Appendix C
Report on the Creation of a Land Cover / Land Use Database for Select Proposed Reservoir Sites In Texas

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Texas Parks & Wildlife GIS Lab

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Statement of Need

Texas Water Development Board is tasked with evaluating proposed reservoir sites. Land cover information is needed to evaluate sites with respect to possible wetland impacts and other mitigation needs. Land cover information allows efficient evaluation of relative costs and risks associated with reservoir development on a particular site. The most recent ground verified land cover / vegetation database for Texas is The Vegetation Types of Texas – Including Cropland, McMahan, et.al. 1984, PWD Bulletin 7000-120. The most recent unverified database is the 1992 National Land Cover Dataset (USGS). These dataset are unsuitable for site evaluation due to age, lack of resolution, and / or unverified accuracy and a new database needs to be developed.

Proposed Methodology

All proposed reservoir sites will be mapped using a modified version of the Texas Land Classification System (Appendix B). This classification system is an expansion of the National Land Cover Database (NLCD) Classification System (Appendix A) and is a standard land cover / land use classification system for Texas. The modified version will use all classes considered necessary to quickly evaluate potential reservoir sites as to relative risk of impacts to wetlands and other land resources subject to mitigation. The classification system is a generalization and is intended to allow rapid mapping to a level of detail considered sufficient for planning level evaluation of reservoir sites. The classes included in the system are (using NLCD / Texas Land Classification nomenclature):

Land Cover Type	Definition
1.1 Open Water	All areas of open water, generally with less than 25 percent cover of vegetation or soil.
2.0 Developed	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-100 % of total cover
4.111 Deciduous Forest	Areas dominated by trees where 75% or more of the canopy cover can be determined to be trees which loose all their leaves for a specific season of the year.
4.112 Evergreen Forest	Areas dominated by trees where 50% or more of the canopy cover can be determined to be trees which maintain their leaves / needles all year. All mixed Pine / Oak forests in this class. Includes Pine plantations and other evergreen dominated silvaculture operations.
4.1121 Broad-leaf Evergreen Forest	Areas dominated by evergreen trees that have well-defined leaf blades and are relatively wide in shape. Example species include: *Quercus virginicus, Quercus fusiformis*.
4.12 Shrubland	Areas where trees have less than 25% canopy cover and the existing vegetation is dominated by plants that have persistent woody stems, a relatively low growth habit (generally less than 4 m), and which generally produce several basal shoots instead of a single shoot. Includes true shrubs, trees that are small or stunted because of environmental conditions, desert scrub, and chaparral. In the eastern US, includes former cropland or pasture lands which are now covered by brush to the extent that they are no longer identifiable or usable as cropland or pasture. Clear-cut areas will exhibit a stage of shrub cover during the regrowth cycle. Some common species which would be classified as shrub land are mountain mahogany, sagebrush, and scrub oaks.
4.21 Natural Herbaceous	Areas dominated by native or naturalized grasses, forbs, ferns and weeds. They can be managed, maintained, or improved for ecological purposes such as weed/brush control or soil erosion. Includes vegetated vacant lots and areas where it cannot be determined whether the vegetation was planted or cultivated such as in areas of dispersed grazing by

Land Cover Type	Definition
	feral or domesticated animals. Includes landscapes dominated by grass-like plants such as bunch grasses, palouse grass, palmetto prairie areas, and tundra vegetation, as well as true prairie grasses.
4.22 Planted / Cultivated Herbaceous	Areas of herbaceous vegetation planted and/or cultivated by humans for agronomic purposes in developed settings. The majority of vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, pasture, or seed. Temporarily flooded are included in this category. Does not include harvested areas of naturally occurring plants such as wild rice and cattails.
4.31111 Seasonally Flooded Forest	Tree dominated areas on which surface water or soil saturation is present for extended periods during the growing season, but is absent by the end of the growing season in most years. Example species include: *Quercus laurifolia, Fraxinus pennsylvanica, Nyssa sp., Acer rubrum, Liquidambar styraciflua, Ulmus americana*
4.3112 Swamp	Tree dominated areas on which surface water persists throughout the growing season, except during drought years. Example species include: *Nyssa aquatica, Taxodium distichum*.
4.312 Shrub Wetland	Wetlands with greater 25% shrub cover and less than 25% tree cover. Usually fresh water inundation, includes seasonal and greater flooding regimes. Example species include: *Arundinaria gigantea, Baccharis salicifolia, Salix Sp., Cephalanthus occidentalis, Planera aquatica and Forestiera acuminata*
4.32 Emergent Herbaceous Wetlands	Areas dominated by wetland herbaceous vegetation which is present for most of the growing season. Includes fresh-water, brackish-water, and salt-water marshes, tidal marshes, mountain meadows, wet prairies, and open bogs.

Table 1. Reservoir Site Land Cover Classification System

Land cover will be mapped using Landsat ETM+ and TM data from the most current suitable datasets available in the State of Texas imagery archive, December 1999 to March 2003 (Table 1). Imagery collected during and out of the growing season will be used. Data will be combined and an unsupervised clustering routine (Isodata) in Leica Geosystems Erdas Imagine 9.0 will be run. Data will be grouped statistically into 30 clusters and these will be assigned to one of the land cover classes. Using the national hydric soils list from the Natural Resources Conservation Service (NRCS) and the Soil Survey Geographic (SSURGO) database from the same source to develop a map of the hydric soils in the area of interest and then using this to modify the land cover classes. Only soils map units classified as Sloughs, flood plains, or salt marshes with greater than 70% hydric inclusions are included for analysis. Classes 4.111 Deciduous Forest, 4.112 Evergreen Forest and 4.1121 Broad-leaf Evergreen Forest areas that intersect the hydric soils area will be reclassified to 4.31111 Seasonally Flooded Forest. Class 4.21 Natural Herbaceous areas that intersect the hydric soil area will be reclassified to 4.32 Emergent Herbaceous Wetlands. Class 4.12 Shrubland areas will be reclassified to 4.312 Shrub Wetland. Minimum mapping unit is 1 hectare.

Row / Path	Date
25-37	1/10/2000
25-37	4/18/2001
25-38	9/6/2000
25-38	11/3/2001
25-39	1/10/2000
25-39	7/20/2000
26-37	4/25/2001
26-37	12/14/2001
26-38	2/4/2001
26-38	4/25/2001
26-39	12/16/1999
26-39	4/25/2001
26-40	2/4/2001
26-40	4/25/2001
26-42	6/12/2001
26-42	3/30/2003
27-40	7/21/2001
27-40	12/31/2002
28-36	4/4/2000
28-36	2/2/2001
28-37	4/4/2000
28-37	3/9/2002
29-37	5/29/2000
29-37	1/8/2001

Table 1

Boundary information for each potential reservoir site, provided by Texas Natural Resource Information System, will be intersected with land cover data. No buffer was applied because the small size of some sites would lead make comparison of areas difficult as relatively large percentages of total area would be outside the footprint of the reservoir sites.

Random points are selected from each class and DOQQ imagery evaluation will be conducted to get a limited amount of verification of accuracy. Points will be overlaid on 2004 National Agricultural Imagery Program DOQ mosaics displayed at 1:10,000 scale and will be evaluated as to accuracy of land cover class.

Deliverables

1. Land cover database for priority potential reservoir sites (see Appendix C). Data delivered in ESRI personal geodatabase format. UTM WGS84 Meters projection. 11x17 proof maps in both paper and Adobe Acrobat formats.

2. DOQ imagery verification report and database. Data delivered in ESRI personal geodatabase format. Geographic WGS84 Decimal Degree (change due to locations crossing UTM boundaries) projection.

Results

Overall accuracy of the classification is 91%. Errors of omission and commission were computed for each class (Table 2). Classification accuracy is grouped for all landcover classes. Class 4.31111 Seasonally Flooded Forest is mapped conservatively and may occupy a larger percentage of the landscape than mapped. Small inclusions into matrix soils or soils that had smaller percentages of hydric soil types / areas may have this class present and not be mapped.

Class	1	2	3	4	5	6	7	8	9	10	11	12	Error of Omission
1	36												**0.000**
2		9											**0.000**
3			44	2			1						**0.064**
4				9				2					**0.182**
5					12								**0.000**
6			1	1		42	2						**0.087**
7						3	42	10					**0.236**
8	1							23					**0.042**
9									24		1	1	**0.077**
10										8			**0.000**
11											15		**0.000**
12										1	1	22	**0.083**
Error of Commission	**0.027**	**0.000**	**0.022**	**0.250**	**0.000**	**0.067**	**0.067**	**0.343**	**0.000**	**0.111**	**0.118**	**0.043**	

Table 2

Appendix A – NLCD Land Cover Classification System[1]

11. Open Water—All areas of open water, generally with less than 25 percent cover of vegetation or soil.
12. Perennial Ice/Snow—All areas characterized by a perennial cover of ice and/or snow, generally greater than 25 percent of total cover.
21. Developed, Open Space—Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes
22. Developed, Low Intensity—Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49 percent of total cover. These areas most commonly include single-family housing units.
23. Developed, Medium Intensity—Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50–79 percent of the total cover. These areas most commonly include single-family housing units.
24. Developed, High Intensity—Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover.
31. Barren Land (Rock/Sand/Clay)—Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulations of earthen material. Generally, vegetation accounts for less than 15 percent of total cover.
32. Unconsolidated Shore*—Unconsolidated material such as silt, sand, or gravel that is subject to inundation and redistribution due to the action of water. Characterized by substrates lacking vegetation except for pioneering plants that become established during brief periods when growing conditions are favorable. Erosion and deposition by waves and currents produce a number of landforms representing this class.
41. Deciduous Forest—Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species shed foliage simultaneously in response to seasonal change.
42. Evergreen Forest—Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. More than 75 percent of the tree species maintain their leaves all year. Canopy is never without green foliage.
43. Mixed Forest—Areas dominated by trees generally greater than 5 meters tall, and greater than 20 percent of total vegetation cover. Neither deciduous nor evergreen species are greater than 75 percent of total tree cover.
51. Dwarf Scrub—Alaska only areas dominated by shrubs less than 20 centimeters tall with shrub canopy typically greater than 20 percent of total vegetation. This type is often co-associated with grasses, sedges, herbs, and non-vascular vegetation.
52. Shrub/Scrub—Areas dominated by shrubs; less than 5 meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes true shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.
71. Grassland/Herbaceous—Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80 percent of total vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.
72. Sedge/Herbaceous—Alaska only areas dominated by sedges and forbs, generally greater than 80 percent of total vegetation. This type can occur with significant other grasses or other grass like plants, and includes sedge tundra, and sedge tussock tundra.
73. Lichens—Alaska only areas dominated by fruticose or foliose lichens generally greater than 80 percent of total vegetation.

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[1] Homer, C., Haung, C., Yang, L., Wylie, B., and Coan, M. Development of a 2001 Nation Land-Cover Database for the United States. Photogrammetric Engineering and Remote Sensing. Vol 70. No. 7, July 2004, pp.829-840.

74. Moss—Alaska only areas dominated by mosses, generally greater than 80 percent of total vegetation.
81. Pasture/Hay—Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.
82. Cultivated Crops—Areas used for the production of annual crops, such as corn, soybeans, vegetables, tobacco, and cotton, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.
90. Woody Wetlands—Areas where forest or shrubland vegetation accounts for greater than 20 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

91. Palustrine Forested Wetland*—Includes all tidal and non-tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent.

92. Palustrine Scrub/Shrub Wetland*—Includes all tidal and non-tidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Total vegetation coverage is greater than 20 percent. The species present could be true shrubs, young trees and shrubs or trees that are small or stunted due to environmental conditions.

93. Estuarine Forested Wetland*—Includes all tidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts are equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

94. Estuarine Scrub/Shrub Wetland*—Includes all tidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent. Total vegetation coverage is greater than 20 percent.

95. Emergent Herbaceous Wetlands—Areas where perennial herbaceous vegetation accounts for greater than 80 percent of vegetative cover and the soil or substrate is periodically saturated with or covered with water.

96. Palustrine Emergent Wetland (Persistent)*—Includes all tidal and non-tidal wetlands dominated by persistent emergent vascular plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5 percent. Plants generally remain standing until the next growing season.

97. Estuarine Emergent Wetland*—Includes all tidal wetlands dominated by erect, rooted, herbaceous hydrophytes (excluding mosses and lichens) and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent and that are present for most of the growing season in most years. Perennial plants usually dominate these wetlands.

98. Palustrine Aquatic Bed*—The Palustrine Aquatic Bed class includes tidal and nontidal wetlands and deepwater habitats in which salinity due to ocean-derived salts is below 0.5 percent and which are dominated by plants that grow and form a continuous cover principally on or at the surface of the water. These include algal mats, detached floating mats, and rooted vascular plant assemblages.

99. Estuarine Aquatic Bed*—Includes tidal wetlands and deepwater habitats in which salinity due to ocean-derived salts is equal to or greater than 0.5 percent and which are dominated by plants that grow and form a continuous cover principally on or at the surface of the water. These include algal mats, kelp beds, and rooted vascular plant assemblages.

Appendix B – Texas Land Classification System[2]

Expand the USGS MRLC classification categories to include the following new vegetative categories unique to Texas and call the new classification scheme the Texas Land Classification System. The new categories to MRLC are highlighted in blue.

VEGETATED - areas having generally 25% or more of the land or water with vegetation. Arid or semi-arid areas may have as little as 5% vegetation cover.

4.1 Woody Vegetation - land with at least 25% tree and (or) shrub canopy cover.

4.11 Forested – trees with crowns overlapping (generally 60-100% cover)

4.111 Deciduous Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees which loose all their leaves for a specific season of the year.

4.1111 Cold Deciduous Forest – area dominated by trees that shed their leaves as a strategy to avoid seasonal periods of low temperature. Example species include: *Quercus stellata , Quercus marilandica.*

4.112 Evergreen Forest - area dominated by trees where 75% or more of the canopy cover can be determined to be trees which maintain their leaves all year.

4.1121 Broad-leafed Evergreen Forest - area dominated by evergreen trees that have well-defined leaf blades and are relatively wide in shape. Example species include: *Quercus virginicus, Quercus fusiformis.*

4.1122 Needle-leafed Evergreen Forest – area dominated by evergreen trees with slender elongated leaves. Example species include: *Pinus echinata, Pinus palustris, Pinus taeda, Juniperus virginiana.*

4.113 Mixed Forest - areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the canopy cover.

4.12 Shrubland - areas where trees have less than 25% canopy cover and the existing vegetation is dominated by plants that have persistent woody stems, a relatively low growth habit (generally less than 4 m), and which generally produce several basal shoots instead of a single shoot. Includes true shrubs, trees that are small or stunted because of environmental conditions, desert scrub, and chaparral. In the eastern US, include former cropland or pasture lands which are now covered by brush to the extent that they are no longer identifiable or usable as cropland or pasture. Clear-cut areas will exhibit a stage of shrub cover during the regrowth cycle. Some common species which would be classified as shrub land are mountain mahogany, sagebrush, and scrub oaks.

4.121 Deciduous Shrubland - areas where 75% or more of the land cover can be determined to be shrubs which loose all their leaves for a specific season of the year.

4.1211 Cold Deciduous Shrubland - area dominated by shrubs that shed their leaves as a strategy to avoid seasonal periods of low temperature. Example species include: *Quercus sinuata, Rubis sp., Smilax Sp.*

4.1212 Drought Deciduous

4.122 Evergreen Shrubland - areas where 75% or more of the land cover can be determined to be shrubs which keep their leaves year round.

4.1221 Broad-leafed Evergreen Shrubland - area dominated by evergreen shrubs that have well-defined leaf blades and are relatively wide in shape. Example species include: *Quercus havardii, Quercus fusiformis.*

4.1222 Needle-leafed Evergreen Shrubland – area dominated by evergreen shrubs with slender elongated leaves. Example species include: *Juniperus ashei, Juniperus virginiana.*

4.123 Mixed Shrubland - areas dominated by shrubs where neither deciduous nor evergreen species represent more than 75% of the land cover.

4.124 Desert Scrub - land areas predominantly in arid and semi-arid portions of the southwestern U.S. Existing vegetation is sparse and often covers only 5-25% of the land. Example species include sagebrush, creosote, saltbush, greasewood, and cacti.

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[2] Interagency LULC Working Group, GIS Managers Committee, Texas Geographic Information Council. Texas Land Classification System. October 1999.

4.13 Planted/Cultivated Woody (Orchards/Vineyards/Groves) – areas containing plantings of evenly spaced trees, shrubs, bushes, or other cultivated climbing plants usually supported and arranged evenly in rows. Includes orchards, groves, vineyards, cranberry bogs, berry vines, and hops. Includes tree plantations planted for the production of fruit, nuts, Christmas tree farms, and commercial tree nurseries. Exclude pine plantations and other lumber or pulp wood plantings, which will be classified as Forest.

4.131 Irrigated Planted/Cultivated Woody - orchards, groves, or vineyards where a visible irrigation system is in place to supply water

4.132 Citrus - trees or shrubs cultivated in orchards or groves that bear edible fruit such as orange, lemon, lime, grapefruit, and pineapple.

4.133 Non-managed Citrus - orchards or groves containing fruit bearing trees or shrubs which are no longer maintained or harvested by humans.

Evidence of non-managed citrus includes the growth of non citrus shrubs, trees, and grasses within an orchard or grove.

4.14 Woodland – Open stands of trees with crowns not usually touching (25- 59% cover).

4.141 Deciduous Woodland - area dominated by trees where 75% or more of the canopy cover can be determined to be trees which loose all their leaves for a specific season of the year.

4.1411 Cold Deciduous Woodland – area dominated by trees that shed their leaves as a strategy to avoid seasonal periods of low temperature. Example species include: *Quercus stellata, Quercus marilandica, Juglans nigra, Quercus alba.*

4.142 Evergreen Woodland - area dominated by trees where 75% or more of the canopy cover can be determined to be trees which maintain their leaves all year.

4.1421 Broad-leafed Evergreen Woodland - area dominated by evergreen trees that have well-defined leaf blades and are relatively wide in shape. Example species include: *Quercus virginicus, Quercus fusiformis.*

4.1422 Needle-leafed Evergreen Woodland - area dominated by evergreen trees with slender elongated leaves. Example species include: *Pinus palustris, Pinus taeda, Juniperus virginiana.*

4.143 Mixed Woodland - areas dominated by trees where neither deciduous nor evergreen species represent more than 75% of the canopy cover.

4.2 Herbaceous Vegetation - areas dominated by non-woody plants such as grasses, forbs, ferns and weeds, either native, naturalized, or planted. Trees must account for less than 25% canopy cover while herbaceous plants dominate all existing vegetation.

4.21 Natural Herbaceous - areas dominated by native or naturalized grasses, forbs, ferns and weeds. It can be managed, maintained, or improved for ecological purposes such as weed/brush control or soil erosion. Includes vegetated vacant lots and areas where it cannot be determined whether the vegetation was planted or cultivated such as in areas of dispersed grazing by feral or domesticated animals. Includes landscapes dominated by grass-like plants such as bunch grasses, palouse grass, palmetto prairie areas, and tundra vegetation, as well as true prairie grasses.

4.211 Natural Grasslands - natural areas dominated by true grasses. Includes undisturbed tall-grass and short-grass prairie in the Great Plains of the U.S.

4.2111 Short Grasslands – natural areas dominated by Graminoid vegetation usually less than 0.5 meters tall when inflorescences are fully developed. Example species include: *Bouteloua eriopoda,*
Bouteloua gracilis, Buchloe dactyloides.

4.2112 Medium – Tall Grasslands – natural areas dominated by graminoid vegetation usually more than 0.5 meters tall when inflorescences are fully developed. Example species include:
Paspalum sp., Schizachyrium scoparium, Andropogon gerardii, Panicum virgatum.

4.212 Natural Forb – natural areas dominated by broad-leaved herbaceous plants. Example species include: *Giant Ragweed, Bigelowia nuttallii.*

4.22 Planted/Cultivated Herbaceous - areas of herbaceous vegetation planted and/or cultivated by humans for agronomic purposes in developed settings. The majority of vegetation in these areas is planted and/or maintained for the production of food, feed, fiber, pasture, or seed. Temporarily flooded are included in this category. Do not include harvested areas of naturally occurring plants such as wild rice and cattails.

4.221 Fallow/Bare Fields - areas within planted or cultivated regions that have been tilled or plowed and do not exhibit any visible vegetation cover.

4.222 Small Grains - areas used for the production of grain crops such as wheat, oats, barley, graham, and rice. Category is difficult to distinguish from cultivated grasses grown for hay and pasture. Indicators of small grains may be a less than 10% slope, annual plowing and seeding, distinctive field patterns and sizes, different timing of green-up and harvest, different harvesting practices, a very "even" texture and tone, or regional variations discovered during field checks.

4.2221 Irrigated Small Grains - areas used for the production of small grain crops where a visible irrigation system is in place to supply water including the flooding of entire fields. Category includes rice fields. Presence of irrigation system does not guarantee that the field is irrigated. The specific small grain crops that follow while difficult to classify compared to specific row crops were included for sake of completion.

4.2222 Non-Irrigated Small Grains – Denotes fields without any visible sign of irrigation system.

4.223 Row Crops - areas used for the production of crops or plants such as corn, soybeans, vegetables, tobacco, flowers and cotton. Fields which exhibit characteristics similar to row crops, but that do not have any other distinguishing features for a more specific category may be included.

4.224 Specialty Crops - includes vegetables such as potatoes, tomatoes and fruits such as cantaloupe, and watermelon.

4.225 Cultivated Grasses - areas of herbaceous vegetation, including perennial grasses, legumes, or grass-legume mixtures that are planted by humans and used for erosion control, for seed or hay crops, for grazing animals, or for landscaping purposes

4.2251 Irrigated

4.22511 Pasture/Hay - areas of cultivated perennial grasses and/or legumes (e.g., alfalfa) used for grazing livestock or for seed or hay crops. Pasturelands can have a wide range of cultivation levels. It can be managed by seeding, fertilizing, application of herbicides, plowing, mowing, or baling. Pastureland has often been cleared of trees and shrubs, is generally on steeper slopes than cropland, and is intended to graze animals at a higher density than open rangeland, and is often fenced and divided into smaller parcels than rangeland or cropland. Hay fields may be more mottled than small grain fields as they are not plowed annually and may be harvested and baled two or three times a year in some locations.

4.22512 Turf - areas growing grasses such as St. Augustine for yards.

4.2252 Non-irrigated Cultivated Grasses

4.22521 Pasture

4.22522 Turf

4.226 Other cultivated

4.3 Vegetated Wetland - areas where the water table is at, near, or above the land surface for a significant part of most years and vegetation indicative of this covers more than 25% of the land surface. Wetlands can include marshes, swamps situated on the shallow margins of bays, lakes, ponds, streams, or reservoirs; wet meadows or perched bogs in high mountain valleys, or seasonally wet or flooded low spots or basins. Do not include agricultural land, which is flooded for cultivation purposes.

4.31 Woody Wetland - areas dominated by woody vegetation. Includes seasonally flooded bottomland, mangrove swamps, shrub swamps, and wooded swamps including those around bogs. Wooded swamps and southern flood plains contain primarily cypress, tupelo, oaks, and red maple. Central and northern flood plains are dominated by cottonwoods, ash, alder, and willow. Flood plains of the Southwest may be dominated by mesquite, salt cedar, seepwillow, and arrowweed. Northern bogs typically contain tamarack or larch, black spruce, and heath shrubs. Shrub swamp vegetation includes alder, willow, and buttonbush.

4.311 Forested Wetland – area with tree canopy greater than 25%, surface water present or saturated soils present for variable periods, which may or may not have detectable seasonality.

4.3111 Riparian Forest – tree dominated wetlands along river or stream courses.

4.31111 Seasonally flooded - tree dominated area on which surface water or soil saturation is present for extended periods during the growing season, but is absent by the end of the growing season in most years. Example species include: *Quercus*

laurifolia, Fraxinus pennsylvanica, Nyssa sp., Acer rubrum, Liquidambar styraciflua, Ulmus americana

4.31112 Temporarily Flooded – tree dominated area on which surface water is present for brief periods during the growing season. Example species include: *Quercus virginiana, Celtis laevigata, Carya illinoinensis, Ulmus crassifolia, and Platanus occidentalis.*

4.3112 Swamp – tree dominated area on which surface water persists throughout the growing season, except during drought years. Example species include: *Nyssa aquatica, Taxodium distichum.*

4.312 Shrub Wetland – wetland with shrub canopy cover greater than 25%.

4.3121 Tidal – shrub dominated wetlands with less than 25% tree canopy cover, tidal (usually saline to some extent) water covers land surface, usually on a daily cycle. Example species include: *Tamarix Sp., Baccharis halimifolia, Avicennia germinans.*

4.3122 Non-Tidal – wetlands with greater 25% shrub cover and less than 25% tree cover. Usually fresh water inundation, includes seasonal and greater flooding regimes. Example species include: *Arundinaria gigantea, Baccharis salicifolia, Salix Sp.*

4.32 Emergent Herbaceous Wetlands - areas dominated by wetland herbaceous vegetation which is present for most of the growing season. Includes fresh-water, brackish-water, and salt-water marshes, tidal marshes, mountain meadows, wet prairies, and open bogs.

4.321 Marsh – Herbaceous fresh water wetlands, dominated by rooted vascular emergent herbaceous vegetation. Example species include: *Typha sp., Juncus effusus, Rhynchospora sp., Scirpus americanus, Colocasia esculenta, Ludwigia Sp., Sagitaria Sp.*

4.3211 Prairie Pothole – off channel, isolated wetlands. Usually depressions in the landscape. Common in the panhandle region of Texas.

4.322 Tidal Marsh - wetland areas dominated by saline herbaceous vegetation, water depth and/or inundation usually changing on a daily cycle. Example species include: *Spartina patens, Spartina alternaflora, Scirpus pungens, Juncus roemerianus, and Phragmites australis*.

Appendix C – Reservoir List

Bedias
Brownsville Weir
Brushy Creek
Cedar Ridge
Cuero 2
Fastrill 274
George Parkhouse 1
George Parkhouse 2
Lower Bois D'Arc
Marvin Nichols 1
Nueces Off Channel
Palmetto Bend 2
Ralph Hall
Ringgold
Tehaucana
Wilson Hollow