, chemical, and biological characteristics observed in Louisiana streams are presented to support the ecoregional groupings and boundary refinements.



II. OBJECTIVE

The objective of this document is to present ecoregional boundary refinements for the inland areas of Louisiana. Justification and documentation representing multiple lines of evidence are presented to support the ecoregion refinements. These water quality standards ecoregions ultimately provide the framework and basis for determining regionally appropriate water quality criteria that will be regulated for the protection of designated uses within water bodies of Louisiana.

III. BACKGROUND

A. ECOREGIONAL APPROACH

The Louisiana Department of Environmental Quality (LDEQ) is utilizing an ecoregional approach for water quality management. Specifically, this ecoregional approach is being utilized for determining appropriate water quality standards throughout water bodies in Louisiana. An ecoregion is an area with similar ecological characteristics such as climate, soil type, land surface form, flora, fauna, and potentially similar land use and hydrology. Within an ecoregion, reference water bodies that are considered to be 'least-impacted' by human activities represent regionally attainable conditions. Thus, ecological-based water quality criteria and standards can be based on the ecological characteristics of reference water bodies that represent the attainable conditions within an ecoregion (LDEQ 2008a, LDEQ 2010c (LAC 33:IX.Chapter 11)). This results in regionally specific criteria that may be more appropriate than existing national benchmark levels and also provides a framework for developing regionally appropriate water quality standards and criteria in Louisiana water bodies.

LDEQ initiated the ecoregional program to water quality management in the late 1980's. During this effort, ecoregions within Louisiana were delineated, reference stream sites in inland areas were identified, and physical, chemical, and biological characteristics were monitored, observed, and described. As LDEQ is currently refining water quality criteria, including dissolved oxygen (LDEQ 2008a, LDEQ 2008b), and evaluating development of numeric nutrient criteria (LDEQ 2006, LDEQ 2009) on an ecoregional basis, LDEQ is refining the ecoregion delineations through consideration of more current information that includes GIS-based maps and sources developed by state and federal agencies; physical, chemical, and biological characteristics observed at reference water bodies; and chemical characteristics observed at ambient surface water monitoring stream locations throughout Louisiana. The synthesis of maps and the physical, chemical, and biological information provide the basis for ecoregion boundary refinement.

B. NATIONAL ECOREGIONS

In the late 1980s, the United States Environmental Protection Agency (USEPA) produced a map of national ecoregional boundaries, including Louisiana, based on evaluation of geographical, geological, biological, and other environmental characteristics. This national effort provided a basis for understanding regional patterns of ecological characteristics that may serve as a framework for state-level management of water resources (Omernik 1986). While the national approach did provide a framework for regional management of water resources, state-specific conditions such as man-made impacts that may form water resource boundaries (such as levees, dredged canals and waterways, locks, and floodgates) were not considered in the USEPA evaluation of national ecoregions (LDEQ 1992).

C. Louisiana Ecoregions

In the early 1990's, LDEQ utilized guidance from USEPA (Omernik 1986, Gallant et al. 1989, Omernik and Griffith 1991) and incorporated state-specific information in the development of ecological regions within Louisiana. This work on the development of Louisiana ecoregions was conducted through cooperation with LDEQ and the University of Southwestern Louisiana Center for Louisiana Inland Water Studies (USL-CLIWS). In this effort, state-based geographic information such as soil associations, US Geological Survey (USGS) contour maps, US Army Corps of Engineers (USACE) hydrological modifications, and LDEQ basin-subsegment boundaries among other data sources were compiled and synthesized to provide the basis for Louisiana ecoregions.

In 1992, LDEQ produced an initial draft map of Louisiana ecoregion delineations (LDEQ 1992, see Appendix A, Figure 2). In these ecoregion delineations, LDEQ refined the USEPA designated ecoregions in Louisiana by the addition of the Atchafalaya Basin, Coastal Chenier Plains, Coastal Deltaic Plains, Mississippi River, Red River Alluvial Plains, Sabine River, and Terrace Uplands Ecoregions. In development of the Terrace Uplands Ecoregion, LDEQ consolidated the USEPA designated Southeastern Plains, Mississippi Valley Loess Plains, and the Southern Coastal Plains Ecoregions to form the Terrace Uplands Ecoregion. Thus the initial draft ecoregion map produced by LDEQ delineated ten ecoregions throughout the state (Atchafalaya Basin, Coastal Chenier Plains, Coastal Deltaic Plains, Mississippi Alluvial Plain, Mississippi River, Red River Alluvial Plains, Sabine River, South Central Plains, Terrace Uplands, and Western Gulf Coastal Plains Ecoregions). It was also suggested in this initial effort that additional large river ecoregions in Louisiana (such as the Pearl and Ouachita River Basins) may potentially be added in future delineation refinements (LDEQ 1992).

In 1994, LDEQ revised the 1992 draft map by modifying the southern boundary of the Red River Alluvial Plains Ecoregion to join the Mississippi River levee and continue southward to the Old River Diversion Channel (see Appendix A, Figure 3). LDEQ also subdivided the Mississippi River Alluvial Plains Ecoregion into an Upper and a Lower Mississippi River Alluvial Plains Ecoregion. The Sabine River Ecoregion was removed by combining it with the adjacent South Central Plains and the Western Gulf Coastal Plains Ecoregions, respectively (see Appendix A, Figure 4).

In 2001, LDEQ revised the ecoregional delineations with modifications to the boundaries of the Lower Mississippi River Alluvial Plains, Red River Alluvial Plains, South Central Plains, Terrace Uplands, Upper Mississippi River Alluvial Plains, and Western Gulf Coastal Plains Ecoregions (Appendix A, Figure 5). The Red River Alluvial Plains Ecoregion was modified to conform to levees of the Red River and became the Red River Ecoregion. Additionally, large river ecoregions were added for the Sabine and Pearl Rivers. For the South Central Plains (SCP) and Western Gulf Coastal Plains (WGCP) Ecoregions transition area, the boundary was moved further south in the central portion and also moved to along the eastern edge of the Vermilion-Teche Water Quality Management Basin. These changes to the SCP and WGCP Ecoregion boundary were likely made based on ecoregional research by DeWalt (1995, 1997) through observation that the southern portion of the SCP retained biological characteristics that more closely resembled that of the SCP than the WGCP in the central portion of the transitional area.

The 2001 LDEQ delineated ecoregions (Appendix A, Figure 6) have been used extensively in the LDEQ water quality standards program efforts for refinement of appropriate, regional dissolved oxygen water quality criteria (LDEQ 2007, LDEQ 2008a, LDEQ 2008b), are being used in the development of numeric nutrient criteria (LDEQ 2006 *Nutrient Criteria Development Plan*, LDEQ 2009), and have been used in research of Louisiana water bodies (Kelso and Rutherford 2008, EPA 2005).

IV. INLAND ECOREGIONAL BOUNDARY REFINEMENT PROCESS

A. SOURCES OF INFORMATION

LDEQ is utilizing various GIS-based data sets available from state and federal agencies that provide documentation on land surface forms, climate, land use, forestry and other factors that support ecoregional delineation. In addition, LDEQ has conducted chemical water quality, physical habitat assessment, and biological fish and benthic macroinvertebrate data collection efforts in inland ecoregion reference streams (LDEQ 1996, LDEQ 2009). This chemical, physical, and biological information available from reference streams will further aid in documenting ecological characteristics to support delineation efforts.

LDEQ is utilizing this information from reference streams to illustrate ecoregional groupings based on chemical water quality as well as physical habitat and biological aquatic organisms observed at reference water bodies within different inland regions of the state. Additionally, water quality characteristics observed at ambient surface water monitoring stream locations throughout the state also help to demonstrate regional differences and further aided in the refinement of inland ecoregional delineations. In this effort, only select inland ecoregional boundaries and groupings were considered for refinement as these areas are currently those where water quality criteria development and/or refinement are taking place.

Several sources of information were evaluated including: LDEQ ecoregional studies (i.e., DeWalt 1995a, DeWalt 1995b, and LDEQ 1992); the USEPA ecoregion project (Daigle et al. 2006); ecoregional recommendations from external sources (Daigle et al. 2006; McNab et al. 2007); various GIS-based data sets (including Digital Orthophoto Quarter Quadrangle (DOQQ), Digital Elevation Model 2007 (DEM), and GIS-calculated percent change in slope); soil data from USGS National Wetlands Research Center STATSGO; land use coverage from USGS National Land Cover Data (NLCD 2001); LDEQ collected water quality data at inland reference streams (LDEQ 1996, LDEQ 2009); and data from the LDEQ Ambient Monitoring Program (LDEQ 2010b).

1. *Ecoregional Recommendations from External Sources*

Ecoregion recommendations from external sources considered in boundary refinement are given in Appendix B. External recommendations were based on a variety of approaches, data, and objectives. Sources included USEPA's Level III and Level IV Ecoregions (Daigle et al. 2006) as well as the USDA Forest Service Ecoregion Delineations (McNab et al. 2007).

2. *Base Maps*

Base maps evaluated and considered in boundary refinement are given in Appendix C. It should be noted that base maps of well known hydrologic units, such as LDEQ basins and subsegments or that of USGS Hydrologic Unit Maps (HUCs) (Seaber et al. 1987), were considered but not utilized in ecoregional delineation refinement. Previous research indicates that many hydrologic units are not true watersheds, and thus do not necessarily correspond to spatial patterns in ecological characteristics (Omernik 1991, Griffith et al. 1999, Omernik 2003). While hydrologic units such as basins, subsegments, and HUCs may provide a framework for the cataloging and inventory of water quality and other data, these hydrologic units are not necessarily true indicators of distribution and patterns of ecological characteristics which ultimately define an ecoregion.

3. *Chemical Characteristics*

Water quality was considered from inland reference stream and ambient surface water stream monitoring locations throughout the state. Because of differences in patterns of chemical water quality constituents, it may not be possible that every chemical water quality parameter evaluated will group according to ecoregion. Thus, determination of ecoregional boundary refinement utilizing water quality information is based not necessarily on the distribution of one specific parameter but on overall patterns in water quality throughout regions within the state. Water quality specific data that was evaluated and considered in the refinement of ecoregion boundaries are presented in Appendix D.

4. *Physical and Biological Characteristics*

Physical habitat and biological fish and benthic macroinvertebrates were evaluated from reference water bodies. These physical and biological components of reference streams may be used to document the aquatic habitat and the observed fish and benthic macroinvertebrate taxa distribution at reference water bodies. These ecological characteristics further aided in characterization of ecoregions. Physical habitat and biological fish and benthic macroinvertebrate specific data that were evaluated and considered in the refinement of ecoregion boundaries are presented in Appendices E and F, respectively.

5. SLOPE

The overall uniformity of slope was used in delineating each ecoregion. Slope refers to the percent change in elevation that characterizes the shape a landform; e.g., hilly landforms will have greater slope than flat plains. Slope is also relevant in that certain habitat types, soils, and some waterbody forms are commonly associated with certain landforms; e.g., hydric soils in wetlands typically occur in areas with low slope. Additionally, dissolved oxygen has a greater ability to reaerate in the water column of waterbodies that are located in ecoregions with high or moderate slopes. Slope data is presented in Appendix C, Figure 19.

6. FIELD RECONNAISSANCE

Additionally, field reconnaissance was conducted at reference water bodies and at other water bodies throughout the state. Field reconnaissance served as ground-truthing of the watershed and aquatic habitat features as well as other important ecological characteristics such as land use, land form, and vegetation type to support ecoregion refinements.

7. LAND USE

The predominance of land use was used in delineating each ecoregion. Certain landforms and soils types can limit the degree to which land can be used; particularly with agriculture and forestry. Land use is also relevant in determining the degree of man-made alterations to the landscape. Land use data is presented in Appendix C, Figure 20 and Appendix G.

B. SYNTHESIS AND MULTIPLE LINES OF EVIDENCE

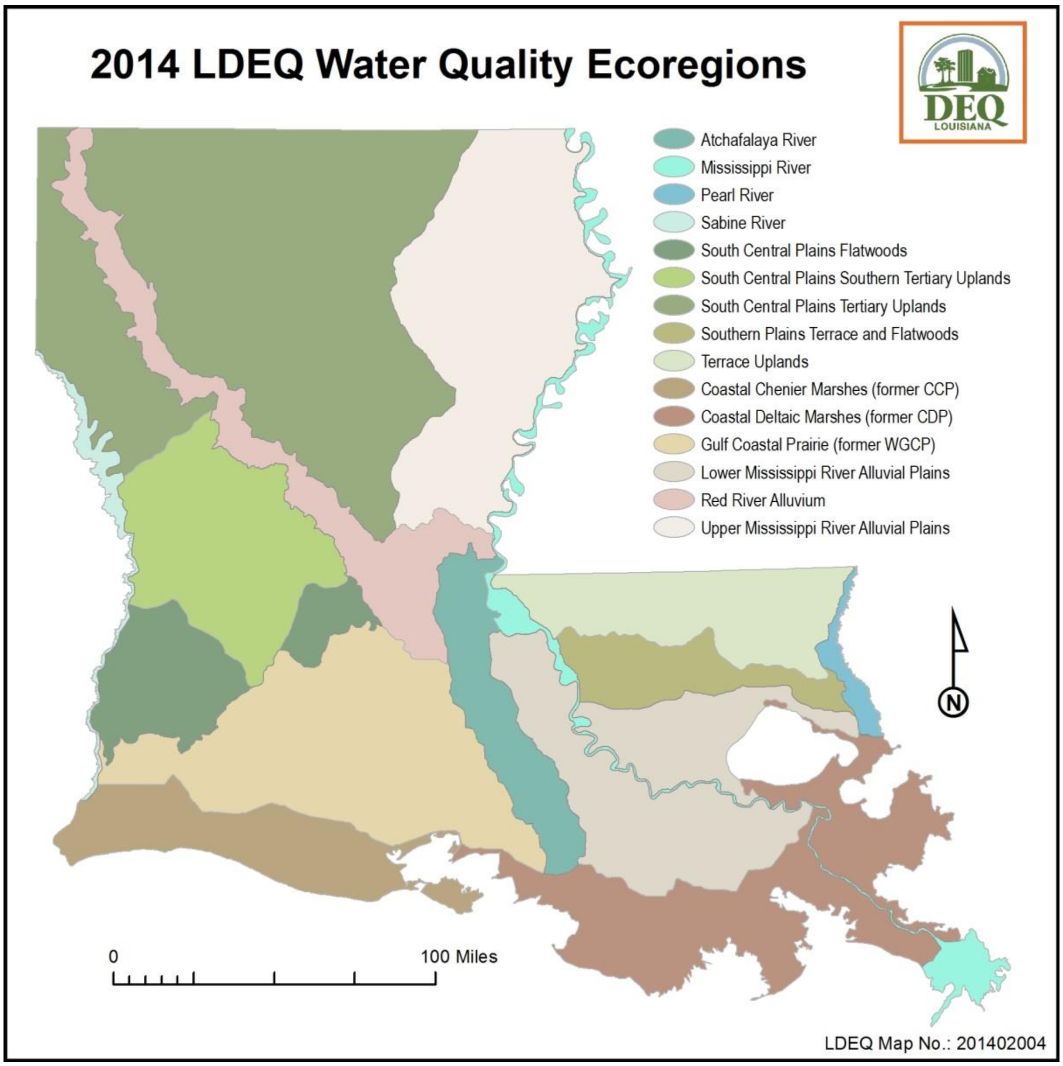
By compiling the GIS-based maps and the physical, chemical, and biological information evaluated and reviewed, LDEQ has refined the inland ecoregional boundaries. These boundary refinements represent a synthesis of the available information and are supported in many cases by multiple lines of evidence. These boundary refinements were made to further support the development and refinement of appropriate regional water quality criteria within Louisiana.

The 2014 water quality standards ecoregions for Louisiana are presented below. Proposed refinements are discussed relative to changes from the 2001 ecoregion delineations and naming conventions. Where deemed more appropriate, ecoregional names were also refined.

V. 2014 WATER QUALITY STANDARDS ECOREGIONS

For 2014, LDEQ has refined several ecoregional boundaries and in some cases refined ecoregional names. The 2014 water quality standards ecoregions for Louisiana are given in Figure 1. Physical, chemical, and biological information as well as GIS-based sources were utilized in the refinement. These refinements support the framework for the development and/or refinement of water quality standards within Louisiana.

Figure 1. Water Quality Standards Ecoregions for Louisiana (2014).
The 15 water quality standards ecoregions in Louisiana include: 1) Atchafalaya River; 2) Coastal Deltaic Marshes; 3) Coastal Chenier Marshes; 4) Gulf Coastal Prairie; 5) Lower Mississippi River Alluvial Plains; 6) Mississippi River; 7) Pearl River; 8) Red River Alluvium; 9) Sabine River; 10) South Central Plains Flatwoods; 11) South Central Plains Southern Tertiary Uplands; 12) South Central Plains Tertiary Uplands; 13) Terrace Uplands (Southern Plains); 14) Southern Plains Terrace and Flatwoods; and 15) Upper Mississippi River Alluvial Plains.



A. BOUNDARY REFINEMENTS

The following sections provide a key to the major updates made from the 2001 to the 2014 water quality standards ecoregions.

1. SUBREGIONALIZATION OF THE SCP ECOREGION

Changes to the SCP and WGCP Ecoregion boundary resulted in portions of the southern boundary of the SCP Ecoregion (SCP Southern Tertiary Uplands) being extended further south. This takes into account the transition in elevation (Appendix C, Figures 17 and 18), slope (Appendix C, Figure 19), land use (Appendix C, Figure 20), soil type (Appendix C, Figure 24), and geology (Appendix C, Figure 25) that occur between the southern SCP and northern WGCP, documentation that reference sites in the southern SCP maintain the biological characteristics of the SCP, and other noted habitat characteristics at reference sites within this area (DeWalt 1995b, LDEQ 2009, see also Appendix D -F).

The SCP Ecoregion is subdivided into three ecoregions: SCP Flatwoods, SCP Southern Tertiary Uplands, and SCP Tertiary Uplands. These groupings take into account ecological differences observed in theses zones especially with regard to land form. The SCP Flatwoods subregion is generally characterized as having low elevation (Appendix C, Figures 17 and 18) and less slope (Appendix C, Figure 19) than the SCP Southern Tertiary Uplands and the SCP Tertiary Uplands. The SCP Southern Tertiary Uplands is also distinct from the other subregions in terms of geological complexity (Appendix C, Figure 25; Table 1). Differences in water quality (see Appendix D), habitat (see Appendix E), and observed biological fish species distribution (see Appendix F) were also taken into account when subdividing the SCP.

Table 1. Geological Groups, Formations, and Members within each subregion of the SCP (see Appendix C, Figure 24 for corresponding spatial information).

Ecoregion	Geological Unit	Description
SCPSTU	Sparta Formation	White to light gray massive sands with interbedded clays; some thin interbeds of lignite or lignitic sands and shales.
	Cook Mountain Formation	Greenish gray sideritic, glauconitic clay in upper part may weather to brown ironstone; yellow to brown clays and fossiliferous marl in lower part may weather to black soil. Ironstone concretions near base.
	Jackson Group (Undifferentiated)	Light gray to brown lignitic clays with interbeds of limonitic sands or lignite; near base, calcareous, glauconitic, and fossiliferous beds may weather to black soil.
	Cockfield Formation	Brown lignitic clays, silts, and sands; some sideritic glauconite may weather to brown ironstone in lower part.
	Catahoula Formation	Gray to white sandstones, loose quartz sand, tuffaceous sandstone, volcanic ash, and brown sandy clays; petrified wood locally.
	Carnahan Bayou Member	Yellow to gray siltstones, sandstones, and clays with thin tuffaceous beds; some lenses of black chert gravel; petrified wood locally.
	Dough Hills Member	Gray to yellow silty clays; light gray calcareous clays which may weather to black soil; some siliceous silt and volcanic ash beds.
	Williamson Creek Member	White to gray silts, siltstones, silty clays, and sand beds; some lenses of black chert gravel.
	Blounts Creek Member	Gray to green silty clays, siltstones, and silts with abundant sand beds; some lignite and lenses of black chert gravel.

Ecoregion	Geological Unit	Description
SCPSTU	Castor Creek Member	Gray to dark gray calcareous slays which may weather to black soil; lignitic clays and noncalcareous clayey soils.
	High Terraces	Tan to orange clay, silt, and sand with a large amount of basal gravel. Surfaces are highly dissected and less continuous than lower terraces. Composed of terraces formerly designated as Williana, Citronelle, and the highest Bentley.
SCPF	Intermediate Terraces	Light gray to orange-brown clay, sandy clay, and silt; much sand and gravel locally. Surfaces show more dissection and are topographically higher than the Prairie Terraces. Composed of terraces formerly designated as Montgomery, Irene, and most of the Bentley.
	Prairie Terraces	Light gray to light brown clay, sandy clay, silt, sand, and some gravel. Surfaces generally show little dissection and are topographically higher than the Deweyville. Three levels are recognized: two along alluvial valleys, the lower coalescing with its broad coastwise expression; the third, still lower, found intermittently gulfward.
	Deweyville Terrace	Gray mixed with brown-to-red clay and silty clay; some sand and gravel locally. Topographically higher that Holocene alluvium and lower than Prairie terraces. Found along streams of intermediate size.
SCPTU West of RRA	Wilcox Group (Undifferentiated)	Gray to brown lignitic sands and silty to sandy lignitic clays, many seams of lignite; some limestone and glauconite. Includes small Carrizo Sand (Claiborne Group?) outcrops.

2. *WGCP ECOREGION*

While the northern portion of the WGCP has become part of the SCP Flatwoods Ecoregion, the remaining portion of the WGCP Ecoregion will be evaluated in future ecoregional studies. The remaining portion of the WGCP Ecoregion will be referred to as the Gulf Coastal Prairie (GCP) Ecoregion to reflect the soil type found in this region (see Appendix C, Figure 24).

3. *SCP AND UMRAP BOUNDARY*

The eastern boundary of the SCP Ecoregion and the western boundary of the UMRAP Ecoregion have been modified to account for observed ecological differences between these two regions (e.g., elevation, slope, land use, and vegetation). More recent GIS-based maps and sources were heavily utilized in this boundary refinement (see Appendix C, Figures 17-20 and 22-23). This portion of the SCP Ecoregion, adjacent to the UMRAP Ecoregion, is referred to as the SCP Tertiary Uplands.

4. *TU AND LMRAP BOUNDARY*

Modifications to the southern boundary of the TU and the northern boundary of the LMRAP Ecoregions were also heavily based on more recent GIS-based maps and sources. Elevation and slope differ distinctly between the southern boundary of the TU and the northern boundary of the LMRAP Ecoregions (Appendix C, Figures 17-19). Additionally, extensive research and field reconnaissance investigating the tidal extent in that area as well as known fish species distribution further supported ecoregional refinement in this area (see Appendix C, Figure 30; LDEQ 1990; Sobczak 1976; Watson et al. 1981; Knight and Hastings 1984; Delorme 2003; Read 2008).

5. *SUBDIVISION OF THE TERRACE UPLANDS ECOREGION*

The southern extent of the former TU Ecoregion and the northern extent of the LMRAP Ecoregion were refined as discussed in Section 4 above. The remaining area of the TU Ecoregion was further subdivided into the southern portion as the Southern Plains Terrace and Flatwoods (SPTF) Ecoregion and the northern portion as the Terrace Uplands (Southern Plains) Ecoregion. This was done due to the transitional nature of the Southern Plains Terrace and Flatwoods between the more southern, low elevation LMRAP and the more northern, high elevation TU (Southern Plains). The southern boundary of the TU Ecoregion and the northern extent of the SPTF were determined based on several ecological factors with emphasis on soil type and geology (Appendix C, Figures 24 and 25). However, it should be noted that additional research or studies may be warranted for this transitional area to characterize the nature of this region in regard to determining the appropriate water quality management strategies (e.g., water quality standards development).

6. *RED RIVER ECOREGION REFINEMENT*

In the historical ecoregion delineations for Louisiana, the Red River was viewed as an ecoregion including the surrounding alluvial plain (1992) and as a large river system confined by levees (2001). In review of the available information, the Red River Alluvial Plains are different in regard to land form (e.g., land use, elevation, slope, soil type, and geology) and water quality compared to the surrounding inland SCP Ecoregions; thus the Red River Alluvial Plains should be observed as an ecoregion separate from the SCP Ecoregions (see Appendix C, Appendix D). Refinement was made to the SCP Ecoregion boundaries in relation to the Red River Alluvial Plains. While the Red River is confined by levees, water quality differences among the river and the Red River Alluvial Plains were not apparent. Field reconnaissance was also conducted in this region. However, at the time that water quality criteria are developed and/or refined for the Red River, a closer inspection of water quality characteristics may be conducted to further clarify the need for a separate ecoregion for the main stem of the Red River apart from the Red River Alluvial Plains.

7. *CDP AND LMRAP BOUNDARY*

At this time, information exists to support refinement of the southern LMRAP and the northern CDP boundary. Refinement was heavily based on observed land form (soil type, geology, and land use) and vegetation (see Appendix C). Field reconnaissance was also conducted in parts of this area.

8. *CDP AND CCP BOUNDARY*

The eastern boundary of the CCP and the western boundary of the CDP were refined based on the soil type and geology of the area (Appendix C, Figure 24 and 25) and differences in water quality (Appendix D). The newly refined ecoregions will be referred to as the Coastal Chenier

Marshes (CCM) Ecoregion and the Coastal Deltaic Marshes (CDM) Ecoregion to better reflect soil type.

B. 2014 Ecoregion Descriptions

1) Atchafalaya River

This ecoregion is surrounded by a levee system on the northern, eastern, and western boundaries. The southern limit of this ecoregion extends to the Intracoastal Waterway. This ecoregion has low relief and much standing water. Vegetation is dominated by oak, tupelo, and bald cypress.

2) Coastal Deltaic Marshes

The Coastal Deltaic Marshes (CDM) Ecoregion is located on the southeast Louisiana coast. This ecoregion is bisected by the Mississippi River. This ecoregion is bounded on the west by the eastern shoreline of Vermilion Bay and portions of the northern boundary are the Intracoastal Waterway. The southern and eastern portion of this ecoregion is the Gulf of Mexico. The northeastern border is with the Lower Mississippi River Alluvial Plains Ecoregion and the Pearl River Ecoregion. The CDM also wrap around eastern portions of Lake Pontchartrain. This ecoregion is typified by low elevation and relief as well as both fresh and salt marsh vegetation. It is also characterized by extensive hydromodification for navigation and flood protection.

3) Coastal Chenier Marshes

This second coastal ecoregion is located on the southwest Louisiana coast. The Coastal Chenier Marshes (CCM) Ecoregion is bounded on the northwestern edge by the Intracoastal Waterway and on the east by the eastern shoreline of Vermilion Bay. The southern portion of this ecoregion is the Gulf of Mexico. Low elevation and relief along with ridges or "cheniers" oriented parallel to the coastline are typical of this ecoregion. Vegetation consists of both fresh and salt marsh types. There are several concentrated areas of hydromodification for navigation and salinity control.

4) Gulf Coastal Prairie

Typified by flat plains, the Gulf Coastal Prairie (GCP) is located in southwestern Louisiana and ranges westward along the eastern coast of Texas. The southern boundary has been modified to coincide with the location of the Intracoastal Waterway. The eastern boundary is the western Atchafalaya River levee system. The northern boundary is up to the SCP Flatwoods Ecoregion. Vegetation is characteristic of the bluestem/sacahuista prairie type (bluestem and cordgrass) and land use consists of mainly cropland and some cropland combined with grazing land. The soil associations represented in this ecoregion are Gulf Coast Flatwoods and Coastal Prairie. Relief and slope are low in this ecoregion.

5) Lower Mississippi River Alluvial Plains

The southern section of the Mississippi Alluvial Plain is bisected by the Mississippi River. The western boundary is formed by the Atchafalaya River levee system and the southern boundary is formed by the Intracoastal Waterway. Part of the northern boundary of the southern component of this ecoregion is formed by the west bank of the Mississippi River. The northern boundary east of the Mississippi River is formed by the southern limit of the Southern Plains Terrace and

Flatwoods. This ecoregion contains natural levees of moderate elevation and slope. Vegetation includes both cypress forest and bottomland hardwoods. Many of the streams in this ecoregion have been hydrologically modified for navigation and flood protection. Relief and slope are low in this ecoregion.

6) Mississippi River
This ecoregion, bounded entirely by the Mississippi River levee network, extends 569 miles from the Arkansas-Louisiana state line to the delta in southeast Louisiana. Because of the unique attributes of this river system, it was designated as a separate ecoregion.

7) Pearl River
This ecoregion is a border river between the states of Mississippi and Louisiana, located on the southern end of Mississippi and a small portion of southeastern Louisiana. The system is braided into various tributaries and terminates in a primarily undisturbed cypress swamp. The headwaters originate approximately 100 miles inland from Louisiana, near Jackson, Mississippi.

8) Red River Alluvium
This ecoregion bisects the South Central Plains Southern Tertiary Uplands and the South Central Plains Tertiary Uplands Ecoregions. The southern boundary of the Red River Alluvium Ecoregion is formed by the northern extent of the Atchafalaya River levee and canal system. This ecoregion is composed of the Red River alluvial plain and is characterized by bottom hardwood vegetation. Relief is moderate and slope low in this ecoregion.

9) Sabine River
This ecoregion is a border river between Texas and Louisiana. This ecoregion includes the Toledo Bend Reservoir and the Sabine River, and due to their atypical qualities and extensive hydrological modification, these water bodies were considered to be a separate ecoregion. Louisiana and Texas each share a portion of the Toledo Bend Reservoir; however, the Sabine River Authority in Texas generally maintains the water levels in the reservoir. Louisiana and Texas representatives cooperate in the management of water quantity and quality in both the Sabine River and Toledo Bend Reservoir that are part of this ecoregion.

10) South Central Plains Flatwoods
The South Central Plains Flatwoods (SCPF) Ecoregion is considered a transitional area between the South Central Plains Southern Tertiary Uplands Ecoregion and the Gulf Coastal Prairie Ecoregion (former Western Gulf Coastal Plains). The eastern border is the Red River Alluvium Ecoregion and the Sabine River Ecoregion forms the western boundary. Vegetation is longleaf forest. Relief and slope are moderate in this ecoregion.

11) South Central Plains Southern Tertiary Uplands
The southern extent of the South Central Plains Southern Tertiary Uplands (SCPSTU) Ecoregion is the transitional South Central Plains Flatwoods Ecoregion. The northwestern boundary is the South Central Plains Tertiary Uplands Ecoregion and the northeastern and eastern boundary the Red River Alluvium Ecoregion. The Sabine River Ecoregion forms the western boundary for

this ecoregion. This ecoregion encompasses the Kisatchie National Forest. Vegetation is shortleaf forest. Relief and slope are high in this ecoregion.

12) South Central Plains Tertiary Uplands

The South Central Plains Tertiary Uplands (SCPTU) Ecoregion is bisected by the Red River Alluvium Ecoregion. The northern border is at the Arkansas and Louisiana state line, whereas the western border is the Texas and Louisiana state line. The Sabine River Ecoregion forms the southwestern border for this ecoregion. The southern border is the South Central Plains Southern Tertiary Uplands and the Red River Alluvium Ecoregions. The eastern border is the Upper Mississippi River Alluvial Plains Ecoregion. Vegetation is shortleaf and oak/hickory forest. Relief and slope are high in this ecoregion.

13) Terrace Uplands

The Mississippi River levee system is the western boundary of the Terrace Uplands (TU) Ecoregion. The southern boundary of this ecoregion is the Southern Plains Terrace and Flatwoods and the eastern boundary is the Pearl River Ecoregion. The Terrace Uplands Ecoregion is characterized by longleaf and shortleaf vegetation types. Relief and slope are high in this ecoregion.

14) Southern Plains Terrace and Flatwoods

The Southern Plains Terrace and Flatwoods (SPTF) Ecoregion is a transitional area between the more northern Terrace Uplands Ecoregion and the more southern Lower Mississippi River Alluvial Plains Ecoregion. Vegetation includes bluffland-woodland types, mixed longleaf forests, and some prairie grassland. This ecoregion is characterized by moderate relief and slope.

15) Upper Mississippi River Alluvial Plains

The Upper Mississippi River Alluvial Plains Ecoregion is located in the northeastern part of Louisiana. The continuity of the Upper Mississippi River Alluvial Plains Ecoregion southward through Louisiana is interrupted by the Red River Alluvium Ecoregion and the Atchafalaya River Ecoregion. The eastern boundary of this ecoregion is formed by the Mississippi River levee system. The western boundary is the South Central Plains Tertiary Uplands. The southern extent of this ecoregion terminates at the Red River. A majority of this ecoregion is characterized with relief and slope that are low to moderate. Land use consists of mainly cropland in these areas. There are also portions of this ecoregion that contain natural ridges of moderate elevation and slope. Habitat types in these areas include both cypress forest and bottomland hardwoods. Many of the streams throughout this entire ecoregion have been hydrologically modified for irrigation.

VI. NEXT STEPS FOR USE OF ECOREGIONS IN WATER QUALITY MANAGEMENT

LDEQ has considered several sources including base maps, water quality, watershed and aquatic habitat features, and biological aquatic species distribution in the ecoregional groupings and the refinement of the inland ecoregional boundaries within the state of Louisiana. These ecoregions represent regions of similar ecological characteristics based on factors LDEQ considers important in the development and/or refinement of water quality standards.

The use of the ecoregional approach for derivation of water quality standards for the protection of designated uses represents significant progress toward the setting of regionally appropriate water quality criteria for the protection of the fish and wildlife propagation use in Louisiana's water bodies. Implementation of the ecoregion approach through LDEQ's development and/or refinement of water quality standards (LDEQ 2010c, LAC 33:IX) represents a first step in the use of ecoregions to not only characterize the attainable water quality using a regional approach, but to provide a framework for implementation, assessment, and the ultimate management of water resources within the state.

A. MODELING, TOTAL MAXIMUM DAILY LOADS, AND PERMITS

As water quality standards provide an endpoint for Total Maximum Daily Loads (TMDLs) and permit limits, modelers and permit writers should be informed of the use of ecoregions in development and/or refinement of water quality standards. Additionally, modelers and permit writers may evaluate the use of ecoregionally-derived water quality standards in their processes in order to evaluate next steps for model development and permitting.

As it may be difficult to identify reference sites in some areas of the state due to recent development and urbanization, other methods, such as evaluating the historical ambient water quality conditions prior to land development and urbanization or water quality modeling, may need to be employed in determining the protective water quality conditions within certain ecoregions where land development and urbanization are prevalent. Thus collaboration with water quality standards staff and modelers may be useful in this effort to set appropriate water quality criteria in regions where identification of reference areas may prove difficult.

B. EVALUATION OF SUBSEGMENT BOUNDARIES

Management of water resources has historically been conducted through a basin and subsegment approach (LDEQ 2010c, LAC 33: IX), which is still appropriate for many water quality standards, including most human health criteria. There are twelve water resource management basins delineated within the state that currently include over 470 smaller subsegments. These subsegments within basins serve as the current framework from which water quality standards are implemented (LDEQ 2010c, LAC 33:IX) and water quality assessments reported (LDEQ Integrated Report – 305(b) Report and 303(d) List of Water Body Impairments). Also, subsegments provide the framework for endpoints for TMDLs and measures for permit limits.

Ecoregional boundaries are typically independent of subsegment boundaries; thus in some cases, subsegments may actually delineate water resources that fall within two or more ecoregions. As a result, the determination of the most appropriate water quality criterion may not be intuitive. As subsegment delineations are evaluated, some may warrant refinement; those subsegments that cross ecoregion boundaries may be considered a priority for this re-evaluation. Approaches other than subsegment refinements will also be evaluated for the adoption and implementation of ecoregional-based water quality standards.

C. Ambient Monitoring Locations

Water quality assessments are conducted and reported on a biannual basis through evaluation of water quality at ambient monitoring locations throughout the state. In the water quality assessments, water quality at ambient locations within subsegments are compared to the water quality criteria for designated uses for that subsegment, and determinations of use support are made. Water bodies that fail to support the designated uses are then listed on the 303(d) list [see Clean Water Act Section 303(d)] of water bodies not meeting standards.

As these water quality assessments are currently reported by subsegment, each subsegment may contain one or more ambient monitoring sites where water quality is measured and used to assess the condition of the water body within the subsegment, as compared to the applicable water quality criteria and designated uses. Locations of ambient monitoring sites may need to be re-evaluated to account for ecology-based uses and criteria, especially in areas where subsegment boundaries were refined and in subsegments that may cover more than one ecoregion to ensure that the assessment location is appropriate.

D. Implementation of Water Quality Standards

As water quality standards are being developed and refined through the use of an ecoregional approach, the water body type (i.e., stream, lake, bay/estuary, wetland, etc.) is also taken into consideration in the determination of appropriate, regionally based water quality standards (LDEQ 2006, LDEQ 2008a, LDEQ 2008b, LDEQ 2010c, LAC 33:IX). Currently, water quality standards are implemented according to subsegment. Thus, in subsegments with multiple water body types (such as those that contain water bodies classified as stream, lake, and possibly wetland), the water quality standard of the named water body is the one that is listed in the water quality regulations for the subsegment (LDEQ 2010c, LAC 33:IX). Water quality standards developed by LDEQ do protect all water bodies within a subsegment and therefore all water bodies within the state. However, as LDEQ progresses with development and refinement of water quality criteria on an ecoregional and water body type basis, further clarification may be needed in the regulations as to the applicable water quality criterion for a given water body when multiple water body types are present within a subsegment.

E. Water Quality Assessments and Integrated Reporting

Development and/or refinement of water quality standards using an ecoregional approach may also necessitate changes to water quality assessment procedures. With the move to setting more appropriate regionally-based water quality criteria based on attainable conditions within an ecoregion and water body type, water quality assessment reporting that compliments the water quality criteria derivation framework may be evaluated and employed.

In addition, the production of the Integrated Report that contains the 303(d) list of waters not meeting standards is currently based on subsegments. However, with the progression toward setting of ecoregional based water quality criteria, it may be necessary and more appropriate to report water quality assessments and impairments by ecoregion and water body type or in some other manner more consistent with the ecoregional approach.

F. BEST MANAGEMENT PRACTICES

The demonstration of similar ecological characteristics within ecoregions, as well as differences in ecological characteristics among ecoregions, illustrate that factors most important in affecting water quality throughout the state may differ with respect to ecoregions. Use of ecoregional concepts should be utilized in the implementation of best management practices for water management programs, such as nonpoint source programs and watershed initiatives, within different ecoregions throughout the state. An ecoregion-based framework may provide the basis for attainable endpoints towards water quality improvements.

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APPENDIX A: HISTORICAL LDEQ ECOREGION DELINEATIONS

Maps depicting the historical LDEQ ecoregions are presented in this appendix.
Figure 2 depicts the initial Louisiana ecoregions delineated in 1992; Figures 3 and 4 depict the Louisiana ecoregions with refinements to the Red River Alluvial Plains boundary and that of the Mississippi River levees in 1994; Figures 5 and 6 depict the Louisiana ecoregions with further line refinements in 2001; and Figure 7 depicts the ecoregions delineated in 2001 along with refinements proposed for 2011.

Figure 2. LDEQ initial ecoregion delineations developed in 1992 (LDEQ 1992).
In 1992, LDEQ delineated ten ecoregions throughout the state: Atchafalaya Basin, Coastal Chenier Plains, Coastal Deltaic Plains, Mississippi Alluvial Plain, Mississippi River, Red River Alluvial Plains, Sabine River, South Central Plains, Terrace Uplands, and Western Gulf Coastal Plains Ecoregions.

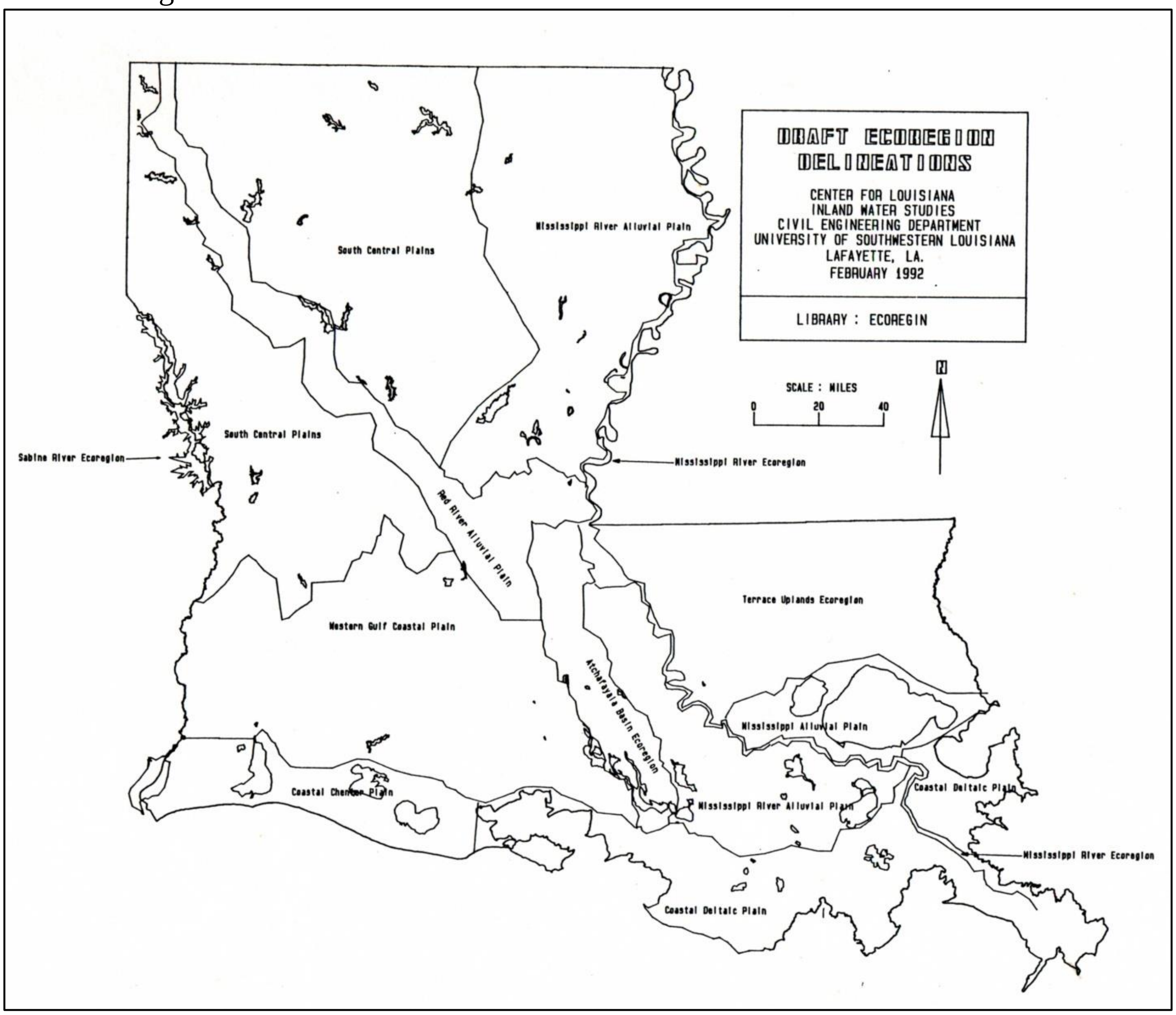
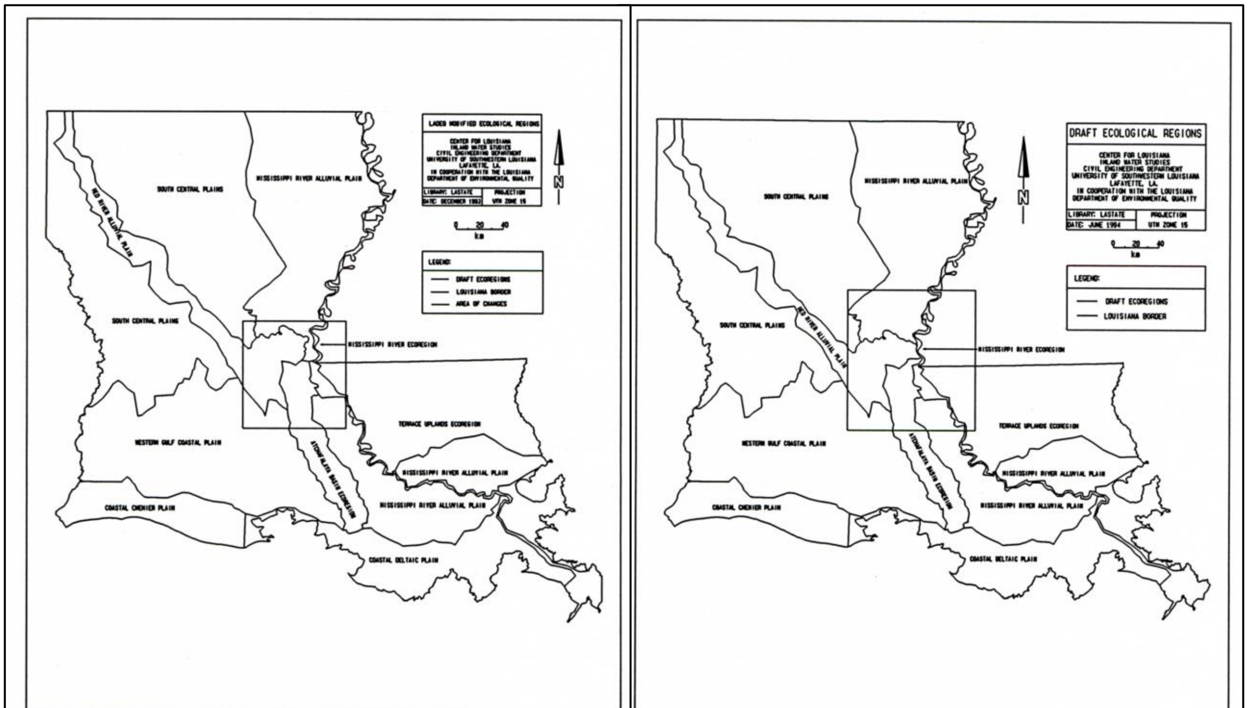


Figure 3. LDEQ Red River Alluvial Plains Ecoregion refinement (LDEQ 1994).
In 1994, LDEQ refined the Red River Alluvial Plains Ecoregion boundary based on Mississippi River levees and Old River Diversion Channel structure (LDEQ 1994). The area where revisions occurred is shown in the enclosed boxes.



Original LDEQ Designated Draft Louisiana Ecoregions. The area where revisions occurred is enclosed by the box.

Updated LDEQ Designated Draft Ecoregions. The area where revisions occurred is enclosed by the box.

Figure 4. LDEQ draft ecoregion delineation map developed in 1994.
In 1994, LDEQ developed a draft ecoregion delineation map showing ten ecoregions. Several inland stream reference sites are also depicted on this map.

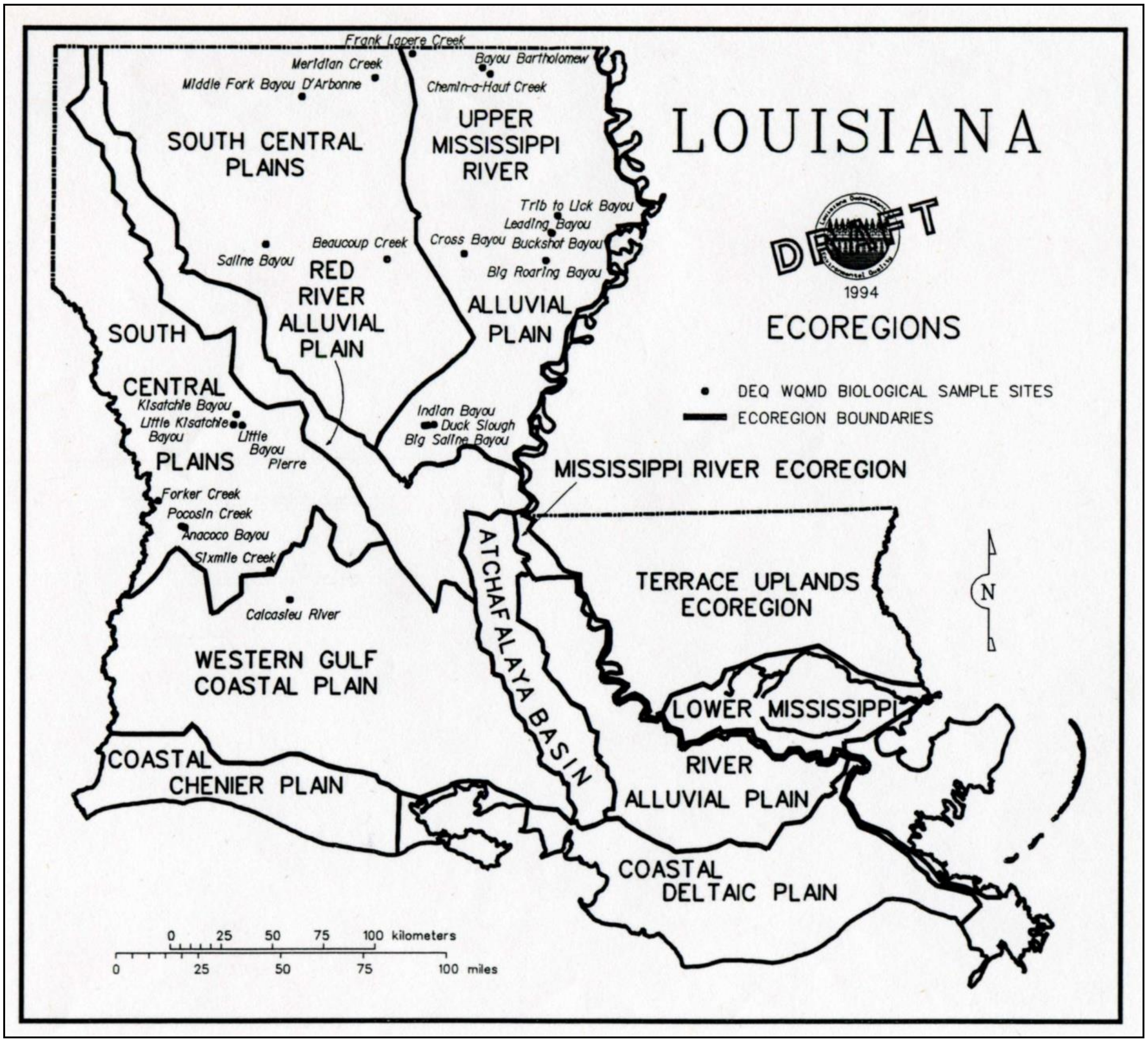


Figure 5. 2001 LDEQ ecoregion delineation modifications.
In 2001, modifications were made to the boundaries of the South Central Plains, Terrace Uplands, Upper Mississippi River Alluvial, Lower Mississippi River Alluvial Plains, and Western Gulf Coastal Plains. Large river ecoregions for the Sabine and Pearl Rivers were added and the boundary of the Red River Alluvial Plain Ecoregion was modified to conform to levees. Solid black line represents LDEQ ecoregion boundaries from 2001 to 2011, whereas solid gray line represents ecoregion boundaries from 1994 to 2000.

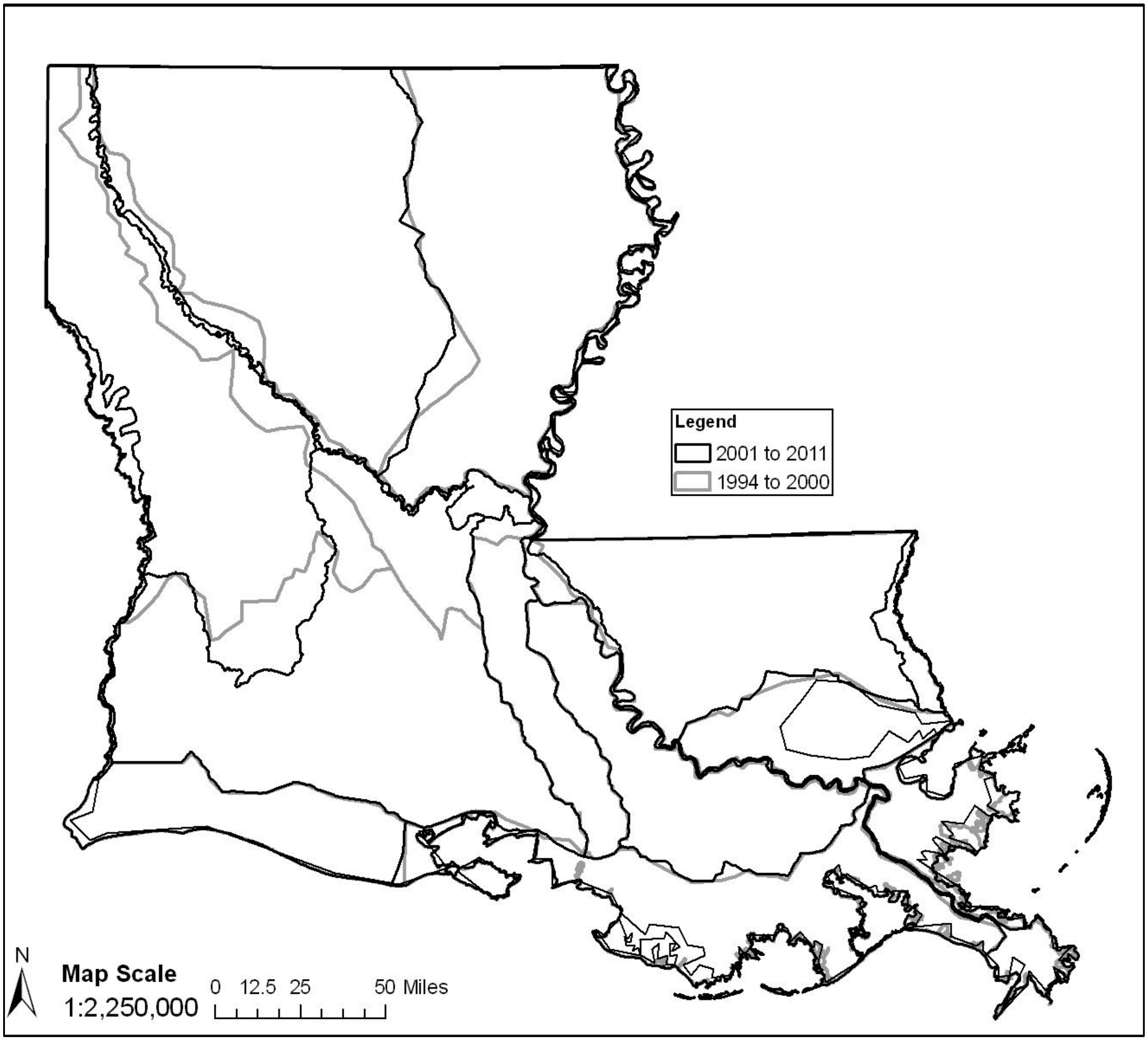


Figure 6. LDEQ ecoregional boundaries for twelve ecoregions, including several large rivers systems in Louisiana (map dated February 2003, as included in Lane and Day 2008).

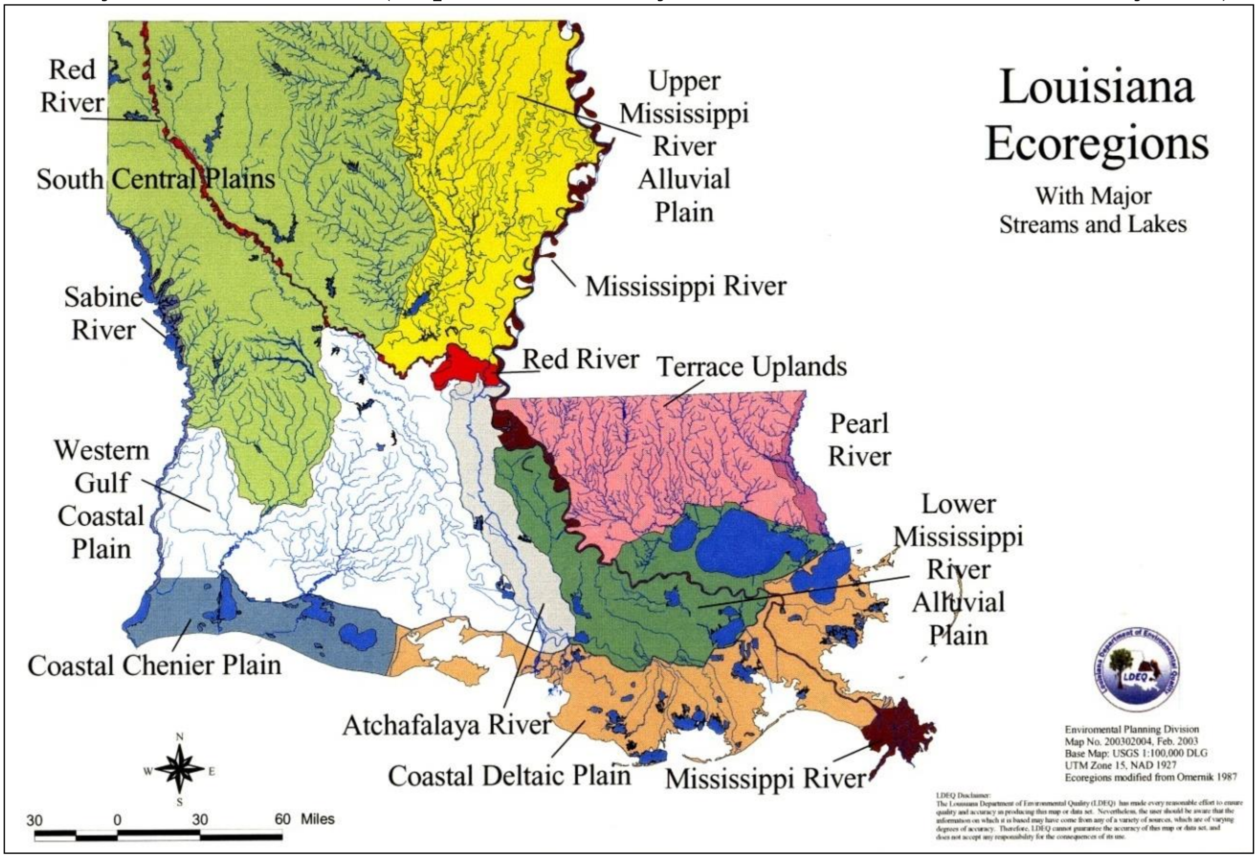
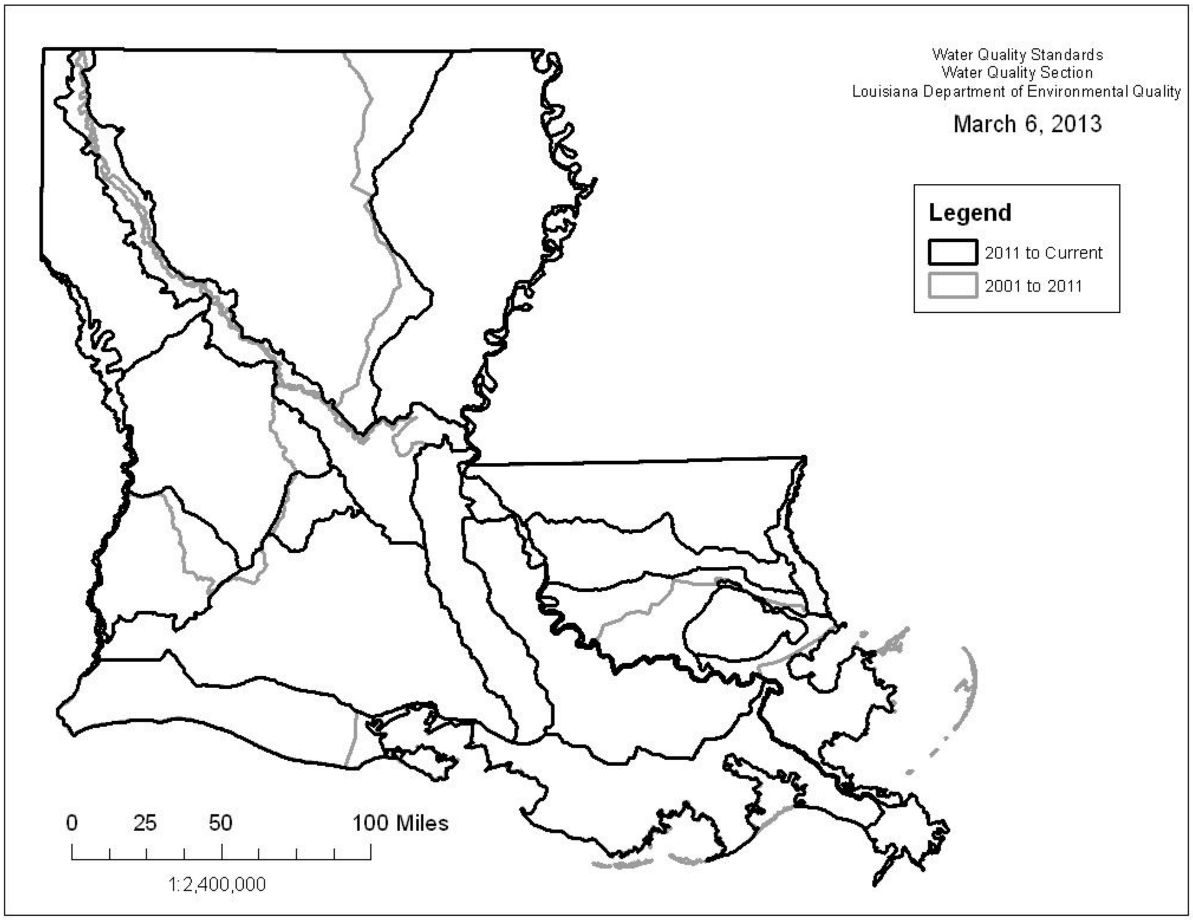


Figure 7. 2011 LDEQ ecoregion delineation modifications.
Solid black line represents LDEQ ecoregion boundaries from 2011 to current, whereas solid gray line represents ecoregion boundaries from 2001 to 2011.



APPENDIX B: ECOREGION RECOMMENDATIONS FROM EXTERNAL SOURCES.

The following ecoregion recommendations (listed in Appendix B, Table 2) were evaluated and considered in the refinement of ecoregion delineations for the state of Louisiana.

Table 2. Ecoregion recommendations evaluated and considered in the refinement of Louisiana Water Quality Standards Ecoregions for 2011.
Figure refers to the figure number presented in this document; Name refers to a short description of the data set; Description (Metadata) refers to a longer description of the data set to include relevant metadata; Source Agency refers to the agency that maintains the data or that housed the data set obtained for this evaluation (such as USEPA – United States Environmental Protection Agency and USDA – United States Department of Agriculture); Date refers to the date of the data; and website link refers to a link to website or other online source for the data set.

Figure	Name	Description (Metadata)	Source Agency	Date	Website (NA indicates not applicable)
Figure 8	USEPA Level 3 Ecoregions of Louisiana	Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. They are designed to serve as a spatial framework for the research, assessment, management, and monitoring of ecosystems and ecosystem components. These general purpose regions are critical for structuring and implementing ecosystem management strategies across federal agencies, state agencies, and nongovernment organizations that are responsible for different types of resources within the same geographical areas. The approach used to compile this map is based on the premise that ecological regions can be identified through the analysis of patterns of biotic and abiotic phenomena, including geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology. The relative importance of each characteristic varies from one ecological region to another. A Roman numeral hierarchical scheme has been adopted for different levels for ecological regions. Level I is the coarsest level, dividing North America into 15 ecological regions. Level II divides the continent into 52 regions (Commission for Environmental Cooperation Working Group, 1997). At Level III, the continental United States contains 104 regions whereas the conterminous United States has 84 (U.S. Environmental Protection Agency, 2005).	USEPA	2006	http://www.epa.gov/wed/pages/ecoregions/la_eco.htm

Figure	Name	Description (Metadata)	Source Agency	Date	Website (NA indicates not applicable)
Figure 9	USEPA Level 4 Ecoregions of Louisiana	Level IV ecoregions are further subdivisions of Level III ecoregions(see above).	USEPA	2006	http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm#Level III
Figure 10	Ecological Subregions: Provinces for the Conterminous United States	This data set includes polygons for ecological sections and subsections within subregions within the conterminous United States. This data set contains regional geographic delineations for analysis of ecological relationships across ecological units. The 2007 Section and Subsection map and associated data issued by the USDA Forest Service Washington Office-Ecosystem Management Coordination staff are our official inventory of ecological units at the subregional scale and refine our inventory at the regional scale. Polygon descriptions are presented for the delineated 190 section ecological units. Brief descriptions of the section map units provide an abstract primarily of the climate, physiography, and geologic substrate that combine to form ecosystems with distinctive vegetation and other unique ecological characteristics.	USDA, Forest Service	2007	http://fsgeodata.fs.fed.us/other_resources/ecosubregions.html
Figure 11	Ecological Subregions: Sections for the Conterminous United States	This data set includes polygons for ecological sections and subsections within subregions within the conterminous United States. This data set contains regional geographic delineations for analysis of ecological relationships across ecological units. The 2007 Section and Subsection map and associated data issued by the USDA Forest Service Washington Office-Ecosystem Management Coordination staff are our official inventory of ecological units at the subregional scale and refine our inventory at the regional scale. Polygon descriptions are presented for the delineated 190 section ecological units. Brief descriptions of the section map units provide an abstract primarily of the climate, physiography, and geologic substrate that combine to form ecosystems with distinctive vegetation and other unique ecological characteristics.	USDA, Forest Service	2007	http://fsgeodata.fs.fed.us/other_resources/ecosubregions.html
Figure 12	Bailey's Ecoregions for eastern US	This shapefile is usually referred to as "Bailey's ecoregions" but limited to Southern States excluding the Dry Domain (prairie) ecoregions.	USDA-Forest Service, Southern Forest Resource Assessment	2000	http://www.srs.fs.usda.gov/sustain/data/ecoregions/index.htm http://www.fs.fed.us/land/pubs/ecoregions/toc.html

Figure 8. US Environmental Protection Agency (EPA) Level 3 Ecoregions (Daigle et al. 2006).

Level 3 USEPA Ecoregions: 34 – Western Gulf Coastal Plain; 35 – South Central Plains; 65 – Southeastern Plains; 73 – Mississippi Alluvial Plain; 74 – Mississippi Valley Loess Plains; 75 – Southern Coastal Plain.

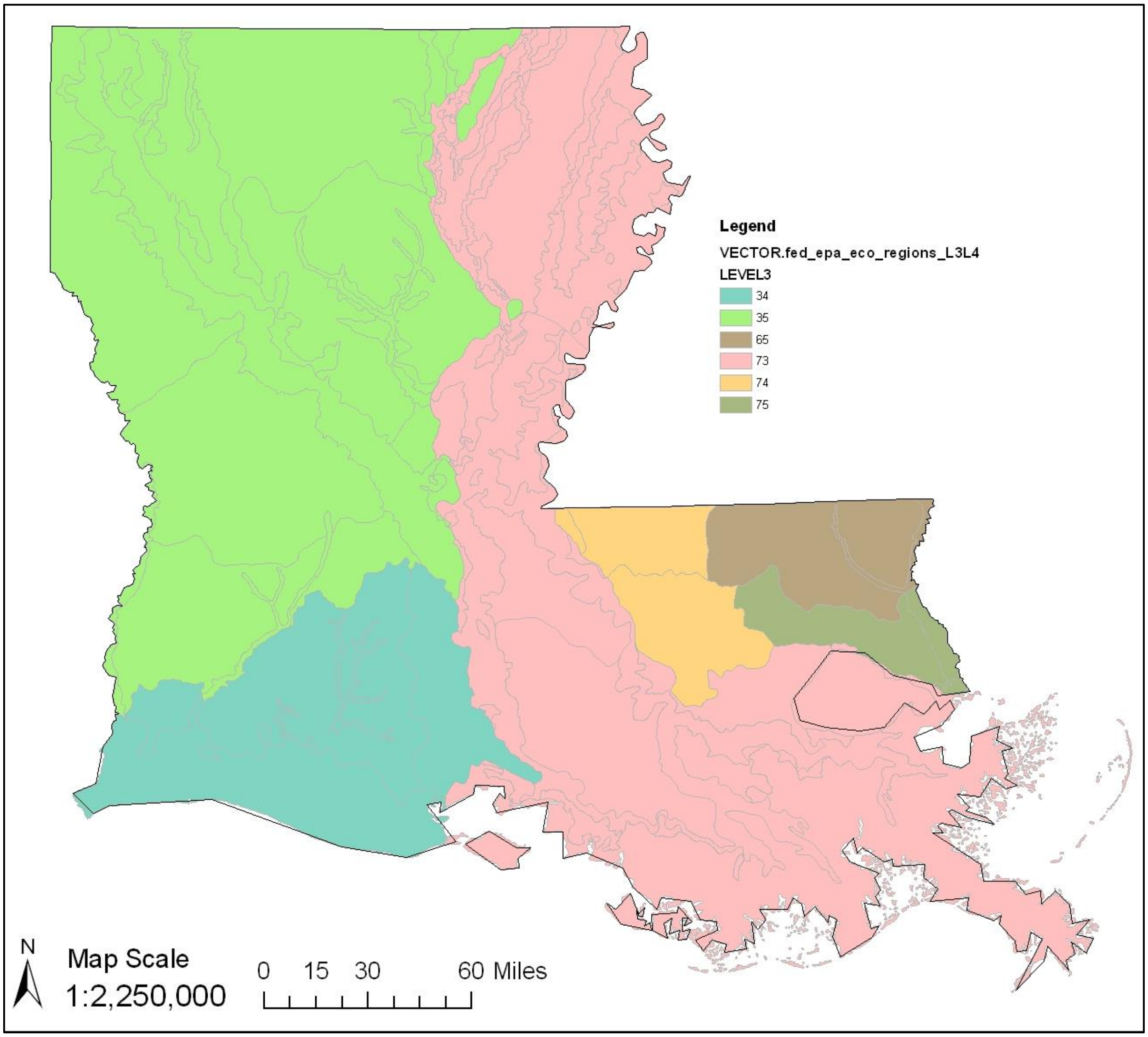


Figure 9. US Environmental Protection Agency (EPA) Level 4 Ecoregions (Daigle et al. 2006).

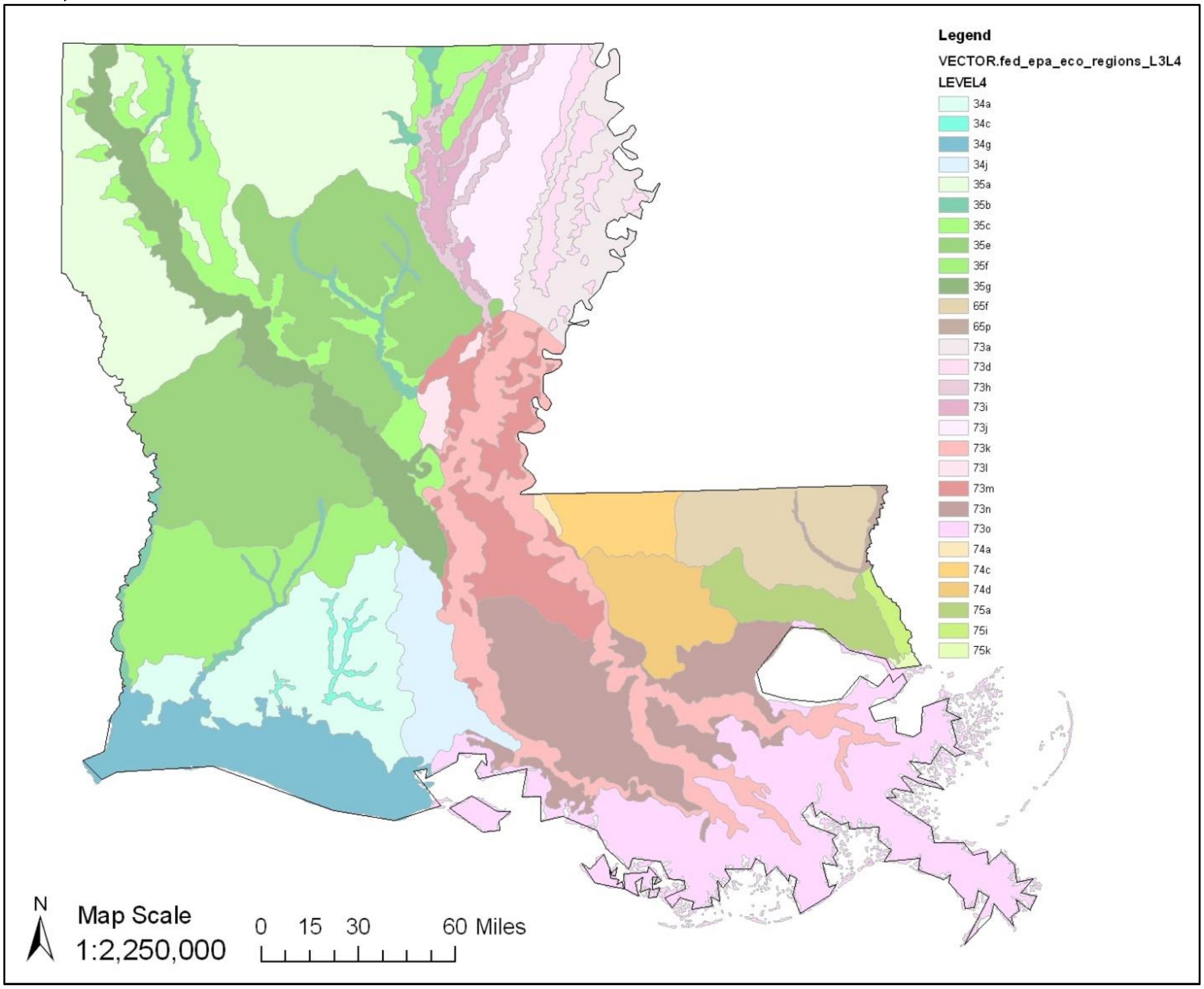


Figure 10. USDA Forest Service, ecological subregions: provinces for the Conterminous United States (McNab et al. 2007). Data set from 2007.

Province Descriptions: Southeastern Mixed Forest Province (231); Outer Coastal Plain Mixed Forest (232); Lower Mississippi Riverine Forest Province (234).

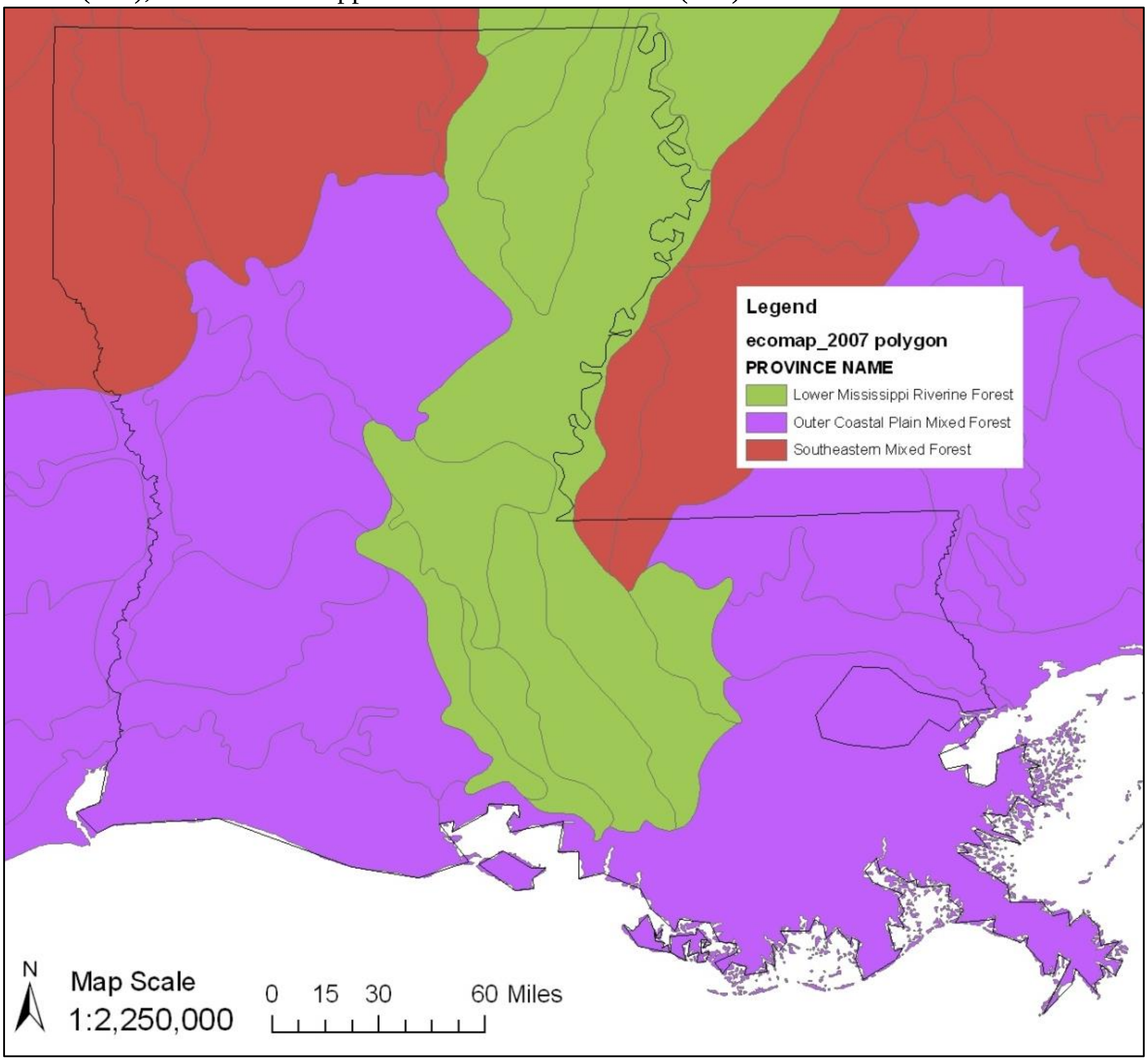


Figure 11. USDA Forest Service ecological subregions: sections for the Conterminous United States (McNab et al. 2007). Data set from 2007.
Section Descriptions: Arkansas Alluvial Plains Section (234E); Atchafalaya and Red River Alluvial Plains Section (234C); Coastal Plains and Flatwoods-Western Gulf Section (232F); Coastal Plains-Loess Section (231H); Coastal Plains-Middle Section (231B); Gulf Coastal Lowlands Section (232L); Gulf Coastal Plains and Flatwoods Section (232B); Louisiana Coastal Prairie and Marshes (232E); Mid Coastal Plains-Western Section (231E); Southern Mississippi River Alluvial Plains (234A); White and Black River Alluvial Plains (234D).

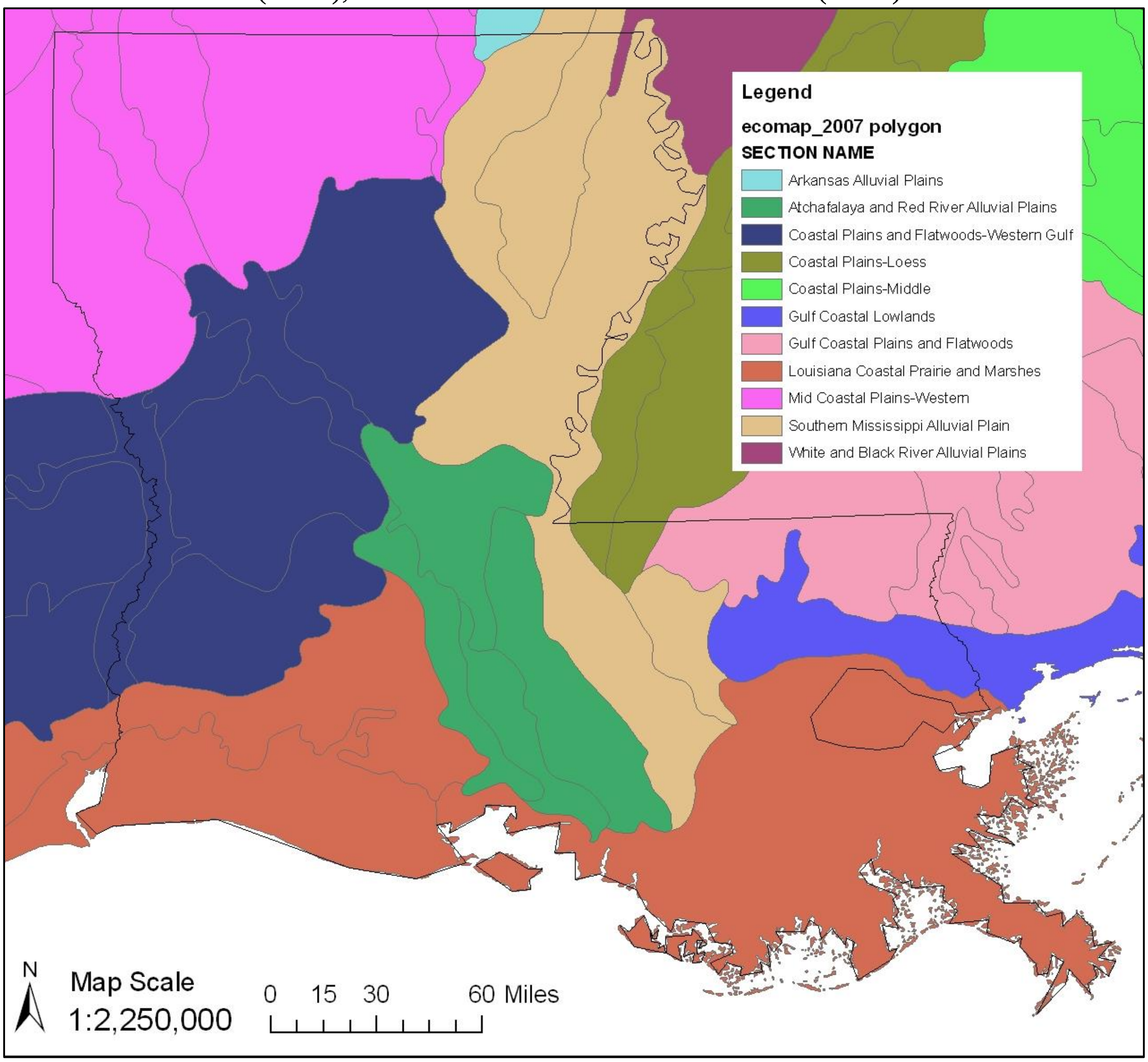
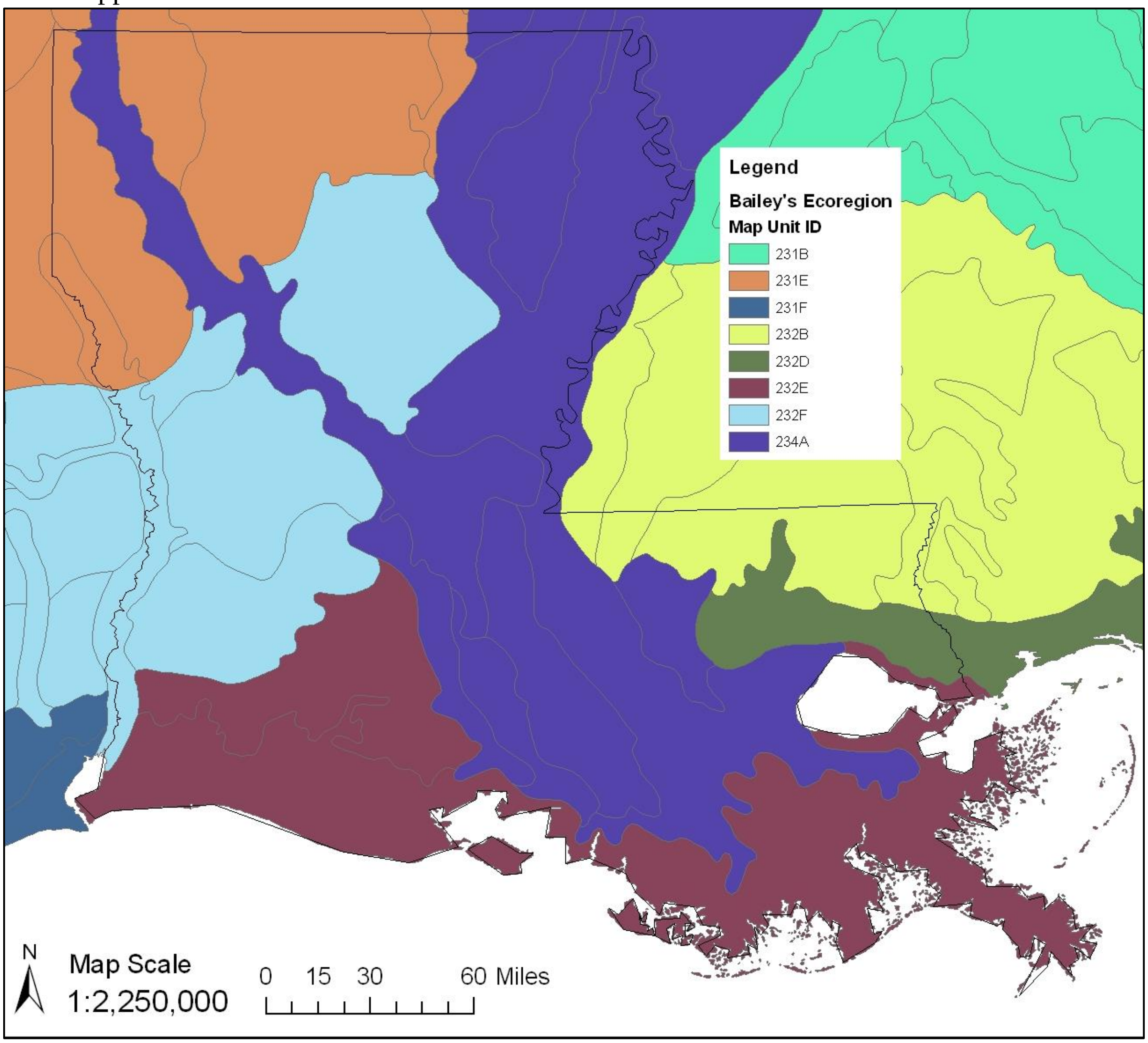


Figure 12. Bailey's Ecoregions (USDA Forest Service).
Map Units: 231 – Southeastern Mixed Forest Province; 231B – Coastal Plains, Middle; 231E – Mid Coastal Plains, Western; 231F – Eastern Gulf Prairies and Marshes; 232 – Outer Coastal Plain Mixed Forest Province; 232B – Coastal Plains and Flatwoods, Lower; 232D – Florida Coastal Lowlands (Western); 232E – Louisiana Coast Prairies and Marshes; 232F – Coastal Plains and Flatwoods, Western Gulf; 234 – Lower Mississippi Riverine Forest Province; 234A – Mississippi Alluvial Basin.



APPENDIX C: BASE MAPS

The following GIS-based sources (listed in Appendix C, Table 3 below) were evaluated and considered in the refinement of ecoregion delineations for the state of Louisiana.

Table 3. GIS-based sources for evaluation and consideration in the refinement of Louisiana Water Quality Standards Ecoregions for 2011.

Figure refers to the figure number presented in this document; Name refers to a short description of the data set; Description (Metadata) refers to a longer description of the data set to include relevant metadata; Source Agency refers to the agency that maintains the data or that housed the data set obtained for this evaluation (such as LDEQ – Louisiana Department of Environmental Quality, LDEQ/WQ – LDEQ Water Quality Section, LOSCO – Louisiana Oil Spill Coordinator's Office, USGS – United States Geologic Survey, USDA – United States Department of Agriculture, NRCS – Natural Resource Conservation Service, NWRC – National Wetlands Research Center, LGS – Louisiana Geologic Survey, USEPA – United States Environmental Protection Agency); Date refers to the date of the data; and website link refers to a link to website or other online source for the data set.

Figure	Name	Description (Metadata)	Source Agency	Date	Website (NA indicates not applicable)
Figure 13	Orthorectified aerial photography [Raster. DOQQ]	Raster images of Digital Orthophoto Quarter Quads (DOQQs) for areas within state	LDEQ	2007 to 2008	NA
Figure 14	Landsat Thematic Mapper Satellite Image in UTM Zone 15, NAD83 [landsat5tm_la_lsu_2005.sid]	This data set is a Landsat Thematic Mapper satellite image of the State of Louisiana using bands 7-5-3 as an RGB composite.	LOSCO	2005	http://lagic.lsu.edu/loscoweb/

Figure	Name	Description (Metadata)	Source Agency	Date	Website (NA indicates not applicable)
Figure 15	Landsat Thematic Mapper Satellite Image [louisiana-tm753-pan-fusion-2002]	This data set is a satellite image of the lands and waters of the State of Louisiana. It was created by combining fourteen scenes of 30-meter resolution Landsat Thematic Mapper (TM) imagery with 15-meter resolution panchromatic imagery. The TM and panchromatic imagery for each scene are coincident. The original image data were geo-rectified and resampled using cubic convolution to 25-meter (TM) and 12.5-meter (pan) cells by the Earth Resources Observation Systems (EROS) Data Center. These data were purchased from EROS by the Louisiana Department of Environmental Quality (northern half of state) and the USGS's National Wetlands Research Center Lafayette (southern half of state.) The processing to produce a seamless enhanced image was performed at LDEQ by a LDEQ contractor. The work was funded by a grant from the US EPA to the LDEQ Non-Point Source Water Pollution Section. The image was constructed from a red, green, blue (RGB) composite of bands 7, 5 & 3 fused with the panchromatic image to produce the enhanced TM pan sharpened mosaic.	LDEQ	2002	NA
Figure 16	24K Digital Raster Graphic (DRG) of state of Louisiana [RASTER.FED_USGS_DRG24K_24BIT_06]	A Digital Raster Graphic (DRG) is a scanned image of a USGS standard series topographic map, including all map collar information. The image inside the map neatline is georeferenced to the surface of the earth and fit to the Universal Transverse Mercator (UTM) projection. The horizontal positional accuracy and datum of the DRG matches the accuracy and datum of the source map. The map is scanned at a minimum resolution of 250 dots per inch.	USGS	2006	NA
Figure 17	Louisiana Digital Elevation Dataset in UTM Zone 15, NAD83 [LDEQ_24KDEM_2004]	The Louisiana Digital Elevation Dataset was derived from the U.S. Geological Survey National Elevation Database (NED). This data was projected to Universal Transverse Mercator Zone 15, NAD83. The vertical units have been converted from meters to feet. The U.S. Geological Survey NED is a seamless mosaic of best-available elevation data. The 7.5-minute elevation data for the conterminous United States are the primary initial source data. In addition to the availability of complete 7.5-minute data, efficient processing methods were developed to filter production artifacts in the existing data, convert to the NAD83 datum, edge-match, and fill slivers of missing data at quadrangle seams. One of the effects of the NED processing steps is a much-improved base of elevation data for calculating slope and hydrologic derivatives. Dataset contains mosaicked original USGS blocks clipped to Louisiana state boundary.	LDEQ, LOSCO	2004	NA

Figure	**Name**	**Description (Metadata)**	**Source Agency**	**Date**	**Website** (NA indicates not applicable)
Figure 18	Louisiana Digital Elevation Dataset in UTM Zone 15, NAD83—Elevation by Class [LDEQ_24KDEM_2004]	See description of Figure 11 above. Elevation (feet) grouped into classes.	LDEQ	2004	NA
Figure 19	Louisiana Digital Elevation Dataset in UTM Zone 15, NAD83—Percent Change in Slope [LDEQ_24KDEM_2004]	See description of Figure 11 above. Percent change in slope calculated through ArcView GIS to show areas where change in slope is greater than in other areas within the state of Louisiana	LDEQ/WQ	Source data from 2004; calculated 2010	NA

Figure	Name	Description (Metadata)	Source Agency	Date	Website (NA indicates not applicable)
Figure 20	Louisiana Land Cover Data Set in UTM Zone 15, NAD83 [landcover_la_nlcd_usgs_2001.tif]	The National Land Cover Database 2001 land cover layer for mapping zone 37A was produced through a cooperative project conducted by the Multi-Resolution Land Characteristics (MRLC) Consortium. The MRLC Consortium is a partnership of federal agencies (www.mrlc.gov), consisting of the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA), the U.S. Forest Service (USFS), the National Park Service (NPS), the U.S. Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM) and the USDA Natural Resources Conservation Service (NRCS). One of the primary goals of the project is to generate a current, consistent, seamless, and accurate National Land Cover Database (NLCD) circa 2001 for the United States at medium spatial resolution. This landcover map and all documents pertaining to it are considered "provisional" until a formal accuracy assessment can be conducted. For a detailed definition and discussion on MRLC and the NLCD 2001 products, refer to Homer et al. (2004) and <http://www.mrlc.gov/mrlc2k.asp>.	USGS/ National Land Cover Data	2001	http://seamless.usgs.gov/
Figure 21	Major Land Resource Areas	USDA 2006, Weindorf 2007	USDA, NRCS	2006	http://soils.usda.gov/survey/geography/mlra/
Figure 22	National Forest Type	This geospatial dataset was created by the USFS Forest Inventory and Analysis (FIA) program and the Remote Sensing Applications Center (RSAC) to show the extent, distribution, and forest type composition of the nation’s forests. The dataset was created by modeling forest type from FIA plot data as a function of more than one hundred geospatially continuous predictor layers. This process results in a view of forest type distribution in greater detail than is possible with the FIA plot data alone. Nearly one-half million FIA sample plots nationwide were used to develop these models. Among the predictor layers used were digital elevation models (DEM) and DEM derivatives; Moderate Resolution Spectroradiometer (MODIS) multi-date composites, vegetation indices and vegetation continuous fields; class summaries from the 1992 National Land Cover Dataset (NLCD); various ecologic zones; and summarized PRISM climate data. Modeling was performed using a data mining package, Cubist/See5TM, which was loosely coupled with Leica Geosystems ImagineTM image processing software.	USDA, Forest Service	2005	http://fsgeodata.fs.fed.us/rastergateway/forest_type/

Figure	Name	Description (Metadata)	Source Agency	Date	Website (NA indicates not applicable)
Figure 23	Kuchler Potential Natural Vegetation	This coverage was digitized at the USEPA from the 1979 Physiographic Regions Map produced by the BLM, which added 10 physiognomic types to Kuchler's 1966 USGS Potential Natural Vegetation map (and similarly differs from the 1985 USGS map revised by Kuchler and others) The dataset consists of two thematic layers a) Vegetation Form and b) Vegetation Type. Data is gridded at a resolution of 5km by 5km.	USGS	1993	http://www.ngdc.noaa.gov/ecosys/cdroms/ged_iib/datasets/b13/ek.htm
Figure 24	Soils [Vector.fed_usgs_nwrc_statsgosoils]	This data set contains vector lines from the general soil association map. The vector data contain selected base categories of geographic features, and characteristics of these features, in digital form derived from STATSGO soils map and classified data from actual field identification and sampling performed by the United States Department of Agriculture and the Soil Conservation Service.	USGS, NWRC	NA	NA
Figure 25	Geologic map of Louisiana	The vector data contain selected base categories of geographic features, and characteristics of these features, in digital form. The dataset was digitized from a scanned version of a 1:500,000 scale hard copy map of the Geologic Map of Louisiana developed by the Louisiana Geological Survey. The classified data was derived from actual field identification and sampling performed by the Louisiana Geological Survey. Coverage is of the entire State of Louisiana.	LGS	2004	http://sabdata.cr.usgs.gov/sabnet_pub/pub_sab_app.aspx?prodid=14035
Figure 26	Average Annual Precipitation for Louisiana	The data are average annual precipitation for the climatological period 1971-2000. The maps were created from 30 arc-seconds (~800m) PRISM derived grids. Manual and automated checks were made of the polygons to ensure no two adjacent polygons contained the same RANGE value.	USDA, NRCS	2007	http://datagateway.nrcs.usda.gov/
Figure 27	Average annual minimum temperature in January	The data are average January minimum, July maximum and annual temperature for the climatological period 1971-2000. The maps were created from 30 arc-seconds PRISM derived grids. Manual and automated checks were made of the polygons to ensure no two adjacent polygons contained the same RANGE value.	USDA, NRCS	2007	http://datagateway.nrcs.usda.gov/
Figure 28	Average annual maximum temperature in July	The data are average January minimum, July maximum and annual temperature for the climatological period 1971-2000. The maps were created from 30 arc-seconds PRISM derived grids. Manual and automated checks were made of the polygons to ensure no two adjacent polygons contained the same RANGE value.	USDA, NRCS	2007	http://datagateway.nrcs.usda.gov/
Figure 29	Marinas	Location of marinas in Louisiana	LOSCO	2007	http://lagic.lsu.edu/loscoweb/

Figure	**Name**	**Description (Metadata)**	**Source Agency**	**Date**	**Website** (NA indicates not applicable)
Figure 30	Tidal extent	Tidal extent in the Florida Parishes as determined through map interpretation and field reconnaissance.	LDEQ/WQ	2010	NA

Figure 13. Raster images of DOQQ's for the state of Louisiana. Data obtained from the LDEQ SDE Server. Data sets are from 2007 and 2008.

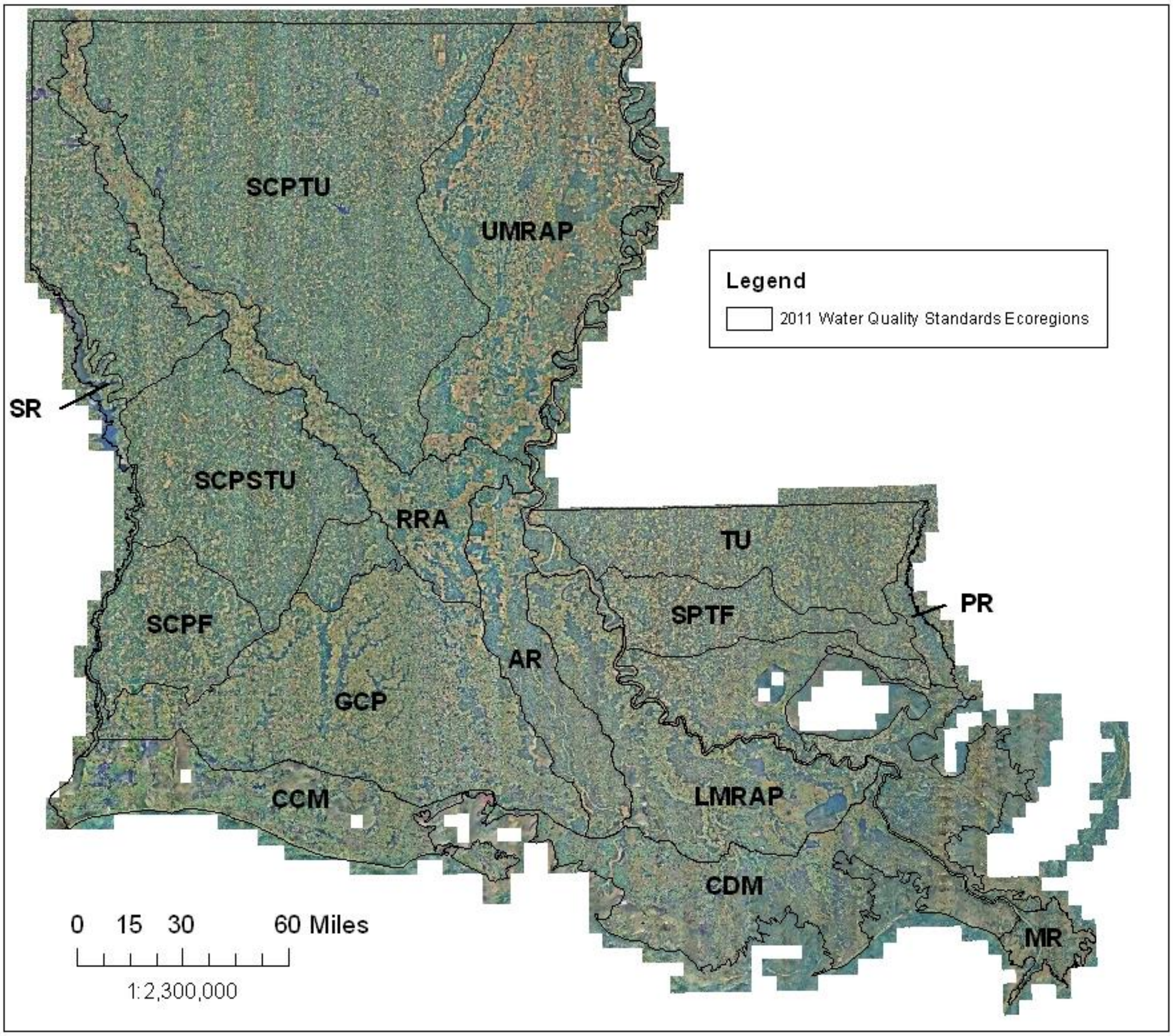


Figure 14. Landsat Thematic Mapper Satellite Image 2005, UTM Zone 15 NAD83, LOSCO (2007) [landsat5tm_la_lsu_2005.sid]. This data set is a Landsat Thematic Mapper satellite image of the State of Louisiana using bands 7-5-3 as an RGB composite.

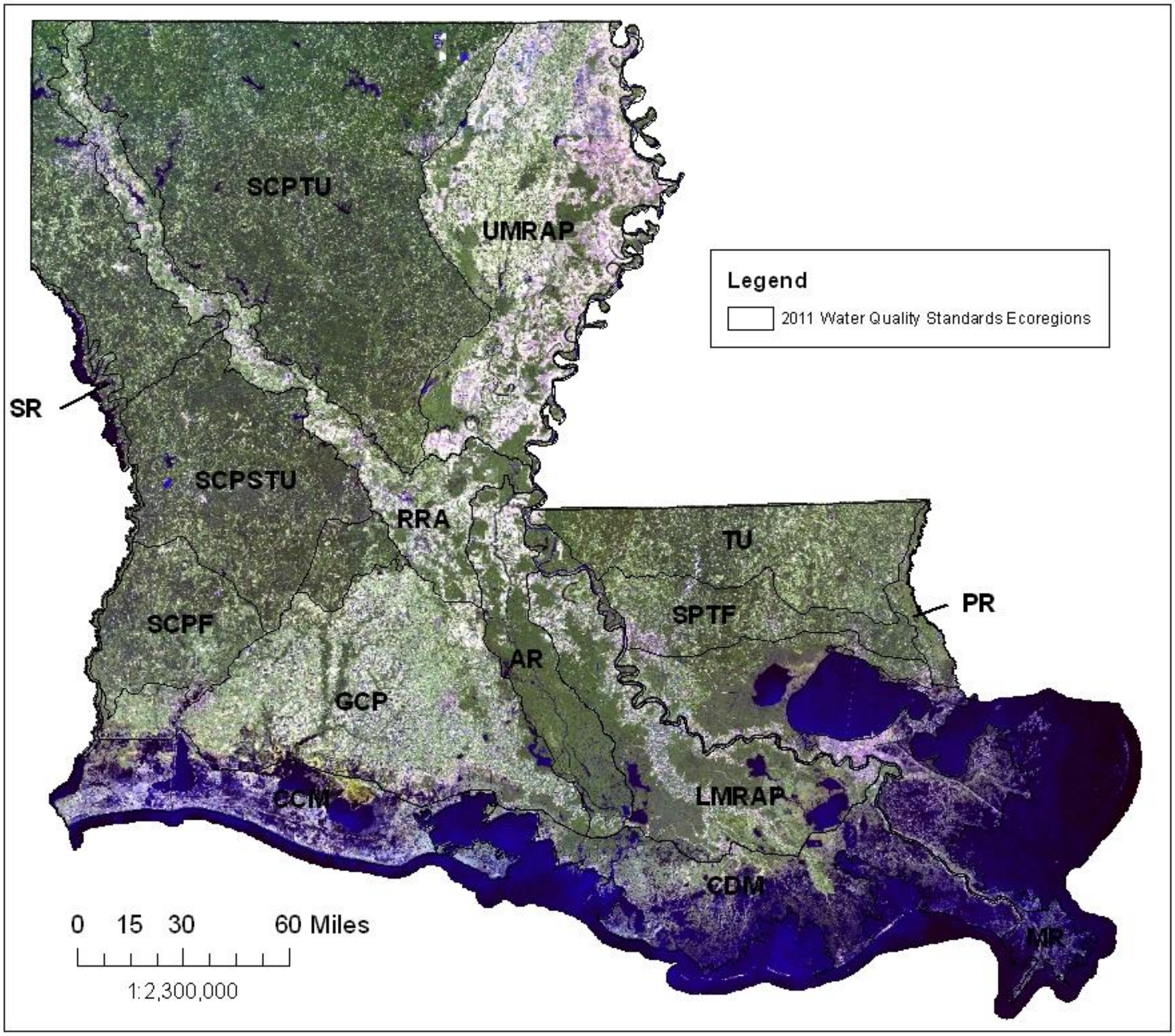


Figure 15. Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan Merge, LDEQ (2002) [louisiana-tm753-pan-fusion-2002].

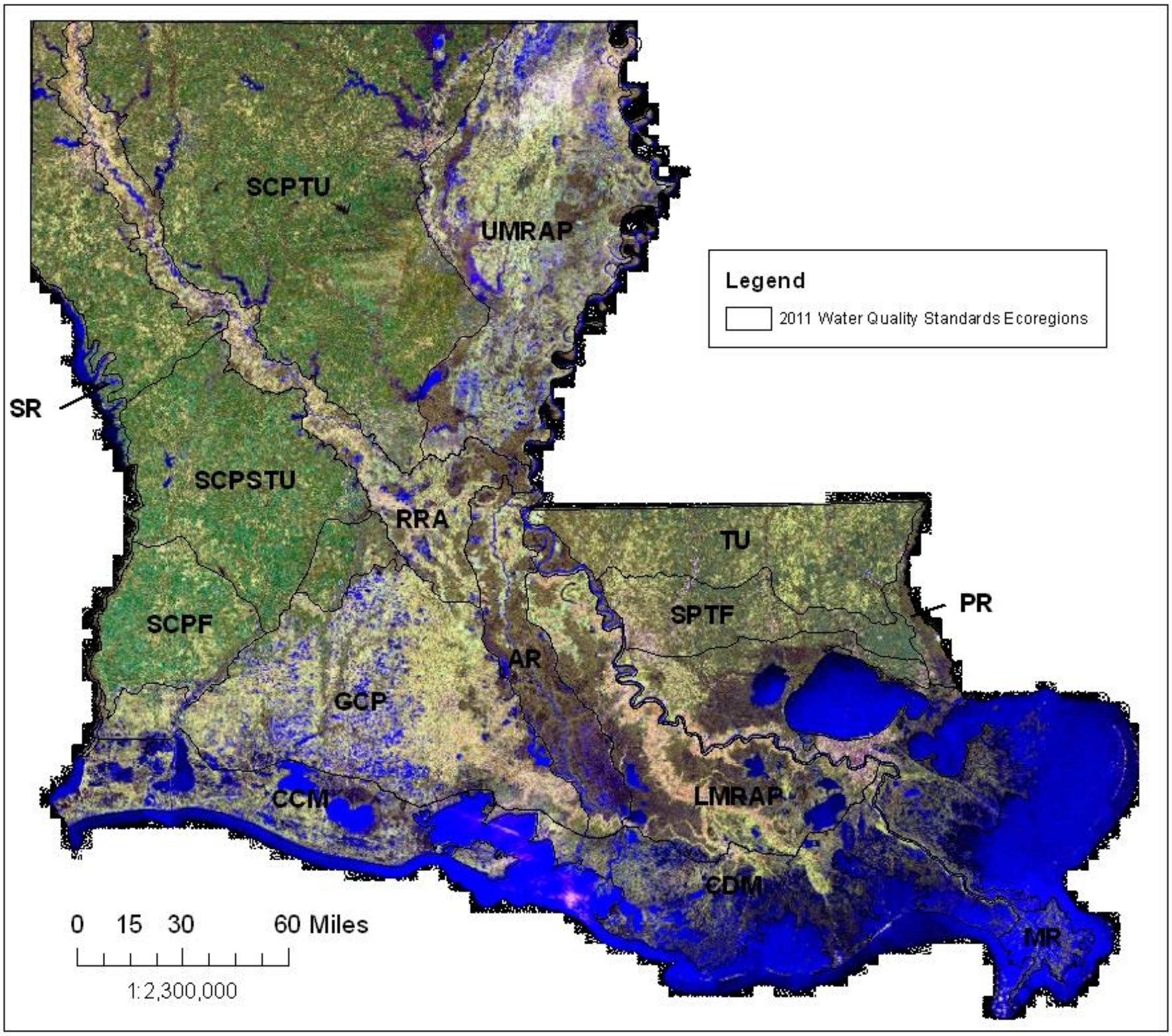


Figure 16. USGS Digital Raster Graphic (DRG) 24 K.

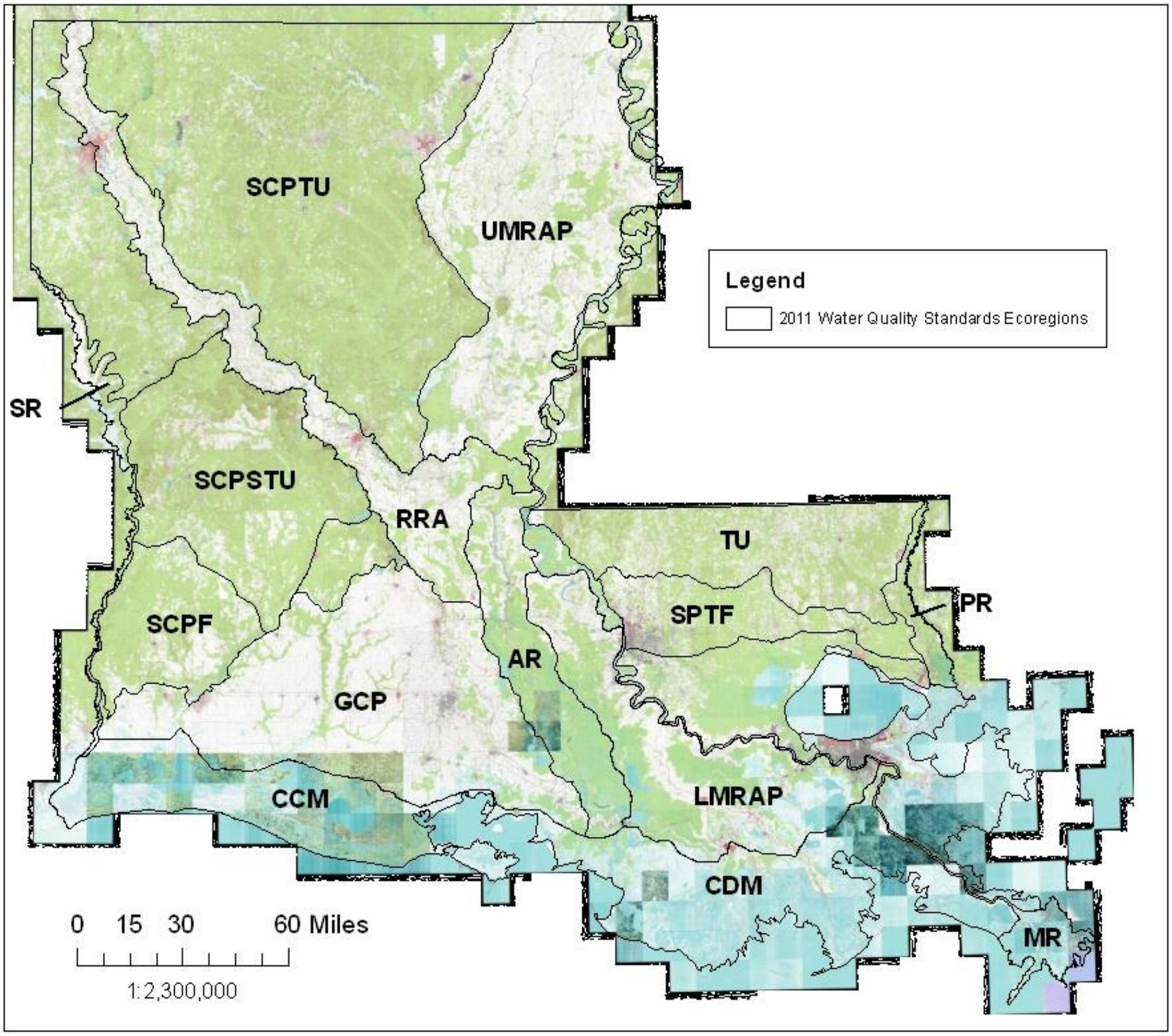


Figure 17. Louisiana Digital Elevation Dataset from LDEQ source data, UTM Zone 15 NAD83, LOSCO (2004) [LDEQ_24KDEM_2004]. Elevation in feet. Data set from 2004.

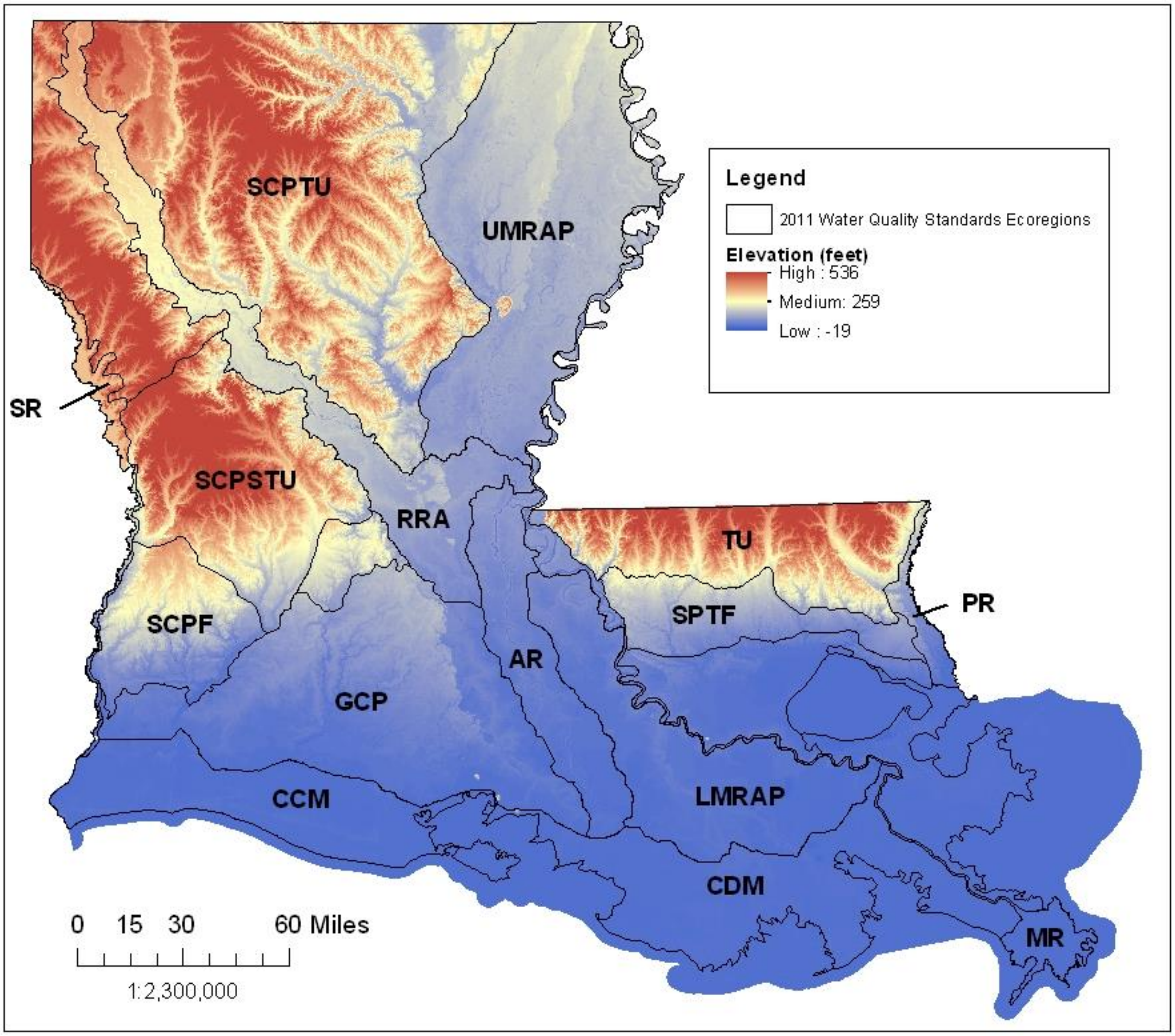


Figure 18. Louisiana Digital Elevation Dataset from LDEQ source data, UTM Zone 15 NAD83, LOSCO (2004) [LDEQ_24KDEM_2004]. Elevation (feet) grouped into classes. Data set from 2004.

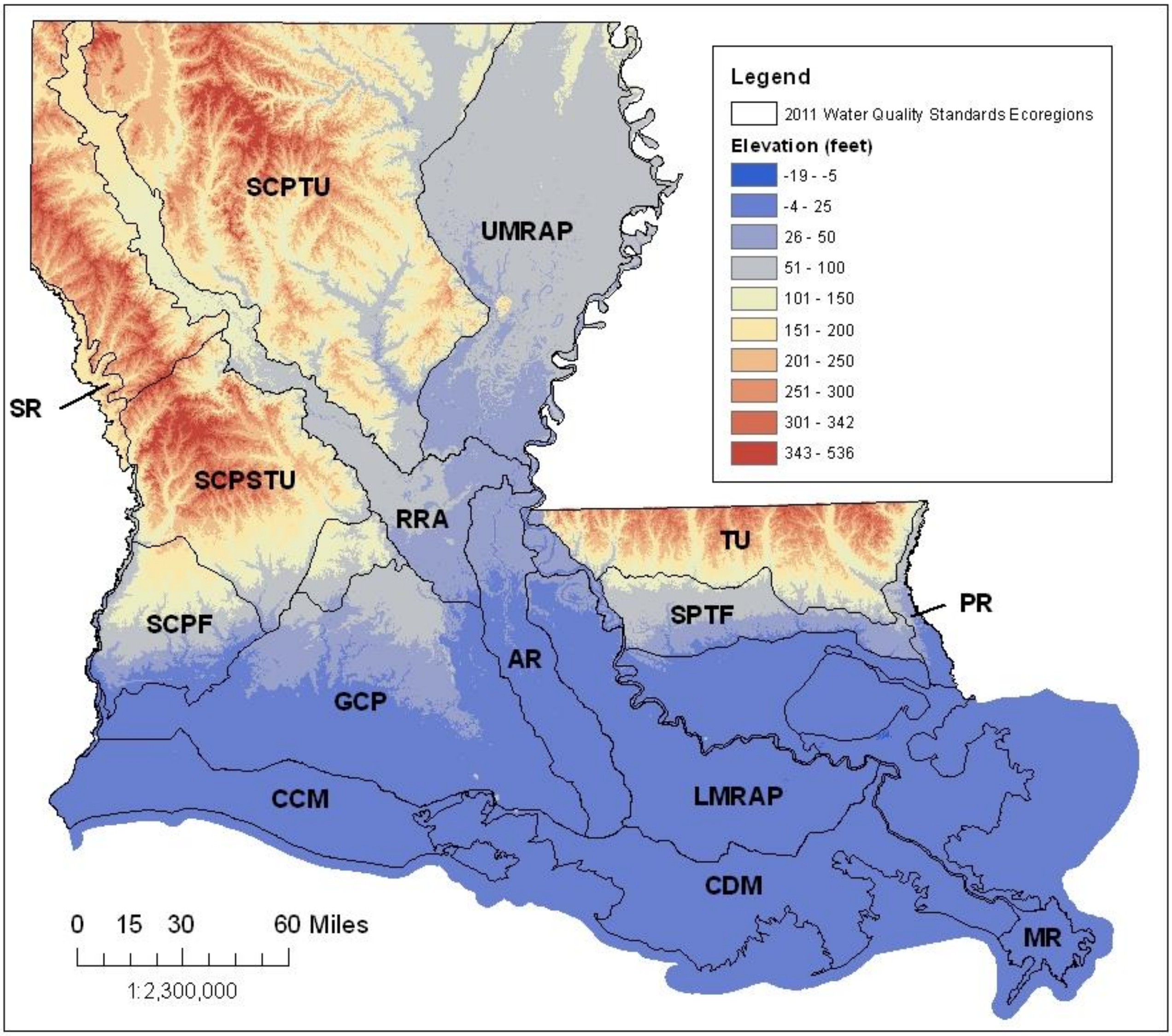


Figure 19. Degree change in slope calculated from Louisiana Digital Elevation Dataset (UTM Zone 15 NAD83, LOSCO (2004) [LDEQ_24KDEM_2004]) using ArcView GIS Spatial Analyst Surface Tools.

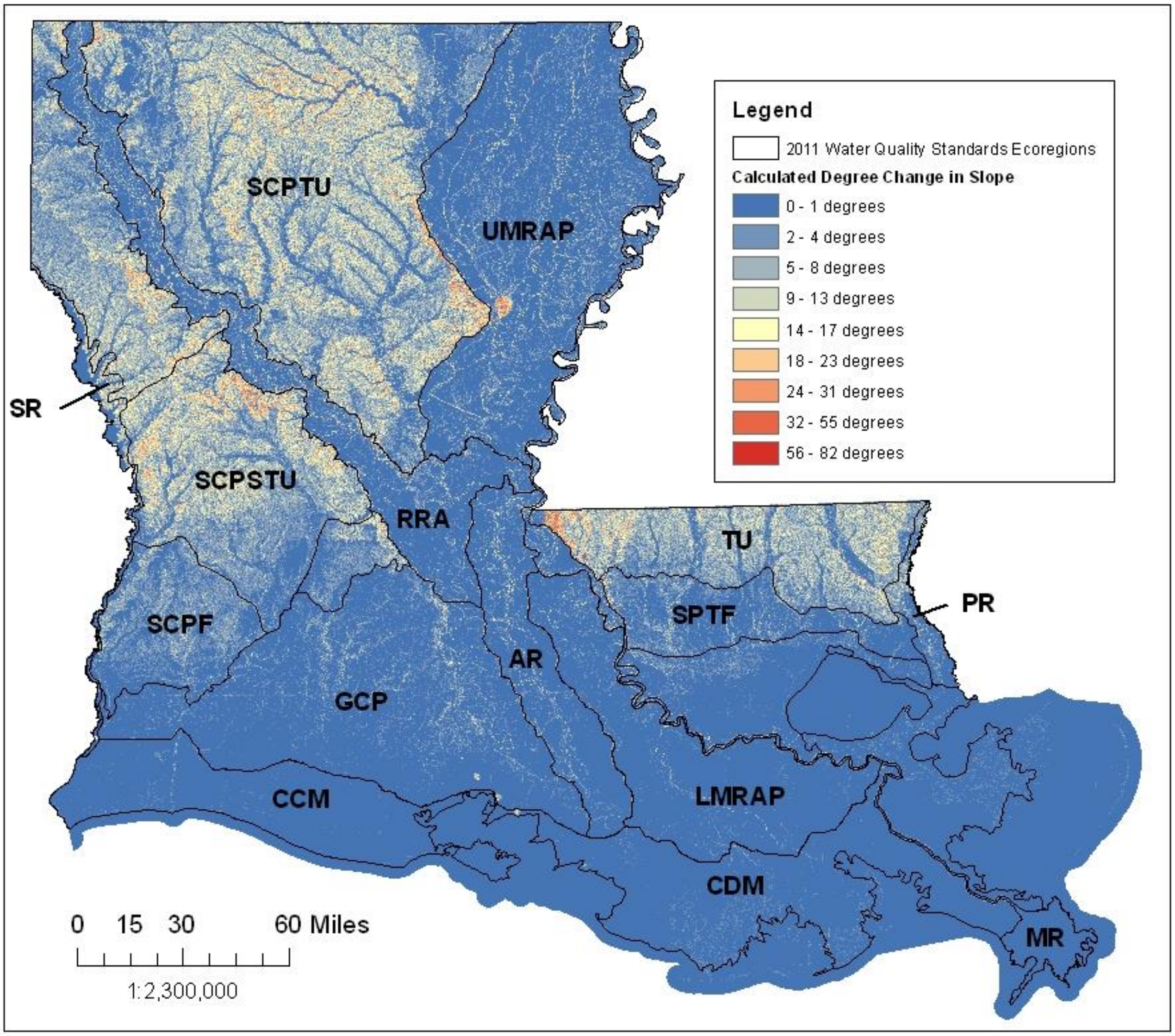


Figure 20. Louisiana Land Cover Data Set, UTM Zone 15 NAD83, USGS [landcover_la_nlcd_usgs_2001.tif]

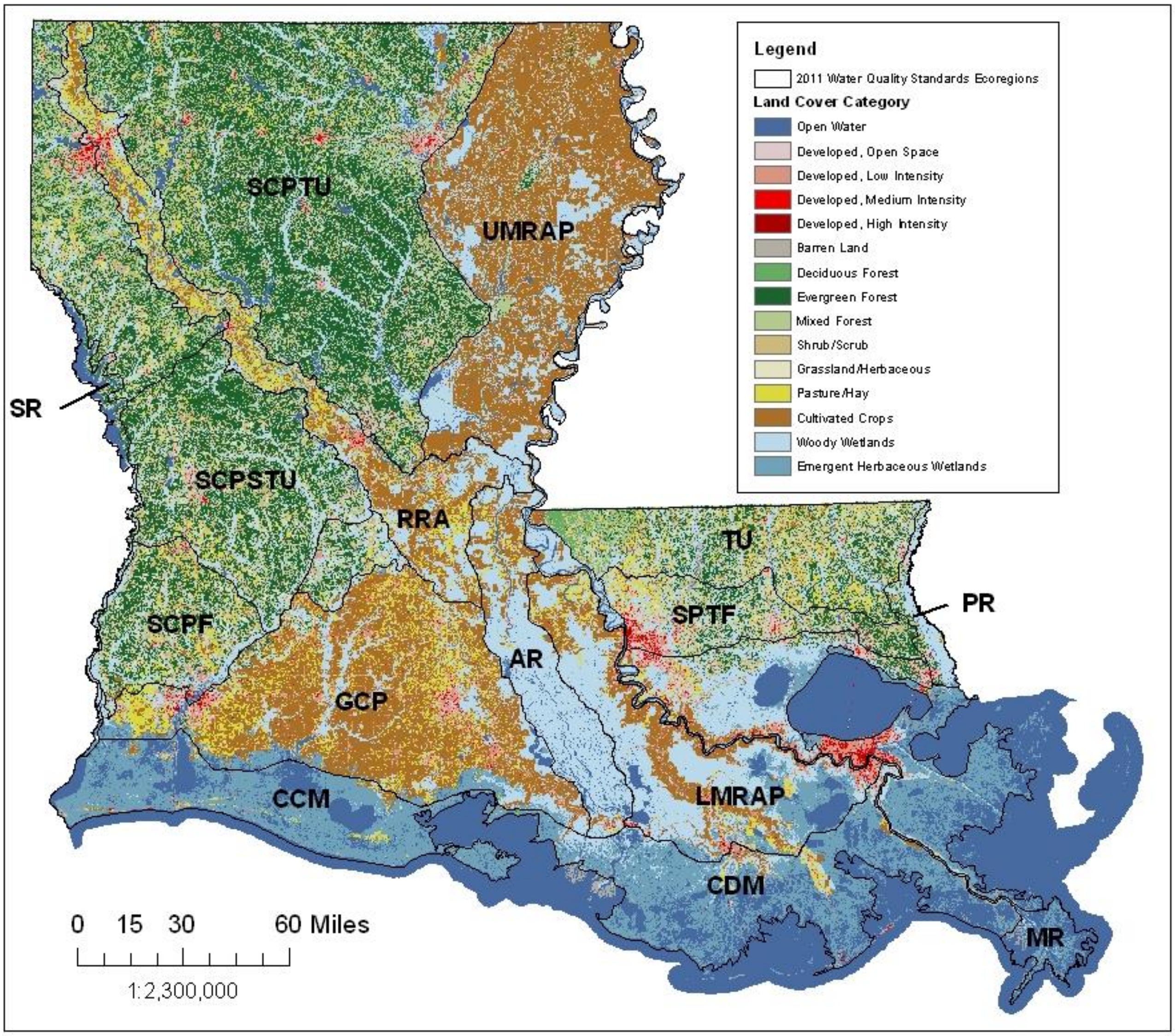


Figure 21. Major Land Resource Areas, US Department of Agriculture, Natural Resource Conservation Service (USDA 2006, Weindorf 2007).
Major Land Resources Areas: 131A – Southern Mississippi River Alluvium; 131B – Arkansas River Alluvium; 131C – Red River Alluvium; 131D – Southern Mississippi River Terraces; 133A – Southern Coastal Plain; 133B – Western Coastal Plain; 134 – Mississippi Valley Loess; 135A – Alabama and Mississippi Blackland Prairie; 150A – Gulf Coast Prairies; 151 – Gulf Coast Marsh; 152A – Eastern Gulf Coast Flatwoods ; 152B – Western Gulf Coast Flatwoods.

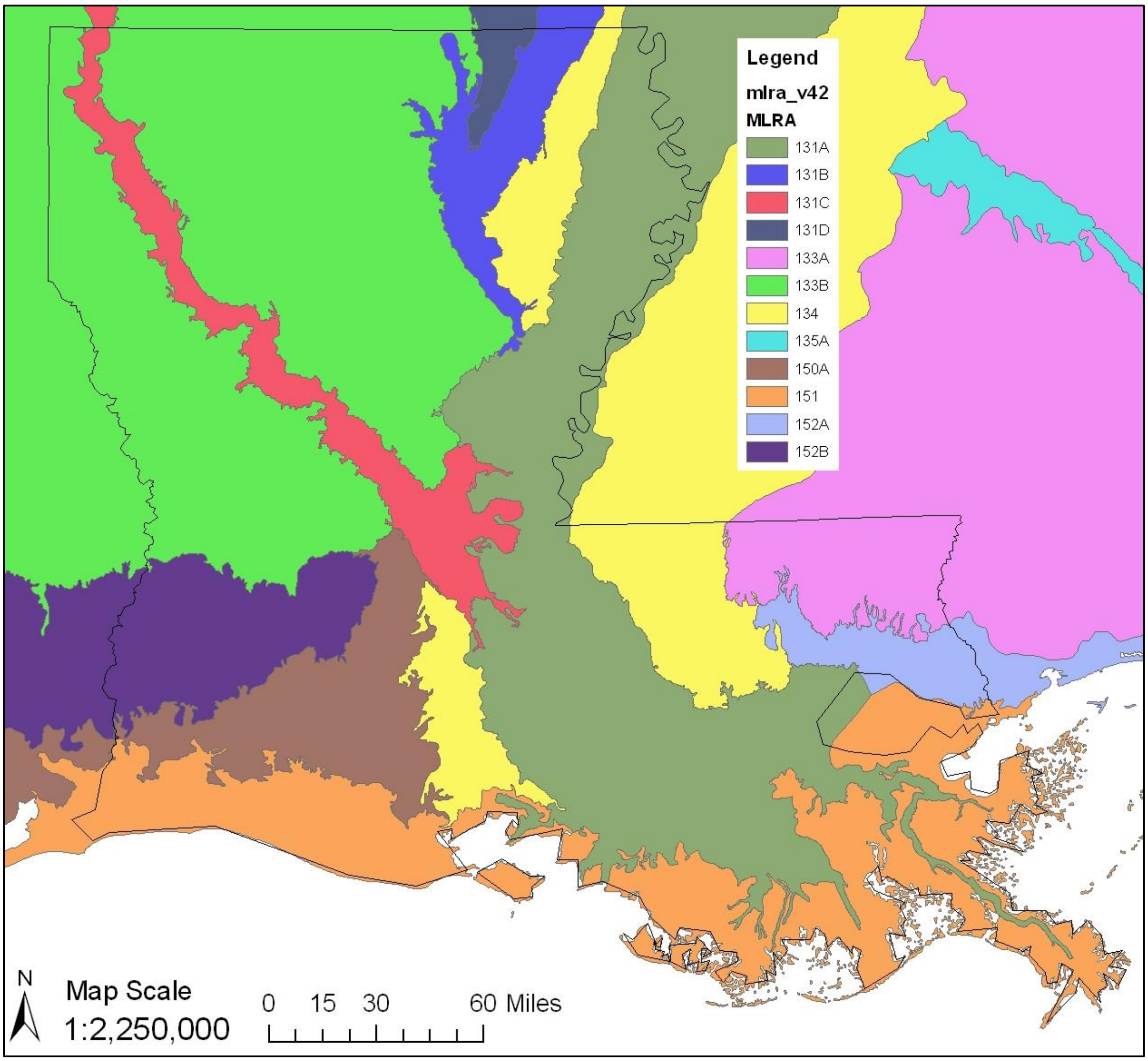


Figure 22. National Forest Service, Forest Group.

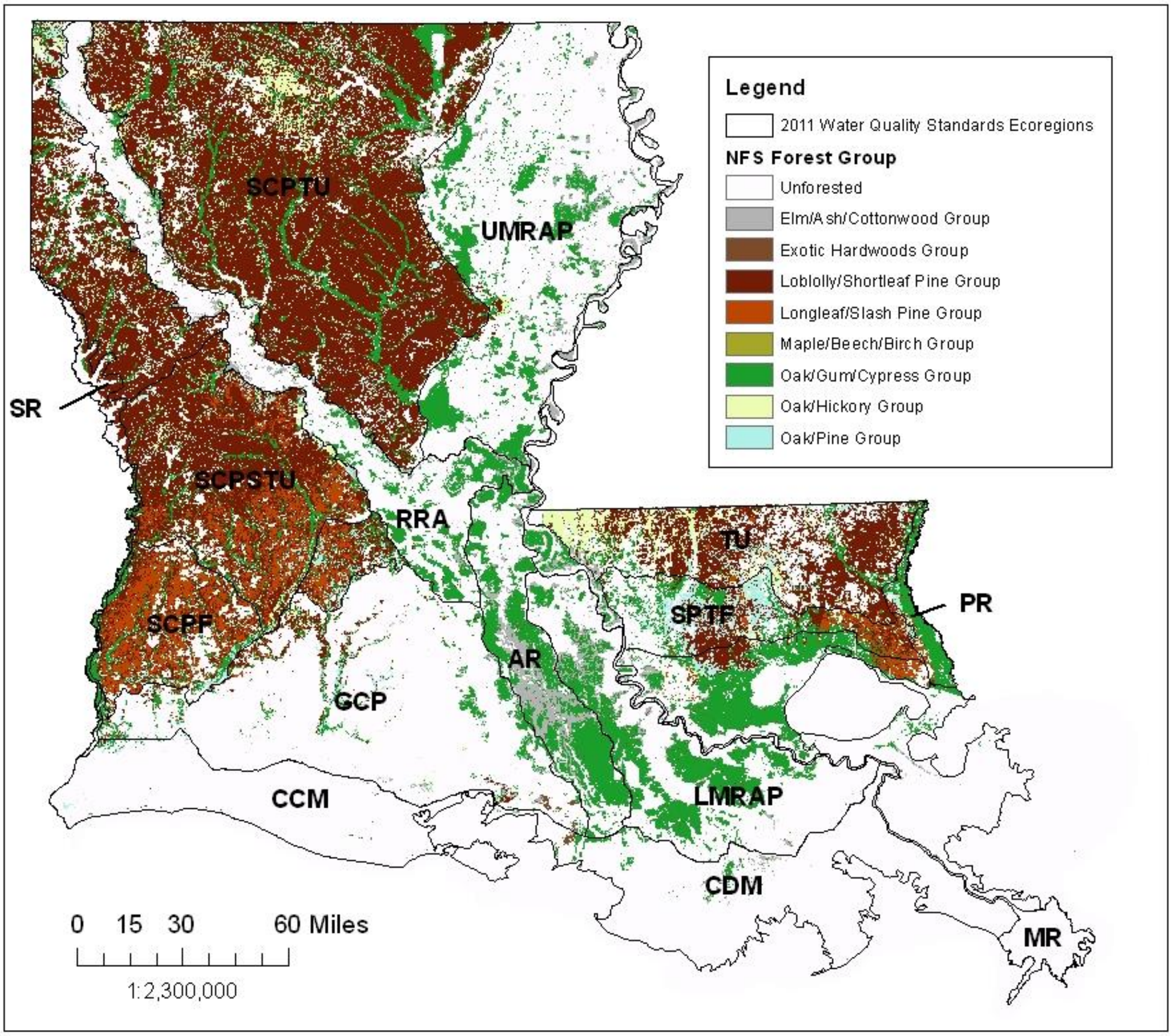


Figure 23. Potential natural vegetation of Kuchler (1993).

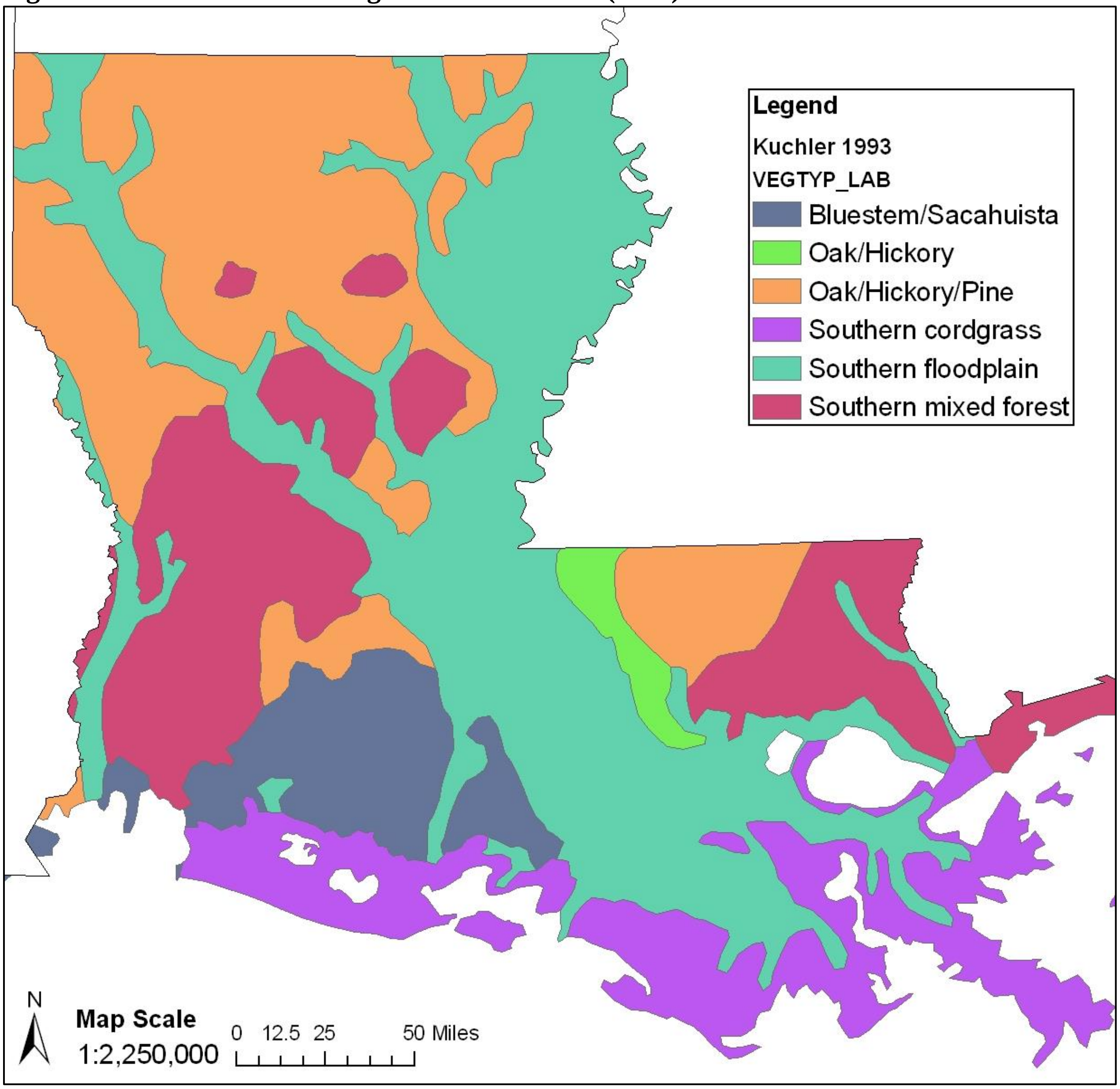


Figure 24. USGS National Wetlands Research Center (NWRC) Soils.

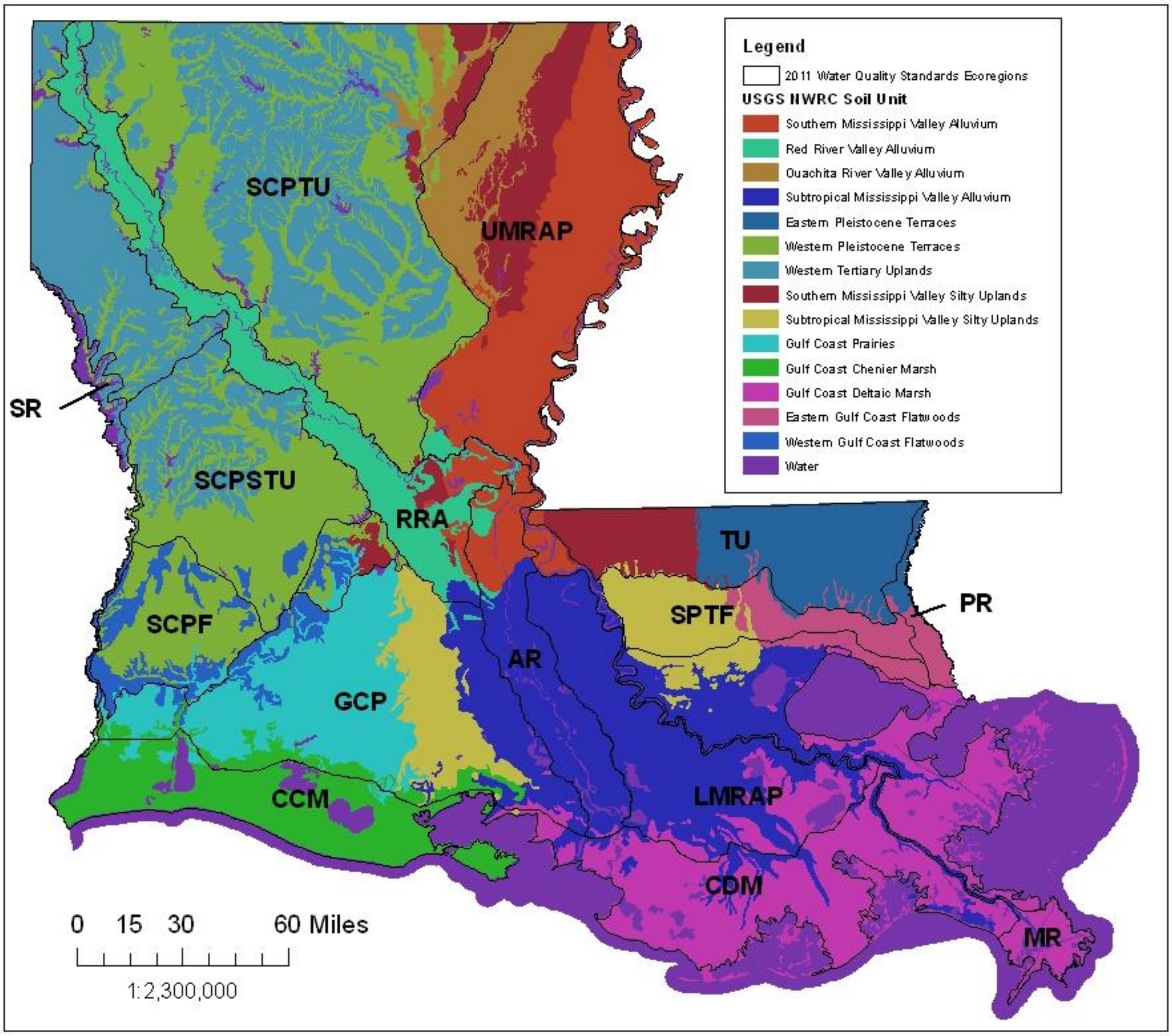


Figure 25. Geologic map of Louisiana (Louisiana Geologic Survey).

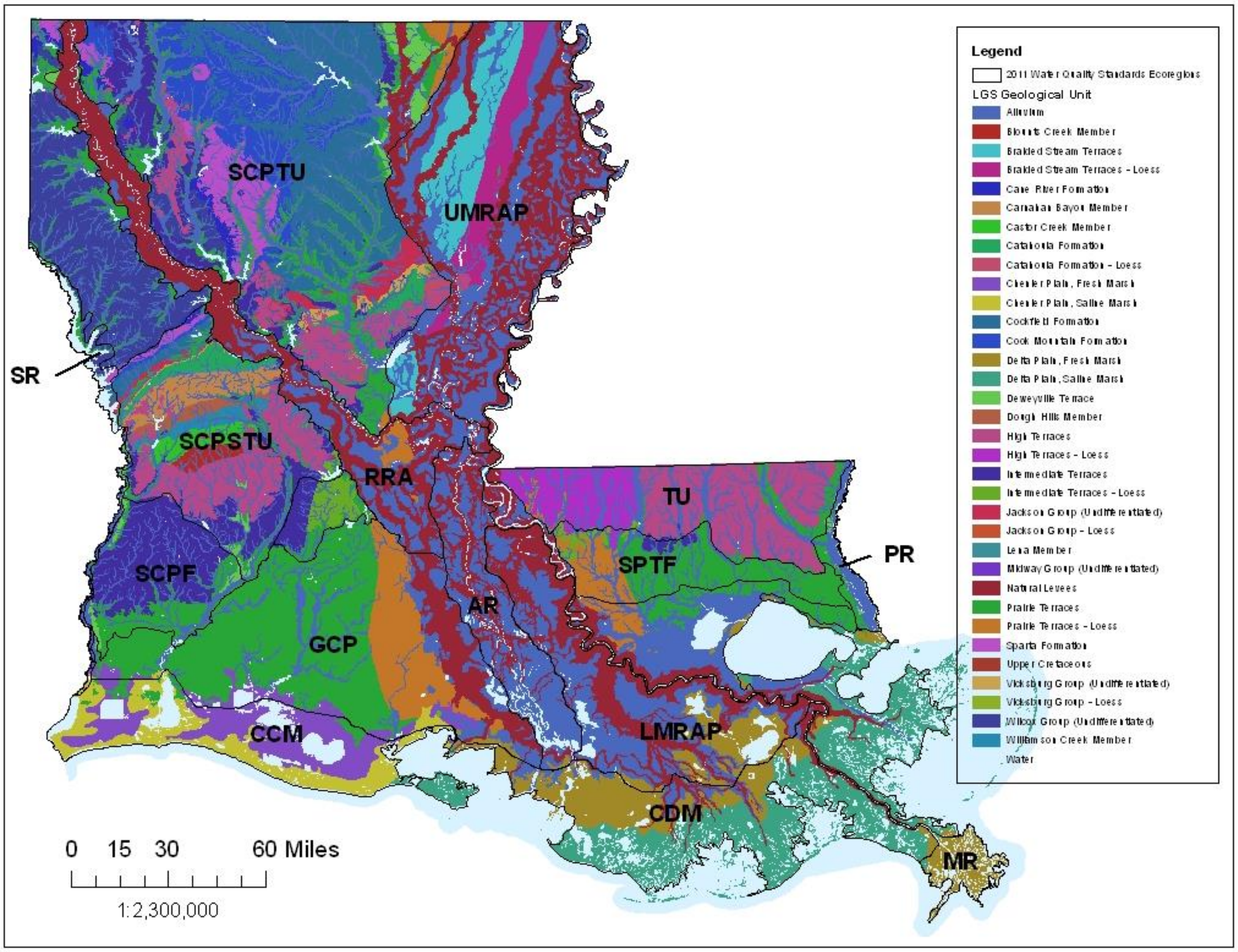


Figure 26. Average annual precipitation for Louisiana (USDA, NRCS). Precipitation in inches.

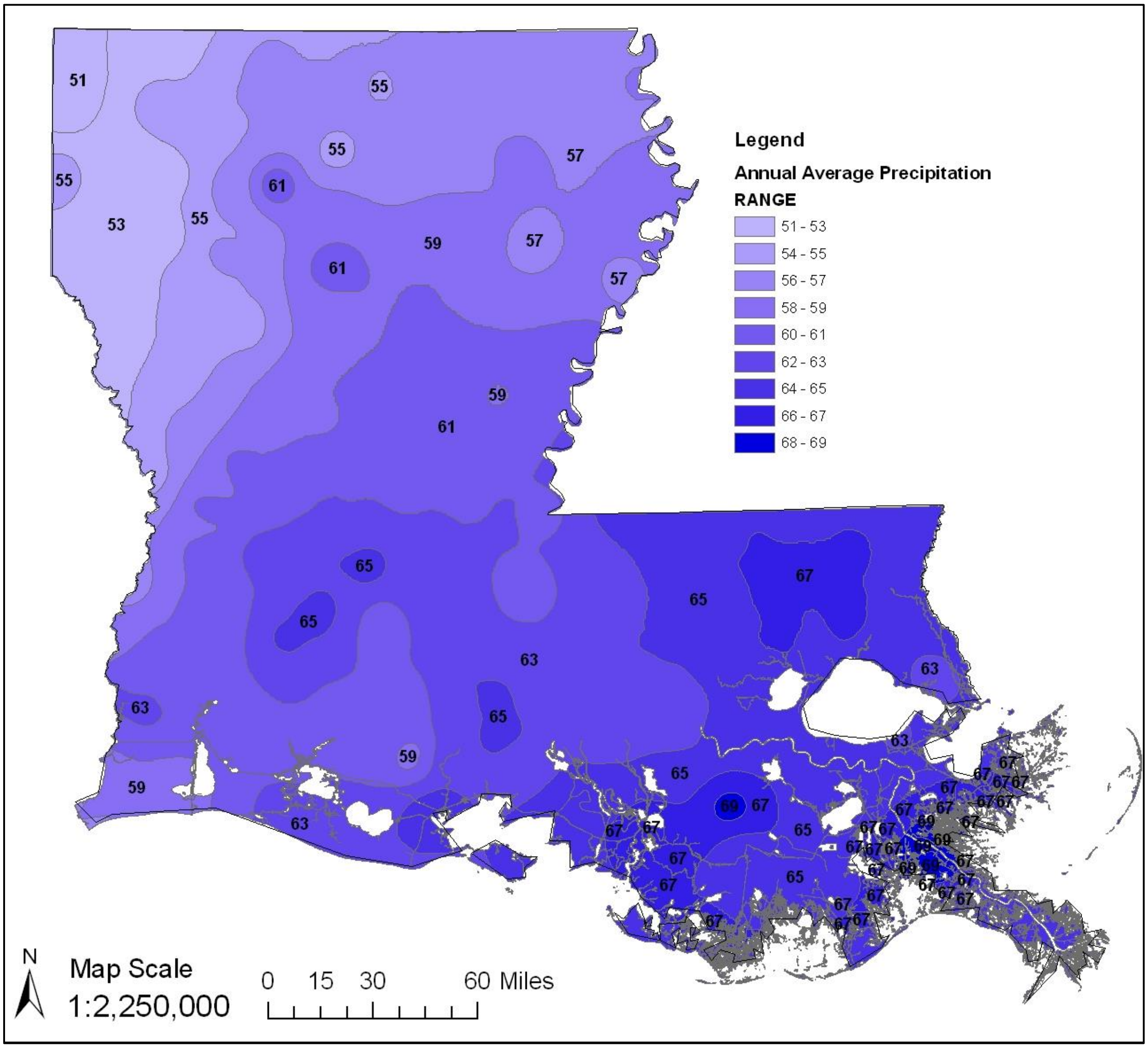


Figure 27. Average annual minimum temperature (Fahrenheit) in January (USDA, NRCS).

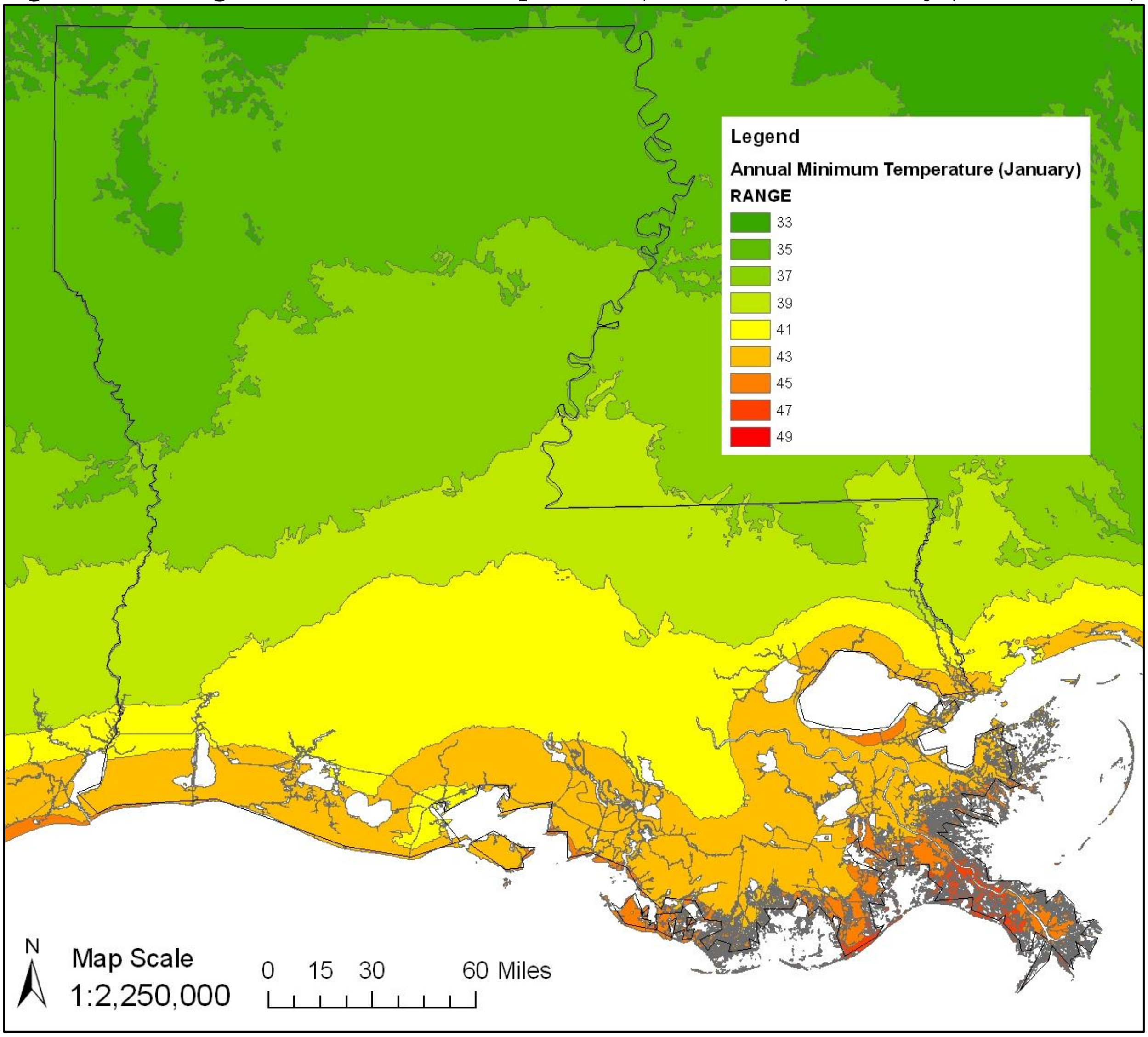


Figure 28. Average annual maximum temperature (Fahrenheit) in July (USDA, NRCS).

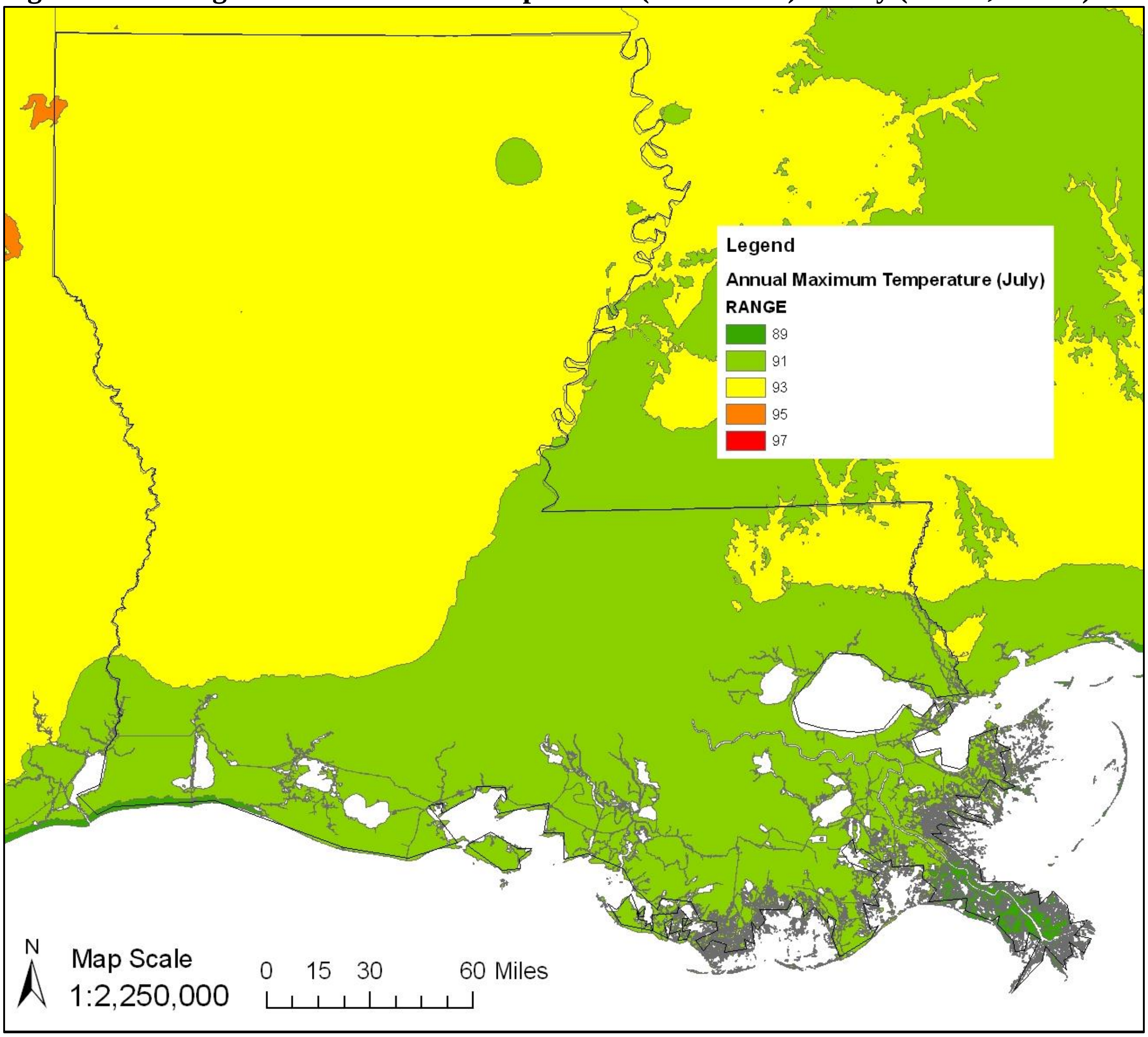


Figure 29. Location of marinas in Louisiana (LOSCO 2007).

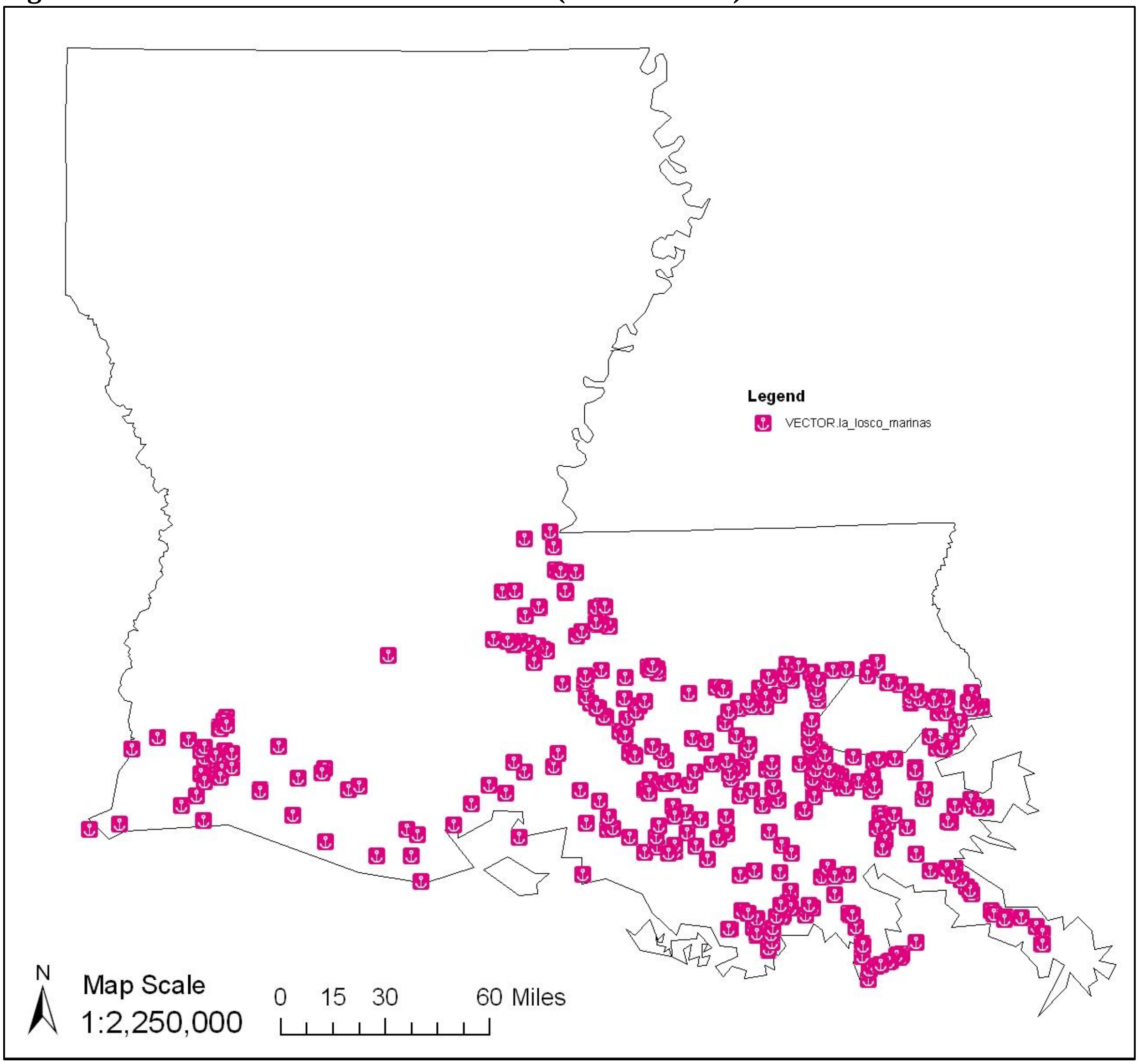
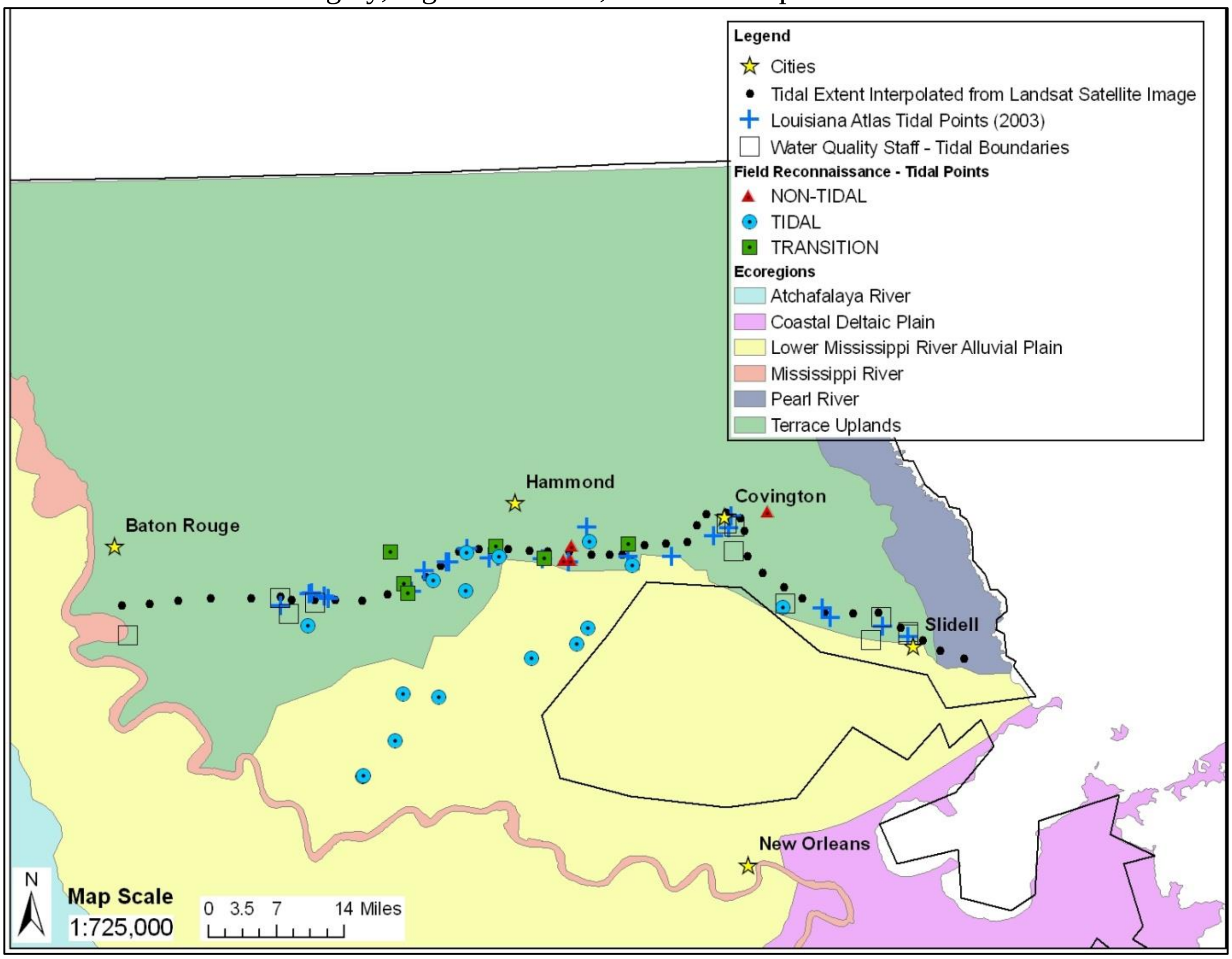


Figure 30. Tidal extent observed in 2010 within the former Terrace Uplands (TU) and Lower Mississippi River Alluvial Plains (LMRAP) Ecoregions.
Tidal points estimated through synthesis of field knowledge and reconnaissance, as well as evaluation of satellite imagery, digital elevation, and other maps.



APPENDIX D: WATER QUALITY CHARACTERISTICS

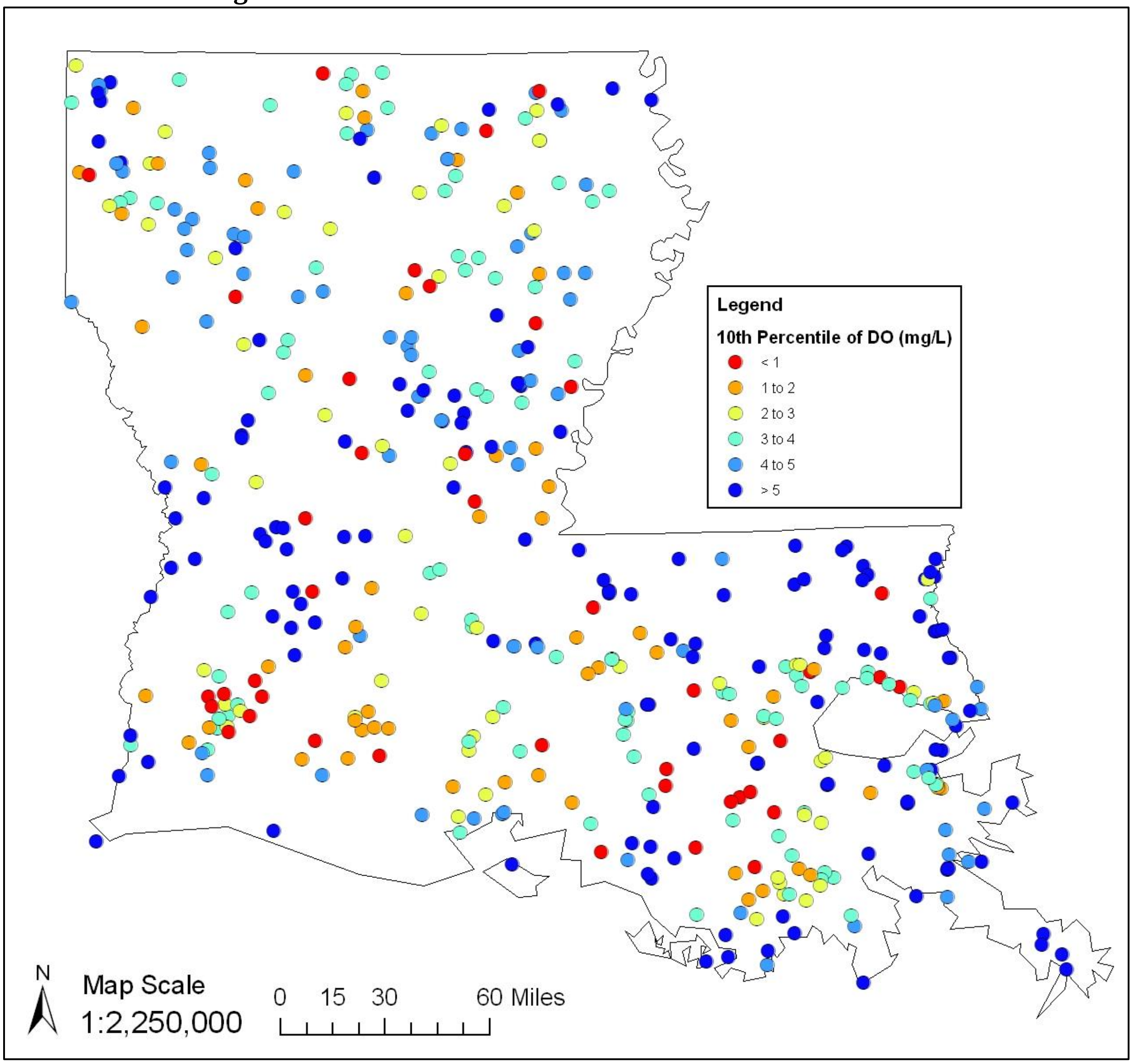
Water quality data collected from inland reference streams and from ambient monitoring stream stations in Louisiana were evaluated and considered in the refinement of ecoregional groupings.

AMBIENT STREAM CHARACTERISTICS

Water quality characteristics at ambient stream sites throughout Louisiana are presented in the accompanying Figure 30 through Figure 37.

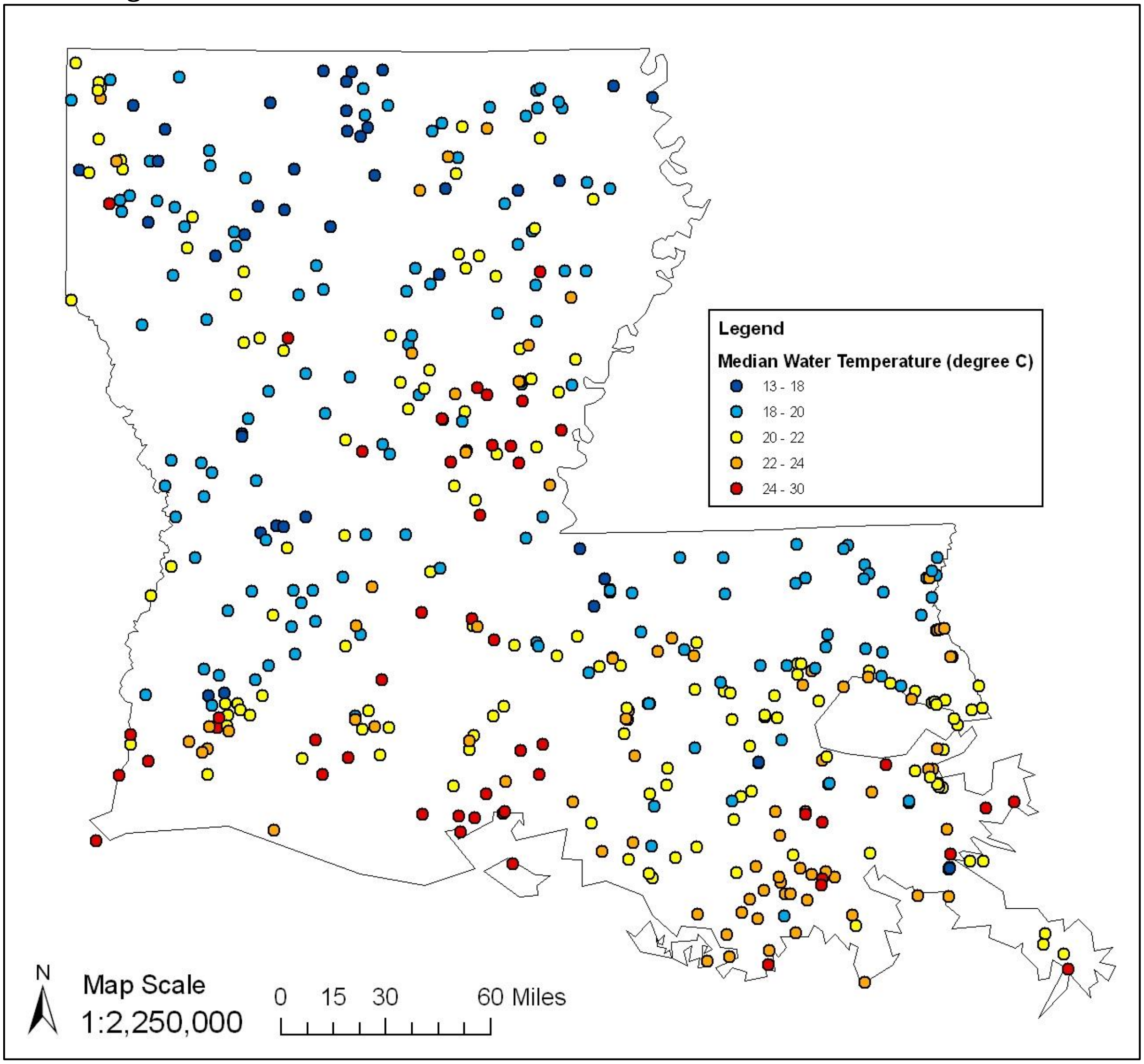
A. DISSOLVED OXYGEN

Figure 31. 10th percentile of dissolved oxygen (DO in units mg/L) observed at LDEQ ambient monitoring stream sites.



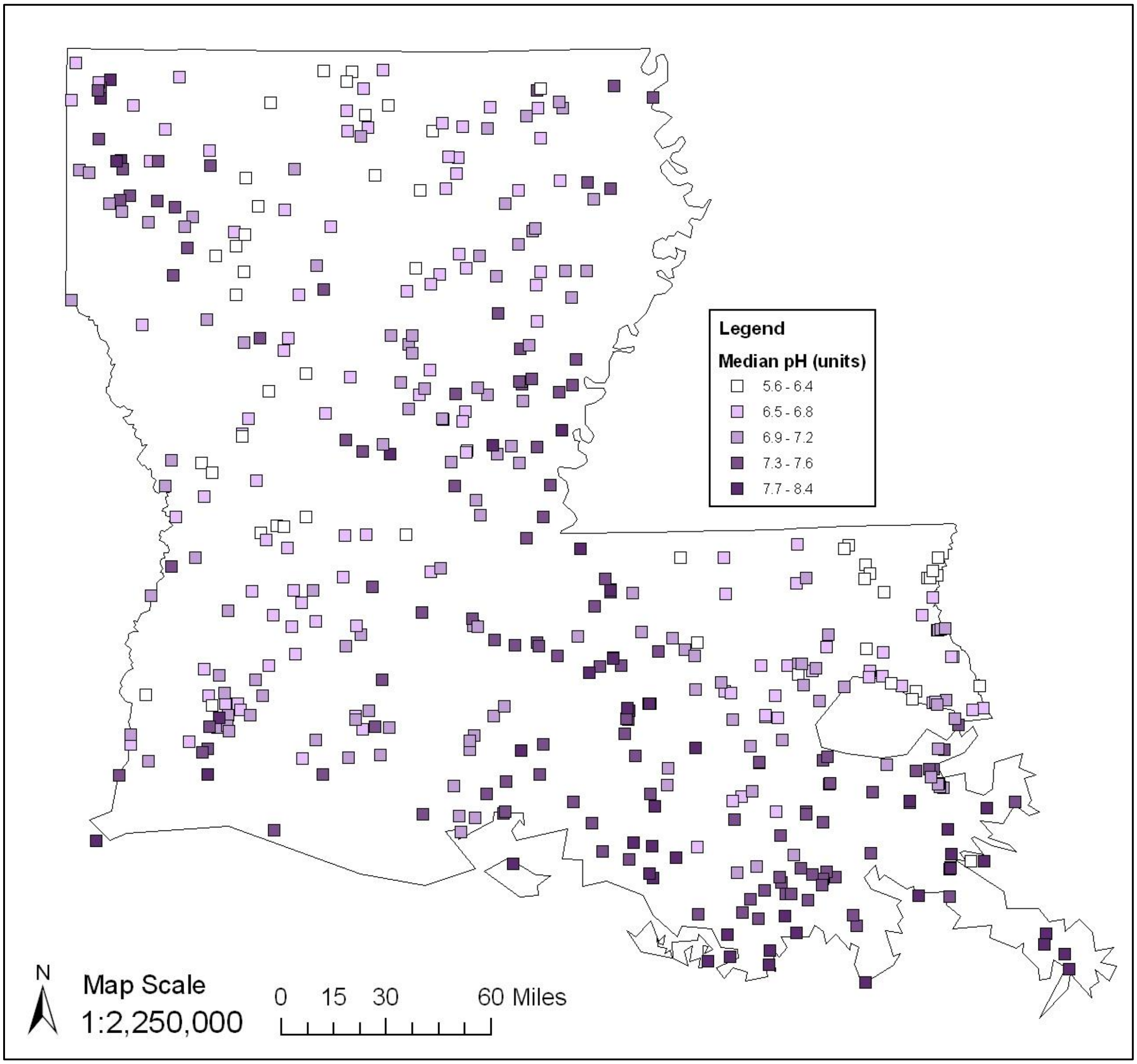
B. WATER TEMPERATURE

Figure 32. Median water temperature (degrees Celsius) observed at LDEQ ambient monitoring stream sites.



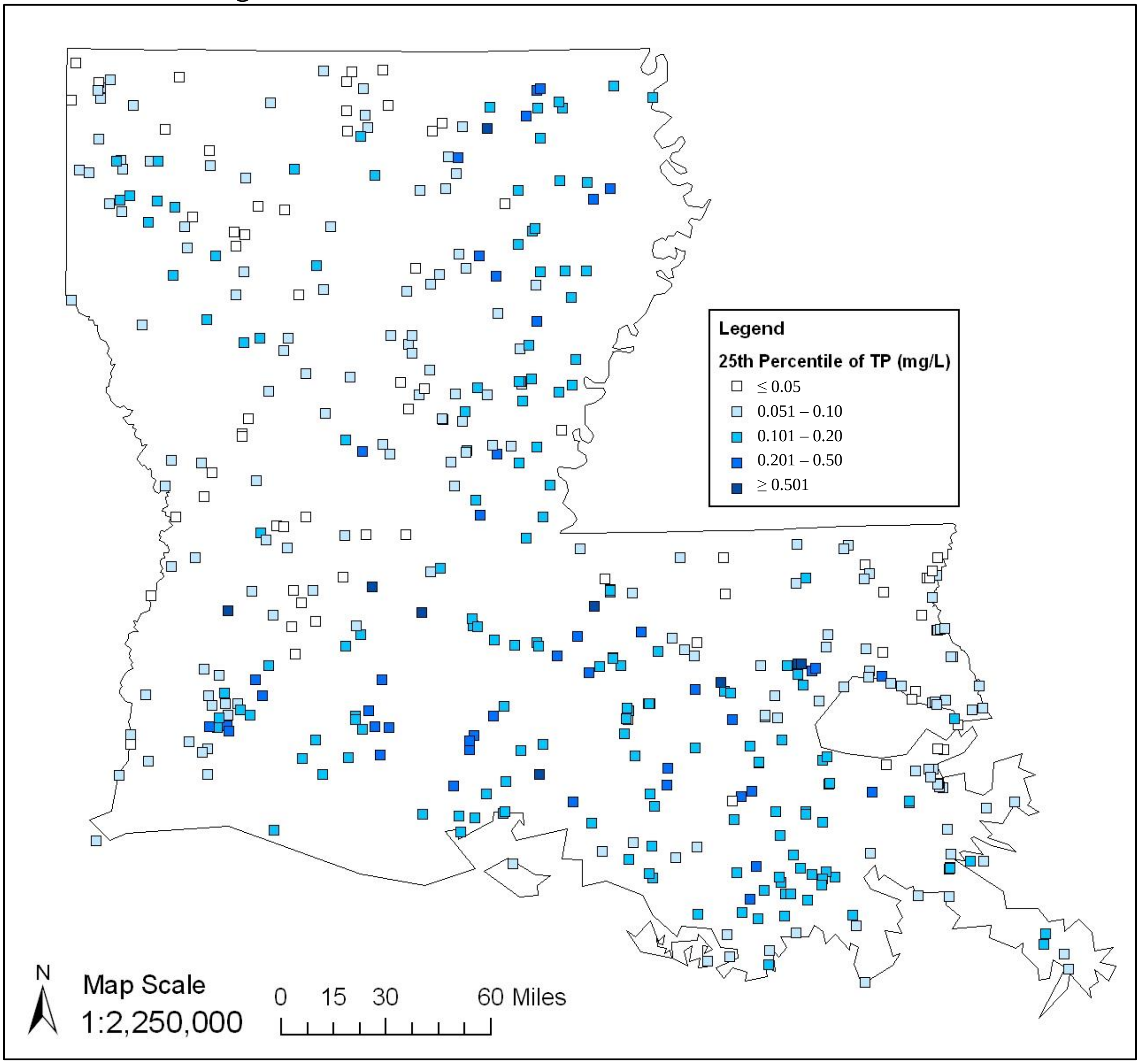
C. pH

Figure 33. Median pH (standard units) observed at LDEQ ambient monitoring stream sites.



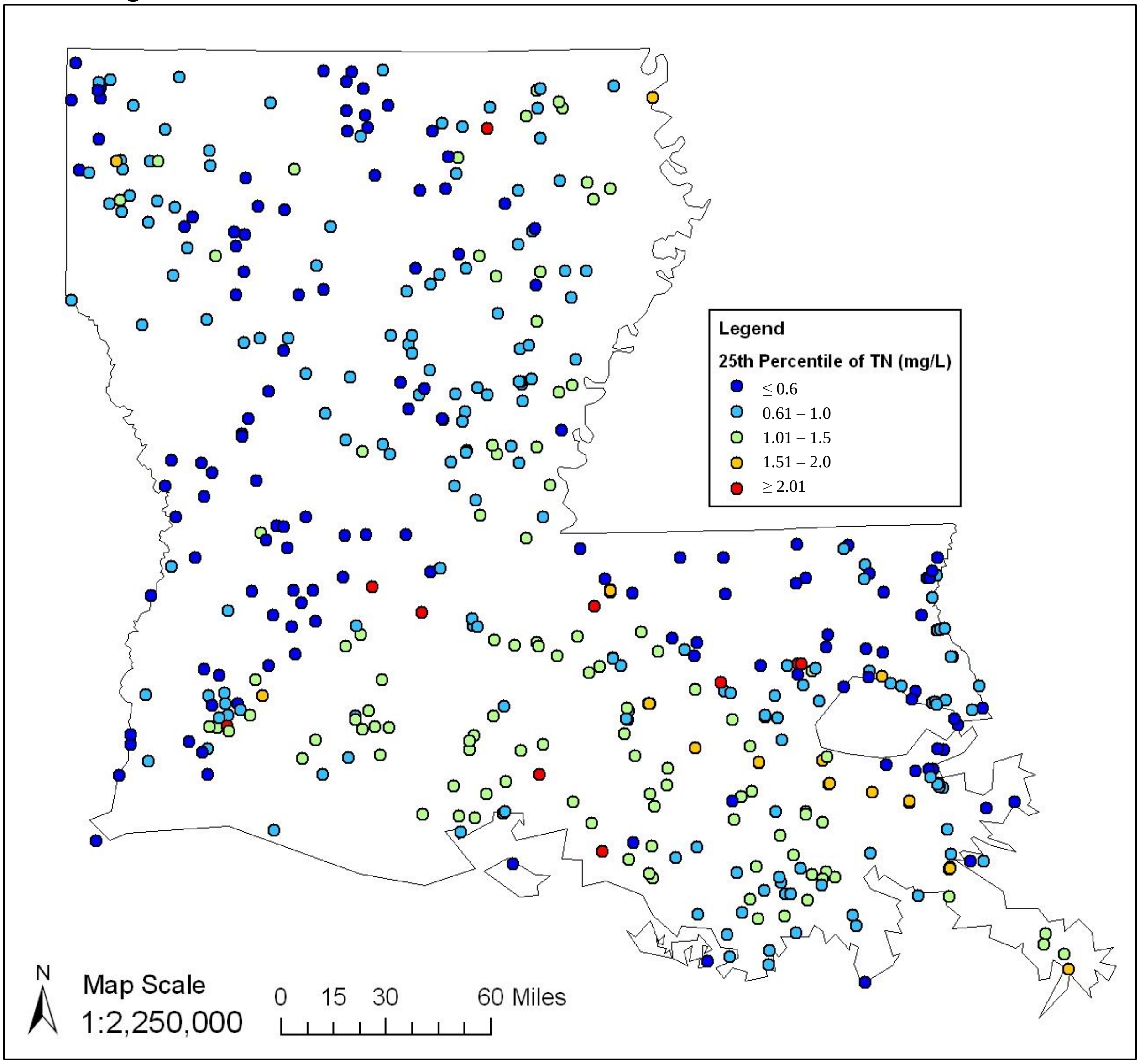
D. TOTAL PHOSPHORUS

Figure 34. 25th percentile of total phosphorus (TP in units mg/L) observed at LDEQ ambient monitoring stream sites.



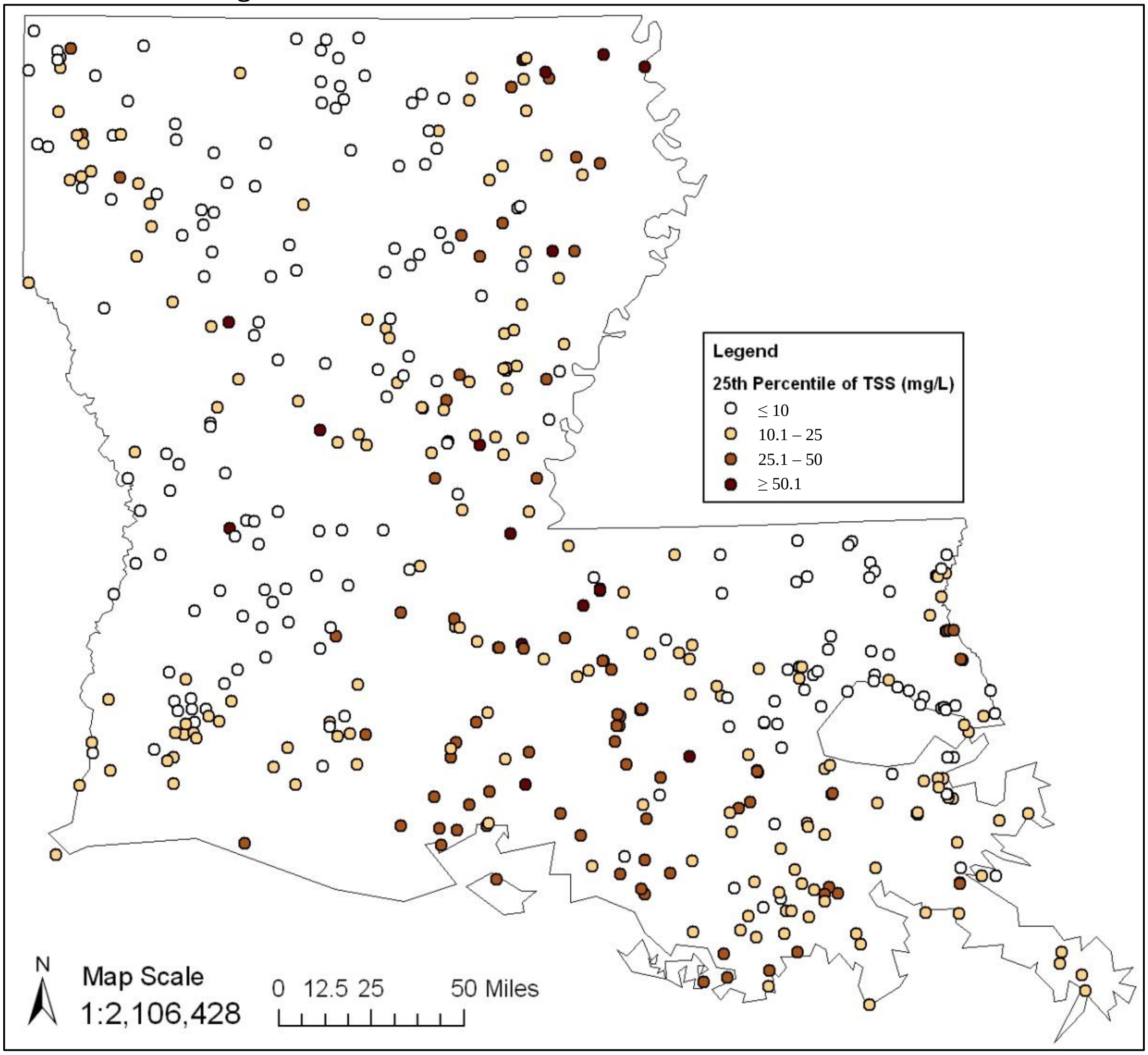
E. TOTAL NITROGEN

Figure 35. 25th percentile of total nitrogen (TN in units mg/L) observed at LDEQ ambient monitoring stream sites.



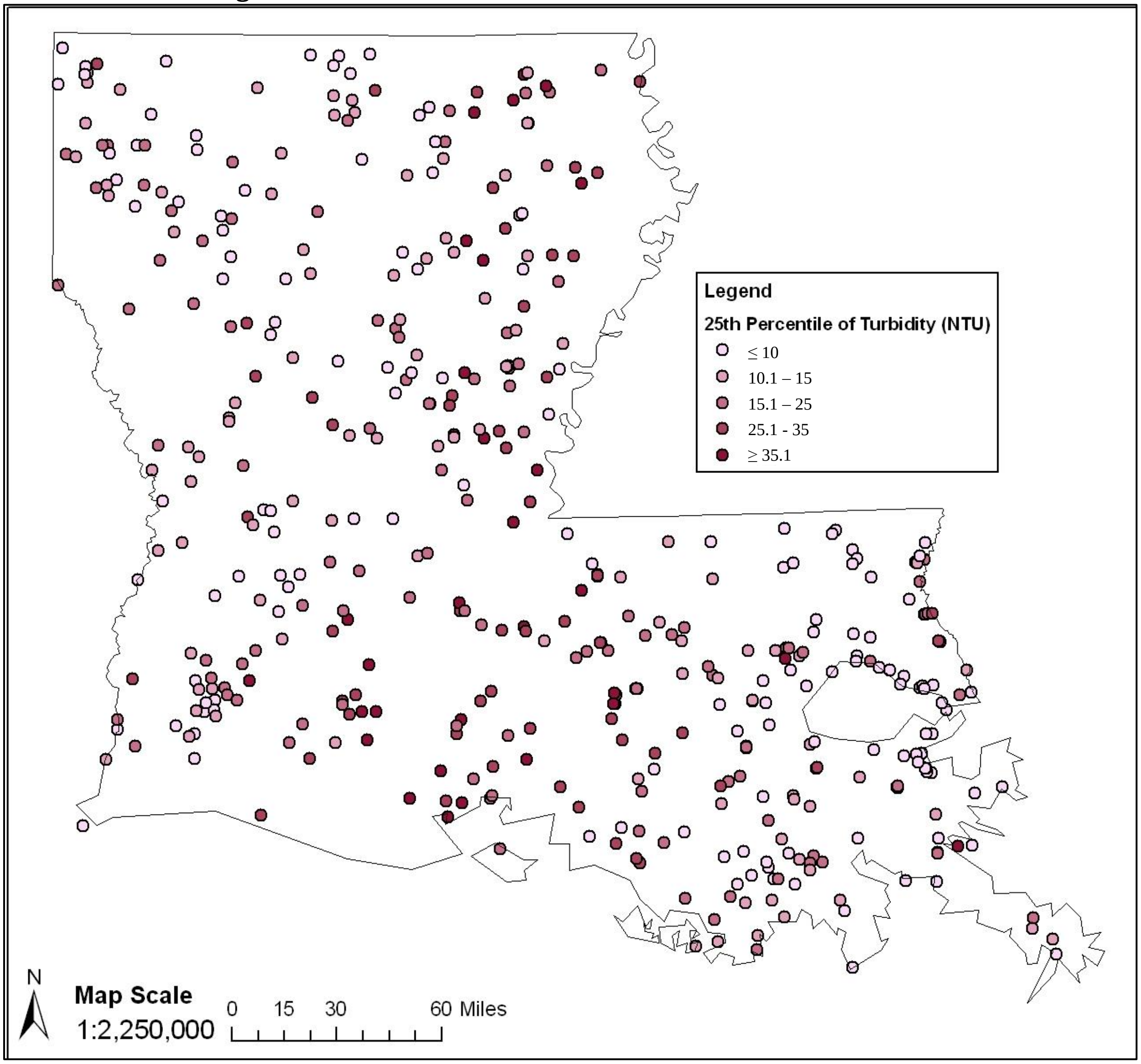
F. TOTAL SUSPENDED SOLIDS

Figure 36. 25th percentile of total suspended solids (TSS in units mg/L) observed at LDEQ ambient monitoring stream sites.



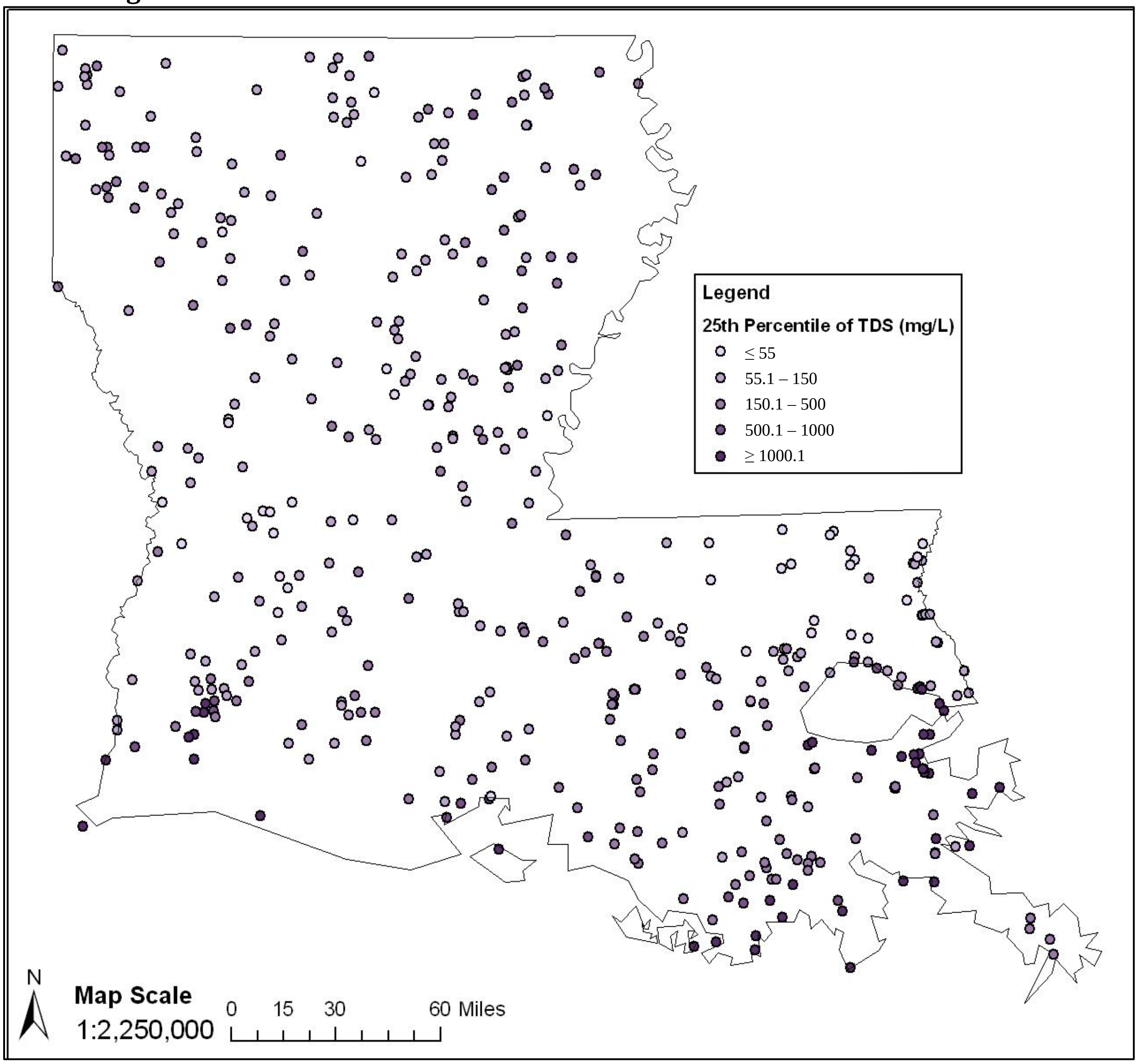
G. TURBIDITY

Figure 37. 25th percentile of turbidity (Nephelometric Turbidity Units, NTU) at LDEQ ambient monitoring stream sites.



H. TOTAL DISSOLVED SOLIDS

Figure 38. 25th percentile of total dissolved solids (TDS in units mg/L) at LDEQ ambient monitoring stream sites.



REFERENCE STREAM CHARACTERISTICS

The inland reference streams sites in Louisiana are listed in Table 4. Water quality characteristics observed at these reference streams sites are presented in the accompanying Figure 39 through Figure 44 in Appendix C.

Table 4. Reference stream sites in Louisiana's inland Water Quality Standards Ecoregions.
Water Quality Standards Ecoregion Abbreviations: SCPF = South Central Plains Flatwoods; SCPSTU = South Central Plains Southern Tertiary Uplands; SCPTU = South Central Plains Tertiary Uplands; TU = Terrace Uplands; UMRAP = Upper Mississippi River Alluvial Plains

Water Quality Standards Ecoregions	Site Number	Site Name	Site Location	Subsegment Number	UTM E	UTM N
SCPF	0488	Bear Head Creek northwest of De Quincy, Louisiana	at bridge on State Highway 389, 6.0 miles northwest of De Quincy, La	LA030807	450417.01400	3377158.24300
SCPF	0489	Beckwith Creek north of De Quincy, Louisiana	at bridge on Smoky Cove Pentecostal Church Road, 11.0 miles north of De Quincy, La.	LA030803	461822.99000	3384746.44200
SCPF	0490	Castor Creek east of Oberlin, Louisiana	at bridge on Parish Road 146, 8.0 miles east of Oberlin, LA	LA050303	536409.70400	3387469.41500
SCPF	0491	Bayou Nezpique northwest of Mamou, Louisiana	at bridge on State Highway 376, 7.0 miles northwest of Mamou, La	LA050301	544132.82800	3392680.49200
SCPF	0492	Cypress Creek east of Oakdale, Louisiana	at bridge on Parish Road, 3.5 miles north of State Highway 106, 7.0 miles east-northeast of Oakdale, La.	LA050301	543257.78700	3411609.75500
SCPF	2199	Hickory Creek near Longville, Louisiana	bridge on State Hwy 110, 2.1 miles west of Longville, La	LA030802	474909.45500	3386047.84700

Water Quality Standards Ecoregions	Site Number	Site Name	Site Location	Subsegment Number	UTM E	UTM N
SCPSTU	0096	Calcasieu River northwest of Oberlin, Louisiana	at bridge on State Hwy 26, 3.0 miles northwest of Oberlin, La	LA030103	517819.42100	3389773.45500
SCPSTU	0445	Sixmile Creek southeast of Grant, Louisiana	1.4 mile southeast of Grant, Louisiana, 2 miles off State Highway 377 on Palestine Church Road at Parish Park.	LA030504	507694.23200	3403859.65200
SCPSTU	0447	Anacoco Bayou north of Rosepine, Louisiana	at bridge on Hawks Road, 5.6 miles west of US Highway 171, 2 miles north of Rosepine, La.	LA110506	466155.90600	3424474.13800
SCPSTU	0448	Kisatchie Bayou south of Natchitoches, Louisiana	at Kisatchie Bayou campground-dead end of Forest Road 366, 24 miles south of Natchitoches, La.	LA101103	491273.67400	3478727.90300
SCPSTU	0450	Little Kisatchie Bayou north of Leesville, Louisiana	at bridge on State Highway 118, 3.0 miles west of Forest Road 360 , 20 miles north of Leesville, La.	LA101103	489843.70900	3473833.94500
SCPSTU	0487	Little Bayou Pierre north of Simpson, Louisiana	at bridge on State Highway 118, 0.8 mile west of Forest Rd. 360, 10 miles north-northwest of Simpson, La.	LA101103	493938.74400	3473443.87900
SCPSTU	0555	Loving Creek southeast of Castor Plunge, Louisiana	50 feet south of bridge on Forest Road 287, 1 miles SE of Castor Plunge, 5.9 miles NW of Woodworth, 6.0 miles west of Cloverdale, La	LA060208	540155.63900	3452264.09400
SCPSTU	1156	Pearl Creek northwest of Burr Ferry, Louisiana	6.8 miles southwest of Caney, 14 miles southwest of Leesville, 16 miles northwest of Rosepine, La	LA110202	453322.73700	3438106.37900
SCPTU	0334	Beaucoup Creek west of Columbia, Louisiana	at La. 126 bridge west of Sikes, La.	LA081503	564005.19200	3552715.45900

Water Quality Standards Ecoregions	Site Number	Site Name	Site Location	Subsegment Number	UTM E	UTM N
SCPTU	0452	Saline Bayou east of Saline, Louisiana	at bridge on State Highway 155, 1.9 mile east of Saline, La	LA100801	505221.93300	3559820.77000
SCPTU	0454	Middle fork Bayou D'Arbonne west of Bernice, Louisiana	at bridge on State Highway 2, 6.3 miles west of Bernice, La	LA080610	522634.99800	3630172.58400
SCPTU	0455	Meridian Creek north of Farmerville, Louisiana	bridge on State Highway 348, 0.9 mile east of Conway, Louisiana, 9 miles of Farmerville, La.	LA080501	557873.27600	3639122.71400
SCPTU	0456	Frank la Pere Creek northeast of Farmerville, Louisiana	at bridge on Parish Road 2239, 0.8 mile east of Litroe, Louisiana 19.5 miles northeast of Farmerville, La.	LA080101	575896.49100	3650516.30700
SCPTU	0457	Chemin-a-Haut Creek north of Bastrop, Louisiana	11.4 miles north-northeast of Bastrop, Louisiana, northeast of Chemin-a-Haut State Park.	LA080401	610050.59500	3643970.09400
TU	0494	Bogue Lusa Creek near Sheridan, Louisiana	at bridge on State Highway 439 1.2 miles south-southwest of Sheridan.	LA090401	786164.79600	3416872.56400
TU	0495	Tchefuncte River west of Wilmer, Louisiana	at bridge on La. Hwy 10, 4.4 miles east of Wilmer, La.	LA040801	759189.65100	3412546.21300
TU	0496	Crittenden Creek north of Greensburg, Louisiana	at bridge on La. Hwy 441, 5.1 miles north-northeast of Greensburg, La.	LA040501	724370.59000	3421288.34300
TU	0497	Darling Creek east of Chipola, Louisiana	At bridge on La. Hwy 38, 0.3 mile east of Chipola, La.	LA040301	710664.64800	3423165.34200
TU	0525	West Fork Thompsons Creek north of Jackson, Louisiana	at bridge on Parish Rd., approx 2 miles east of Laurel Hill, La, 10 miles north-northwest.	LA070502	660381.75200	3427352.33500
TU	0526	Little Comite Creek northeast of Norwood, Louisiana	at bridge on Parish Rd., 1 mile east of State Hwy. 19, 2.5 miles north-northeast of Norwood, La.	LA040101	682920.82100	3430888.41400

Water Quality Standards Ecoregions	Site Number	Site Name	Site Location	Subsegment Number	UTM E	UTM N
TU	0527	Bogue Falaya River at Josephs Road	at bridge on Josephs Road, 1.4 mile north of Folsom, La.	LA040804	770194.18900	3395172.90600
UMRAP	0460	Leading Bayou east of Winnsboro, Louisiana	at bridge on gravel road 2.2 miles from State Highway 610, in Big Lake Wildlife Management Area, 15 miles east of Winnsboro, La.	LA081201	643959.50900	3565645.85100
UMRAP	0461	Buckshot Bayou east of Winnsboro, Louisiana	at bridge on gravel road 2.6 miles from State Highway 610, in Big Lake Wildlife Management Area, 15.4 miles east of Winnsboro, La.	LA081201	644487.50900	3565375.85100
UMRAP	0462	Big Roaring Bayou east of Winnsboro, Louisiana	at bridge on Parish Road northeast of State Highway 4, 12.8 miles east-southeast of Winnsboro, La.	LA081201	641528.45500	3552212.83900
UMRAP	0463	Cross Bayou east of Columbia, Louisiana	at bridge on Parish Road off of State Highway 848	LA080901	601516.29800	3555431.10800
UMRAP	0464	Big Saline Bayou northeast of Pineville, Louisiana	at bridge on Parish Road 1206 east of State Highway 115, 17.3 miles northeast of Pineville, Louisiana.	LA101501	582702.78900	3473325.28000
UMRAP	0465	Indian Bayou northeast of Pineville, Louisiana	at bridge on Parish Road 1206 east of State Highway 115, 2miles east of Big Saline Bayou, 19.4 miles northeast of Pineville, La.	LA101501	584286.78100	3473461.27500
UMRAP	0466	Duck Slough east of Pineville, Louisiana	at bridge on Parish Road 115, 3 miles east of Big Saline Bayou, 20.5 miles east of Pineville, Louisiana.	LA101501	587136.76500	3473731.26800
UMRAP	0484	Muddy Bayou northeast of Alexandria, Louisiana	in Saline Wildlife Management Area, on local road 1.75 mile off New Bridge Road, 8.0 miles east-northeast of Alexandria, La.	LA101502	589911.71500	3476618.25700

Water Quality Standards Ecoregions	Site Number	Site Name	Site Location	Subsegment Number	UTM E	UTM N
UMRAP	0486	John's Bayou east of Alexandria, Louisiana	bridge in Saline wildlife Management Area, on local road 1.0 mile southwest of Muddy Bayou Rd, 24 miles east of Alexandria, La.	LA101502	588601.77800	3472296.26500

A. Dissolved Oxygen

Figure 39. Box-plot distribution of daily minimum dissolved oxygen (mg/L) observed through continuous monitoring within inland ecoregions.
X-axis is ecoregion, lower and upper whiskers represent minimum and maximum observed values, respectively.

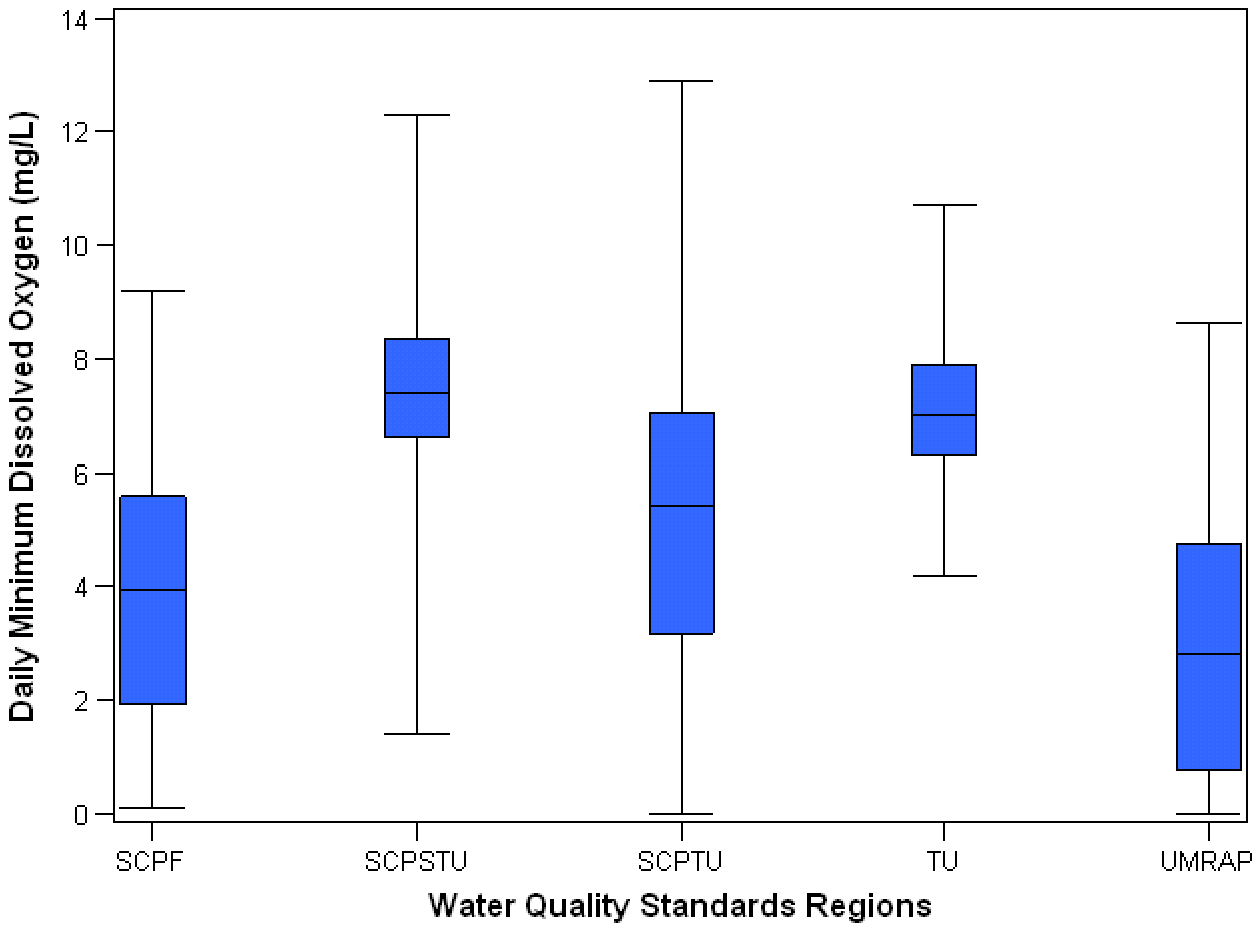
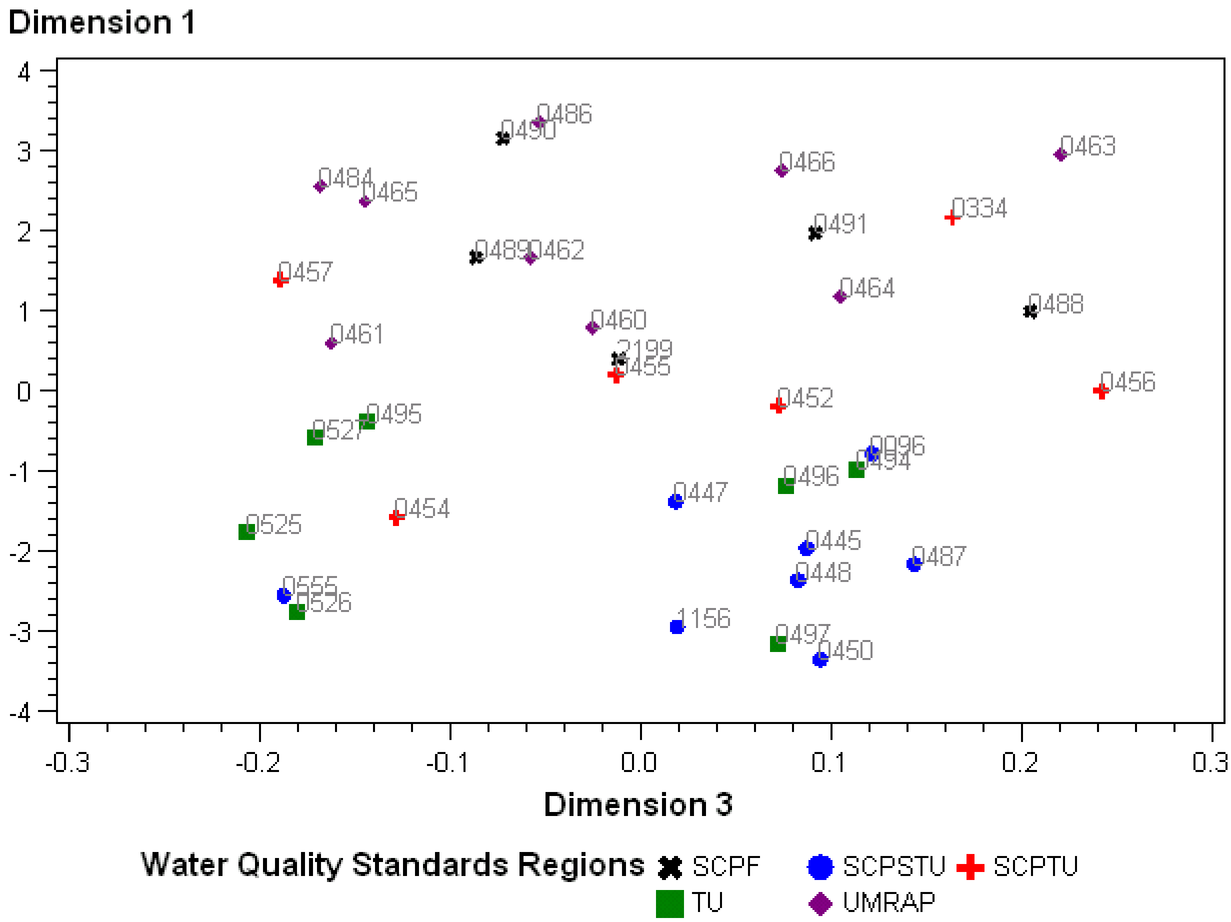


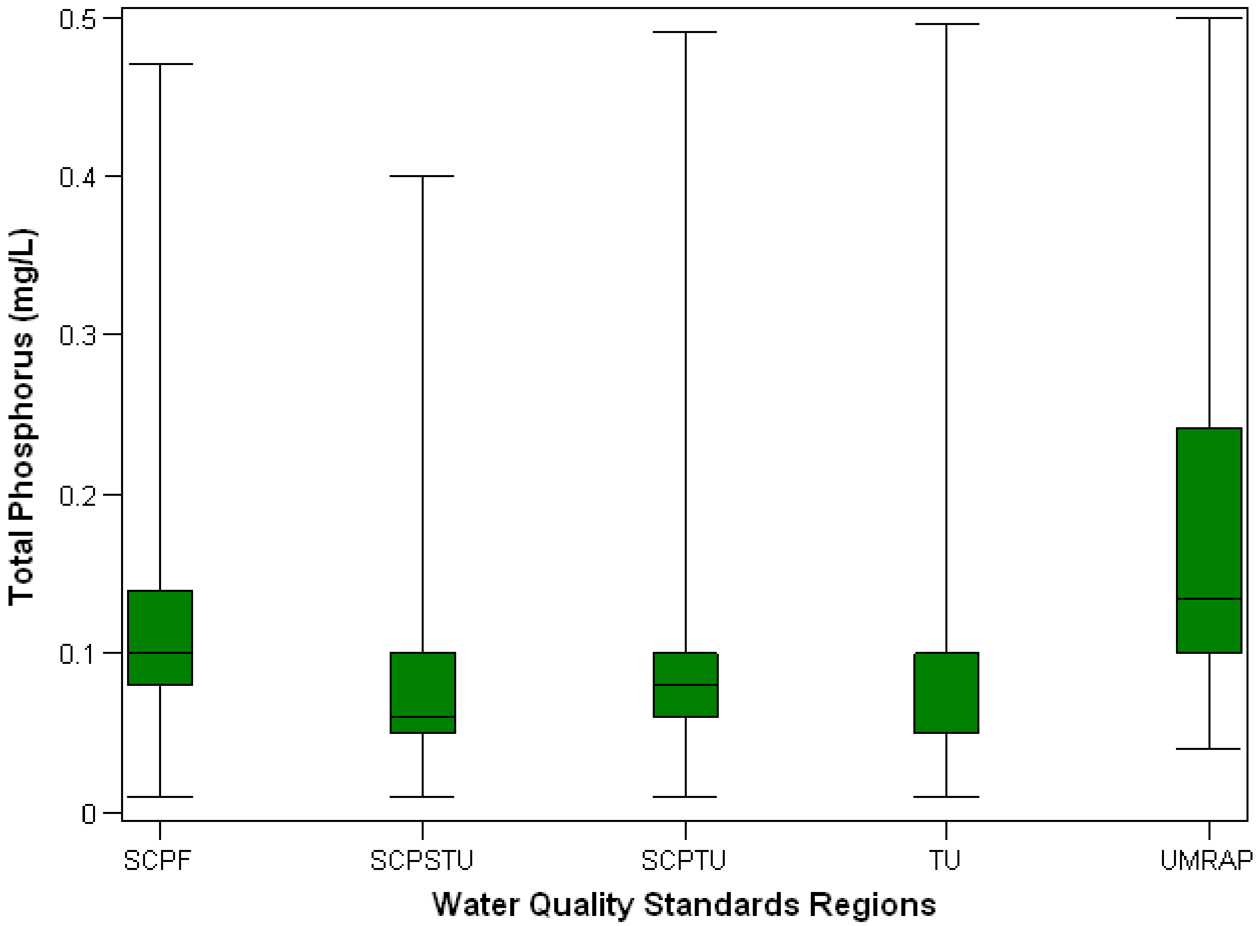
Figure 40. Non-metric multidimensional scaling (NMDS) of dissolved oxygen observed through continuous monitoring at inland reference stream sites.

Graph represents scaling of the 10th percentile of daily dissolved oxygen. Plots are graphed by reference site. Plots closer together may be considered more similar, whereas plots farther apart may be considered less similar in regard to dissolved oxygen.



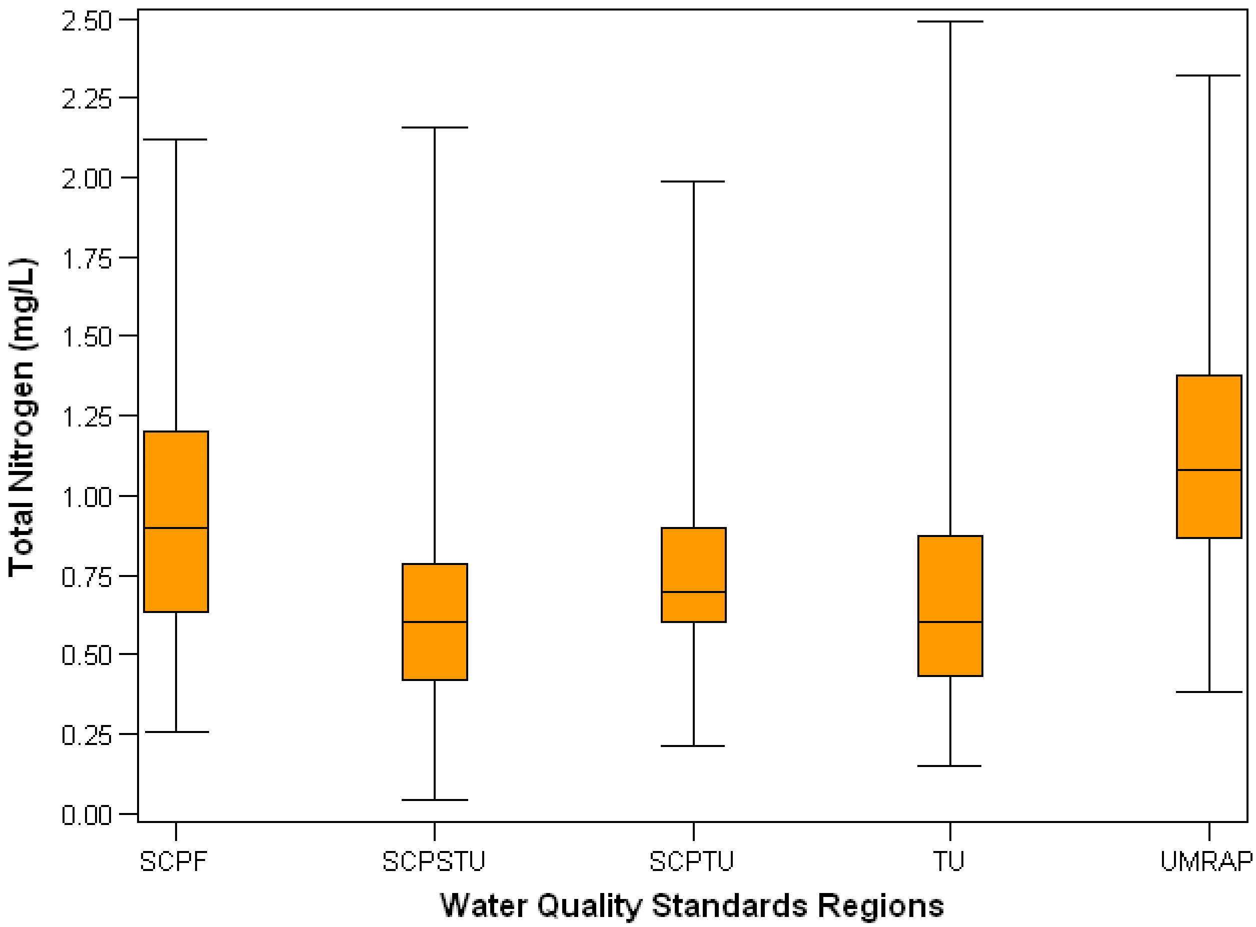
B. Total Phosphorus

Figure 41. Box-plot distribution of total phosphorus (mg/L) within inland ecoregions. X-axis is ecoregion, lower and upper whiskers represent minimum and maximum observed values, respectively.



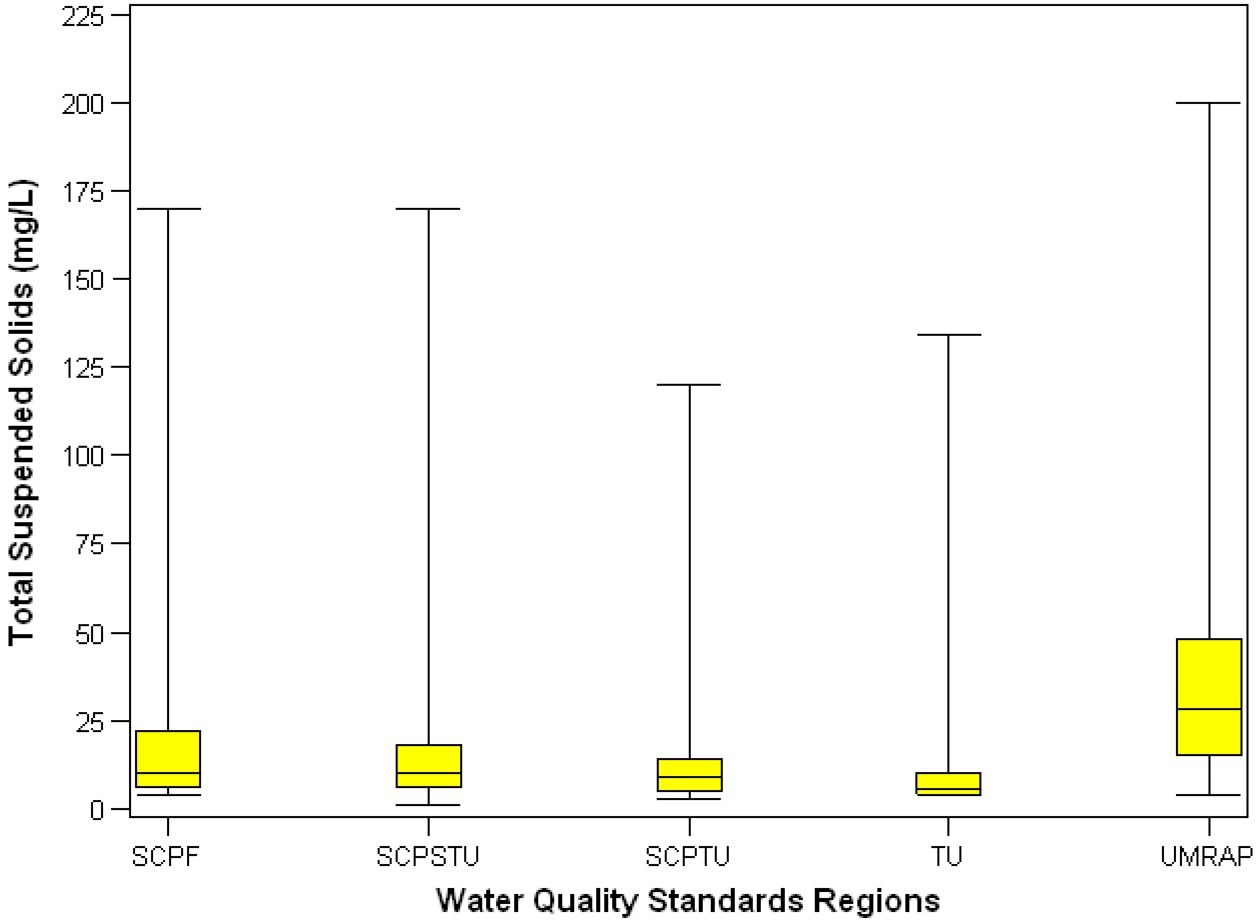
C. Total Nitrogen

Figure 42. Box-plot distribution of total nitrogen (mg/L) within inland ecoregions. Total nitrogen is calculated by summing nitrate-nitrite nitrogen (NO3NO2) and total kjeldahl nitrogen (TKN). X-axis is ecoregion, lower and upper whiskers represent minimum and maximum observed values, respectively.



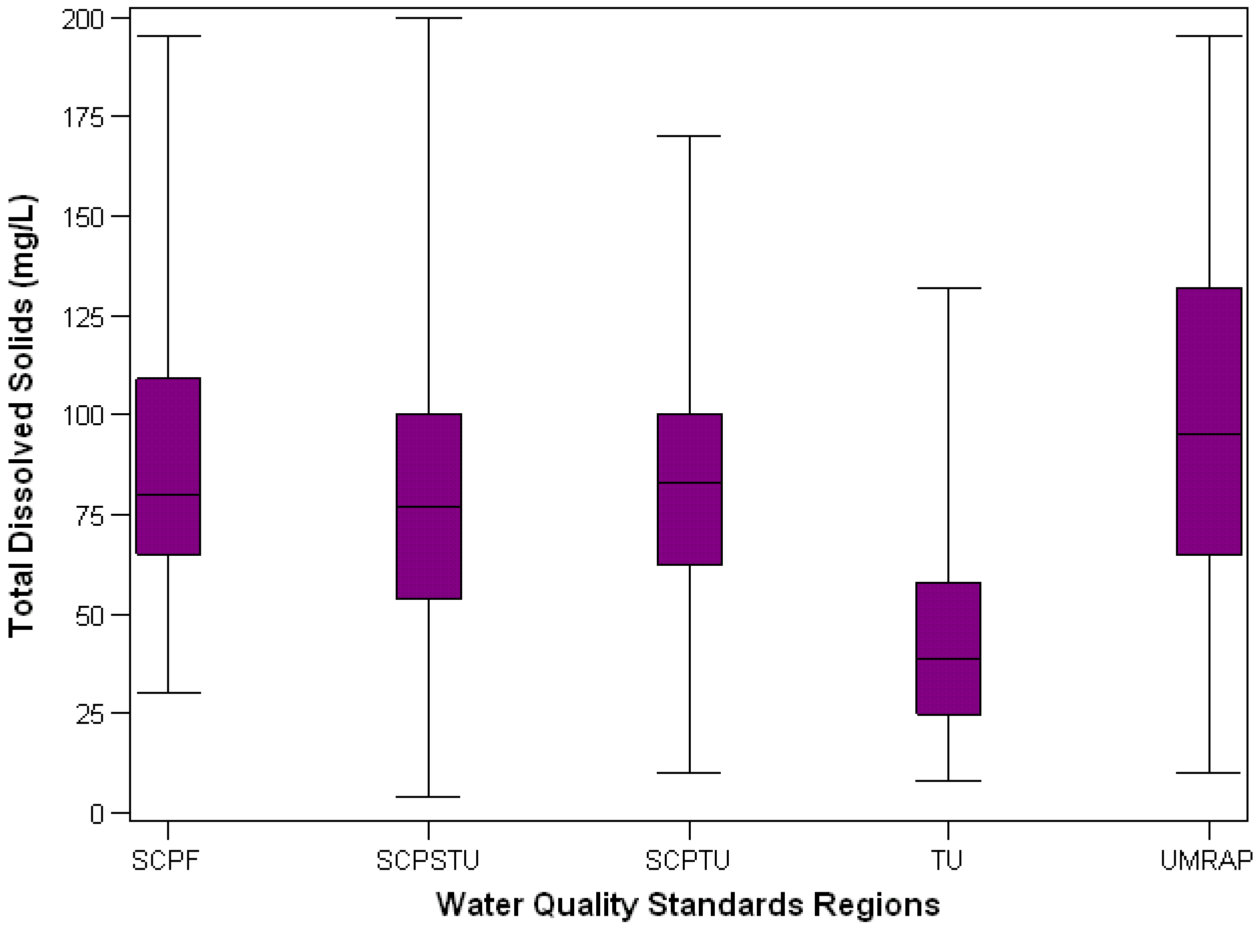
D. TOTAL SUSPENDED SOLIDS

Figure 43. Box-plot distribution of total suspended solids (mg/L) within inland ecoregions. X-axis is ecoregion, lower and upper whiskers represent minimum and maximum observed values, respectively.



E. TOTAL DISSOLVED SOLIDS

Figure 44. Box-plot distribution of total dissolved solids (mg/L) within inland ecoregions. X-axis is ecoregion, lower and upper whiskers represent minimum and maximum observed values, respectively.



APPENDIX E: HABITAT CHARACTERISTICS OF INLAND REFERENCE STREAMS

Visual habitat assessments through rapid assessment methodologies were conducted at reference stream sites. Assessments were conducted in 2009 and from 1991 to 2006 in the spring, summer, and fall (April to October) months; actual months of collection varied among years. The results of these habitat assessments for the reference streams in the selected inland ecoregions are presented and discussed below.

Average estimated stream velocity was significantly higher in SCPSTU (0.44 m/sec) and SCPTU (0.39 m/sec) than in UMRAP (0.18 m/sec) and SCPF (0.12 m/sec) Ecoregions ($p < 0.05$, Tukey's test; Figure 45). Total habitat scores varied among ecoregions (Figure 46); Tukey's test determined that SCPTU>SCPSTU>UMRAP>TU ($p < 0.05$). TU sites scored lowest in bottom substrate/instream cover, deposition, bank stability, and riparian vegetation zone width compared to other ecoregions. SCPTU sites scored highest in bottom substrate/instream cover, pool variability, canopy cover, deposition, and channel sinuosity.

Physical characteristics varied among ecoregions (Figure 47 and Table 3). Percentage of organic material was significantly higher (and, therefore, percentage of inorganic material lower) in SCPF, SCPTU, and UMRAP than in the SCPSTU and TU Ecoregions ($p < 0.05$). Organic material was composed of mostly (>50%) detritus in all ecoregions with moderate amounts of muck-mud (between 7% and 33%) and minimal marl (<1%). The percentage of detritus was significantly greater in the TU Ecoregion than all others and lowest in the UMRAP Ecoregion. Inorganic material in most ecoregions was predominantly composed of silt, sand, and clay. Percentage of sand was significantly higher in SCPSTU and TU than all other ecoregions ($p < 0.05$); silt and clay dominated the substrate in SCPF and UMRAP. SCPTU had significantly higher percentages of bedrock, boulder, and cobble than all other ecoregions ($p < 0.05$).

Figure 45. Mean velocity of reference streams in the five inland ecoregions. Estimated velocities are reported in m/sec. Letters represent Tukey groupings; ecoregions sharing the same letter are not significantly different ($p > 0.05$).

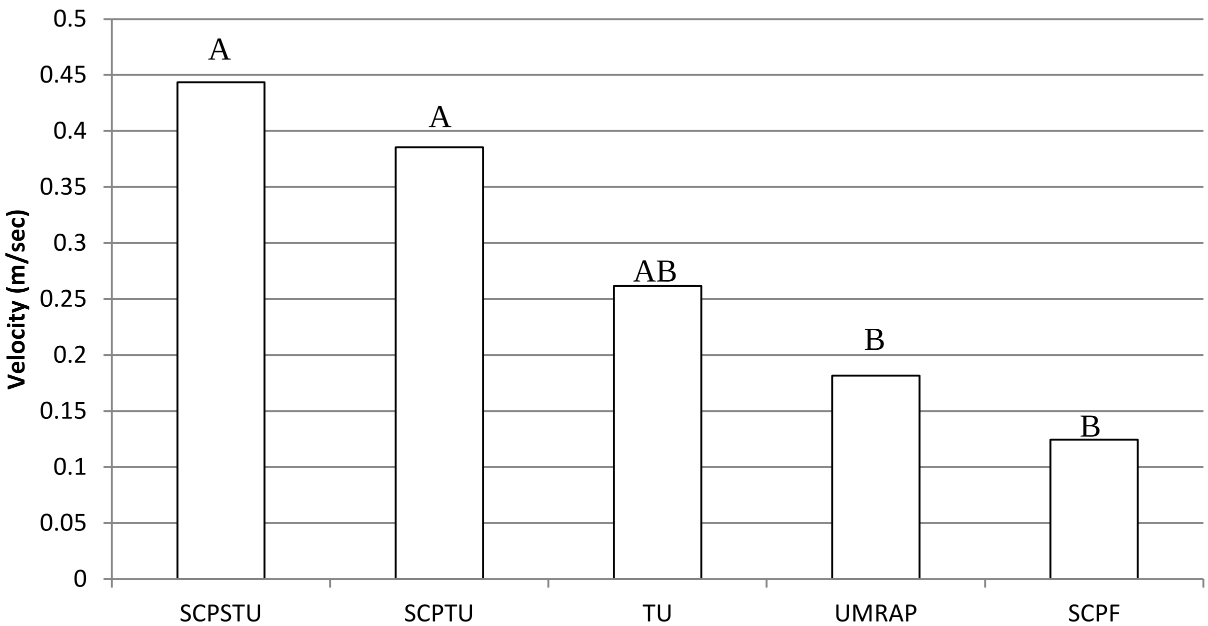


Figure 46. **Mean total habitat scores of reference streams in the five inland ecoregions.** Letters represent Tukey groupings; ecoregions sharing the same letter are not significantly different ($p > 0.05$).

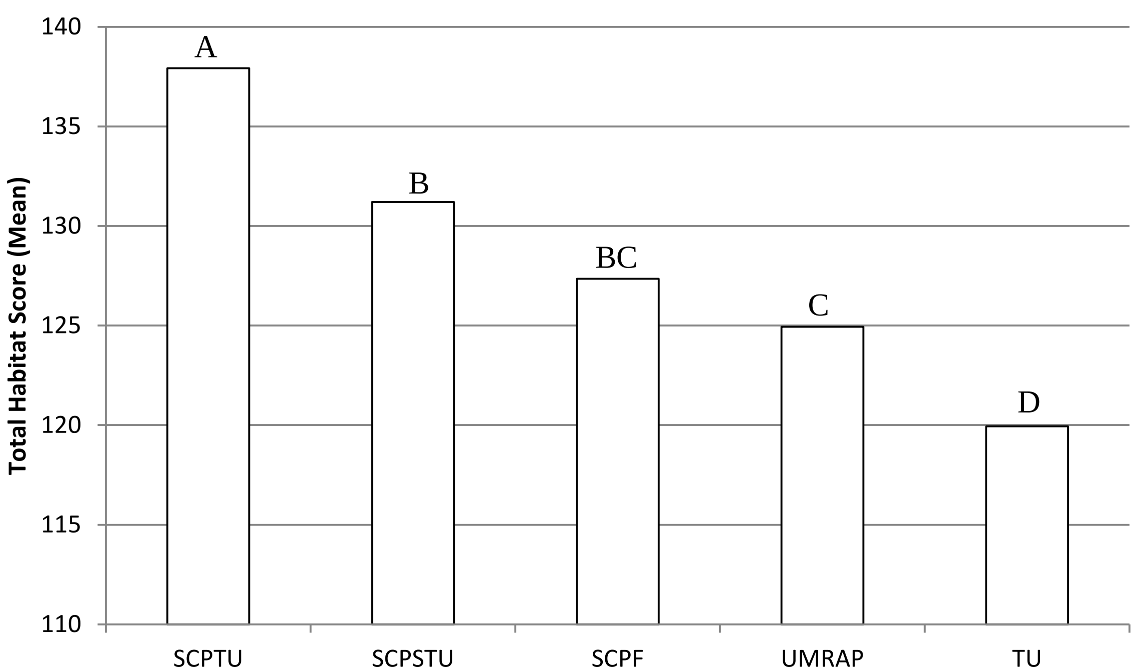


Figure 47. Percentage composition of (A) organic vs. inorganic material, (B) inorganic components (bedrock, boulder, cobble, gravel, sand, silt, and clay), and (C) organic components (detritus, muck-mud, and marl).

Values represent means of all sites in an ecoregion. Data from 2009 was also averaged across habitats (i.e., riffle, run, and stream).

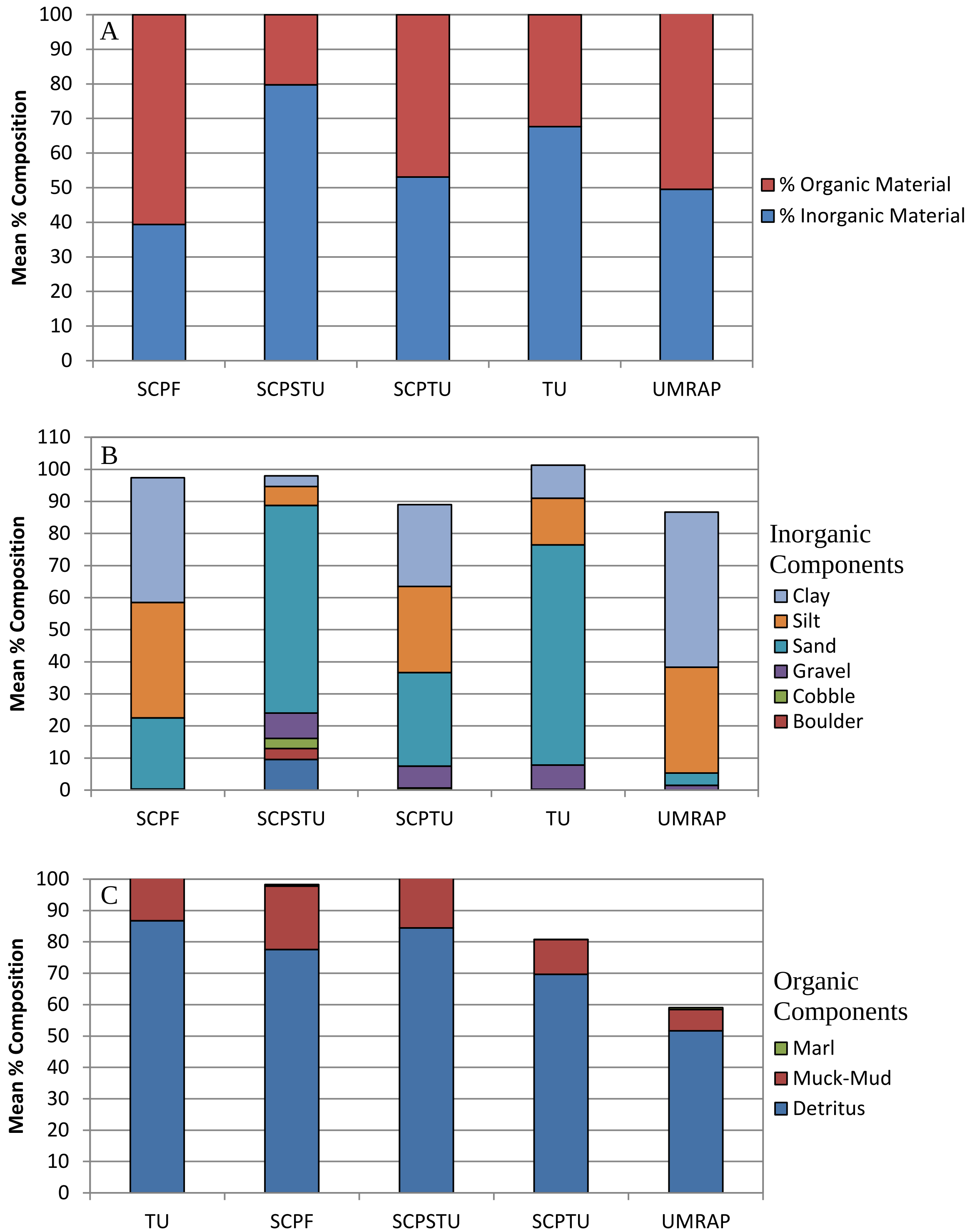
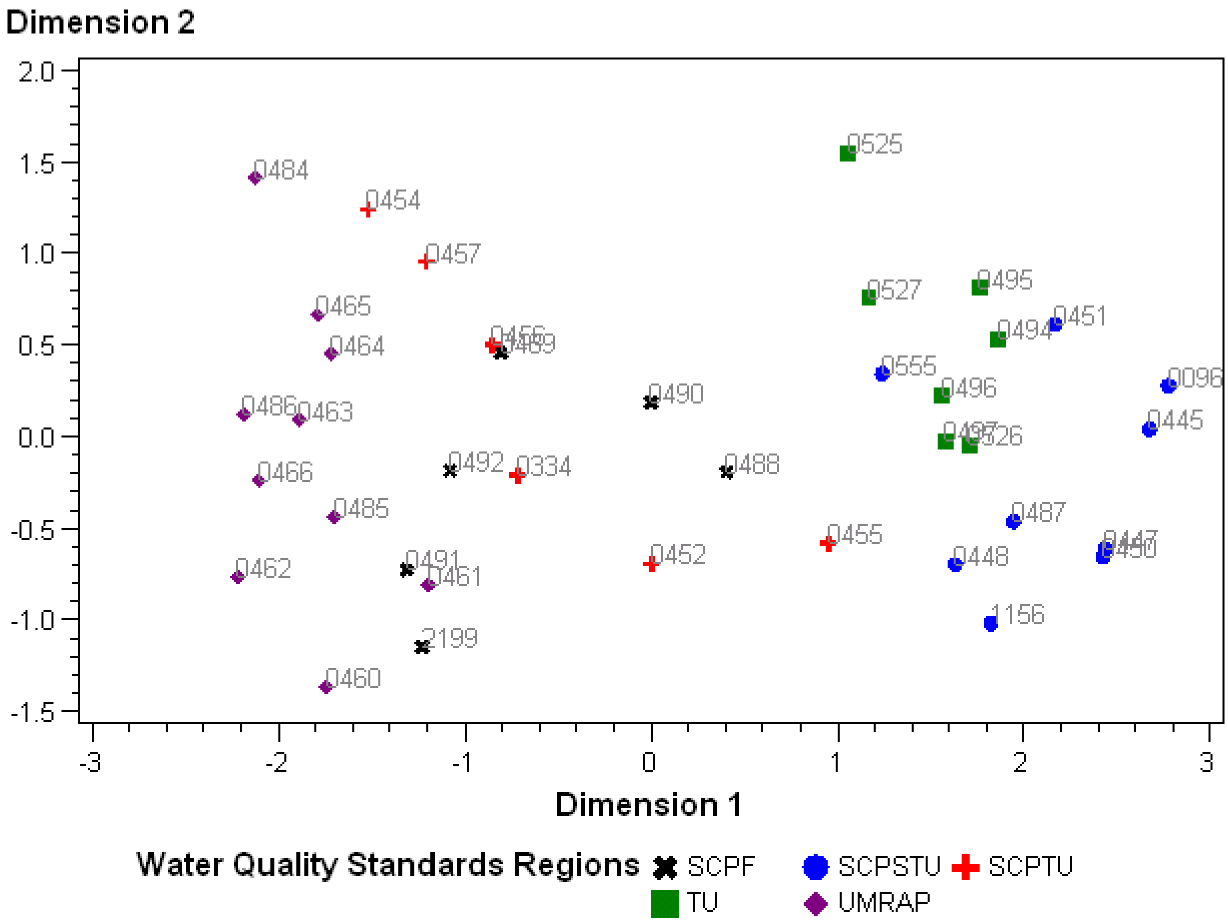


Table 5. Percentages of inorganic and organic components of the stream substrates of each ecoregion. Ecoregions sharing the same letter are not significantly different ($p > 0.05$).

		ECOREGION	MEAN	N	TUKEY GROUPING
INORGANIC COMPOSITION	BEDROCK	SCPSTU	9.5189	176	A
		SCPTU	0.1058	104	B
		SCPF	0	166	B
		TU	0	243	B
		UMRAP	0	131	B
	BOULDER	SCPSTU	3.4432	176	A
		TU	0.0206	243	B
		SCPF	0	166	B
		SCPTU	0	104	B
		UMRAP	0	131	B
	COBBLE	SCPSTU	3.1174	176	A
		SCPTU	0.5801	104	B
		TU	0.1989	243	B
		SCPF	0	166	B
		UMRAP	0	131	B
	GRAVEL	SCPSTU	7.894	176	A
		TU	7.599	243	A
		SCPTU	6.792	104	A
		UMRAP	1.529	131	B
		SCPF	0.317	166	B
	SAND	TU	68.594	243	A
		SCPSTU	64.775	176	A
		SCPTU	29.163	104	B
		SCPF	22.171	166	B
		UMRAP	3.822	131	C
	SILT	SCPF	36.018	166	A
		UMRAP	32.928	130	A
		SCPTU	26.878	104	B
		TU	14.544	242	C
		SCPSTU	5.904	176	D
	CLAY	UMRAP	48.37	129	A
		SCPF	38.924	166	A
		SCPTU	25.503	104	B
		TU	10.342	241	C
		SCPSTU	3.279	174	C
ORGANIC COMPOSITION	DETRITUS	TU	86.723	212	A
		SCPF	77.597	153	AB
		SCPSTU	84.421	171	AB
		SCPTU	69.637	101	B
		UMRAP	51.667	125	C
	MUCK-MUD	UMRAP	32.92	125	A
		SCPF	20.137	153	B
		SCPTU	18.465	101	BC
		TU	11.06	212	C
		SCPSTU	6.754	171	D
	MARL	SCPF	0	153	A
		SCPSTU	0.5809	171	A
		SCPTU	0.165	101	A
		TU	0.0566	212	A
		UMRAP	0.6667	125	A

Figure 48. Composition of inorganic and organic substrates (including observations for each different substrate type and habitat) through visual-based qualitative habitat assessment of stream bottom at inland reference streams.

Plots are graphed by reference site. Plots closer together may be considered more similar, whereas plots farther apart may be considered less similar in regard to substrate composition.



APPENDIX F: BIOLOGICAL CHARACTERISTICS OF INLAND REFERENCE STREAMS

Biological fish and benthic macroinvertebrates observed at inland reference streams sites were evaluated and considered in the refinement of the ecoregional boundaries. The fish and benthic macroinvertebrate characteristics observed at inland reference streams are presented below.

A. FISH

LDEQ sampling of fish communities at reference streams occurred from 1991 to 1996 and again in 2009. LSU sampling at a subset of these streams occurred from 2005 to 2007. Fish were collected by seining in LDEQ collections and by a combination of seining and electroshocking in LSU collections. Communities are described below using total abundance (number of individuals observed in a collection), species richness (number of species observed in a collection) and species composition (through multivariate analysis). A full list of all fish taxa observed in each ecoregion is provided below (Table 4).

Differences were observed among ecoregions in both total abundance and species richness (Figure 49). According to nonparametric pair-wise comparisons (using a Mann-Whitney test) with a Bonferroni correction ($\alpha = 0.05/10$ comparisons $= 0.005$), total abundance and richness were significantly higher in TU than in SCPF, SCPSTU, and SCPTU. Differences in species composition (e.g., representative species lists) were observed as well (Figure 50). Western mosquitofish was an abundant and frequently occurring species in the SCPF, SCPTU, and UMRAP Ecoregions, with much lower abundances (< 2% of the total abundance, on average) and frequencies observed in SCPSTU and TU Ecoregions (Figure 50). SCPSTU and TU had high abundances and frequencies of blacktail shiners and cherryfin shiners (TU only), while SCPF, SCPTU, and UMRAP had very few (< 3% of the total abundance on average).

A non-metric multidimensional scaling (nMDS) ordination revealed distinct groupings of ecoregions in LDEQ data based solely on species composition (Figure 51). Despite some variability within ecoregions (among-site variability), a two-way nested (site nested in ecoregion) analysis of similarities (ANOSIM) on log(x+1) transformed data indicated that species composition was significantly different among most ecoregion pair-wise comparisons (Table 5); only SCPF and SCPTU Ecoregions had similar species compositions ($p = 0.176$). SIMPER (similarity percentages) analysis was used to discriminate the species responsible for the dissimilarity among ecoregions (Table 5). The TU Ecoregion was distinguished from the others by the presence and abundance of cherryfin shiner. Blacktail shiner, redfin shiner, western mosquitofish, and bluegill were distinguishing species in other pair-wise ecoregion comparisons (see Table 5). Ecoregions were less distinguished from one another in data from LSU collections than in LDEQ collections, likely due to a smaller sample size. The variability of collections within ecoregions overwhelmed the variability among ecoregions. This was illustrated by overlapping data points in the nMDS ordination (Figure 52) and by the results of the ANOSIM (Table 6). A significant difference was only observed between TU and SCPF and between TU and SCPTU Ecoregions ($p = 0.029$). According to the SIMPER analysis, this difference was driven by higher abundances of cherryfin shiner in the TU Ecoregion (Table 6).

Table 6. Fish taxa observed at reference stream sites within the inland water quality standards ecoregions.
Taxa are sorted by presence within the different ecoregions, 'X' indicates taxa observed in the corresponding ecoregion.

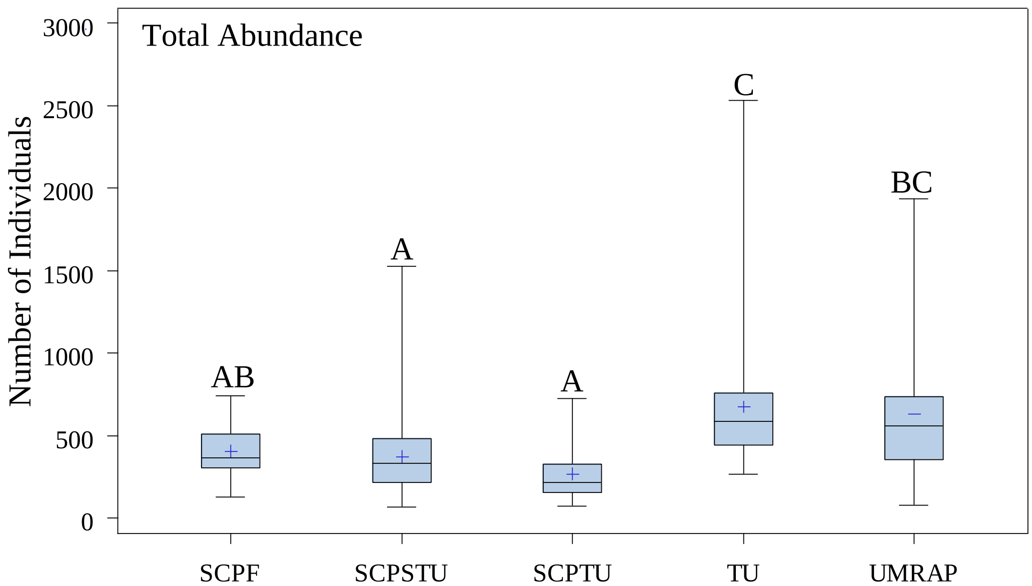
TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
AMEIURUS MELAS	BLACK BULLHEAD	X	X	X	X	X
AMEIURUS NATALIS	YELLOW BULLHEAD	X	X	X	X	X
APHREDODERUS SAYANUS	PIRATE PERCH	X	X	X	X	X
CENTRARCHUS MACROPTERUS	FLIER	X	X	X	X	X
CYPRINELLA VENUSTA	BLACKTAIL SHINER	X	X	X	X	X
ELASSOMA ZONATUM	BANDED PYGMY SUNFISH	X	X	X	X	X
ESOX AMERICANUS VERMICULATUS	GRASS PICKEREL	X	X	X	X	X
ETHEOSTOMA CHLOROSOMA	BLUNTNOSE DARTER	X	X	X	X	X
ETHEOSTOMA GRACILE	SLOUGH DARTER	X	X	X	X	X
ETHEOSTOMA PROELIARE	CYPRESS DARTER	X	X	X	X	X
ETHEOSTOMA WHIPPLEI	REDFIN DARTER	X	X	X	X	X
FUNDULUS NOTATUS	BLACKSTRIPE TOPMINNOW	X	X	X	X	X
FUNDULUS OLIVACEUS	BLACKSPOTTED TOPMINNOW	X	X	X	X	X
GAMBUSIA AFFINIS	WESTERN MOSQUITOFISH	X	X	X	X	X
ICTALURUS PUNCTATUS	CHANNEL CATFISH	X	X	X	X	X
LABIDESTHES SICCULUS	BROOK SILVERSIDE	X	X	X	X	X
LEPOMIS	COMMON SUNFISHES	X	X	X	X	X
LEPOMIS CYANELLUS	GREEN SUNFISH	X	X	X	X	X
LEPOMIS GULOSUS	WARMOUTH	X	X	X	X	X
LEPOMIS MACROCHIRUS	BLUEGILL	X	X	X	X	X
LEPOMIS MARGINATUS	DOLLAR SUNFISH	X	X	X	X	X
LEPOMIS MEGALOTIS	LONGEAR SUNFISH	X	X	X	X	X
LEPOMIS MICROLOPHUS	REDEAR SUNFISH	X	X	X	X	X
LEPOMIS MINIATUS	REDSPOTTED SUNFISH	X	X	X	X	X
LEPOMIS PUNCTATUS	SPOTTED SUNFISH	X	X	X	X	X
LEPOMIS SYMMETRICUS	BANTAM SUNFISH	X	X	X	X	X
LYTHRURUS FUMEUS	RIBBON SHINER	X	X	X	X	X
MICROPTERUS PUNCTULATUS	SPOTTED BASS	X	X	X	X	X
MICROPTERUS SALMOIDES	LARGEMOUTH BASS	X	X	X	X	X
MINYTREMA MELANOPS	SPOTTED SUCKER	X	X	X	X	X
NOTEMIGONUS CRYSOLEUCAS	GOLDEN SHINER	X	X	X	X	X
NOTROPIS ATHERINOIDES	EMERALD SHINER	X	X	X	X	X
NOTROPIS TEXANUS	WEED SHINER	X	X	X	X	X
NOTROPIS VOLUCELLUS	MIMIC SHINER	X	X	X	X	X

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
NOTURUS GYRINUS	TADPOLE MADTOM	X	X	X	X	X
PIMEPHALES VIGILAX	BULLHEAD MINNOW	X	X	X	X	X
POMOXIS ANNULARIS	WHITE CRAPPIE	X	X	X	X	X
CYPRINIDAE	CARPS AND MINNOWS	X	X	X	X	
MICROPTERUS	BLACK BASSES	X	X	X	X	
MOXOSTOMA POECILURUM	BLACKTAIL REDHORSE	X	X	X	X	
NOTURUS NOCTURNUS	FRECKLED MADTOM	X	X	X	X	
PERCINA SCIERA	DUSKY DARTER	X	X	X	X	
FUNDULUS CHRYSOTUS	GOLDEN TOPMINNOW	X	X	X		X
LEPOMIS HUMILIS	ORANGESPOTTED SUNFISH	X	X	X		X
LYTHRURUS UMBRATILIS	REDFIN SHINER	X	X	X		X
ETHEOSTOMA COLLETTEI	CREOLE DARTER	X	X	X		
HYBOGNATHUS NUCHALIS	MISSISSIPPI SILVERY MINNOW	X	X		X	X
PERCINA NIGROFASCIATA	BLACKBANDED DARTER	X	X		X	
APLODINOTUS GRUNNIENS	FRESHWATER DRUM	X	X			X
NOTROPIS	EASTERN SHINERS	X	X			X
ERIMYZON TENUIS	SHARPFIN CHUBSUCKER	X		X	X	X
OPSOPOEODUS EMILIAE	PUGNOSE MINNOW	X		X	X	X
AMIA CALVA	BOWFIN	X		X		X
ETHEOSTOMA ASPRIGENE	MUD DARTER	X		X		X
LEPISOSTEUS OCULATUS	SPOTTED GAR	X		X		X
POMOXIS NIGROMACULATUS	BLACK CRAPPIE	X		X		X
ETHEOSTOMA	SMOOTBELLY DARTERS	X		X		
CARPIODES CARPIO	RIVER CARPSUCKER	X			X	
CATOSTOMIDAE	SUCKERS	X			X	
ETHEOSTOMA PARVIPINNE	GOLDSTRIPE DARTER	X			X	
PERCINA	ROUGHBELLY DARTERS	X			X	
CYPRINUS CARPIO	COMMON CARP	X				X
ETHEOSTOMA FUSIFORME	SWAMP DARTER	X				X
FUNDULUS BLAIRAE	WESTERN STARHEAD TOPMINNOW	X				X
ICTALURUS FURCATUS	BLUE CATFISH	X				X
MENIDIA BERYLLINA	INLAND SILVERSIDE	X				X
ATRACTOSTEUS SPATULA	ALLIGATOR GAR	X				
CARPIODES CYPRINUS	QUILLBACK	X				
CENTRARCHIDAE	SUNFISHES	X				
ESOX	PIKES	X				
ICTALURIDAE	NORTH AMERICAN CATFISHES	X				
LEPISOSTEUS OSSEUS	LONGNOSE GAR	X				

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
NOTURUS	MADTOMS	X				
ERIMYZON OBLONGUS	CREEK CHUBSUCKER		X	X	X	X
ESOX NIGER	CHAIN PICKEREL		X	X	X	X
NOTROPIS CHALYBAEUS	IRONCOLOR SHINER		X	X	X	X
ETHEOSTOMA HISTRIO	HARLEQUIN DARTER		X	X	X	
LUXILUS CHRYSOCEPHALUS	STRIPED SHINER		X	X	X	
PERCINA MACULATA	BLACKSIDE DARTER		X	X	X	
FUNDULUS NOTTII	BAYOU TOPMINNOW		X	X		X
NOTROPIS MACULATUS	TAILLIGHT SHINER		X	X		X
NOTURUS PHAEUS	BROWN MADTOM		X	X		X
PERCINA CAPRODES	LOGPERCH		X	X		X
AMMOCRYPTA VIVAX	SCALY SAND DARTER		X	X		
NOTROPIS SABINAE	SABINE SHINER		X	X		
ANGUILLA ROSTRATA	AMERICAN EEL		X		X	
ETHEOSTOMA SWAINI	GULF DARTER		X		X	
ICHTHYOMYZON GAGEI	SOUTHERN BROOK LAMPREY		X		X	
NOTROPIS LONGIROSTRIS	LONGNOSE SHINER		X		X	
PIMEPHALES NOTATUS	BLUNTNOSE MINNOW		X		X	
SEMOTILUS ATROMACULATUS	CREEK CHUB		X		X	
HYBOPSIS AMNIS	PALLID SHINER		X			X
NOTROPIS ATROCAUDALIS	BLACKSPOT SHINER		X			X
PYLODICTIS OLIVARIS	FLATHEAD CATFISH		X			X
ICHTHYOMYZON CASTANEUS	CHESTNUT LAMPREY		X			
MORONE SAXATILIS	STRIPED BASS		X			
MUGIL CEPHALUS	STRIPED MULLET		X			
PHENACOBIUS MIRABILIS	SUCKERMOUTH MINNOW		X			
ICTIOBUS BUBALUS	SMALLMOUTH BUFFALO			X	X	X
CYPRINELLA LUTRENSIS	RED SHINER			X	X	
FUNDULUS DISPAR	STARHEAD TOPMINNOW			X		
PERCIDAE	PERCHES			X		
DOROSOMA CEPEDIANUM	GIZZARD SHAD				X	X
ERIMYZON SUCETTA	LAKE CHUBSUCKER				X	X
AMBLOPLITES ARIOMMUS	SHADOW BASS				X	
AMBLOPLITES RUPESTRIS	ROCK BASS				X	
AMMOCRYPTA BEANII	NAKED SAND DARTER				X	
CYPRINELLA CAMURA	BLUNTFACE SHINER				X	
ETHEOSTOMA CAERULEUM	RAINBOW DARTER				X	
ETHEOSTOMA STIGMAEUM	SPECKLED DARTER				X	
ETHEOSTOMA ZONALE	BANDED DARTER				X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
FUNDULUS	TOPMINNOWS				X	
FUNDULUS EURYZONUS	BROADSTRIPE TOPMINNOW				X	
HYBOGNATHUS HAYI	CYPRESS MINNOW				X	
HYBOPSIS WINCHELLI	CLEAR CHUB				X	
HYPENTELIUM NIGRICANS	NORTHERN HOG SUCKER				X	
LYTHRURUS ROSEIPINNIS	CHERRYFIN SHINER				X	
MACRHYBOPSIS STORERIANA	SILVER CHUB				X	
NOCOMIS LEPTOCEPHALUS	BLUEHEAD CHUB				X	
NOTROPIS BUCCATUS	SILVERJAW MINNOW				X	
NOTURUS FUNEBRIS	BLACK MADTOM				X	
NOTURUS LEPTACANTHUS	SPECKLED MADTOM				X	
NOTURUS MIURUS	BRINDLED MADTOM				X	
NOTURUS MUNITUS	FRECKLEBELLY MADTOM				X	
PERCINA COPELANDI	CHANNEL DARTER				X	
PERCINA VIGIL	SADDLEBACK DARTER				X	
PETROMYZONTIDAE	LAMPREYS				X	
PIMEPHALES PROMELAS	FATHEAD MINNOW				X	
PTERONOTROPIS SIGNIPINNIS	FLAGFIN SHINER				X	
AMPHIUMA	AMPHIUMAS					X
CTENOPHARYNGODON IDELLA	GRASS CARP					X
DOROSOMA	GIZZARD SHADS					X
DOROSOMA PETENENSE	THREADFIN SHAD					X
ICTIOBUS CYPRINELLUS	BIGMOUTH BUFFALO					X
LEPISOSTEUS PLATOSTOMUS	SHORTNOSE GAR					X
MORONE CHRYSOPS	WHITE BASS					X
PTERONOTROPIS HUBBSI	BLUEHEAD SHINER					X

Figure 49. Box plot distributions of total abundance (top) and species richness (bottom) in the 5 inland ecoregions.
Lower and upper whiskers represent minimum and maximum observed values, respectively, and plus signs (+) represent mean values. Ecoregions with the same letter are not significantly different based on a Mann-Whitney pair-wise comparison of ranks with a Bonferroni correction ($\alpha = 0.05/10$ comparisons = 0.005).



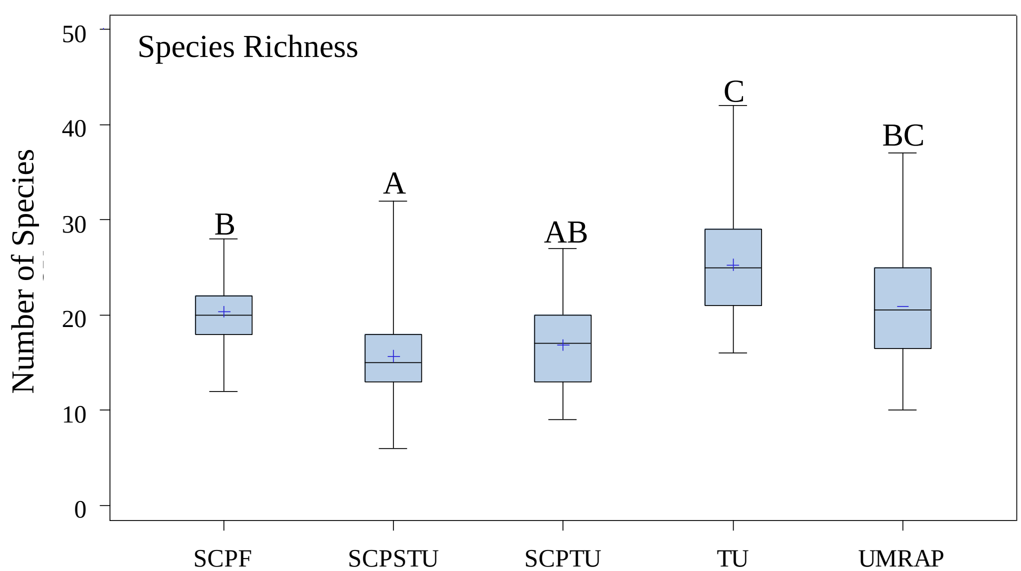


Figure 50. Mean relative abundance of representative species within each inland ecoregion. Values obtained by averaging all relative abundance measures for each representative species of the ecoregion from LDEQ (top) and LSU (bottom) collections.

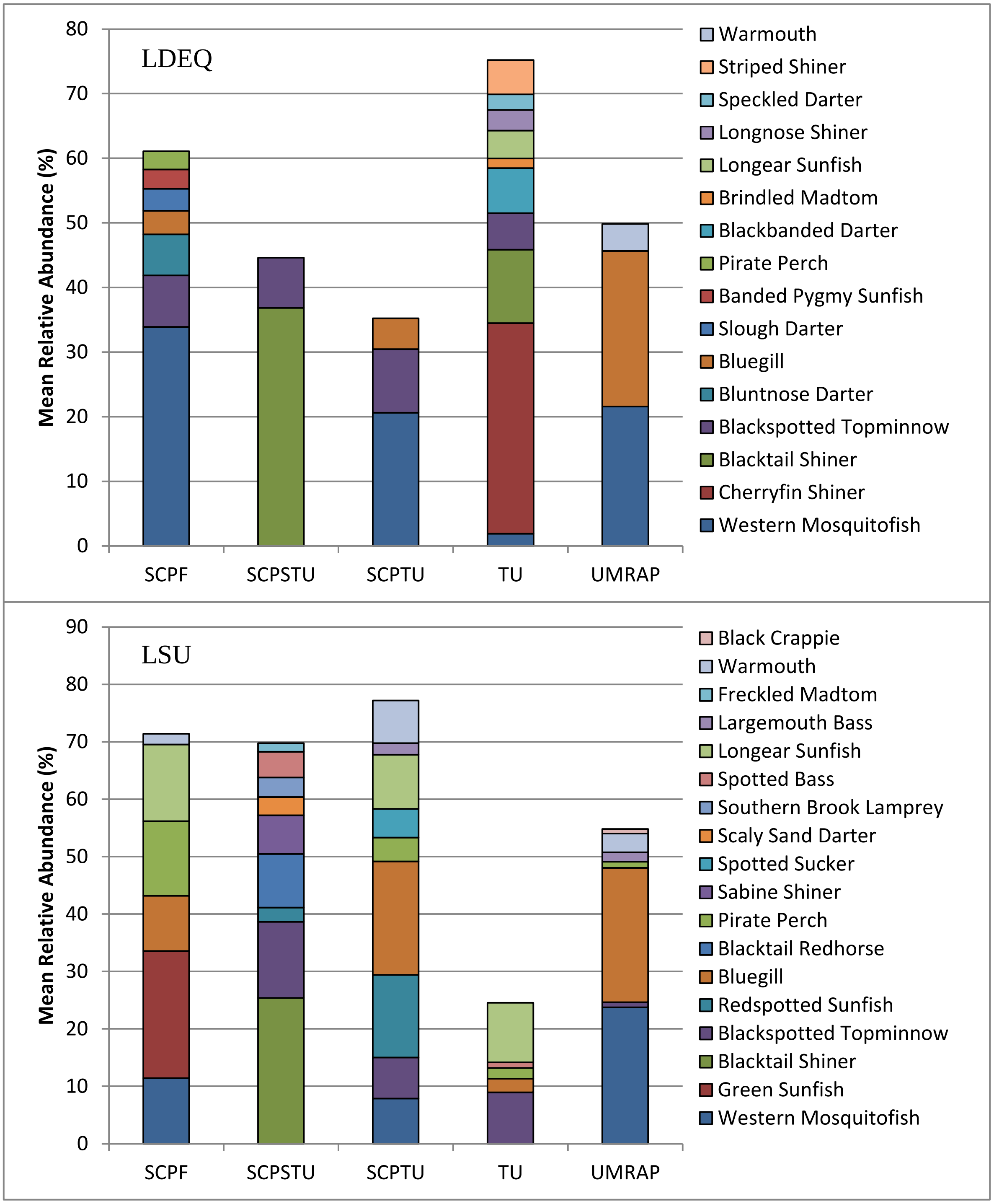


Figure 51. Non-metric multidimensional scaling (nMDS) ordinations of fish taxa observed in LDEQ collections based on Bray-Curtis similarity matrix of non-transformed data. Data points represent reference sites and are coded by ecoregion. The closer points are to one another, the more similar they are in species composition.

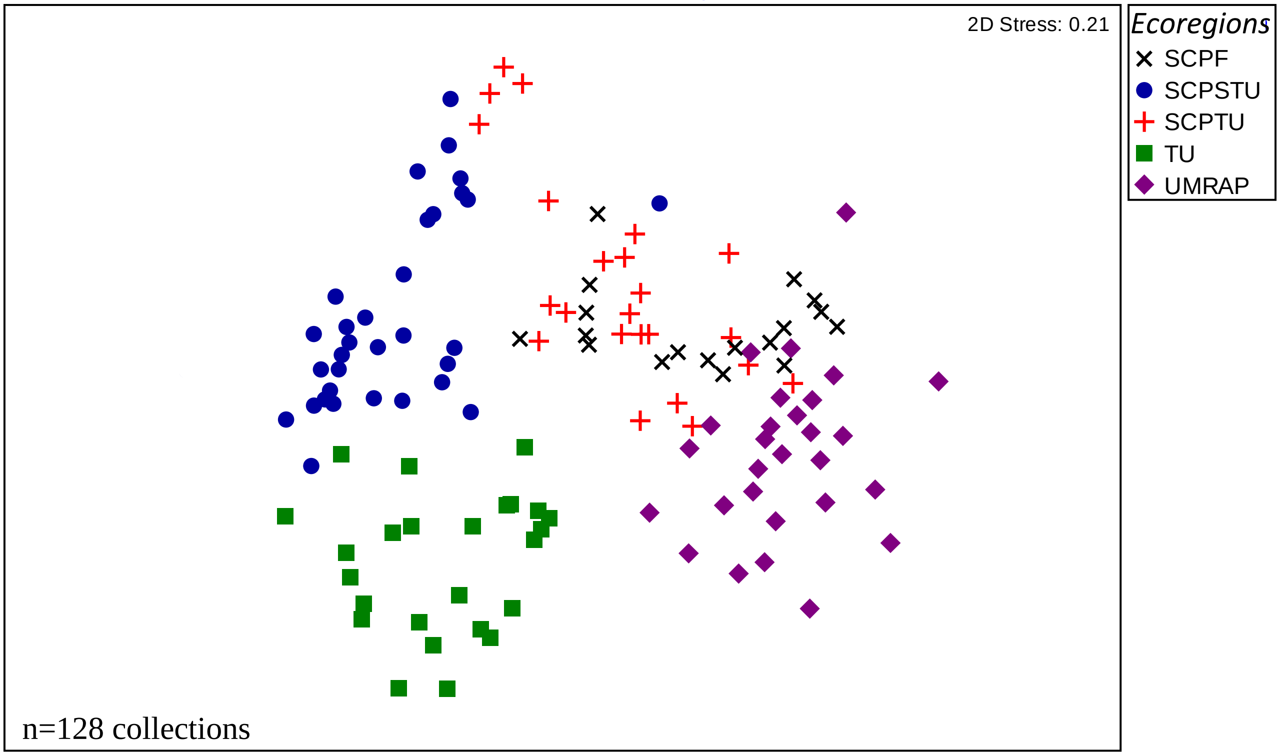


Table 7. Pair-wise comparisons of LDEQ data by ecoregion based on a two-way nested ANOSIM (site nested in ecoregion).
Analysis was based on Bray-Curtis dissimilarity using log (x+1) transformed data. The global R for the ecoregion effect was 0.689 (p = 0.001).

			SIMPER ANALYSIS		
Pair-wise comparison	**R statistic**	**P-value**	**Species Contributing Most to the Dissimilarity**	**% contribution to dissimilarity**	**Ecoregion with highest abundance of this species**
SCPF vs. SCPSTU	0.595	**0.003**	Western Mosquitofish	6.48	SCPF
SCPF vs. SCPTU	0.151	0.429	--	--	--
SCPF vs. TU	0.918	**0.003**	Cherryfin Shiner	6.18	TU
SCPF vs. UMRAP	0.591	**0.003**	Bluegill	4.33	UMRAP
SCPSTU vs. SCPTU	0.505	**0.002**	Blacktail Shiner	7.75	SCPSTU
SCPSTU vs. TU	0.641	**0.002**	Cherryfin Shiner	7.02	TU
SCPSTU vs. UMRAP	0.938	**0.0001**	Blacktail Shiner	6.03	SCPSTU
SCPTU vs. TU	0.892	**0.0006**	Cherryfin Shiner	6.99	TU
SCPTU vs. UMRAP	0.444	**0.002**	Redfin Shiner	5.40	SCPTU
TU vs. UMRAP	0.971	**0.0002**	Cherryfin Shiner	5.86	TU

Figure 52. Non-metric multidimensional scaling (nMDS) ordinations of fish taxa observed in LSU sampling based on Bray-Curtis similarity matrix of non-transformed data.
Data points represent reference sites and are coded by ecoregion. The closer points are to one another, the more similar they are in species composition.

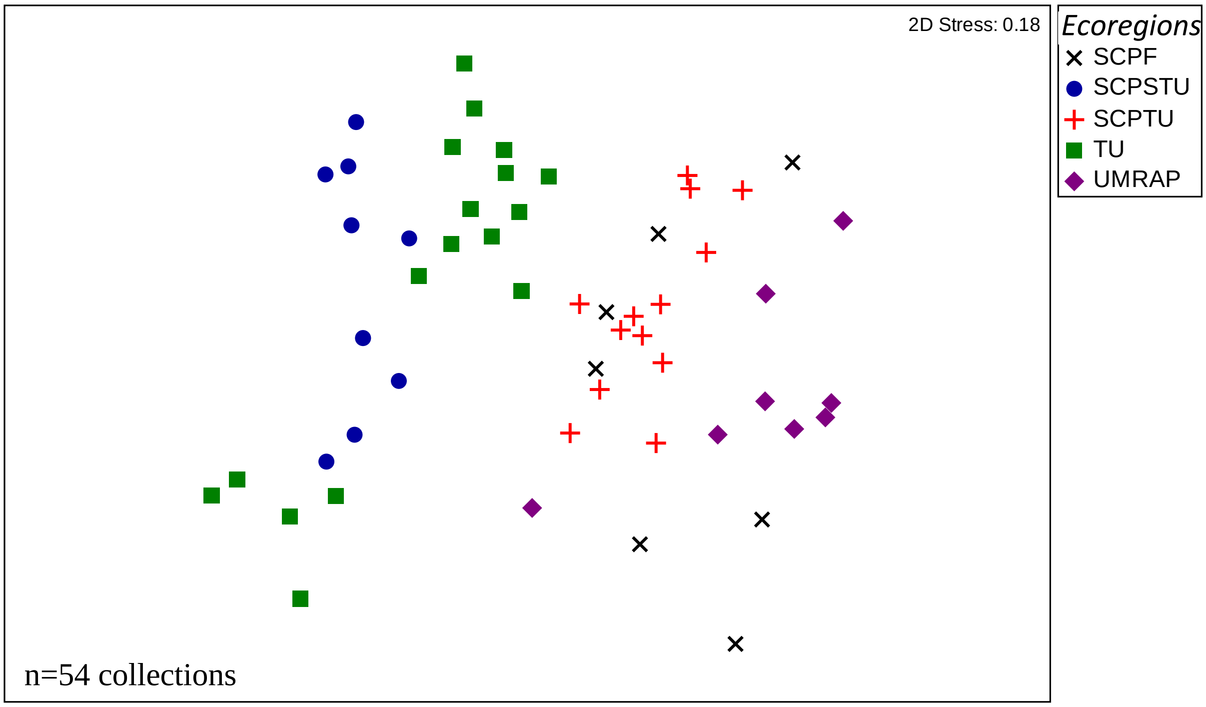


Table 8. Pair-wise comparisons of LSU data by ecoregion based on a two-way nested ANOSIM (site nested in ecoregion).
Analysis was based on Bray-Curtis dissimilarity using log (x+1) transformed data. The global R for the ecoregion effect was 0.811 (p = 0.001).

			SIMPER ANALYSIS		
Pair-wise comparison	**R statistic**	**P-value**	**Species Contributing Most to the Dissimilarity**	**% contribution**	**Ecoregion with highest abundance of this species**
SCPF vs. SCPSTU	1.00	0.10	--	--	--
SCPF vs. SCPTU	0.037	0.40	--	--	--
SCPF vs. TU	0.722	**0.029**	Cherryfin Shiner	5.46	TU
SCPF vs. UMRAP	0.25	0.40	--	--	--
SCPSTU vs. SCPTU	1.00	0.10	--	--	--
SCPSTU vs. TU	0.643	0.133	--	--	--
SCPSTU vs. UMRAP	1.00	0.333	--	--	--
SCPTU vs. TU	0.648	**0.029**	Cherryfin Shiner	5.34	TU
SCPTU vs. UMRAP	0.5	0.10	--	--	--
TU vs. UMRAP	0.893	0.067	--	--	--

B. BENTHIC MACROINVERTEBRATES

Table 9. Benthic macroinvertebrate taxa observed at reference stream sites within the inland water quality standards ecoregions.
Taxa are sorted by presence within the different ecoregions, 'X' indicates taxa observed in the corresponding ecoregion.

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
ABLABESMYIA MALLOCHI	MIDGE	X	X	X	X	X
ABLABESMYIA RAMPHEGRP	MIDGE	X	X	X	X	X
ARGIA	DAMSELFLY	X	X	X	X	X
ATRICHOPOGON	MIDGE, BITING	X	X	X	X	X
BEZZIA COMPLEX	MIDGE, BITING	X	X	X	X	X
CAECIDOTEA	ISOPOD	X	X	X	X	X
CAENIS	MAYFLY	X	X	X	X	X
CAMBARIDAE	CRAYFISH	X	X	X	X	X
CHEUMATOPSYCHE	CADDISFLY	X	X	X	X	X
CHIRONOMIDAE	MIDGE	X	X	X	X	X
CHIRONOMUS	MIDGE	X	X	X	X	X
CLADOTANYTARSUS	MIDGE	X	X	X	X	X
CLIMACIA AREOLARIS	SPONGILLAFLIES	X	X	X	X	X
CRANGONYX	AMPHIPOD	X	X	X	X	X
CRICOTOPUS ORTHOCLADIUS	MIDGE	X	X	X	X	X
CRYPTOCHIRONOMUS FULVUSGRP	MIDGE	X	X	X	X	X
DICROTENDIPES	MIDGE	X	X	X	X	X
DICROTENDIPES NERVOSUS	MIDGE	X	X	X	X	X
DINEUTUS	BEETLE, WHIRLIGIG	X	X	X	X	X
DROMOGOMPHUS	DRAGONFLY	X	X	X	X	X
FERRISSIA	SNAIL, PULMONATE	X	X	X	X	X
GOMPHUS	DRAGONFLY	X	X	X	X	X
GYRAULUS	SNAIL, PULMONATE	X	X	X	X	X
HEMERODROMIA	FLY, DANCE	X	X	X	X	X
HYALELLA AZTECA	AMPHIPOD	X	X	X	X	X
HYDRACARINA	MITE, WATER	X	X	X	X	X
HYDROPORUS	BEETLE, PREDACEOUS DIVING	X	X	X	X	X
HYDROPTILA	CADDISFLY	X	X	X	X	X
LABRUNDINIA	MIDGE	X	X	X	X	X
LARSIA	MIDGE	X	X	X	X	X
LARSIA INDISTINCTA	MIDGE	X	X	X	X	X
MACROMIA	DRAGONFLY	X	X	X	X	X
MACRONYCHUS GLABRATUS	BEETLE, RIFFLE	X	X	X	X	X
MICROVELIA	WATER STRIDER	X	X	X	X	X
NATARSIA SP A	MIDGE	X	X	X	X	X

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
OECETIS	CADDISFLY	X	X	X	X	X
OLIGOCHAETA	WORM	X	X	X	X	X
PALAEMONETES KADIAKENSIS	SHRIMP, GRASS	X	X	X	X	X
POLYCENTROPUS	CADDISFLY	X	X	X	X	X
POLYPEDILUM CONVICTUMGRP	MIDGE	X	X	X	X	X
POLYPEDILUM FALLAX	MIDGE	X	X	X	X	X
POLYPEDILUM HALTERALEGRP	MIDGE	X	X	X	X	X
POLYPEDILUM SCALAENUMGRP	MIDGE	X	X	X	X	X
PROCAMBARUS	CRAYFISH	X	X	X	X	X
PROCLADIUS	MIDGE	X	X	X	X	X
PSEUDOCHIRONOMUS	MIDGE	X	X	X	X	X
PSEUDOLIMNOPHILA	FLY, CRANE	X	X	X	X	X
SPHAERIUM	CLAM	X	X	X	X	X
STENACRON INTERPUNCTATUM	MAYFLY	X	X	X	X	X
STENELMIS GROSSA	BEETLE, RIFFLE	X	X	X	X	X
STENOCHIRONOMUS	MIDGE	X	X	X	X	X
TANYTARSUS	MIDGE	X	X	X	X	X
THIENEMANNIMYIA GRP	MIDGE	X	X	X	X	X
TREPOBATES	WATER STRIDER	X	X	X	X	X
TRIBELOS FUSCICORNE	MIDGE	X	X	X	X	X
ABLABESMYIA	MIDGE	X	X	X	X	
ACERPENNA PYGMAEA	MAYFLY	X	X	X	X	
ANCYRONYX VARIEGATA	BEETLE, RIFFLE	X	X	X	X	
BAETIS	MAYFLY	X	X	X	X	
BAETIS INTERCALARIS	MAYFLY	X	X	X	X	
BOYERIA VINOSA	DRAGONFLY	X	X	X	X	
CORBICULA FLUMINEA	CLAM	X	X	X	X	
CORYDALUS CORNUTUS	DOBSONFLY	X	X	X	X	
CORYNONEURA	MIDGE	X	X	X	X	
CRICOTOPUS BICINCTUS	MIDGE	X	X	X	X	
DICROTENDIPES NEOMODESTUS	MIDGE	X	X	X	X	
GYRETES IRICOLOR	BEETLE, WHIRLIGIG	X	X	X	X	
GYRINUS	BEETLE, WHIRLIGIG	X	X	X	X	
HEXAGENIA	MAYFLY	X	X	X	X	
HEXATOMA	FLY, CRANE	X	X	X	X	
HYDROPSYCHE MISSISSIPPIENSIS	CADDISFLY	X	X	X	X	
HYDROPSYCHIDAE	CADDISFLY	X	X	X	X	
LABRUNDINIA PILOSELLA	MIDGE	X	X	X	X	
LYPE DIVERSA	CADDISFLY	X	X	X	X	
MACROMIA TAENIOLATA	DRAGONFLY	X	X	X	X	
MICROTENDIPES PEDELLUSGRP	MIDGE	X	X	X	X	
NECTOPSYCHE	CADDISFLY	X	X	X	X	
NILOTANYPUS FIMBRIATUS	MIDGE	X	X	X	X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
NILOTHAUMA	MIDGE	X	X	X	X	
PARAMETRIOCNEMUS	MIDGE	X	X	X	X	
PARAPHAENOCLADIUS	MIDGE	X	X	X	X	
PENTANEURA INCONSPICUA	MIDGE	X	X	X	X	
PROCLOEON	MAYFLY	X	X	X	X	
RHEOCRICOTOPUS ROBACKI	MIDGE	X	X	X	X	
RHEOTANYTARSUS	MIDGE	X	X	X	X	
RHEUMATOBATES	WATER STRIDER	X	X	X	X	
SIALIS	ALDERFLY	X	X	X	X	
SIMULIUM	FLY, BLACK	X	X	X	X	
STELECHOMYIA PERPULCHRA	MIDGE	X	X	X	X	
STEMPELLINELLA	MIDGE	X	X	X	X	
STENELMIS	BEETLE, RIFFLE	X	X	X	X	
STENONEMA	MAYFLY	X	X	X	X	
STENONEMA EXIGUUM	MAYFLY	X	X	X	X	
STENONEMA INTEGRUM	MAYFLY	X	X	X	X	
STENONEMA SMITHAE	MAYFLY	X	X	X	X	
STENONEMA TERMINATUM	MAYFLY	X	X	X	X	
SYMPOSIOCLADIUS LIGNICOLA	MIDGE	X	X	X	X	
THIENEMANNIELLA	MIDGE	X	X	X	X	
TIPULA	FLY, CRANE	X	X	X	X	
TRIBELOS JUCUNDUM	MIDGE	X	X	X	X	
XYLOTOPUS PAR	MIDGE	X	X	X	X	
BATRACOBDELLA PHALERA	LEECH	X	X	X		X
CAMBARELLUS	DWARF CRAYFISH	X	X	X		X
PARACHIRONOMUS	MIDGE	X	X	X		X
PELTODYTES SEXMACULATUS	BEETLE, CRAWLING	X	X	X		X
TRICHOCORIXA	WATER BOATMEN	X	X	X		X
VIVIPARUS	SNAIL	X	X	X		X
BRACHYCERCUS FLAVUS	MAYFLY	X	X	X		
CERACLEA PUNCTATA	CADDISFLY	X	X	X		
PERLESTA DECIPIENS	STONEFLY	X	X	X		
PROCAMBARUS CLARKII	CRAYFISH	X	X	X		
BAETIDAE	MAYFLY	X	X		X	X
NANOCLADIUS	MIDGE	X	X		X	X
POLYPEDILUM AVICEPS	MIDGE	X	X		X	X
XENOCHIRONOMUS XENOLABIS	MIDGE	X	X		X	X
ACRONEURIA	STONEFLY	X	X		X	
CRYPTOTENDIPES FULVUSGRP	MIDGE	X	X		X	
DUBIRAPHIA	BEETLE, RIFFLE	X	X		X	
DUBIRAPHIA N SP A	BEETLE, RIFFLE	X	X		X	
HAGENIUS BREVISTYLUS	DRAGONFLY	X	X		X	
HETAERINA	DAMSELFLY	X	X		X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
LEPTOPHLEBIA	MAYFLY	X	X		X	
NILOTANYPUS	MIDGE	X	X		X	
ORCONECTES	CRAYFISH	X	X		X	
PARAKIEFFERIELLA SP A	MIDGE	X	X		X	
PARALAUTERBORNIELLA NIGROHALTERALE	MIDGE	X	X		X	
PARALEPTOPHLEBIA VOLITANS	MAYFLY	X	X		X	
PARAMERINA	MIDGE	X	X		X	
PARATANYTARSUS	MIDGE	X	X		X	
PARATENDIPES SUBEQUALIS	MIDGE	X	X		X	
PERLESTA SHUBUTA	STONEFLY	X	X		X	
PROCAMBARUS VIOSCAI	CRAYFISH	X	X		X	
RHAGOVELIA	WATER STRIDER	X	X		X	
STENELMIS XYLONASTIS	BEETLE, RIFFLE	X	X		X	
TRIAENODES	CADDISFLY	X	X		X	
HYDROVATUS	BEETLE, PREDACEOUS DIVING	X	X			X
BELOSTOMA LUTARIUM	GIANT WATER BUG	X	X			
MICROTENDIPES	MIDGE	X	X			
POLYPEDILUM SP C	MIDGE	X	X			
ABLABESMYIA PELEENSIS	MIDGE	X		X	X	X
CAECIDOTEA LATICAUDATA	ISOPOD	X		X	X	X
CLINOTANYPUS	MIDGE	X		X	X	X
CORIXIDAE	WATER BOATMEN	X		X	X	X
CYPHON	BEETLE, MARSH	X		X	X	X
DICROTENDIPES MODESTUS	MIDGE	X		X	X	X
DICROTENDIPES SIMPSONI	MIDGE	X		X	X	X
ENALLAGMA	DAMSELFLY	X		X	X	X
ENDOCHIRONOMUS NIGRICANS	MIDGE	X		X	X	X
EPICORDULIA PRINCEPS	DRAGONFLY	X		X	X	X
GLYPTOTENDIPES	MIDGE	X		X	X	X
HELOBDELLA ELONGATA	LEECH	X		X	X	X
HYDROMETRA	WATER MEASURER	X		X	X	X
KIEFFERULUS	MIDGE	X		X	X	X
LIBELLULIDAE	DRAGONFLY	X		X	X	X
LIRCEUS	ISOPOD	X		X	X	X
PHYSELLA	SNAIL, PULMONATE	X		X	X	X
CHOROTERPES	MAYFLY	X		X	X	
GOMPHIDAE	DRAGONFLY	X		X	X	
LABIOBAETIS FRONDALIS	MAYFLY	X		X	X	
LEPTOPHLEBIIDAE	MAYFLY	X		X	X	
LUMBRICULIDAE	WORM	X		X	X	
PHYLOCENTROPUS	CADDISFLY	X		X	X	
PYCNOPSYCHE	CADDISFLY	X		X	X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
RHEUMATOBATES RILEYI	WATER STRIDER	X		X	X	
CHAULOIDES RASTRICORNIS	FISHFLY	X		X		X
ERPOBDELLA MOOREOBDELLA	LEECH	X		X		X
HELISOMA	SNAIL, PULMONATE	X		X		X
HELOBDELLA STAGNALIS	LEECH	X		X		X
HELOBDELLA TRISERIALIS	LEECH	X		X		X
LIBELLULA	DRAGONFLY	X		X		X
NASIAESCHNA PENTACANTHA	DARNER	X		X		X
TETRAGONEURIA CYNOSURA	DRAGONFLY	X		X		X
VIVIPARUS GEORGIANUS	SNAIL	X		X		X
CORISELLA	WATER BOATMEN	X		X		
HARNISCHIA	MIDGE	X		X		
LIMONIA	FLY, CRANE	X		X		
PHAENOPSECTRA OBEDIENSGRP	MIDGE	X		X		
PLACOBDELLA PARASITICA	LEECH	X		X		
ANOPHELES	MOSQUITO	X			X	X
BELOSTOMA	GIANT WATER BUG	X			X	X
LABRUNDINIA JOHANNSENI	MIDGE	X			X	X
MESOVELIA	WATER TREADER	X			X	X
PARACHIRONOMUS CARINATUS	MIDGE	X			X	X
POLYPEDILUM ILLINOENSEGRP	MIDGE	X			X	X
TIPULIDAE	FLY, CRANE	X			X	X
ZAVRELIELLA MARMORATA	MIDGE	X			X	X
ABLABESMYIA ANNULATA	MIDGE	X			X	
ARGIA TIBIALIS	DAMSELFLY	X			X	
AXARUS SP	MIDGE	X			X	
BRACHYCERCUS PINI	MAYFLY	X			X	
CALOPTERYX	DAMSELFLY	X			X	
CAMPELOMA DECISUM	SNAIL	X			X	
CERATOPOGONIDAE	MIDGE, BITING	X			X	
CHIRONOMINI	MIDGE	X			X	
CHRYSOPS	FLY, DEER	X			X	
DESMOPACHRIA	BEETLE, PREDACEOUS DIVING	X			X	
DOLICHOPODIDAE	FLY, LONGLEGGED	X			X	
DROMOGOMPHUS SPINOSUS	DRAGONFLY	X			X	
DUBIRAPHIA BREVIPENNIS	BEETLE, RIFFLE	X			X	
DUBIRAPHIA N SP C	BEETLE, RIFFLE	X			X	
DUGESIA TIGRINUM	PLANARIAN	X			X	
EPOICOCLADIUS	MIDGE	X			X	
ERIOPTERA	FLY, CRANE	X			X	
ERPOBDELLA	LEECH	X			X	
GOELDICHIRONOMUS FLUCTUANS	MIDGE	X			X	
GYRINIDAE	BEETLE, WHIRLIGIG	X			X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
HEPTAGENIIDAE	MAYFLY	X			X	
HEXAGENIA LIMBATA	MAYFLY	X			X	
LABIOBAETIS	MAYFLY	X			X	
LABRUNDINIA BECKI	MIDGE	X			X	
LARSIA DECOLORATA	MIDGE	X			X	
LEPTOCERIDAE	CADDISFLY	X			X	
LIOPOREUS PILATEI	BEETLE, PREDACEOUS DIVING	X			X	
LUMBRICIDAE	WORM	X			X	
MESOVELIA AMOENA	WATER TREADER	X			X	
METROBATES ALACRIS	WATER STRIDER	X			X	
MICROPSECTRA	MIDGE	X			X	
MUSCIDAE	FLY	X			X	
NEOPORUS	BEETLE, PREDACEOUS DIVING	X			X	
NEOPORUS BLANCHARDIGRP	BEETLE, PREDACEOUS DIVING	X			X	
NEOPORUS CLYPEALIS	BEETLE, PREDACEOUS DIVING	X			X	
OECETIS AVARA	CADDISFLY	X			X	
ORCONECTES LANCIFER	CRAYFISH	X			X	
ORCONECTES PALMERI	CRAYFISH	X			X	
ORMOSIA	FLY, CRANE	X			X	
ORTHOCLADIINAE	MIDGE	X			X	
PALPOMYIA COMPLEX	MIDGE, BITING	X			X	
PARACHIRONOMUS PECTINATELLAE	MIDGE	X			X	
PHAENOPSECTRA PUNCTIPESGRP	MIDGE	X			X	
PILARIA	FLY, CRANE	X			X	
PISIDIUM	CLAM	X			X	
POLYCENTROPODIDAE	CADDISFLY	X			X	
POLYPEDILUM	MIDGE	X			X	
POLYPEDILUM TRITUM	MIDGE	X			X	
SISYRA VICARIA	SPONGILLAFLIES	X			X	
SPERCHOPSIS TESSELLATA	BEETLE, WATER SCAVENGER	X			X	
SPHAERIIDAE	CLAM	X			X	
STENELMIS SINUATA	BEETLE, RIFFLE	X			X	
SYNURELLA	AMPHIPOD	X			X	
TABANIDAE	FLY, DEER	X			X	
TABANUS COMPLEX	FLY, DEER	X			X	
ARGULUS	FISH LOUSE	X				X
CERACLEA	CADDISFLY	X				X
CHAOBORUS PUNCTIPENNIS	MIDGE, PHANTOM	X				X
CULEX	MOSQUITO	X				X
GOELDICHIRONOMUS HOLOPRASINATUS	MIDGE	X				X
HESPEROCORIXA	WATER BOATMEN	X				X

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
PACHYDIPLAXVLONGIPENNIS	DRAGONFLY	X				X
PARAPLEA STRIOLA	BACKSWIMMER	X				X
PERITHEMIS TENERA	DRAGONFLY	X				X
PLACOBDELLA ORNATA	LEECH	X				X
POLYPEDILUM TRIGONUS	MIDGE	X				X
RANATRA	WATER SCORPION	X				X
SOMATOCHLORA LINEARIS	DRAGONFLY	X				X
TANYPUS PUNCTIPENNIS	MIDGE	X				X
TAPHROMYSIS LOUISIANAE	SHRIMP	X				X
VIVIPARIDAE	SNAIL	X				X
ACALYPTRIDAE	FLY?	X				
ANCYLIDAE	SNAIL, PULMONATE	X				
BELOSTOMA FLUMINEA	GIANT WATER BUG	X				
BIDESSONOTUS SP	BEETLE, PREDACEOUS DIVING	X				
BRANCHIOBDELLIDA SP	WORM	X				
BUENOA	BACKSWIMMER	X				
CALOPTERYX AMERICANA	DAMSELFLY	X				
CHAOBORUS ALBATUS	MIDGE, PHANTOM	X				
CHLOROTABANUS	FLY, DEER	X				
CRANGONICTIDAE	AMPHIPOD	X				
CULICOIDES	MIDGE, BITING	X				
CYSTOBRANCHUS	LEECH	X				
DICROTENDIPES LUCIFER	MIDGE	X				
DINEUTUS CILIATUS	BEETLE, WHIRLIGIG	X				
DYTISCIDAE	BEETLE, PREDACEOUS DIVING	X				
EINFELDIA N SP	MIDGE	X				
ENOCHRUS	BEETLE, WATER SCAVENGER	X				
EPHYDRIDAE	FLY, SHORE	X				
ERIOPTERINI	FLY, CRANE	X				
ERPOBDELIDAE	LEECH	X				
ERPOBDELLIDAE	LEECH	X				
EUPERA CUBENSIS	CLAM	X				
GOELDICHIRONOMUS	MIDGE	X				
GOELDICHIRONOMUS HOLOPRASINUS	MIDGE	X				
GOMPHUS SUBMEDIANUS	DRAGONFLY	X				
GONOMYIA	FLY, CRANE	X				
HEBETANCYLUS EXCENTRICUS	SNAIL, PULMONATE	X				
HELISOMA ANCEPS	SNAIL, PULMONATE	X				
HETEROSTERNUTA PULCHER	BEETLE, PREDACEOUS DIVING	X				
HYDROPORUS OBLITUSGRP	BEETLE, PREDACEOUS DIVING	X				
HYDROPTILIDAE	CADDISFLY	X				
LABRUNDINIA BECKAE	MIDGE	X				

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
LIMONIINAE	FLY, CRANE	X				
LIOPOREUS TRIANGULARIS	BEETLE, PREDACEOUS DIVING	X				
MEGISTOCERA	FLY, CRANE	X				
MEGISTOCERA LONGIPENNIS	FLY, CRANE	X				
MOOREOBDELLA	LEECH	X				
MOOREOBDELLA MICROSTOMA	LEECH	X				
NEOPLEA STRIOLA	BACKSWIMMER	X				
NEOPORUS AULICUS	BEETLE, PREDACEOUS DIVING	X				
ODONATA	DRAGONFLIES AND DAMSELFLI	X				
ORCONECTES DIFFICILIS	CRAYFISH	X				
ORCONECTES HATHAWAYI	CRAYFISH	X				
ORTHEMIS	DRAGONFLY	X				
PACHYDRUS	BEETLE, PREDACEOUS DIVING	X				
PARACHIRONOMUS MONOTENUIC	MIDGE	X				
PARAKIEFFERIELLA	MIDGE	X				
PHILOBDELLA FLORIDANA	LEECH	X				
PHILOBDELLA GRACILIS	LEECH	X				
PHYSIDAE	SNAIL, PULMONATE	X				
PROCAMBARUS BIVITTATUS	CRAYFISH	X				
PROCAMBARUS DUPRATZI	CRAYFISH	X				
RHAPHIUM	FLY, LONGLEGGED	X				
RHEOCRICOTOPUS	MIDGE	X				
RHEUMATOBATES TRULLIGER	WATER STRIDER	X				
SETACERA	FLY, SHORE	X				
SYRPHIDAE	FLY, SYRPHID	X				
TROPISTERNUS L NIMBATUS	BEETLE, WATER SCAVENGER	X				
UNNIELLA MULTIVIRGA	MIDGE	X				
VILLOSA LIENOSA	MUSSEL	X				
CALOPTERYX MACULATA	DAMSELFLY		X	X	X	
CHIMARRA	CADDISFLY		X	X	X	
ISONYCHIA	MAYFLY		X	X	X	
LABIOBAETIS EPHIPPIATUS	MAYFLY		X	X	X	
LABIOBAETIS PROPINQUUS	MAYFLY		X	X	X	
MICROCYLLOEPUS PUSILLUS	BEETLE, RIFFLE		X	X	X	
MICROTENDIPES RYDALENSISGRP	MIDGE		X	X	X	
NEOPERLA	STONEFLY		X	X	X	
NEURECLIPSIS	CADDISFLY		X	X	X	
PARACLADOPELMA	MIDGE		X	X	X	
TVETENIA	MIDGE		X	X	X	
CAMPELOMA	SNAIL		X	X		X
POLYPEDILUM ILLINOENSE	MIDGE		X	X		X
RANATRA BUENOI	WATER SCORPION		X	X		X

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
COPELATUS	BEETLE, PREDACEOUS DIVING		X	X		
ENDOCHIRONOMUS	MIDGE		X	X		
EUKIEFFERIELLA DEVONICA	MIDGE		X	X		
EUKIEFFERIELLA SP X	MIDGE		X	X		
LENZIELLA	MIDGE		X	X		
PSECTROCLADIUS	MIDGE		X	X		
ZAVRELIA	MIDGE		X	X		
BEROSUS	BEETLE, WATER SCAVENGER		X		X	X
MESOSMITTIA	MIDGE		X		X	X
ACENTRELLA AMPLA	MAYFLY		X		X	
ACRONEURIA ABNORMIS	STONEFLY		X		X	
ACRONEURIA ARENOSA	STONEFLY		X		X	
ATHERIX LANTHA	FLY, WATERSNIPE		X		X	
BRILLIA	MIDGE		X		X	
CAENIS HILARIS	MAYFLY		X		X	
CRYPTOCHIRONOMUS	MIDGE		X		X	
DIXELLA	MIDGE, DIXID		X		X	
ECTOPRIA THORACICA	BEETLE, WATER-PENNY		X		X	
HELICHUS BASALIS	BEETLE, LONG-TOE		X		X	
HELICHUS FASTIGIATUS	BEETLE, LONG-TOE		X		X	
HELICHUS LITHOPHILUS	BEETLE, LONG-TOE		X		X	
HETAERINA AMERICANA	DAMSELFLY		X		X	
HETAERINA TITIA	DAMSELFLY		X		X	
HYDROPSYCHE BIDENS	CADDISFLY		X		X	
LEUCTRA	STONEFLY		X		X	
MACROMIA GEORGINA	DRAGONFLY		X		X	
NEUROCORDULIA	DRAGONFLY		X		X	
OXYETHIRA	CADDISFLY		X		X	
PARACYMUS	BEETLE, WATER SCAVENGER		X		X	
PARAGNETINA FUMOSA	STONEFLY		X		X	
POTAMYIA FLAVA	CADDISFLY		X		X	
PROGOMPHUS OBSCURUS	DRAGONFLY		X		X	
STEMPELLINA	MIDGE		X		X	
STENELMIS ANTENNALIS	BEETLE, RIFFLE		X		X	
TORTOPUS INCERTUS	MAYFLY		X		X	
TRICORYTHODES	MAYFLY		X		X	
CRICOTOPUS ISOCLADIUS	MIDGE		X			X
DERALLUS	BEETLE, WATER SCAVENGER		X			X
DUBIRAPHIA HARLEYI	BEETLE, RIFFLE		X			X
ENDOCHIRONOMUS SUBTENDENS	MIDGE		X			X
ABLABESMYIA PHILOSPHAGNOS	MIDGE		X			
AMERICAENIS	MAYFLY		X			
BRACHYCENTRUS NUMEROSUS	CADDISFLY		X			

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
BRACHYVATUS	BEETLE, PREDACEOUS DIVING		X			
CAMBARUS	CRAYFISH		X			
CLOEON	MAYFLY		X			
DUBIRAPHIA SP A	BEETLE, RIFFLE		X			
DYTHEMIS	DRAGONFLY		X			
EPHEMERIDAE	MAYFLY		X			
EPHORON ALBUM	MAYFLY		X			
EURYLOPHELLA	MAYFLY		X			
HEPTAGENIA	MAYFLY		X			
HYDROCANTHUS	BEETLE, BURROWING		X			
MAYATRICHIA	CADDISFLY		X			
NATARSIA N SP A	MIDGE		X			
ORCONECTES NR DIFFICILIS	CRAYFISH		X			
PARAMERINA INCONSPICUA	MIDGE		X			
PSEUDOCLOEON	MAYFLY		X			
STENONEMA FEMORATUM	MAYFLY		X			
COENAGRIONIDAE	DAMSELFLY			X	X	X
HELOPHORUS	BEETLE, WATER SCAVENGER			X	X	X
PARACLADOPELMA UNDINE	MIDGE			X	X	X
PHAENOPSECTRA	MIDGE			X	X	X
TRIBELOS	MIDGE			X	X	X
EURYLOPHELLA TRILINEATA	MAYFLY			X	X	
HYDROPSYCHE	CADDISFLY			X	X	
MACROSTEMUM CAROLINA	CADDISFLY			X	X	
PERLIDAE	STONEFLY			X	X	
AGABUS AERUGINOSUS	BEETLE, PREDACEOUS DIVING			X		X
CALLIBAETIS	MAYFLY			X		X
CAMBARELLUS PUER	DWARF CRAYFISH			X		X
NEOGERRIS HESIONE	WATER STRIDER			X		X
PELTODYTES	BEETLE, CRAWLING			X		X
TABANUS	FLY, DEER			X		X
CERACLEA SPONGILLOVORAX	CADDISFLY			X		
DEROVATELLUS	BEETLE, PREDACEOUS DIVING			X		
GLOSSOSCOLECIDAE	WORM			X		
LYMNAEIDAE	SNAIL, PULMONATE			X		
MICROCHIRONOMUS	MIDGE			X		
MOLOPHILUS	FLY, CRANE			X		
MOOREOBDELLA FERVIDA	LEECH			X		
OMISUS	MIDGE			X		
PARACLOEODES MINUTUS	MAYFLY			X		
PARATENDIPES	MIDGE			X		
PERITHEMIS	DRAGONFLY			X		
PRISTINELLA	WORM			X		

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
SIALIS RELATA	ALDERFLY			X		
SMICRIDEA	CADDISFLY			X		
TUBIFICIDAE NOCAPS	WORM			X		
TUBIFICIDAE W CAPS	WORM			X		
CORDULIIDAE	DRAGONFLY				X	X
CRYPTOTENDIPES	MIDGE				X	X
CULICIDAE	MOSQUITO				X	X
GUTTIPELOPIA GUTTIPENNIS	MIDGE				X	X
HYDROCHUS	BEETLE, WATER SCAVENGER				X	X
LIMNOPHILA	FLY, CRANE				X	X
PARACHIRONOMUS FREQUENS	MIDGE				X	X
TANYPUS	MIDGE				X	X
TROPISTERNUS	BEETLE, WATER SCAVENGER				X	X
ABLABESMYIA KARELIA	MIDGE				X	
ACERPENNA	MAYFLY				X	
ALLUAUDOMYIA	MIDGE, BITING				X	
ANACAENA	BEETLE, WATER SCAVENGER				X	
ANISOCENTROPUS PYRALOIDES	CADDISFLY				X	
ANTILLOCLADIUS	MIDGE				X	
ANTOCHA	FLY, CRANE				X	
APSECTROTANYPUS JOHNSONI	MIDGE				X	
ARGIA BIPUNCTULATA	DAMSELFLY				X	
ARGIA SEDULA	DAMSELFLY				X	
ATHERIX	FLY, WATERSNIPE				X	
BARBAETIS	MAYFLY				X	
BEZZIA	MIDGE, BITING				X	
BRACHYCENTRUS	CADDISFLY				X	
BRACHYCERCUS	MAYFLY				X	
BRACHYCERCUS MACULATUS	MAYFLY				X	
BRILLIA FLAVIFRONS	MIDGE				X	
CALOPTERYGIDAE	DAMSELFLY				X	
CALOPTERYX DIMIDIATA	DAMSELFLY				X	
CENTROPTILUM	MAYFLY				X	
CERATOPSYCHE SLOSSONAE	CADDISFLY				X	
CHELIFERA	FLY, DANCE				X	
CHOROTERPES BASALIS	MAYFLY				X	
COPELATUS CHEVROLATI	BEETLE, PREDACEOUS DIVING				X	
COPELATUS GLYPHICUS	BEETLE, PREDACEOUS DIVING				X	
COPEPODA	COPEPOD				X	
DEMICRYPTOCHIRONOMUS	MIDGE				X	
DJALMABATISTA PULCHERVARIANT	MIDGE				X	
ELMIDAE	BEETLE, RIFFLE				X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
ENOCHRUS OCHRACEUS	BEETLE, WATER SCAVENGER				X	
EURYLOPHELLA DORIS	MAYFLY				X	
FALLCEON QUILLERI	MAYFLY				X	
GLOSSIPHONIIDAE	LEECH				X	
GOMPHUS ABBREVIATUS	DRAGONFLY				X	
GOMPHUS EXILUS	DRAGONFLY				X	
GOMPHUS GOMPHUS	DRAGONFLY				X	
GOMPHUS PARVIDENS	DRAGONFLY				X	
GONIELMIS DIETRICHI	BEETLE, RIFFLE				X	
HABROPHLEBIODES BRUNNEIPENNIS	MAYFLY				X	
HEBRUS	WATER BUG				X	
HELIUS	FLY, CRANE				X	
HELOCORDULIA UHLERI	DRAGONFLY				X	
HELOPICUS SUBVARIANS	STONEFLY				X	
HEXAGENIA BILINEATA	MAYFLY				X	
HYDROBIUS	BEETLE, WATER SCAVENGER				X	
HYDROPHILIDAE	BEETLE, WATER SCAVENGER				X	
HYDROPORUS STAGNALIS	BEETLE, PREDACEOUS DIVING				X	
HYDROPORUS UNDULATUS	BEETLE, PREDACEOUS DIVING				X	
HYDROPSYCHE BETTENI	CADDISFLY				X	
HYDROPSYCHE ELISSOMA	CADDISFLY				X	
ISONYCHIA SICCA	MAYFLY				X	
LABRUNDINIA NR BECKI	MIDGE				X	
LEPIDOSTOMA	CADDISFLY				X	
LEUCROCUTA	MAYFLY				X	
MAYATRICHIA AYAMA	CADDISFLY				X	
MESOVELIA CRYPTOPHILA	WATER TREADER				X	
METROBATES	WATER STRIDER				X	
METROBATES HESPERIUS	WATER STRIDER				X	
MICROVELIA HINEI	WATER STRIDER				X	
NECTOPSYCHE EXQUISITA	CADDISFLY				X	
NEOPERLA CHOCTAW	STONEFLY				X	
NEOPORUS DILATATUS	BEETLE, PREDACEOUS DIVING				X	
NEOPORUS LYNCEUSGRP	BEETLE, PREDACEOUS DIVING				X	
NEOPORUS MELLITUS	BEETLE, PREDACEOUS DIVING				X	
NEOPORUS STRATIOPUNCTATUS	BEETLE, PREDACEOUS DIVING				X	
NEOPORUS VITTATIPENNIS	BEETLE, PREDACEOUS DIVING				X	
NEOTRICHIA	CADDISFLY				X	
NEUROCORDULIA ALABAMENSIS	DRAGONFLY				X	
NEUROCORDULIA VIRGINIENSIS	DRAGONFLY				X	
NIGRONIA SERRICORNIS	FISHFLY				X	
NILOTANYPUS AMERICANUS	MIDGE				X	

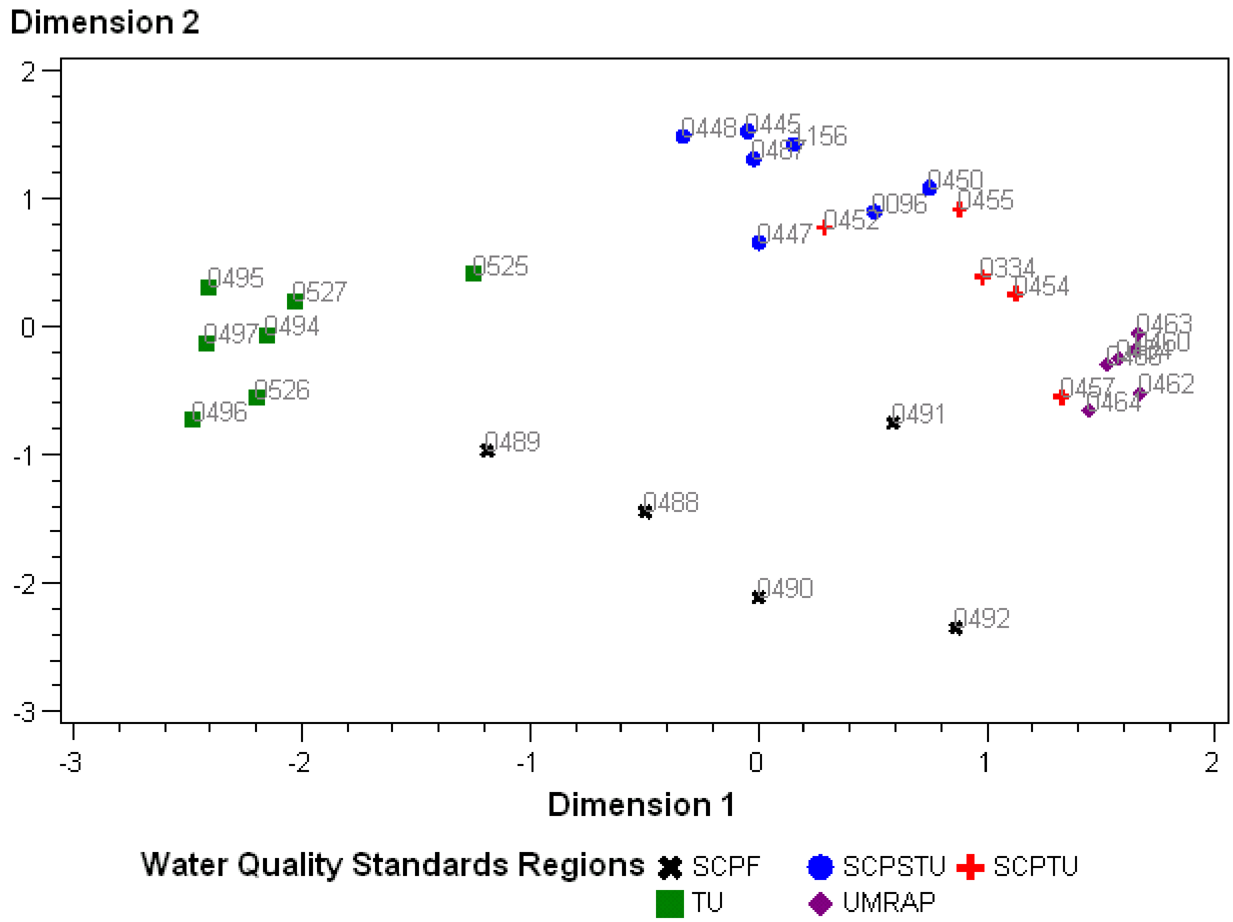
TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
NILOTANYPUS NR AMERICANA	MIDGE				X	
NILOTANYPUS NR KANSENSIS	MIDGE				X	
OECETIS MORSEI SPHYRA	CADDISFLY				X	
OECETIS NOCTURNA	CADDISFLY				X	
OECETIS PERSIMILIS	CADDISFLY				X	
OECETIS SCALA	CADDISFLY				X	
OECETIS SPHYRA	CADDISFLY				X	
ORTHOCLADIUS ANNECTENS	MIDGE				X	
PAGASTIELLA	MIDGE				X	
PARACHAETOCLADIUS	MIDGE				X	
PARACHAETOCLADIUS ABNOBAEUS	MIDGE				X	
PARACLADOPELMA LOGANAE	MIDGE				X	
PARACLADOPELMA NEREIS	MIDGE				X	
PARACYMUS DISPERSUS	BEETLE, WATER SCAVENGER				X	
PARAGNETINA	STONEFLY				X	
PARAKIEFFERIELLA SP C	MIDGE				X	
PARATENDIPES ALBIMANUS	MIDGE				X	
PERICOMA TELMATOSCOPUS	FLY, MARSH				X	
PERLESTA	STONEFLY				X	
PERLINELLA	STONEFLY				X	
PERLINELLA DRYMO	STONEFLY				X	
PERLODIDAE	STONEFLY				X	
PHAENOPSECTRA PUNTIPESGRP	MIDGE				X	
POLYPEDILUM N SP	MIDGE				X	
PROCAMBARUS PENNI	CRAYFISH				X	
PSEUDOCENTROPTILOIDES USA	MAYFLY				X	
PSEUDORTHOCLADIUS	MIDGE				X	
PSEUDOSMITTIA	MIDGE				X	
PTERONARCYS DORSATA	STONEFLY				X	
RHAGOVELIA CHOREUTES	WATER STRIDER				X	
RHEOCRICOTOPUS TUBERCULATUS	MIDGE				X	
RHEOTANYTARSUSVROBACKI	MIDGE				X	
RHEUMATOBATES CHOREUTES	WATER STRIDER				X	
RHEUMATOBATES TENUIPES	WATER STRIDER				X	
ROBACKIA CLAVIGER	MIDGE				X	
ROBACKIA DEMEIJEREI	MIDGE				X	
SCIRTIDAE	BEETLE, MARSH				X	
SIGARA	WATER BOATMEN				X	
SIMULIUM HAYSI	FLY, BLACK				X	
STENELMIS CONVEXULA	BEETLE, RIFFLE				X	
STICTOCHIRONOMUS	MIDGE				X	
STRATIOMYIDAE	FLY, SOLDIER				X	
STYLURUS	DRAGONFLY				X	

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
STYLURUS AMNICOLA	DRAGONFLY				X	
STYLURUS NOTATUS	DRAGONFLY				X	
SYNORTHOCLADIUS	MIDGE				X	
TANYPODINAE	MIDGE				X	
TANYTARSINI	MIDGE				X	
TETRAGONEURIA	DRAGONFLY				X	
TINODES	CADDISFLY				X	
TRIAENODES IGNITUS	CADDISFLY				X	
TRIAENODES PERNA HELO	CADDISFLY				X	
TRIAENODES TARDUS	CADDISFLY				X	
TRICHOCORIXA CALVA	WATER BOATMEN				X	
TRICHOPTERA	CADDISFLY				X	
VILLOSA VIBEX	MUSSEL				X	
XESTOCHIRONOMUS	MIDGE				X	
ZAVRELIMYIA	MIDGE				X	
	BEETLE, PREDACEOUS DIVING					X
ACENTRIA	MOTH					X
AGABUS	BEETLE, PREDACEOUS DIVING					X
ANODOCHILUS						X
ASHEUM BECKI	MIDGE					X
BELOSTOMA FLUMINEUM	GIANT WATER BUG					X
CAMBARELLUS SHUFELDTII	DWARF CRAYFISH					X
CARUNCULINA PARVA	MUSSEL					X
CHAOBORUS PUNTIPENNIS	MIDGE, PHANTOM					X
CLADOPELMA	MIDGE					X
COPTOTOMUS	BEETLE, PREDACEOUS DIVING					X
CYRNELLUS FRATERNUS	CADDISFLY					X
DROMOGOMPHUS SPOLIATUS	DRAGONFLY					X
EINFELDIA NATCHITOCHEAE	MIDGE					X
ERYTHEMIS SIMPLICICOLLIS	DRAGONFLY					X
FITTKAUIMYIA	MIDGE					X
GAMMARUS	AMPHIPOD					X
GAMMARUS FASCIATUS	AMPHIPOD					X
HALIPLUS	BEETLE, CRAWLING					X
HELOBDELLA	LEECH					X
HYDROCHUS EQUICARINATUS	BEETLE, WATER SCAVENGER					X
HYDROCHUS FOVEATUS	BEETLE, WATER SCAVENGER					X
HYDROCHUS SCABRATUS	BEETLE, WATER SCAVENGER					X
LABRUNDINIA NEOPILOSELLA	MIDGE					X
LABRUNDINIA NR SP A	MIDGE					X
LABRUNDINIA SP A	MIDGE					X
LACCOPHILUS	BEETLE, PREDACEOUS DIVING					X
LARSIA BERNERI	MIDGE					X

TAXA	COMMON NAME	SCP FLATWOODS	SCP SOUTHERN TERTIARY UPLANDS	SCP TERTIARY UPLANDS	TU	UMRAP
LIMNOPORUS	WATER STRIDER					X
LIPOGOMPHUS	WATER BUG					X
MACROBDELLA	LEECH					X
NANOCLADIUS NR DISTINCTUS	MIDGE					X
NOCTUIDAE	MOTH					X
NOTONECTA	BACKSWIMMER					X
NOTONECTA IRRORATA	BACKSWIMMER					X
ORTHEMIS FERRUGINEA	DRAGONFLY					X
PARACHIRONOMUS DIRECTUS	MIDGE					X
PARACHIRONOMUS HIRTALATUS	MIDGE					X
PARACHIRONOMUS MONOCHROMUS	MIDGE					X
PELOCORIS FEMORATUS	WATER BUG, CREEPING					X
PLANARIA	PLANARIAN					X
PROCLADIUS NR BELLUS	MIDGE					X
RANTHUS						X
SUPHIS	BEETLE, BURROWING					X
SUPHISELLUS	BEETLE, BURROWING					X
TANYPUS CARINATUS	MIDGE					X
TANYPUS PUNTIPENNIS	MIDGE					X
TANYPUS STELLATUS	MIDGE					X

Figure 53. Non-metric multidimensional scaling of observed benthic macroinvertebrate taxa at inland reference stream sites.

Plots are graphed by reference site. Plots closer together may be considered more similar, whereas plots farther apart may be considered less similar in regard to benthic macroinvertebrate taxa composition.



APPENDIX G: LAND USE

Land use data was evaluated using the 2001 USGS National Land Cover Database (Appendix C, Figure 20). The following tables breakdown each ecoregion by percentage of land use.

A. ATCHAFALAYA RIVER ECOREGION

AR_LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	2,009	0.2%
Cultivated Crops	142,449	13.9%
Deciduous Forest	27	0.0%
Developed High Intensity	197	0.0%
Developed Low Intensity	12,368	1.2%
Developed Medium Intensity	1,092	0.1%
Developed Open Space	197	0.0%
Emergent Herbaceous Wetlands	43,772	4.3%
Grassland/Herbaceous	6,975	0.7%
Mixed Forest	10	0.0%
Open Water	71,070	6.9%
Pasture/Hay	39,914	3.9%
Shrub/Scrub	1,164	0.1%
Woody Wetlands	705,640	68.7%

B. COASTAL DELTAIC MARSH ECOREGION

CDM LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	21,394	0.8%
Cultivated Crops	35,359	1.3%
Deciduous Forest	2,042	0.1%
Developed High Intensity	14,963	0.6%
Developed Low Intensity	73,091	2.7%
Developed Medium Intensity	26,191	1.0%
Developed Open Space	4,682	0.2%
Emergent Herbaceous Wetlands	1,422,510	52.6%
Evergreen Forest	1,979	0.1%
Grassland/Herbaceous	1,731	0.1%
Mixed Forest	36	0.0%
Open Water	878,446	32.5%
Pasture/Hay	29,464	1.1%
Shrub/Scrub	6,588	0.2%

Woody Wetlands	186,820	6.9%

C. COASTAL CHENIER MARSHES ECOREGION

CCM LU/LC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	8,900	0.6%
Cultivated Crops	21,324	1.5%
Deciduous Forest	17	0.0%
Developed High Intensity	495	0.0%
Developed Low Intensity	8,770	0.6%
Developed Medium Intensity	1,794	0.1%
Developed Open Space	3,696	0.3%
Emergent Herbaceous Wetlands	941,327	66.2%
Evergreen Forest	6	0.0%
Grassland/Herbaceous	417	0.0%
Mixed Forest	3	0.0%
Open Water	392,622	27.6%
Pasture/Hay	18,273	1.3%
Shrub/Scrub	3,611	0.3%
Woody Wetlands	20,481	1.4%

D. GULF COASTAL PRAIRIE ECOREGION

GCP LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	1,654	0.1%
Cultivated Crops	1,543,270	48.2%
Deciduous Forest	3,392	0.1%
Developed High Intensity	10,208	0.3%
Developed Low Intensity	216,313	6.8%
Developed Medium Intensity	30,253	0.9%
Developed Open Space	36,017	1.1%
Emergent Herbaceous Wetlands	203,959	6.4%
Evergreen Forest	36,696	1.1%
Grassland/Herbaceous	50,176	1.6%
Mixed Forest	3,037	0.1%
Open Water	68,806	2.1%
Pasture/Hay	467,261	14.6%
Shrub/Scrub	29,967	0.9%
Woody Wetlands	501,795	15.7%

E. Lower Mississippi River Alluvial Plains Ecoregion

LMRAP LULC Analysis		
Land Use/land Cover	**Acres**	**Percent**
Barren Land	1,590	0.1%
Cultivated Crops	449,945	17.1%
Deciduous Forest	1,687	0.1%
Developed High Intensity	15,180	0.6%
Developed Low Intensity	146,441	5.6%
Developed Medium Intensity	27,887	1.1%
Developed Open Space	57,029	2.2%
Emergent Herbaceous Wetlands	302,810	11.5%
Evergreen Forest	55,987	2.1%
Grassland/Herbaceous	18,045	0.7%
Mixed Forest	231	0.0%
Open Water	208,935	7.9%
Pasture/Hay	135,761	5.1%
Shrub/Scrub	43,408	1.6%
Woody Wetlands	1,172,639	44.5%

F. Mississippi River Ecoregion

MR LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	20,262	3.0%
Cultivated Crops	43,332	6.4%
Deciduous Forest	1,976	0.3%
Developed High Intensity	1,135	0.2%
Developed Low Intensity	10,373	1.5%
Developed Medium Intensity	1,299	0.2%
Developed Open Space	5,098	0.7%
Emergent Herbaceous Wetlands	97,966	14.4%
Evergreen Forest	98	0.0%
Grassland Herbaceous	2,428	0.4%
Mixed Forest	2,336	0.3%
Open Water	276,551	40.6%
Pasture/Hay	6,281	0.9%
Shrub/Scrub	1,048	0.2%
Woody Wetlands	210,586	30.9%

G. Pearl River Ecoregion

PR LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	953	0.6%
Cultivated Crops	2,307	1.4%
Deciduous Forest	15	0.0%
Developed High Intensity	126	0.1%
Developed Low Intensity	4,110	2.4%
Developed Medium Intensity	1,194	0.7%
Developed Open space	8,937	5.2%
Emergent Herbaceous Wetlands	3,559	2.1%
Evergreen Forest	20,274	11.9%
Grassland/Herbaceous	1,681	1.0%
Mixed Forest	204	0.1%
Open water	7,614	4.5%
Pasture/Hay	5,343	3.1%
Shrub/Scrub	10,223	6.0%
Woody Wetlands	104,080	61.0%

H. Red River Alluvium Ecoregion

RRA LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	2,157	0.1%
Cultivated Crops	458,488	28.6%
Deciduous Forest	19,487	1.2%
Develop High Intensity	4,813	0.3%
Developed Low Intensity	65,061	4.1%
Developed Medium Intensity	12,572	0.8%
Developed Open Space	36,482	2.3%
Emergent Herbaceous Wetlands	33,082	2.1%
Evergreen Forest	20,319	1.3%
Grassland/Herbaceous	8,456	0.5%
Mixed Forest	8,076	0.5%
Open Water	88,155	5.5%
Pasture/Hay	330,834	20.6%
Shrub/Scrub	83,123	5.2%
Woody Wetlands	434,158	27.0%

I. Sabine River Ecoregion

SR LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	747	0.3%
Deciduous Forest	324	0.1%
Developed High intensity	61	0.0%
Developed Low Intensity	2,191	0.9%
Developed Medium Intensity	282	0.1%
Developed Open Space	3,752	1.6%
Emergent Herbaceous Wetlands	21,021	8.9%
Evergreen Forest	41,309	17.5%
Grassland/Herbaceous	6,672	2.8%
Mixed Forest	6,374	2.7%
Open Water	84,320	35.7%
Pasture/Hay	837	0.4%
Shrub/Scrub	10,200	4.3%
Woody Wetlands	58,135	24.6%

J. Southern Plains Terrace and Flatwoods Ecoregion

SPTF LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	5,185	0.6%
Cultivated Crops	19,180	2.4%
Deciduous Forest	1,832	0.2%
Developed High Intensity	5,433	0.7%
Developed Low Intensity	50,234	6.3%
Developed Medium Intensity	19,847	2.5%
Developed Open Space	76,309	9.5%
Emergent Herbaceous Wetlands	3,799	0.5%
Evergreen Forest	155,228	19.3%
Grassland/Herbaceous	31,777	4.0%
Mixed Forest	1,258	0.2%
Open Water	7,403	0.9%
Pasture/Hay	83,207	10.4%
Shrub/Scrub	121,857	15.2%
Woody Wetlands	219,759	27.4%

K. SOUTH CENTRAL PLAINS SOUTHERN TERTIARY UPLANDS ECOREGION

SCPSTU LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	4,817	0.2%
Cultivated Crops	4,198	0.2%
Deciduous Forest	21,581	1.0%
Developed High Intensity	1,127	0.1%
Developed Low Intensity	41,083	2.0%
Developed Medium Intensity	3,635	0.2%
Developed Open Space	65,355	3.2%
Emergent Herbaceous Wetlands	5,017	0.2%
Evergreen Forest	860,906	41.8%
Grassland/Herbaceous	136,098	6.6%
Mixed Forest	139,389	6.8%
Open Water	21,571	1.0%
Pasture/Hay	59,972	2.9%
Shrub/Scrub	333,303	16.2%
Woody Wetlands	360,156	17.5%

L. SOUTH CENTRAL PLAINS TERTIARY UPLANDS ECOREGION

SCPTU LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	5,017	0.1%
Cultivated Crops	74,008	1.0%
Deciduous Forest	379,903	5.3%
Developed High Intensity	8,226	0.1%
Developed Low Intensity	179,569	2.5%
Developed Medium Intensity	23,947	0.3%
Developed Open Space	279,802	3.9%
Emergent Herbaceous Wetlands	19,722	0.3%
Evergreen Forest	3,027,120	42.4%
Grassland/Herbaceous	53,231	0.7%
Mixed Forest	581,096	8.1%
Open Water	193,737	2.7%
Pasture/Hay	268,510	3.8%
Shrub/Scrub	1,050,680	14.7%
Woody Wetlands	988,339	13.9%

M. Terrace Uplands Ecoregion

TU LULC Analysis		
Land Use/Land Cover	Acres	Percent
Barren Land	9,294	0.6%
Cultivated Crops	83,305	5.6%
Deciduous Forest	69,281	4.7%
Developed High Intensity	385	0.0%
Developed Low Intensity	9,682	0.7%
Developed Medium Intensity	1,860	0.1%
Developed Open Space	61,953	4.2%
Emergent Herbaceous Wetlands	5,573	0.4%
Evergreen Forest	336,086	22.6%
Grassland/Herbaceous	49,317	3.3%
Mixed Forest	56,180	3.8%
Open Water	12,151	0.8%
Pasture/Hay	206,632	13.9%
Shrub/Scrub	219,436	14.8%
Woody Wetlands	366,473	24.6%

N. South Central Plains Flatwoods Ecoregion

SCPF LULC Analysis		
Land Use/Land Cover	Acres	Percent
Barren Land	1,541	0.1%
Cultivated Crops	34,701	2.8%
Deciduous Forest	1,559	0.1%
Developed High Intensity	2,099	0.2%
Developed Low Intensity	55,587	4.4%
Developed Medium Intensity	3,026	0.2%
Developed Open Space	15,070	1.2%
Emergent Herbaceous Wetlands	10,454	0.8%
Evergreen Forest	366,601	29.3%
Grassland/Herbaceous	108,152	8.7%
Mixed Forest	28,322	2.3%
Open Water	9,930	0.8%
Pasture/Hay	91,914	7.4%
Shrub/Scrub	218,618	17.5%
Woody Wetlands	302,220	24.2%

O. UPPER MISSISSIPPI RIVER ALLUVIAL PLAINS ECOREGION

UMRAP LULC Analysis		
Land Use/Land Cover	**Acres**	**Percent**
Barren Land	379	0.0%
Cultivated Crops	2,189,141	65.0%
Deciduous Forest	27,636	0.8%
Developed High Intensity	580	0.0%
Developed Low Intensity	11,881	0.4%
Developed Medium Intensity	2,635	0.1%
Developed Open Space	133,644	4.0%
Emergent Herbaceous Wetlands	30,253	0.9%
Evergreen Forest	22,094	0.7%
Grassland/Herbaceous	978	0.0%
Mixed Forest	92,554	2.7%
Open Water	101,954	3.0%
Pasture/Hay	7,341	0.2%
Shrub/Scrub	12,751	0.4%
Woody Wetlands	734,174	21.8%