DA Permit SAJ-1993-01395

Attachment G - Compensatory Mitigation Plan
Attachment A, Part 1 - Wetlands Work Plan

USACE RECLAMATION PLAN—WETLANDS

MOSAIC FERTILIZER, LLC SOUTH PASTURE EXTENSION

HARDEE COUNTY, FLORIDA

Mosaic Fertilizer, LLC

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Table of Contents

1.0 OVERVIEW 1
1.1 Purpose 1
1.2 Methodology 1
1.3 Objectives 2
2.0 WETLAND RECLAMATION 4
2.1 Forested Wetlands (FLUCFCS 611, 613, 616, 617, 625, 626, 627, 630) 5
2.2 Herbaceous Wetlands (FLUCFCS 640, 641, 643) 7
2.3 Wetland Monitoring 12
2.4 Wetland Success Criteria 13
3.0 WETLAND ENHANCEMENT 13
3.1 Wetland 06W-20-P 14
3.2 Wetland 12W-40-P 14
4.0 SHORT TERM UTILITY CROSSING RECLAMATION 15
5.0 MITIGATION CONSTRUCTION TIMING 15

Tables

Table RP-1. South Pasture Extension Impact Summary by General Land Use 2
Table RP-2. Plants to be Utilized in Revegetation of Reclaimed Native Habitat Areas. 8

Figures

Figure RP-1 Wetland Transect Map
Figure RP-2 Existing Land Use Map
Figure RP-3 Post Reclamation Land Use
Figure RP-4 Reclamation Activities
Figure RP-5 Mine and Reclamation Sequence

Attachments

Attachment A	Description of Plant Communities Present on the CF South Pasture Extension
Attachment B	Existing Wetland Transects Maps
Attachment C	Post Reclamation Wetland Transect Maps
Attachment D	AMEC - BCI Integrated Model Report

1.0 OVERVIEW

Mosaic Fertilizer, LLC. (Mosaic) currently owns and operates phosphate mining and beneficiation facilities, totaling approximately 15,000 acres in northwest Hardee County, Florida. Mining and beneficiation operations were initiated north of State Road 62 and north of the town of Ft. Green in 1978 (North Pasture). The North Pasture Mine, now closed and reclaimed, was designed to produce approximately 1 million tons per year of phosphate rock.

In 1993, the mining operation was relocated to the present location south of State Road 62 and expanded to a 4 million ton per year operation. The existing operation is referred to as the South Pasture Mine and is authorized to operate under Conceptual Reclamation Plan CFI-SP-CPC and Wetland Resource Permit No. 252607909, both issued by the Florida Department of Environmental Protection (FDEP), and Federal Clean Water Act Section 404 permit no. 199301395, issued by the United States Army Corps of Engineers (USACE), as well as other federal, state, and local authorizations.

The South Pasture Extension (SPE) consists of approximately 7,513 acres located immediately south of the South Pasture Mine. With this application, Mosaic is seeking approval to extend mining operations into this adjoining site to assure a long-term supply of phosphate rock, to help meet national and global demand.

1.1 Purpose

The reclamation plans herein are presented to provide reasonable assurance that the overall site-wide reclamation plan and detailed plans for reclaiming uplands meet the requirements imposed upon Mosaic by Chapter 62C-16 in the Florida Administrative Code (F.A.C.) and that the wetland mitigation plans meet the criteria for permit issuance contained in 33 C.F.R. Part 332. With respect to mitigation necessary to meet the criteria for issuance of a federal Section 404 dredge and fill permit, Mosaic has prepared a Compensatory Mitigation Plan as required by Title 33 of the Code of Federal Regulations Part 332.4 (c) (33 CFR 332.4 (c)). This USACE Reclamation Plan is part of the Mitigation Work Plan incorporated by reference in the federal CMP.

1.2 Methodology

The design of the SPE mine plan has undergone numerous iterations in an attempt to eliminate and reduce impacts to wetlands, streams and high quality uplands to the extent practicable. Coordination with local, state and federal agencies has resulted in the current mine plan, which has resulted in unavoidable impacts to certain natural systems. Areas to remain preserved were designed to avoid high quality wetlands as well as larger contiguous systems of native habitat types along naturally occurring creek system (Brushy and Lettis Creeks) corridors. The land disturbance resulting from the proposed mining and associated activities on the SPE are summarized in Table RP-1 below.

Table RP-1. South Pasture Extension Impact Summary by General Land Use

Land use type	Existing	Short Term and Long Term Impact[1]	Preserved Area	Reclaimed[4]	Total Avoided and Reclaimed
Agricultural uplands[2]	3,522.4	3322.9	73.9	3190.7	3264.6
Native uplands	1,978.9	1392.4	343.4	1430.1	1773.5
Open waters[3]	83.1	65.8	17.4	71.3	88.7
Herbaceous/shrub wetlands	1,116.1	951.8	164.1	1009.2	1173.3
Forested wetlands	812.2	470.7	341.5	489.3	830.8
TOTAL	**7512.8**	**6418.1**	**1094.6**	**6418.2**	**7512.8**

[1]Includes short-term utility corridor and dragline crossing disturbances

[2]Includes agricultural land uses, cattle pond spoil areas, and trails

[3]Includes streams, ditches, lakes, and cattle ponds

[4]Includes restoration of short-term utility corridor and dragline crossing disturbances

1.3 Objectives

In designing the habitat reclamation plan for the SPE, elements of the final recommendations outlined in the report, *Wildlife Habitat and Wildlife Utilization of Phosphate Mines Lands*, prepared by ENTRIX, Inc., and the University of South Florida (Durbin, et al. 2008) for the Florida Institute of Phosphate Research (FIPR) were incorporated to the greatest extent practicable. Components of each level of recommendations have been addressed in the plan in order to create optimal habitat reclamation based on current scientific literature. Specific areas of focus include habitat heterogeneity, variety in habitat targets (site-specific), oversight of reclamation material placement, and adaptive management plans (monitoring and maintenance), which are detailed below.

Reclamation of the wetland and upland habitats at SPE is designed to maximize natural habitat analogues along preservation boundaries and create contiguous areas of native and reclaimed habitat. Reclamation of natural ecosystems is also planned such that certain reclaimed native habitats on the SPE will be continuously connected to reclaimed and preserved areas on the South Pasture to the north. Reclamation of native habitat analogues contiguous with the areas to remain preserved will provide

wildlife corridors primarily along riparian corridors allowing for enhanced management of the post-reclamation landscape through prescribed fire. Acreage reclaimed to pasture or similar agricultural uses are situated adjacent to roadways to allow for ease of farming and future development potential in the Hardee County industrial corridor. Reclaiming agricultural areas in close proximity to roadways also reduces the need for prescribed burns for land management near traffic corridors. While reclamation of uplands is a requirement of state, not federal, law, references to upland habitat reclamation are included in this Objectives section because reclaimed upland habitat provides buffers to the associated wetlands and surface waters, and inclusion of upland native habitat in the post-reclamation landscape provides habitat heterogeneity, a goal of the AEIS Mitigation Framework.

On a landscape level, the post-reclamation landscape will provide habitat heterogeneity, which has been shown to increase the abundance and diversity of vertebrates relative to a fragmented landscape. The reclamation plan outlined below details the reclamation of seventeen upland and wetland native habitat types. There are four additional native habitat types which will not be disturbed during mining. Each reclamation area has been designed to contain vegetation strata known to occur in the cover type being reclaimed. Habitat types such as forested wetlands have been designed to contain a substantial component of shrub and sub-canopy species. A list of selected species to be used by habitat type is presented in Table RP-2. Some upland habitat types, especially longleaf pine flatwoods, are known for their sparse tree canopy and for the diversity of their groundcover grasses and forbs. These uplands contain a diverse shrub cover and typically very few sub-canopy tree species. Reclaimed flatwoods will be designed to approximate these natural conditions. A current description of the Florida Land Use and Cover Classification System (FLUCFCS) codes is presented in Attachment A.

To assist in the development of the reclamation plan, Cardno ENTRIX utilized data collected as part of an intensive field work effort that spanned several years. This effort included wetland delineations, quality assessments using the Uniform Mitigation Assessment Methodology (UMAM), detailed vegetation and land use mapping, and wildlife and listed species surveys, as well as several specialized studies. One important specialized study was the establishment and documentation of some forty vegetative transects across representative wetlands. Transects began approximately 10 yards landward of the wetland line, traversed through the wetland and continued for approximately 10 yards beyond the wetland limit on the opposite side. Surveyed points were established wherever a change in vegetation or topography occurred and at seasonal high elevations. The vegetation between points was characterized in terms of species presence and relative abundance. Figure RP-1 depicts the locations of each transect on the SPE property, with representative cross-section and plan view drawings of this information provided as Attachment B.

Information gathered from the transects was utilized in the design of the proposed reclaimed wetlands. Vegetative associations were evaluated and utilized to design each reclaimed wetland and the associated wetland land use type. Representative cross

sections, plan views, and planting palettes for each reclaimed wetland land use are provided in Attachment C. Additionally, for those land use types which may contain wetlands of varying depths, such as freshwater marshes (FLUCFCS 641), multiple cross sections have been prepared to recreate the varying potential depths. The integrated hydrologic modeling prepared by AMEC - BCI provides the elevations and seasonal high water levels for a select few wetlands shown in the Cross-Section Sheets attached to the AMEC - BCI Integrated Model report (Attachment D). The modeling demonstrates that the plan doesn't have any systematic hydrology flaws and works well for the modeled wetlands.

Reclaimed and enhanced wetland habitats will be designed to meet or exceed the requirements of 33 CFR Part 332, as well as 40D-4, F.A.C. and the Southwest Florida Water Management District (SWFWMD) Basis of Review. Final location of the wildlife habitat management areas, as defined in the Long-Term Management Plan (see Attachment D of the Compensatory Mitigation Plan), will be based on species requirements and discussions with Florida Fish and Wildlife Conservation Commission (FFWCC), Fish and Wildlife Service (FWS), and USACE. Reclamation areas will also meet or exceed the criteria listed in Hardee County's Article 3.14.01 Performance Standards, which are at least as stringent as those requirements outlined by the USACE in the Permit. Figures RP-2 and RP-3 depict the pre and post-reclamation land use designations and Figure RP-4 shows the various reclamation types across the site. Target post-reclamation habitat types are based on the combined results of the extensive field work detailed above. Specifically, descriptions of reclaimed habitat types, including species composition, vegetative structure, zonation, elevations, and wildlife utilization, are based on information gathered which details existing habitat types on site.

To ensure that the reclamation goals are met, an adaptive management approach will be an integral part of the Reclamation Plan implementation. If the USACE and/or FDEP determine that the plan is not meeting its goals, Mosaic will develop and implement corrective actions.

Mosaic understands an important component of a successful reclamation plan is utilizing on-site native soil which would otherwise be impacted by mining practices. On-site, native soils provide both the native seedbed important to re-establishing native vegetative communities and the organic matter necessary to support the vegetation and hydric regimes. Use of native soils typically expedites successful release from mitigation and monitoring requirements. Mosaic will use the topsoil from existing native habitats within reclaimed wetlands whenever practicable. Mosaic has an exemplary record of creating successful mitigation areas and believes implementation of this plan at the SPE will be no different.

2.0 WETLAND RECLAMATION

All wetlands will be reclaimed to maximize direct transfer of muck from mined wetlands for use in creating an appropriate growing medium to the extent practicable. If timing

between clearing of donor sites and completion of the restoration does not allow for direct transfer, muck may be stockpiled for later use in a manner to minimize both oxidation and colonization by nuisance species. In the event that sufficient wetland muck or topsoil is not available, Mosaic will coordinate the use of other appropriate materials with USACE. Bay swamp reclamation will be prioritized to receive available muck before other reclamation areas. Only wetland topsoil that is reasonably free of any nuisance or exotic vegetation will be used in reclamation. Vegetation will be planted with species appropriate for the target habitat type. Selected species to be planted by habitat type are listed in Table RP-2.

The post-mining hydrologic modeling reports (attached as Attachment D – AMEC_BCI Integrated Model Report) will be utilized to ensure that tailings are placed and graded to the correct depth and extent to ensure that the hydrologic regimes for reclaimed wetlands are successful in supporting and sustaining the target wetland types. All wetlands will be monitored for hydrologic performance and vegetative composition; monitoring guidelines are included in the Compensatory Mitigation Plan and will be designated in the DA Permit.

2.1 Forested Wetlands (FLUCFCS 611, 613, 616, 617, 625, 626, 627, 630)

Forested wetlands will be created on sand tailings and then graded and capped with suitable wetland topsoil, if available or other suitable organic matter (with specific depths and structure to be determined by habitat type need; i.e. soils for a bay swamp would need greater water-holding-capacity than for a hydric pine flatwoods). Mosaic recognizes the need to provide for microhabitat enhancement and habitat heterogeneity within the wetland. Consequently, stumps, logs, and shrubs will be installed several inches above the seasonal high water line to provide hummocks. Snags will also be placed within the wetlands to encourage wildlife usage. Direct transfer of small shrubs and trees from the future mining areas will be utilized to the extent practicable.

Species to be planted will be consistent with the species diversity and density of the targeted wetland community type as listed in Table RP-2. Species will be selected based on design elevations of constructed wetlands and comparisons with similar wetlands proposed for impact. After development of the canopy layer, shrubs will be planted in the forested wetlands between years 5 and 7. If the seed source in the transferred muck has not provided substantial ground cover by that point, additional shade tolerant herbaceous species, such as ferns and lizard's tail *(Saururus cernuus)* may also be planted at the same time as the shrub layer.

Bay Swamp (FLUCFCS 611)

Areas reclaimed as bay swamps will be designed as shallow depressions (3-6 feet deep) set into sloping uplands. They will have irregular but generally level bottoms and steep side slopes on up to 80% of their perimeter. The steep side slopes will provide seepage of groundwater from the surrounding uplands. The down-slope boundary will allow drainage of excess water. Elevations will be designed so that the bottom of the bay remains saturated throughout most of the year. Organic matter in the form of muck

harvested from bay swamps proposed for mining, if available, will be spread across the depression. The muck layer will also provide a seed source for initial groundcover. Shrubs will be planted to an average density of 200 plants per acre with at least 5 shrub species included in Table RP-2 and trees will be planted with at least 5 species included in Table RP-2, with bay being the dominant species with the goal of 400 surviving trees per acre.

Gum Swamp (FLUCFCS 613)
Forested wetlands will be capped with four to six inches of wetland topsoil, as available and practicable, which is expected to provide a variety of roots, seeds and propagules of native wetland vegetation. Approximately 600 to 700 trees and 200 shrubs per acre will be planted within this wetland type. Shrubs will be planted to an average density of 200 plants per acre with at least 5 shrub species included Table RP-2 and will be planted with at least 5 species included in Table RP-2.

Inland Ponds and Sloughs (FLUCFCS 616)
Forested wetlands will be capped with four to six inches of wetland topsoil, as available and practicable, which is expected to provide a variety of roots, seed, and propagules of native wetland vegetation. Approximately 600 to 700 trees and 200 shrubs per acre will be planted within this wetland type. Shrubs will be planted to an average density of 200 plants per acre with at least 5 shrub species included Table RP-2 and will be planted with at least 5 species included in Table RP-2.

Mixed Wetland Hardwoods (FLUCFCS 617)
Forested wetlands will be capped with four to six inches of wetland topsoil, as available and practicable, which is expected to provide a variety of roots, seeds, and propagules of native wetland vegetation. Approximately 600 to 700 trees and 200 shrubs per acre will be planted within this wetland type. Shrubs will be planted to an average density of 200 plants per acre with at least 5 shrub species included Table RP-2 and will be planted with at least 5 species included in Table RP-2. Portions of this land use type occur within the temporary utility crossings. These areas will be reclaimed to what existed prior to the temporary impacts. Existing willow swamp wetlands (FLUCFCS 618) will be reclaimed as mixed wetland hardwood as willow swamps are viewed as a ruderal and undesirable habitat type and will be replaced with a more desirable wetland cover type.

Hydric Pine Flatwoods (FLUCFCS 625)
Areas designated as hydric pine flatwoods will be reclaimed by placing a minimum layer of 15 inches of sand tailing over the overburden and topsoiling with direct transfer of 3 to 6 inches of native topsoil from hydric pine flatwoods if available. The transferred topsoil is expected to provide a variety of roots, seeds, and propagules of native wetland vegetation. Longleaf and slash pine will be planted in the appropriate areas to achieve densities between 25 and 75 trees per acres. Shrubs typical of central Florida hydric flatwoods will be recruited from the topsoiling, planted, and/or seeded to achieve a minimum average density of 300 shrubs per acre. Shrubs will be planted to include

species listed in Table RP-2 and trees will be planted with at least 5 species included in Table RP-2.

Hydric Pine Savanna (FLUCFCS 626)
Forested wetlands will be capped with four to six inches of wetland topsoil, as available and practicable, which is expected to provide a variety of roots, seeds, and propagules of native wetland vegetation. Shrubs will be planted to an average density of 200 plants per acre Shrubs will be planted and will include species listed in Table RP-2 and trees will be planted with at an average density of 25 trees per acre will be planted with at least 5 species included in Table RP-2.

Slash Pine Swamp Forest (FLUCFCS 627)
Forested wetlands will be capped with four to six inches of wetland topsoil, as available and practicable, which is expected to provide a variety of roots, seeds, and propagules of native wetland vegetation. Shrubs will be planted to an average density of 200 plants per acre with at least 5 shrub species included Table RP-2 and an average density of 600 to 700 trees per acre will be planted with at least 5 species included in Table RP-2.

Wetland Mixed Hardwood-Coniferous (FLUCFCS 630)
Forested wetlands will be top dressed with four to six inches of wetland topsoil, as available and practicable, which is expected to provide a variety of roots, seeds, and propagules of native wetland vegetation. Shrubs will be planted to an average density of 200 plants per acre with at least 5 shrub species included Table RP-2 and an average density of 600 to 700 trees per acre will be planted with at least 5 species included in Table RP-2.

2.2 Herbaceous Wetlands (FLUCFCS 640, 641, 643)

Herbaceous wetlands will be reclaimed on sand tailings and in areas disturbed but not mined. Direct transfer of muck will be the preferred method for revegetating herbaceous wetlands. Only muck that is available and is reasonably free of nuisance or exotic vegetation will be used. Monitoring of the reclaimed vegetation will determine if additional planting is needed to achieve the requisite vegetation density or diversity for the planned wetland community. When direct transfer of muck is not practicable, herbaceous plants will be planted on 3-foot centers according to the species listed within Table RP-2, as appropriate for each habitat type. Additionally, plantings will occur within the appropriate zone of the wetland, as determined by established or predicted water levels.

As with the forested wetlands, habitat heterogeneity will be encouraged with variations in topography and slope. Hydroperiods for herbaceous wetlands will range from seasonally inundated to permanent inundation. Herbaceous wetlands will also support wide transitional zones typical of pre-mining marshes, including wet prairie fringe. Distinct zonations and diversity of plant species will be encouraged through design of individual marshes.

Vegetated Non-Forested Wetlands (FLUCFCS 640)
Reclaimed vegetated non-forested wetlands will be capped with topsoil collected from on-site wetlands that are to be mined, where available and practicable. If an acceptable topsoil source is not available or if natural regeneration does not occur, then plantings with native herbaceous wetland plants, spaced at 3-foot centers will be implemented.

Freshwater Marsh (FLUCFCS 641)
Reclaimed freshwater marsh will be capped with topsoil collected from on-site marshes that are to be mined, where available and practicable. If an acceptable topsoil source is not available or if natural regeneration does not occur, then plantings with native herbaceous wetland plants, spaced at 3-foot centers will be implemented.

Wet Prairie (FLUCFCS 643)
Gentle slopes, no steeper than 10:1, will be graded to create the reclaimed wet prairie wetlands. Where wet prairie is intended to be created as a fringe area adjacent to other reclaimed wetlands, a continuous gentle slope from the upland to wetland will be created. In free standing wet prairie areas, the final topography will be graded with undulations of ± one foot from design elevations to provide a range in elevation adequate to generate acceptable post-reclamation hydroperiod; however, hydrologic modeling will be used to refine the grading design and thus may allow for the avoidance of creating the undulations. Cover crops may be proposed to ensure that the appropriate hydroperiod has been established before planting the final proposed vegetation. The reclaimed wet prairie sites will be planted with a mixture of appropriate species. Although the soils of wet prairie do not contain much organic matter, spreading a 1-4 inch layer of freshly harvested surface soil from existing prairies could provide additional seeds to increase plant diversity and could inoculate the site with aquatic invertebrates, and, if necessary, Mosaic will cut sod from existing prairie in lieu of planting. This will be done to inoculate sites when suitable soil can be found to coincide with mine site clearing activities. Portions of this land use type occur within the temporary utility crossings and the reclamation of these areas will occur as detailed above.

Table RP-2. Plants to be Utilized in Revegetation of Reclaimed Native Habitat Areas.

Common Name	Scientific Name	FLUCFCS	Planting Depth
Canopy			
red maple	*Acer rubrum*	611, 613, 616, 617, 630, 641	SHW[1] to -0.25[2]
water hickory	*Carya aquatica*	617, 630	SHW to -0.25

Common Name	Scientific Name	FLUCFCS	Planting Depth
popash	*Fraxinus caroliniana*	616, 617, 630	SHW to -2.5
Loblolly bay	*Gordonia lasianthus*	611, 613, 617, 627	SHW
dahoon holly	*Ilex cassine*	611, 613, 617, 625	SHW to -0.25
sweetgum	*Liquidambar styraciflua*	611, 613, 617	SHW to -0.1
sweetbay	*Magnolia viginiana*	611, 613, 616, 617, 625, 627, 630	SHW to -0.5
blackgum	*Nyssa sylvatica* var. *biflora*	611, 613, 616, 617, 627, 630	-0.1 to -1.0
swamp bay	*Persea palustris*	613, 611, 616, 617, 625, 627, 630	SHW to -0.5
sand pine	*Pinus clausa*	630	above SHW
slash pine	*Pinus elliottii*	613, 625, 626, 627, 630, 641	above SHW
longleaf pine	*Pinus palustris*	625, 626	above SHW
laurel oak	*Quercus laurifolia*	611, 613, 616, 617, 625, 630, 641	SHW to -0.1
water oak	*Quercus nigra*	611, 617, 626, 630, 641	SHW
cabbage palm	*Sabal palmetto*	611, 616, 617, 625, 630	SHW
pond cypress	*Taxodium ascendens*	616, 617, 627, 625, 630	-1.0 to -3.0
American elm	*Ulmus Americana*	611, 617, 630,	SHW to -0.5

Common Name	Scientific Name	FLUCFCS	Planting Depth
Shrub			
buttonbush	*Cephalanthus occidentalis*	613, 616, 617, 640, 641	-0.5 to -1.5
swamp dogwood	*Cornus foemina*	616, 617, 630	SHW to -0.5
persimmon	*Diospyros virginiana*	611	above SHW
dahoon holly	*Ilex cassine*	616, 617, 627, 630	SHW to -0.25
gallberry	*Ilex glabra*	611, 625, 626, 627, 643	above SHW
Virginia willow	*Itea virginica*	611, 613, 616, 617, 630, 641	SHW to -0.5
fetterbush	*Lyonia lucida*	611, 613, 616, 617, 625, 626, 627, 630, 641, 6417	SHW to -0.25
wax myrtle	*Myrica cerifera*	611, 613, 616, 617, 625, 626, 627, 630, 641, 6417	SHW to -0.25
saw palmetto	*Serenoa repens*	625, 626, 627	above SHW
highbush blueberry	*Vaccinium corymbosum*	611, 613, 617	SHW to -0.25
possom haw	*Viburnum nudum*	617	SHW to -0.25
Walter's viburnum	*Viburnum obovatum*	611, 613, 626, 630, 641	SHW to -0.25
Ground Cover			
blue maidencane	*Amphicarpum muhlenbergianum*	616, 617, 625, 626, 627, 641, 6417, 643	SHW to -0.5
Andropogons	*Andropogon* spp.	625, 626, 627, 641, 6417, 643	SHW

Common Name	Scientific Name	FLUCFCS	Planting Depth
wiregrass	*Aristida beyrichiana*	625, 626, 627, 643	SHW to -0.1
swamp fern	*Blechnum serrulatum*	611, 617, 630, 641	SHW to -0.25
golden canna	*Canna flaccida*	641, 643	-0.25 to -0.5
carex	*Carex* spp.	611, 613, 616, 617, 630, 641, 6417, 643	SHW to -0.5
sawgrass	*Cladium jamaicense*	611, 613, 616, 617, 630, 640, 641, 6417, 643	-0.25 to -1.0
spider lily	*Crinum americanum*	611, 613, 616, 617, 630, 641, 6417, 643	-0.5 to -1.0
sedges	*Cyperus* spp., *Rhynchospora* spp.	611, 613, 616, 617, 625, 626, 627, 630, 641, 643	SHW to -1.0
low panicums	*Dichanthelium sp.*	611, 617, 641, 643	SHW to -0.5
roadgrass	*Eleocharis baldwinii*	613, 625, 626, 627, 630, 641, 643	SHW to -1.0
jointed spike rush	*Eleocharis interstincta*	641	-0.25 to -1.25
iris	*Iris hexagona*	617, 641, 643	SHW to -0.1
soft rush	*Juncus effuses*	616, 617, 626, 630, 640,641, 643	SHW to -1.5
water lily	*Nymphaea odorata*	641, 641	-1.5 to -4.0
cinnamon fern	*Osmunda cinnamomea*	611, 613, 617, 625, 630	SHW to -0.25

Common Name	Scientific Name	FLUCFCS	Planting Depth
maidencane	*Panicum hemitomon*	613, 616, 617, 626, 630, 640, 641, 643	SHW to -1.0
redtop panicum	*Panicum rigidulum*	611, 613, 616, 617, 630, 641, 6417, 643	SHW
Smartwessd	*Polygonum punctatum*	616, 617, 630, 641, 643	-0.25 to -0.5
pickerelweed	*Pontederia cordata*	611, 613, 616, 617, 630, 641, 6411, 6417	-0.5 to -2.0
lizards tail	*Saururus cernuus*	611, 613, 617, 630, 641	-0.25 to -0.5
lance-leaf arrowhead	*Sagittaria lancifolia*	611, 613, 616, 617, 630, 640, 641, 6411, 6417, 643	-0.5 to -2.0
sand cord grass	*Spartina bakeri*	611, 613, 616, 617, 625, 626, 627, 630, 640, 641, 6417, 643	SHW to -0.5
alligator flag	*Thalia geniculata*	613, 616, 617, 640, 641, 6417,	-1.0 to -3.0
Virginia chain fern	*Woodwardia virginica*	611, 613, 617, 630, 643, 641	SHW to -0.25
yellow-eyed grass	*Xyris* spp.	613, 625, 626, 627, 630, 641, 6417, 643	SHW

[1]SHW = Seasonal High Water
[2]Depth below SHW, in feet

2.3 Wetland Monitoring

Success of restoration efforts will be determined by implementing a comprehensive monitoring program which is designed to gather sufficient data to demonstrate appropriate ecological conditions. Transects will be established in areas to be monitored, with periodic sampling points (the number of transects and sampling points will be based on area size) at which the following will be noted:

- Percent cover by desirable species by stratum

- Percent cover by exotic or nuisance species
- Dominant species (planted or recruited at 5 percent cover or greater), with an estimate of cover of each
- Water depth relative to zonation
- The health and viability of the four trees nearest the point (forested areas only) by measuring DBH and height
- Tree density (forested areas only)

Wetlands within the preservation area will be selected for reference wetlands and possibly from areas scheduled for mining later on in the mine plan. These wetlands will serve as reference wetlands for reclamation and mitigation compliance.

The data will be summarized into a report which will include the above information as well as observed wildlife usage, an overall ecological evaluation, and any actions that may be required to improve the system. To the extent practicable, reports will be tabular in form for ease of review and year-to-year comparisons. Nuisance vegetation monitoring will consist of quarterly or semi-annual inspections of wetlands. Chemical or manual removal of the exotic species will occur on a quarterly basis within all reclaimed wetlands until success has been obtained and the wetlands released.

Monitoring (vegetative) of wetland areas will be conducted annually at the end of each growing season. Reports will be submitted prior to the end of the second month following the month in which the monitoring event took place (e.g., monitoring event in September, the report would be submitted no later than 30 November). Annual events would be conducted in the first five years and biennially thereafter until success has been obtained and the wetlands released.

2.4 Wetland Success Criteria

Reclaimed, enhanced, and preserved wetlands and streams will be considered successful when monitoring results show they meet the performance criteria outlined in the DA Permit conditions.

3.0 WETLAND ENHANCEMENT

Wetland enhancement is largely accomplished through the re-establishment of historic hydroperiods and elimination of deleterious agricultural practices. Enhancement will both increase the habitat value of the existing historical wetland area and result in the return of wetland transitional plant species to the wetland fringes, which are often dominated by non-natives (for example, bahia grass if pasture surrounds the wetland).

Other factors can contribute to altered conditions in a wetland. Many of these factors are related to historic agricultural activities such as the direct drainage of wetlands by ditching, reduction or redirection of the wetland watersheds and indirect drainage impact from the lowering of the water table. The water table drainage is primarily the result of the installation of shallow interior ditches, not always present on all sites.

3.1 Wetland 06W-20-P

Wetland enhancement for the SPE will occur mostly within the 06W-20-P wetland system in an area to remain preserved. Review of historical conditions, past site activities and assessment of current conditions were utilized in developing an enhancement plan for the wetland.

Wetland 06W-20-P is a large (103+ ac.) ditched herbaceous wetland within a preserved area that is proposed to be enhanced. Historical aerials show an expansive ditch system was installed prior to 1958 where the ditching extended beyond the one large wetland into adjacent wetlands. This historically deep water marsh system has been drained for over 50 years and has become a highly altered and degraded wetland. The altered hydrology has caused the encroachment of more upland tolerant species, the loss of desirable marsh species, and an abnormal marsh hydroperiod.

Enhancement of this wetland, immediately by way of installing a temporary ditch block at the southern portion of the wetland, where the drainage way exits the wetland, should rehydrate the wetland to historical conditions (as confirmed by modeling predictions). The ditch block crest shall be set at 100' NGVD. The restoration of the historic hydrology should also allow for upland tolerant/wet intolerant species to die out and be replaced with intact suppressed seed source of native and desirable marsh species. Modeling shows that the ditch block should also allow for the rehydration of the wetlands connected to Wetland 06W-20-P by the ditch system (06W-60-P, 06W-76-P, and 07W-08-P). The temporary ditch block shall remain in place until the final connection of reclaimed wetland R-07W-06-617. The final connection of reclaimed wetland R-07W-06-617 shall include regrading of the ditch block to conform to the reclamation plan.

3.2 Wetland 12W-40-P

Wetland enhancement will occur for wetland 12W-40-P, which is in an area to remain preserved. Review of historical conditions, past site activities and assessment of current conditions were utilized in developing an enhancement plan for the wetland.

Wetland 12W-40-P is a small (1.2+ ac.) forested wetland with a natural stream within a preserved area that is proposed to be enhanced. An impoundment on the west end of this wetland has altered historic stream flows by restricting flow into the wetland. The alteration of the hydrology has caused the encroachment of more upland

tolerant species, the loss of desirable marsh species, and an abnormal marsh hydroperiod.

Enhancement of this wetland, by way removing an impoundment at the western portion of the wetland, where the drainage way enters the wetland, should rehydrate the wetland to historical conditions. The restoration of the historic hydrology should also allow for upland tolerant/wet intolerant species to die out and be replaced with intact suppressed seed source of native and desirable marsh species.

4.0 SHORT TERM UTILITY CROSSING RECLAMATION

Mosaic is proposing approximately 2 acres of short term utility crossing within the proposed preserved area. The impact will be temporary and include 0.9 acres of wetlands and natural streams and 1.1 acres of uplands. The crossing will consist of a berm made from sand tailings with culverts placed through them to maintain flow of wetland systems. The size of the culverts will be determined by surface water modeling. The side slopes as well as up and downstream slopes of the crossings will incorporate appropriate erosion control measures. These measures include silt screens, hay bales, and sodding of sloped areas. Once the crossing is no longer required, the erosion control will remain in place while the tailings and culverts are removed and the areas are graded to the pre-mining elevations. The temporarily impacted stream segments and Other Surface Waters will be planted with vegetation according to the pre-mining wetland land use and table RP-2.

5.0 MITIGATION CONSTRUCTION TIMING

The mitigation activities shall be completed according to the following generalized timetable (and graphic) except as otherwise noted:

a. Generalized Timetable for Mitigation Activities

Activity	Relative Time Frame
Commencement of Severance/Site preparation	No more than six (6) months prior to mining operations (unless approved by the USACE for the purposes of directly transferring topsoil/muck to a contoured mitigation site), except as otherwise authorized herein.
Final grading, including muck placement	No later than 18 months after completion of mining operations, including backfilling with sand tailings

Phase A planting (species that tolerate a wider range of water levels)	No later than six (6) months after final grading or 1 year after muck placement
Hydrological Assessment	For two (2) years after contouring in accordance with Specific Condition [2] and the Monitoring Conditions of this permit
Phase B planting (species that tolerate a more narrow range of water levels)	Up to 12 months after the completion of the hydrological assessment
Phase C planting (shade-adapted ground cover and shrub species, additional trees and shrubs to meet the objectives of the Compensatory Mitigation Plan	At least two (2) years prior to release in forested wetlands

b. Disturbance, mining, and construction of mitigation wetlands, streams and other surface waters shall proceed as shown on Figure RP-5. Anticipated deviations from these schedules shall be submitted for review prior to initiating impacts to wetlands out of sequence.

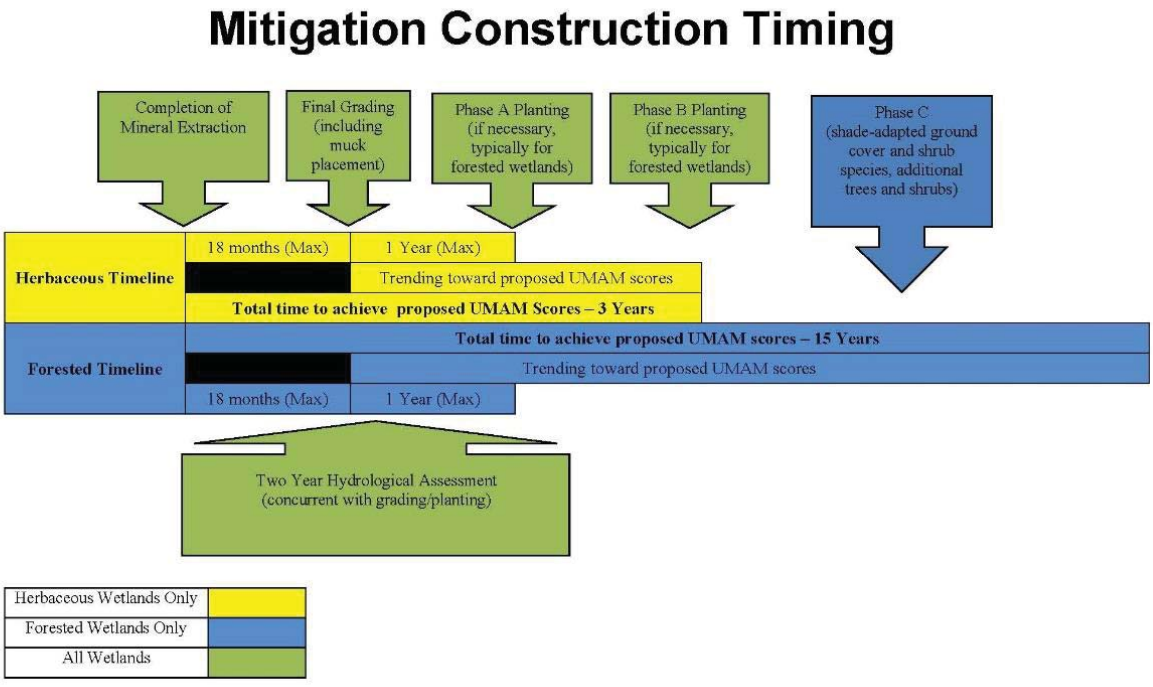


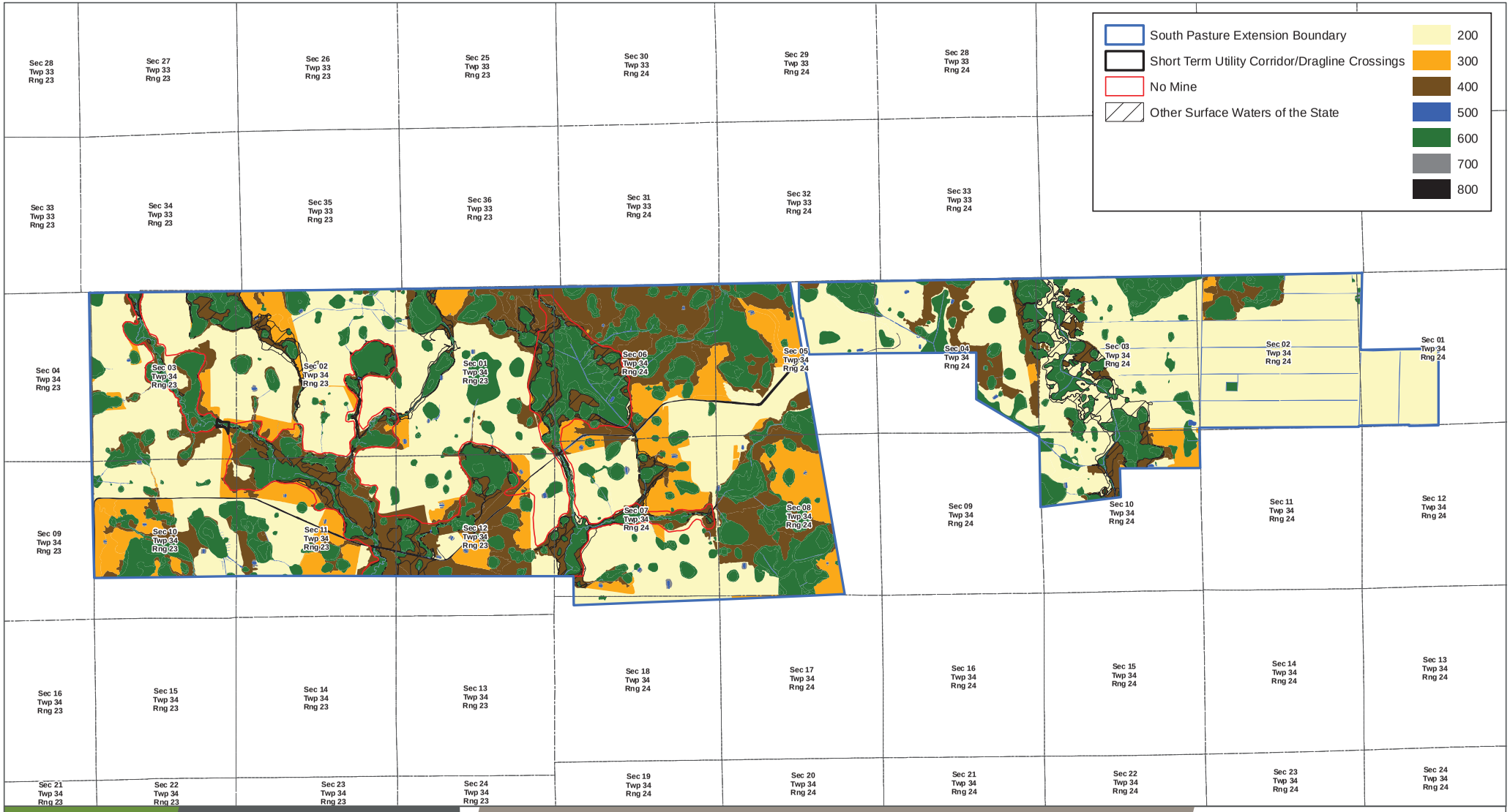


Figure RP-1 Wetland Transect Map

Mosaic Fertilizer
Hardee County, Florida

Cardno ENTRIX
3905 Crescent Park Drive, Riverview, FL 33578 USA
Phone (+1) 813-664-4500 Fax (+1) 813-664-0440
www.cardnoentrix.com

Date Created: 4/10/2014 Date Revised: 4/10/2014 File Path: Q:\UnitedStates\Florida\Tampa\0675\041\working\arcmap\RP2_Fig_1_Wetland_Transect_Location_Map_20140410.mxd
GIS Analyst: Lauren.Federsel



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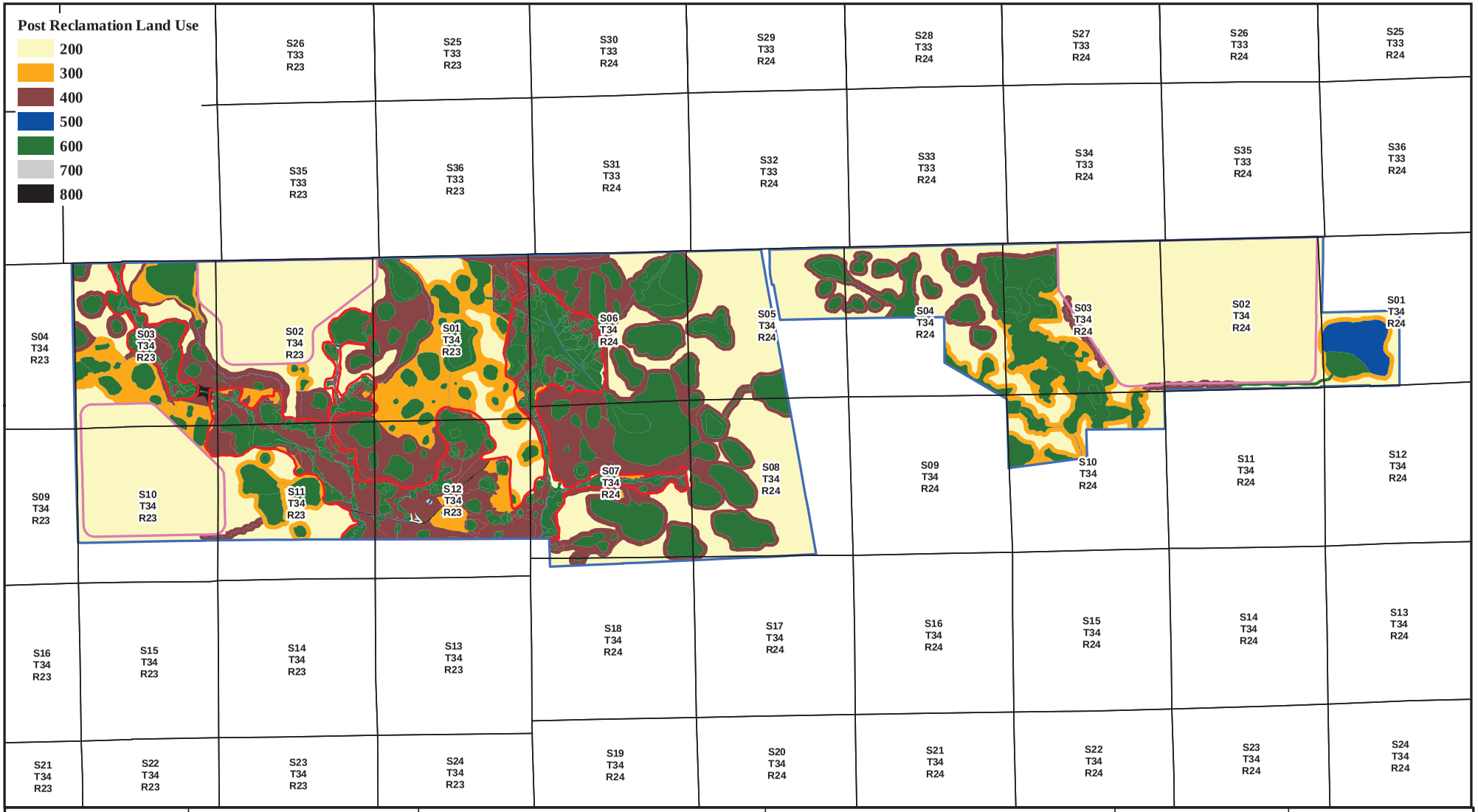
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Figure RP-2 Existing Land Use

Mosaic Fertilizer
Hardee County, Florida

Cardno ENTRIX
3905 Crescent Park Drive, Riverview, FL 33578 USA
Phone (+1) 813-664-4500 Fax (+1) 813-664-0440
www.cardnoentrix.com

Date Created: 4/10/2014 Date Revised: 4/10/2014 File Path: Q:\UnitedStates\Florida\Tampa\0675\041\working\arcmap\RP2_Fig_2_Existing_LU_20140410.mxd
GIS Analyst: Lauren.Federsel



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MOSAIC FERTILIZER, LLC.
SOUTH PASTURE EXTENSION

HARDEE COUNTY, FLORIDA

- South Pasture Extension
- No Mine Boundary
- Short Term Utility Corridor/Drag Line Crossing
- Proposed Clay Settling Areas

Source: Dec. 2014 Mosaic Imagery

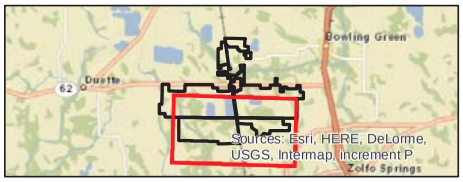
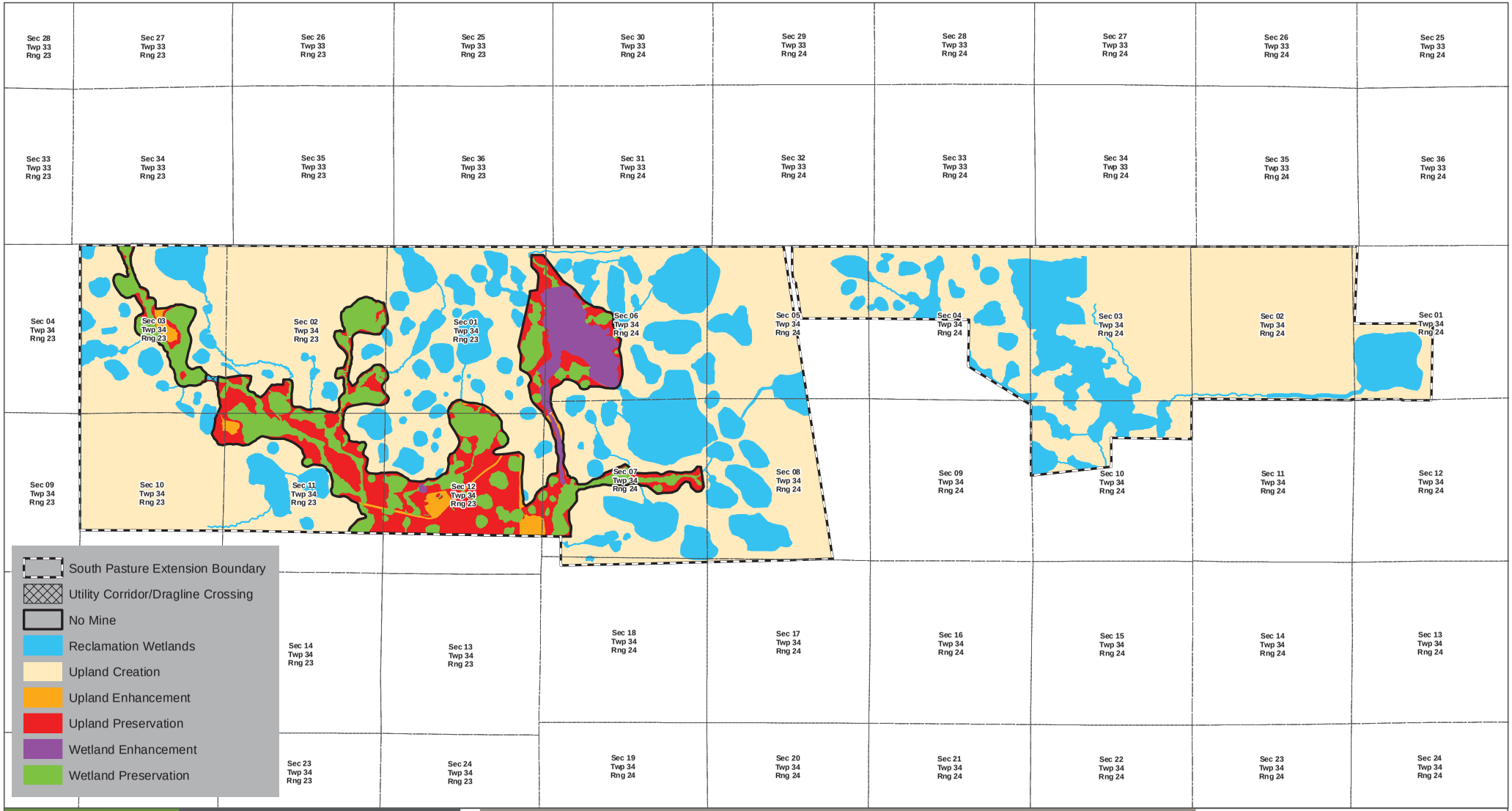


FIGURE RP-3
POST RECLAMATION LAND USE

FLATWOODS Consulting Group

P:\0003MOS\083-SPE USACE Permitting\GIS\ACOE MITIGATION



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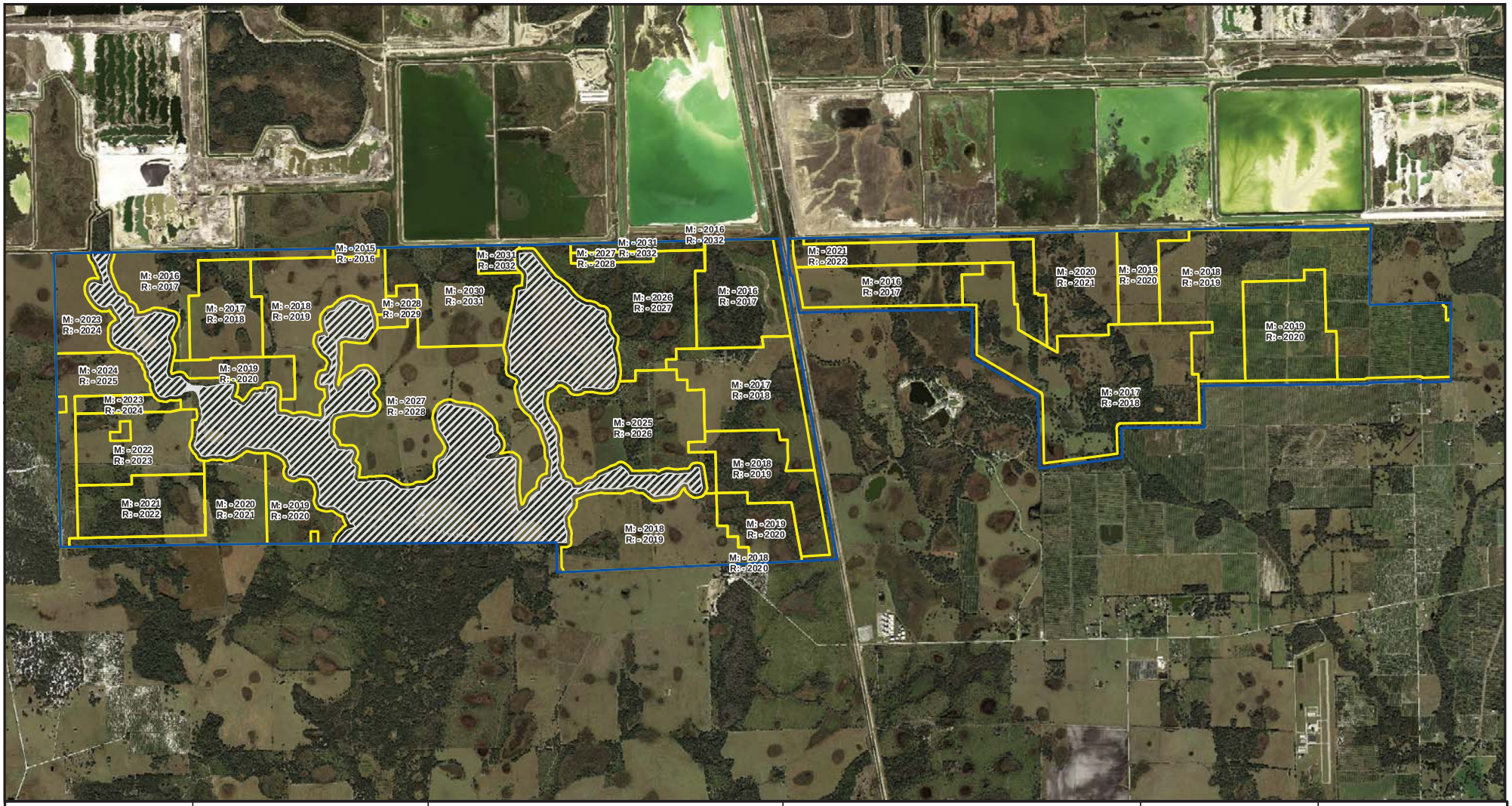
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Figure RP-4 Reclamation Activities

Mosaic Fertilizer
Hardee County, Florida

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www.cardnoentrix.com

Date Created: 4/10/2014 Date Revised: 4/10/2014 File Path: Q:\UnitedStates\Florida\Tampa\0675\041\working\arcmap\RP_Fig4_Reclamation_Activities_20140410.mxd
GIS Analyst: Lauren.Federsel



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SOUTH PASTURE EXTENSION
MOSAIC FERTILIZER LLC

HARDEE COUNTY, FLORIDA

- South Pasture Extension
- Mining & Reclamation Blocks
- Short Term Utility Corridor/Drag Line Crossing
- No Mine Area

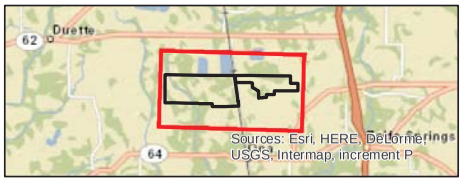


FIGURE RP-5
MINE PLAN & RECLAMATION SEQUENCE

FLATWOODS Consulting Group

P:\0010CFT024-SPE Reference Wetland Selection\GIS\TRANSECT WETLANDS 11X17

ATTACHMENT 1
DESCRIPTION OF PLANT COMMUNITIES PRESENT ON THE CF SOUTH PASTURE EXTENSION

DESCRIPTION OF PLANT COMMUNITIES PRESENT ON THE CF SOUTH PASTURE EXTENSION

The Florida Department of Transportation's (FDOT) 1999 Level III Florida Land Use, Cover and Forms Classification System (FLUCFCS) was utilized to identify land use/covers. All lands meeting the criteria in Chapter 62-340, Florida Administrative Code, as 'wetland' were identified with a 500 or 600-level FLUCFCS code. Non-wetland floodplain areas that are designated as other surface waters in accordance with Rule 62-340.600, F.A.C., were given the appropriate upland land use cover classification with the suffix of "o" indicating "other surface waters." The identification of the limits of surface waters, and therefore land use classifications with "o" modifiers, were the product of computer generation based on floodplain limits provided by Biological Research Associates (BRA) and not the result of a specific field investigation on the part of Environmental Consulting & Technology, Inc. (ECT). Therefore descriptions for land use/covers within upland floodplain jurisdictional areas ("o") do not differ from descriptions within associated upland land use/covers. For example, 211 and 211o are both Improved Pasture with similar vegetative composition.

Instances where jurisdictional wetland areas are currently dominated by upland vegetation (bahia grass, palmetto, or various oaks) were identified with the closest appropriate 600-level code. A site-specific narrative description was included to elucidate their actual character.

Aerial photographs available at the time of the initial field investigation were taken in 2004 and were provided to ECT from Hardee County through BRA. These aerials were flown prior to Hurricane Charlie crossing through, or very near to, the site. These aerials were plotted at a scale of 1 inch = 200 feet (ft) with estimated jurisdictional wetland limits (provided by BRA) overlain. ECT staff biologists familiar with land use/cover mapping and aerial interpretation classified the lands into different categories based on vegetative signatures.

Initial field verification of the aerial photography interpreted land use/cover classifications was then conducted by ECT staff biologists during the weeks of January 10th and 17th, 2005. Breaks in land use/cover were field investigated, as well as general verification of land use cover classes (i.e., dominant species types and coverage). These field maps were then scanned, rectified and digitized in ECT's Geographic Information System (GIS) ArcMap 8.3. Subsequent quality assurance and quality control was conducted to review the maps and ensure that all areas have been mapped and coded accurately.

New aerial photography, flown by Digital Aerial Solutions (DAS), became available and additional field verifications were conducted during the weeks of April 4th and April 11th, 2005. Interim land use/cover classifications were plotted on the new aerials and features were revised based on the better image quality and subsequent groundtruthing.

Staff members from BRA walked the centerline of the streams and ditches with a Global Positioning System (GPS) receiver. Dimensions of the waterways were collected and the

centerlines buffered to better reflect the stream/ditch width. This data collection allowed features to be included on the Land Use Cover map that would not normally be included due to being obscured by tree canopy.

Following the field verification of the upland/wetland boundary by FDEP staff revisions to the land use/classification map were required. During the week of August 7, 2006 staff members from ECT field verified additional wetland areas within the project. These additional wetland areas and subsequent land use cover changes have been incorporated into the final land use/cover map.

The following descriptions correspond to the FLUCFCS-99 Level III classifications and are reflected in the text, maps, and tables in this Environmental Resource Permit and Conceptual Reclamation Plan applications. Two Level IV classifications were utilized to provide categories for shrub dominated wetlands (Shrub, Brush & Vines – 6417) and low grass wetlands (Low Marsh Grasses – 6415) typically at the interface between non-forested wetlands and Improved Pasture – 211.

The property is divided into eastern and western portions by County Road (CR) 663. Two major creek systems exist on the western parcel; Brushy and Lettis Creeks. Brushy Creek enters the northwestern portion of the parcel in Section 3 and traverses in a generally south/southeasterly manner until exiting the site in the eastern portion of Section 11. Lettis Creek is also located within the western parcel. The current headwater for what has been determined to be the remnant stream channel of the Creek is a marsh and historic slough system located in the southeastern portion of Section 1. The slough has been channelized and the actual stream bed for Lettis Creek begins in the very corner of Section 7. Most of the upstream contributing area and flow into Lettis Creek has been altered and redirected through a large ditched marsh system. Water from this system enters Lettis Creek in the mid portion of Section 7. Troublesome Creek is located on the eastern parcel in the north central portion of Section 10. The Creek, within the project boundary has been historically channelized and remnants of the channel can still be observed in the field. The headwaters system for Troublesome Creek has also been severely altered by ditching and other agricultural activities.

211 <u>Improved Pasture</u>—This land use is comprised of lands which have been cleared and seeded with pasture grasses or allowed to be naturally revegetated by native grasses and forbs. Improved pasture is maintained as actively grazed pasture dominated by cultivated pasture grasses such as bahiagrass (*Paspalum notatum*), and limpograss (*Hemarthria altissima*) and may also support the growth of native grasses and other herbaceous plants such as smutgrass (*Sporobolus indicus*), broomsedge (*Andropogon virginicus*), slender goldenrod (*Euthamia caroliniana*), dog fennel (*Eupatorium capillifolium*), cogongrass (*Imperata cylindrica*), Bermudagrass (*Cynodon dactylon*), and common carpetgrass (*Axonopus fissifolius*). Other pasture herbs include threeflower ticktrefoil (*Desmodium triflorum*), coinwort (*Centella asiatica*), turkey tangle frogbit (*Phyla nodiflora*), blanket crabgrass (*Digitaria serotina),* panicled ticktrefoil (*Desmodium paniculatum*), pinebarren flatsedge (*Cyperus retrorsus),* shortleaf spikesedge (*Kyllinga brevifolia*), and fimbry (*Fimbristylis* spp.). Shrubs and/or trees may also occur in pasture sporadically, but in the overall coverage within the land form do not constitute suitable cover or area

to substantiate a separate land use cover designation. Also, depending on the time of year, cycle of mowing, rotation of the herds, or burn regime, some pastures may vary significantly in character. Some may be well grazed while others appear to be overgrown with such species as dog fennel, smutgrass, or broomsedge.

213 Woodland Pastures—These are forested areas (generally oak hammocks) heavily grazed by cattle, or where the understory has been cleared for use by cattle, or has been so highly used by cattle that the native understory has been supplanted by nuisance or non-typical understory species. The canopy is usually dominated by oaks including live oak (*Quercus virginiana*), laurel oak (*Quercus laurifolia*), cabbage palms (*Sabal palmetto*), and scattered slash pine (*Pinus ellottii*). Canopy closure within this classification can vary from scattered trees within a pasture setting, with very few shrubs and dense ground cover by grasses and forbs as described for improved pasture, to a closed or relatively closed canopy with limited ground by grasses and scattered shrubs. Shrubs or shrub like plants include scattered clumps of saw palmetto (*Serenoa repens*), cabbage palm seedlings, wax myrtle (*Myrica cerifera*), caesarweed (*Urena lobata*), catbrier (*Smilax* sp.), and John Charles (*Hyptis verticillata*). Recent hurricane damage has created an extreme amount of fallen limbs. This condition may lead to reduced use by cattle and possible increase in the diversity of plant species within this classification.

215 Field Crops (Hay Fields)—Two areas within the project boundary (Sections 4 and 7) are currently being specifically managed for hay production. Bales were noted on the 2005 aerials and the areas are dominated by limpograss and fenced to prohibit access by cattle. The limpograss has encroached into both upland and wetland habitats adjacent to the hay production areas. Evidence of past cattle grazing was noted, though it is common to graze the areas immediately following hay production. Other areas within the project site may be currently used for hay production but were not easily recognizable due to the time of year, lack of clear field indicators or aerial signature. Also, it is possible that these areas may not continue in the future to be utilized for hay and will revert to pasture lands.

310 Herbaceous Rangeland—This grassland category includes grasses and forbs (herbs other than grasses or grass-like plants), which on the South Pasture Extension are often the results of historic clearing activities that have occurred in other land cover types. An area in Section 5, west of CR 663, was previously cleared for a dragline walkpath. A variety of upland, native grasses such as wiregrass (*Aristida stricta* var. *beyrichiana)*, lovegrass (*Eragrostis* sp.) needlepod rush (*Juncus scripoides*), slender flattop goldenrod (*Euthamia caroliniana*) and bahiagrass scattered at the perimeters. Other species present in the dry prairie areas include coastalplain chaffhead (*Carphephorus corymbosus*), hairy chaffhead (*C. paniculatus*), rabbit tobacco (*Pseudognaphalium obtusifolium*), myrtleleaf St. John's-wort (*Hypericum myrtifolium*), pinebarren goldenrod (*Solidago fistulosa*) and broomsedge.

321 Palmetto Prairie—Palmetto prairie is characterized by a conspicuous and frequently dense cover of saw palmettos with no tree cover or the occurrence of only widely scattered pines and/or oaks. Species typical of Palmetto Prairies included in addition to saw palmettos, other shrub-layer species such as wax myrtle, gallberry (*Ilex*

glabra), muscadine grape (*Vitis rotundifolia*), fetterbush (*Lyonia lucida*), shiny blueberry (*Vaccinium myrsinites*) coastalplain staggerbush (*Lyonia fruticosa*), and fourpetal St. John's-wort (*Hypericum tetrapetalum*). Wiregrass (*Aristida stricta*) and broomsedge are the most common ground-layer species. Other ground-layer components include narrowleaf silkgrass (*Pityopsis graminifolia*) and chaffheads (*Carphephorus paniculatus, C. corymbosus*). Typically, the herbaceous cover associated with palmetto rangeland occurs within the open areas where saw palmettos are absent. These open areas are dry prairie (described under 310) which were too small to be mapped as a separate cover type. This classification type can be found in several forms, depending on the intervening fire regimes that will limit tree cover by hardwoods and pines. Some areas within the project area were at one point most completely lacking in tree cover, but years of fire suppression has allowed oaks or pines to encroach within the palmettos.

329 Other Shrub and Brush—A significant portion of the shrub and brush vegetative cover type represents what appears to be a fallow farm field or citrus grove that has become vegetated with wax myrtle and trees (Section 10; southeast). The wax myrtle, scattered live oaks, slash pine, and cabbage palms are mostly located within the remnant furrows. Open areas between the shrubby furrows are dominated by species typically found in under maintained pasture land. Grazing pressure in the area has kept a more pasture-like setting. Palmetto Prairies (321) that have become more-or-less overgrown with trees, saplings, and shrubs at the expense of grasses and other herbs also comprise a large portion of this classification type (Section 12). The cause of this conversion to brush land is most likely fire suppression or at least a reduction in fire frequency relative to the high frequency of fires that once occurred in these uplands. This type of shrub and brush classification can and will, at some point in the future, be classified as a forested cover type when tree cover exceeds the 10 percent canopy closure. This classification type as also utilized in transitional areas, typically occurring between upland and wetland communities that were dominated by wax myrtle, gallberry, high standing saw palmetto, muscadine grape, and saw greenbrier (*Smilax bona-nox*). Scattered trees of live and laurel oaks, slash pine with vary degrees of cover by herbs such as bahiagrass, smutgrass (*Sporobolus indicus*), and American beautyberry (*Callicarpa americana*) are also common in these areas.

330 Mixed Rangeland—This cover type describes areas where more than one-third intermixture of grassland or shrubland occurs. On the CF South Pasture Extension, this cover type is typically an intermediate condition between Palmetto Prairie (321) and Herbaceous Rangeland (310) where the cover types represent differences in the relative proportions of shrub to grasses within single ecosystem. See Palmetto Prairie (321) and Herbaceous Rangeland (310) for species composition, which are typical. The designation 'rangeland' does not denote use by cattle to a more or less degree than in other areas on the site, but rather is the nomenclature utilized by the FLUCFCS manual for the 300 Level I and II series classifications.

411 Pine Flatwoods—Pine flatwoods on the CF parcel generally occur either in relatively intact large tracts of land or as remnant fringes to previously timbered and/or cleared lands. The largest contiguous pine flatwoods forests are located in

Sections 1, 5, and 6 in the north central portion of the site and also in Section 10 in the southwest portion of the site. Remnant forest components also are located adjacent to Brushy Creek. In general, pine flatwoods occur in areas with flat topography on relatively poorly drained, acidic soils that are characteristically low in nutrients. Structurally, pine flatwoods are pine savannas with an overstory formed by very widely spaced trees that are interspersed within dense, species-rich ground cover consisting of grasses, other herbs, and low-growing shrubs. Two species of pines predominate. Slash pine generally occupies more level, less-drained portions of the site. Slash pine may also grow intermixed with longleaf pine (*Pinus palustris*) on better-drained sites. The shrub and ground cover layers are typical of either Herbaceous Rangeland (310) or Palmetto Prairie (321).

425 Temperate Hardwoods—The upland areas classified as this cover type are most commonly dominated by laurel oak. Other canopy trees such as cabbage palm, slash pine, longleaf pine, live oak, and water oak (*Quercus nigra*) are often present in various combinations and coverages. Wax myrtle, persimmon (*Diospyros virginiana*), gallberry, saw palmetto, saw greenbrier, muscadine grape, Carolina jessamine (*Gelsemium sempervirens*) beautyberry, caesarweed, clustered bushmint (*Hyptis alata*), John Charles, and hog plum (*Ximenia americana*) are other species common to this land use/cover type. Herbs include broomsedge, bahiagrass, goldenrod, carpetgrass, Baldwin's eryngo (*Eryngium baldwinii*), and innocence (*Houstonia procumbens*).

427 Live Oak—This classification type is comprised of forests that are dominated in their overstory by live oaks and sometimes lesser numbers of other oaks such as laurel and water oak. This community exists in several different eco-types on the CF project area. Typically, this forest has a dense to moderate cover of saw palmettos in the understory. Live oaks also occurred on relatively well drained soils next to stream systems or large wetland systems where they have formed groves or sometimes forests in association with other tree species [e.g., Hardwood-Conifer Mixed (434) and Mixed Hardwoods (438)].

The live oak forests of the eastern portion of the project area (Sections 3, 4, 5, and 10, also known as the O'Neil Tract) have been heavily grazed in the understory and in many instances occur in combination with forests that have been classified as Woodland Pasture (213). The difference in the application of these two classifications was based on the extent of the natural understory that occurred in the two areas of similar overstory composition. The understory of the Live Oak classification either had dense or scattered cover by cabbage palm (shrub and tree), hog plum, dwarf palmetto (*Sabal minor*), persimmon, greenbriers, naturalized citrus (*Citrus* spp.), saw palmetto, and John Charles. Where cattle have congregated, the shrub layer is reduced and the groundcover is typical of that of under-maintained pasture. Both Live Oak and Woodland Pasture land use/cover types commonly occur as forested components to the ditched slough systems that now flow into Troublesome Creek.

On the remainder of the CF project area, the Live Oak dominated forests exist typically as a transitional area between native and historically native uplands such as

Palmetto Prairie, Pine Flatwoods and Improved Pasture, and wetlands systems or incised streams or flow ways. The understory character of this forested cover type varies depending on various factors including: elevation, drainage, soil type, grazing pressure, adjacent clearing impacts, and maturity of the canopy. Typically, the oak forests will transition from palmetto prairie or pine flatwoods and the ground cover and understory species will be very similar in character to those noted for these communities. As the forests nears an adjacent wetland area, the palmetto may become sparse, groundcover may become very limited due to canopy closure and grazing impacts or may be comprised of wax myrtle, dwarf palmetto and dense vines.

This classification was also utilized to identify remnant and intact forest components that exist adjacent to streams (Brush and Lettis Creeks) and flow ways on the site. Large oak dominated forests exist within the lands adjacent to the southern reach of Brushy Creek on the project. Again, the character of this land use/cover type can vary, depending on its location in the landscape. Specifically, within Section 12 large portions of the oak forest understory are comprised of a park-like cover of broomsedge with scattered clumps of palmetto and cabbage palm. Trees are more sparsely spaced and it is possible that the open areas were once maintained for active pasture grazing and Woodland Pasture could be applicable if maintenance is reinitiated.

This classification was also used to identify sparsely scattered live oaks that had become established within historically dominated palmetto prairie areas. In these instances the oaks vary in age and density, but were notable on the aerial as warranting a forested designation. As previously mentioned in FLUCFCS 329 (Other Shrub and Brush) these areas have been, or are becoming dominated by, various oaks and wax myrtle due to fire suppression. The Live Oak Forest mapped at the southern boundary of Section 5 illustrates both a mature FLUCFCS 427 and a palmetto prairie that has become dominated by young live oaks.

432 <u>Sand Live Oak</u>—Sand live oak forests are characterized by a tree canopy consisting largely or entirely of sand live oaks (*Quercus geminata*). These forests occupy relatively dry, sandy, well-drained sites—drier than otherwise similar sites that support Live Oak forests (427). Only two areas on the CF project area are dominated by sand live oaks. One area is located in Section 3 on the east side of Brushy Creek. The understory in this less than 8-acre forest has become overgrown with dense palmetto. Gopher apple (*Licania michauxii*), rusty staggerbush (*Lyonia ferruginea*), Adam's needle (*Yucca filamentosa*), wiregrass, various blueberries (*Vacinium myrsinites, V. arboretum, V. corymbosum*) and myrtle oak, Chapman's oak, turkey oak, and dwarf live oak, (*Quercus myrtifolia, Q. chapmanii, Q. laevis, Q. minima*) are other common understory components.

Slightly less than 21.0 acres of Sand Live Oak forest is located at the intersection of Sections 2, 3, 10, and 11 on the south side of Brush Creek. This area is commonly known as the Turkey Feeder Site. Historical aerials indicate that the area was cleared in the 1940's for citrus production. Currently, Improved Pasture exists in the central area of the oak forests. Much of the understory in the southern lobe of this land

use/cover classification has been heavily impacted by cattle grazing, and in many areas could be classified as Woodland Pasture. The understory of the remaining portions of this classification is indicative of areas impacted by cattle grazing. Scattered clumps of palmetto, with scattered cabbage palms and oak saplings are common. Open sandy areas with broomsedge and bahiagrass exist with dense areas of vines and tree saplings.

434 Hardwood-Conifer Mixed—Hardwood-conifer mixed forests are those that contain both pines and hardwoods with the trees of both categories comprising between 33 percent and 67 percent of the canopy cover. The pines may include slash pine, or longleaf pine. Live oaks and laurel oaks are common hardwoods, although other hardwood species may occur. Cabbage palms are sometimes prevalent. A mid-story is comprised of young individuals of overstory tree species and wax myrtle, sabal palms, saw palmetto, American beautyberry, among others. Herbs are prevalent if sufficient light reaches the ground and may include broomsedge, witch grasses, caesarweed, and carpet grasses. Density of palmetto and grassy forbs varies within each forested area. Common woody vines include saw greenbrier and muscadine grape. Hardwood-conifer mixed forests may all be derived from the conversion of other plant communities owing to land use practices, such as timber harvest, fire suppression, drainage, and the sowing of forage grasses. This land use/cover type varies from remnant forests that exist as transitional areas between cleared agricultural lands and wetlands and within larger areas that are in close proximity to Pine Flatwoods and may reflect transformation of forest type based on fire suppression.

438 Mixed Hardwoods—This is an upland hardwood community in which no single species of hardwood appears to achieve a 66 percent dominance of the canopy. On the CF Industries project area, the overstory layer could support a mixture of water oak, live oak, laurel oak, and occasionally sweet gum (*Liquidambar styraciflua*). These tree species can either form a closed canopy or occur sporadically within an open overstory. The shrub layer typically supports saw palmetto, sabal palms, coastal plains staggerbush, gallberry, and wax myrtle.

510 Streams and Waterways—The category of Streams and Waterways (510) is not extended to Level III classifications in the 1999 FDOT FLUCFCS. To better define the different types of streams and waterways that may exist on the South Pasture Extension modified landuse/cover codes shall be incorporated.

- 511 - Natural streams that have not been channelized;
- 512 - Natural streams that have been channelized;
- 513 - Ditches dug through wetlands; and
- 514 - Upland cut ditches.

The newly-created Level III series 500 classifications are best described by attributes other than the vegetation associated with these linear features. A principal secondary defining characteristic is the purpose of the waterway. Although vegetation is not the defining attribute, the species present within the FDEP jurisdictional area is provided. On this basis, the descriptions of the Level III watercourses are as follows:

The location and dimensions of features not visible from the available aerial photography due to tree canopy were surveyed by staff members from BRA that walked the centerline of the streams and ditches with a GPS receiver. Dimensions of the waterways were collected and the centerlines buffered to better reflect the stream/ditch width. Other ditch locations and size were obtained from the wetland delineation limits.

511 Natural Streams—Natural streams are bodies of flowing water in natural watercourses where the channel is natural as distinct from channels in whole or in part dug by man. Flow can be as little as in direct response to rainfall events to continuous. The principal determinant is the presence of the natural channel. For purposes of calculating acreages of natural streams present, the length of the channel is multiplied by the average width from top-of-bank to top-of-bank. Unlike the FDEP FLUCFCS protocol, the channel does not have to be visible on aerial photographs to apply this classification, provided the location, length, and width is accurately determined.

Vegetation within the stream channels is normally sparse due to tree cover, scouring or fluctuation of water levels. Vegetation typically noted within natural stream systems included pickerelweed (*Pontederia cordata*), mild water-pepper (*Polygonum hydropiperoides*), maidencane (*Panicum hemitomon)*, sour paspalum (*Paspalum conjugatum*), and smallfruit beggarticks (*Bidens mitis*). In areas where the stream channels have more open canopies or cattle frequent the areas species common to disturbance were noted, such as softrush (*Juncus effusus*), bahiagrass, dogfennel (*Eupatorium capillifolium*), and common dayflower (*Commelina diffusa*).

512 Ditched Natural Streams—Ditched natural streams are bodies of flowing water in natural watercourses that have been altered in whole or in part by the digging or dredging of an artificial ditch, canal, or channel through or along the historic natural channel. Flow can be as little as in direct response to rainfall events to continuous. The principal determinants are the presence of both a natural channel and an artificial channel, either based upon field conditions or by evidence from historical aerial photographs.

Troublesome Creek has been ditched within its entire historic flow-way. Abandoned oxbow channels and spoil piles were noted at various locations along the current creek channel.

Several small channels flowing into the eastern tributary to Lettis Creek also show evidence of historic channelization. Species composition within these impacted channels is very similar to the natural stream channels, and varies depending both on historic and current impacts.

513 Ditched Wetlands—Ditched wetlands are artificial channels dug through herbaceous or forested wetland jurisdictional areas. These features are evident from aerial photographs and no evidence of flow or water is required to apply this classification.

The typical vegetation is herb dominated comprised primarily of species found in the deeper portions of the wetland traversed by the ditch. The composition of the vegetation varies in relationship to disturbance within the surrounding wetland. Species can include soft rush, manyflower marshpennywort (*Hydrocotyle umbellata)*, smartweed (*Polygonum* sp.), sawgrass (*Cladium jamaicense)*, lizard's tail (*Saururus cernuus*), dixie iris (*Iris hexagona*), and other common wetland herbaceous species.

514 Upland Cut Ditches—Upland cut ditches are linear artificial channels dug through uplands and connected to Waters of the State, whose purpose is to facilitate drainage. As for other ditches, the vegetation is predominantly herbaceous. Typical species include soft rush, smartweed, bahiagrass, manyflower marshpennywort, and Bermudagrass. Commonly, primrose willow and wax myrtle are often times found growing in the ditch or on the banks.

534 Reservoirs Less Than 10 Acres (Cattle Ponds)—This aquatic category includes all of the ponds that were excavated to provide water for cattle. Depending upon intensity of use, the vegetation on the edges ranges from virtually nonexistent to fairly diverse with species similar to that described for ditches.

611 Bay Swamps—In the FDOT FLUCFCS protocol, bay swamps are determined solely by the percentage of bay trees in the forest canopy. At the request of FDEP, however, this classification has been changed. Instead, the determinants are the location near the headwaters of streams, surrounded by uplands that provide a source of ground water flow to the wetland, and downstream topography that allows the soil to be perennially moist, but infrequently flooded. The dominant presence of bay trees in the canopy is not a prerequisite to the use of this classification. Thus, the following description has been written as a substitute for the 1999 FLUCFCS description.

Bay swamps are forested wetlands whose soils are kept perennially wet or inundated from ground water seepage, and whose soil surface is not subject to scouring. Owing to these constraints, organic matter accumlates as muck, and releases strong organic acids of decomposition that drive the pH down to a point that few trees or other plants can tolerate. Collectively, these are called bay trees and include sweetbay (*Magnolia virginiana*), swamp bay (*Persea palustris*), loblolly bay (*Gordonia lasianthus*), and dahoon holly (*Ilex cassine*). Another common tree of bay swamps is swamp tupelo (*Nyssa sylvatica biflora*), a deciduous tree which has other adaptations for survival. Several other kinds of hardwoods may be present in varying densities, including red maple (*Acer rubrum*) and laurel oak. The shrub layer consists of wax myrtle, fetterbush, Virginia willow (*Itea virginica*), highbush blueberry (*Vaccinium corymbosum*), and in wetter areas, buttonbush (*Cephalanthus occidentalis)*. The herb stratum is often dense, especially the fern flora. Ferns include cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), swamp fern (*Blechnum serrulatum*), Virginia chain fern (*Woodwardia virginica*), and netted chain fern (*Woodwardia areolata*).

Three bay swamps have been identified on the CF property. One small bay-dominated forest is located in the middle of improved pasture, which led to severe impacts to the canopy structure as a result of the hurricanes experienced in 2004. Many trees were toppled or snapped, but it was apparent that this area was, and will be, dominated by bays. Species noted included sweet bay, swamp bay, dahoon holly, laurel oak, live oak, wax myrtle, saw palmetto, lizard's tail, sour paspalum, softrush, and netted chain fern.

Two additional areas were observed that have FDEP characteristics of bay swamps in that they lay downslope from xeric sand live oak areas and exhibit deep muck. These areas did not appear to have significant cover by bay trees. Both areas have been classified as 611 – Bay Swamps, based on the revised FDEP criteria. One wetland is in the vicinity of the Turkey Feeder site mentioned previously in the description of 432 – Sand Live Oak. The other area is located in Section 3 on the east side of Brushy Creek

613 Gum Swamps—This forest community is characterized by the dominance of swamp tupelo in the canopy. Other common canopy trees are red maple, laurel oak, and sweetbay. Two instances of occurrence of gum swamps exist on the CF project. One is a wetland that is located in large expanse of improved pasture in Section 2. The other gum swamp is located at the southwestern perimeter of the project boundary in Section 10. Numerous bays were noted within this wetland, but the dominant canopy species was tupelo. The general aspect and species composition of this forest stand resembles Mixed Wetland Hardwood (617), except that swamp tupelo is the most abundant tree species in the overstory.

616 Inland Ponds and Sloughs (Popash)—This category was utilized to identify those forested wetlands that are dominated by Carolina ash (*Fraxinus caroliniana*). This species is normally dominant in the overstory and usually located at the deepest portions of larger systems. Because of the periods of extended deep water within these areas, understory vegetation is often times greatly reduced. When present, species such as pickerelweed and fireflag are noted in the deeper portions. At the wetland perimeters species diversity increases and various oaks may exist. Dixie iris is common with smartweed, softrush, fragrant flatsedge (*Cyperus odoratus*), and savannah false pimpernel (*Lindernia grandiflora*) being present in varying degrees of cover.

617 Mixed Wetland Hardwoods—Jurisdictional forested wetlands that contain a variety of hardwood tree species are designated as mixed wetland hardwood forests. Mixed wetland forests exist in two general conditions on the CF South Pasture project and are generally defined by the duration and frequency of flooding, thereby determining the general species composition in the canopy. Forested wetlands that generally have a longer hydroperiod and/or exhibit deeper water levels are considered as deepwater swamps. Red maple, American elm (*Ulmus americana*), dahoon holly, sweetgum, swamp tupelo, popash and various bays are commonly found in this forest type. Other species in the canopy may include various scattered oaks and slash pine. Shrubs are scattered and include wax myrtle, highbush blueberry, walter's viburnum (*Viburnum obovatum*), primrosewillow (*Ludwigia peruviana*), and

buttonbush. Herbs include soft rush, fireflag (*Thalia geniculata*), lizard's tail, frog's-bit (*Limnobium spongia*), pickerelweed, sawgrass, Dixie iris, manyflower marshpennywort, smartweeds, and maidencane. Ferns are usually present in the herb stratum, and in some forests form a dense ground cover. Common ferns include royal fern, swamp fern, net-vein chain fern, hottentot fern (*Thelypteris interrupta*), cinnamon fern, and Virginia chain fern.

The Mixed Wetland Forests classification also pertains to forests that are only shallowly flooded in the summer wet season. This classification type is typical of wetland jurisdictional areas that are dominated by a canopy of laurel oak with scattered live oaks and slash pines. The classification can also be associated with the upper jurisdictional limits of stream channels and hydric oak hammocks. In some instances cabbage palms are a significant portion of the canopy or subcanopy. The understory cover is normally diminished, based on the closed canopy and also from the stress of frequent access and grazing by cattle. Hog rooting is also common in these forests. When present, shrub species present include dense stands of palmetto, sabal palms, groundsel tree (*Baccharis halimifolia*), wax myrtle, and possumhaw (*Viburnum nudum*). Ground cover includes bahiagrass, carpetgrass, common dayflower, sour paspalum, coinwort, Baldwin's eryngo, drymary (*Drymaria cordata*), and innocence (*Houstonia procumbens*).

618 Willow—Five willow-dominated swamps were noted on the CF parcel and appear to be the results of historic disturbances. Carolina willow (*Salix caroliniana*) comprises nearly the entire overstory and is generally greater than 1-inch diameter at breast height (DBH). The understory, when present is typical of that of the deep water swamps described in the 617-Mixed Wetland Forests category.

625 Hydric Pine Flatwoods—This forest type consists of Pine Flatwoods (411) that occupy jurisdictional wetlands. With respect to its plant species composition and the general aspect of the vegetation, it resembles Pine Flatwoods (411). The forest consists of a canopy dominated by slash pine. Mid-story trees, other than young pines and scattered oaks, are uncommon or absent. The undergrowth consists of dense, species-rich mixtures of relatively low-growing shrubs and herbs. Gallberry and wax myrtle are common shrubs. Saw palmetto forms conspicuous colonies on the most elevated sites but is not as widespread as it is in Pine Flatwoods (411). The species composition of grasses and other herbs is quite variable and includes species that are prevalent both in Pine Flatwoods (411) and Wet Prairies (643), such as bushy broomsedge (*Andropogon glomeratus*), and large carpetgrass.

This classification type has limited cover within the project area and is restricted to wetland jurisdictional areas that are transitional in character and occur between uplands and deeper elevation wetlands. In such sites, saw palmetto-dominated Pine Flatwoods (411) form large, irregularly-shaped colonies that collectively cover most of the land area. Between these colonies, occupying ground that is slightly lower in elevation, are sinuous strips or small patches of entirely herbaceous Wet Prairie (643).

626 Hydric Pine Savanna—This community is limited in extent and is usually found as an upper transition zone around fresh water marshes. Slash pine is the dominant tree and wax myrtle is often times present. Occasionally, cabbage palm and laurel oak occur. The shrub layer is usually sparse and consists of wax myrtle, sapling slash pine, scattered saw palmetto and/or St. John's wort (*Hypericum fasciculatum*). Herbs are usually dense and include maidencane, sand cordgrass (*Spartina bakeri*), smartweeds, big carpetgrass, softrush, beaksedges (*Rhynchospora* spp.), bushy broomsedge, and camphorweeds (*Pluchea* spp.). The composition of the shrub and herb strata is dictated by wetness and impact by cattle. The condition of this type of forested wetland is usually associated with the encroachment of pines into the adjacent marsh due to fluctuating water levels and/or fire suppression.

627 Slash Pine Swamp Forest—This forest cover type consist of slash pine dominating in the overstory with an established subcanopy and groundcover layers. This classification type is limited on the project site and is located in the landscape in proximity to other pine dominated upland or wetland communities. This classification is very similar to the Wetland Mixed Hardwood-Coniferous (630) land use/cover classification, but lacks significant hardwoods in the overstory. The subcanopy is often dominated by a mixture of oak saplings, saw palmetto, wax myrtle, possumhaw, highbush blueberry, Walter's viburnum. A wide variety of wetland herbs inhabit the ground stratum including, but not limited to, swamp fern (*Thelypteris interrupta*), lizard's tail, beaksedges, carpetgrass, broomsedge and toothed midsorus fern.

630 Wetland Mixed Hardwood-Coniferous—This forest cover type consist of slash pines that grow intermixed with laurel oaks, live oaks, or other hardwoods in which neither conifers or hardwood species dominate. Most any hardwood species typical of Mixed Wetland Hardwood Forests (617) may occur. Mid-story trees and shrubs may be prevalent, limited to isolated colonies, or nearly absent. They may consist of young trees typical of the canopy or of larger shrubs such as wax myrtle or scattered palmetto. The ground cover is generally herbaceous and quite variable both in its abundance and in its species composition. It forms a continuous cover where the tree canopy is discontinuous allowing ample light to reach the ground. It can be nearly absent beneath a dense forest canopy or where feral hogs have been feeding. The species composition consists essentially of species that are typical of Wet Prairies (643) but fewer in any given place. Sometimes sour paspalum and weedy species such as Caesar weed and John Charles are prevalent if the area has been disturbed.

This community is often found at the interface between upland Hardwood-Conifer Mixed forests (434) and often times share a similar suite of species. The utilization of one classification over another is more a reflection of jurisdiction rather than a visible difference in species composition.

641 Freshwater Marshes—Freshwater marsh communities consist predominately of emergent aquatic herbs that grow in relatively shallow ponds or sloughs. Typical marsh herbs include pickerelweed, maidencane, beaksedges, yellow-eyed grasses, sand cordgrass, smartweeds, soft rush, buttonweed (*Diodia virginiana*), coinwort, primrosewillows (*Ludwigia* spp.), herb-of-grace (*Bacopa monnieri*), lemon bacopa

(*B. caroliniana*), fireflag, and sawgrass. Numerous additional species are generally present, most of them occurring where the water is not deep. In deepwater marshes where the center may contain over 3 feet of water in the rainy season, true aquatics such as white water lily (*Nymphaea odorata*), and bladderworts (*Utricularia* spp.) sometimes occur. Pickerelweeds and other species associated with the deepest water may be inundated perennially during years of average or above-average rainfall. If a Wet Prairie (643) land use/cover exists adjacent to the Freshwater Marsh, the distinction between the two areas often fluctuations and is variable based on season water levels.

Each species tends to be favored by a particular hydroperiod, defined in terms of the seasonal extent of inundation and water depth. If water depth increases gradually with distance from the edge of the marsh, then each species tends to occupy a particular zone that corresponds to its preferred hydroperiod. Conspicuous species form apparent zones, such as a pickerelweed zone in deep water, an adjacent maidencane zone in shallower water, and a sand cordgrass zone along the edges. These zones are useful as points of reference. However, the distributions of the numerous, less conspicuous species are generally not well correlated with the zones of these more conspicuous species. The positions of zone may shift dramatically during periods of several consecutive years of above- or below-normal rainfall. Following the return of near-normal rainfall, zones may lose their definition temporarily.

Freshwater marshes are heterogeneous in terms of structure and species diversity. The type of marsh and/or its quality is dictated by position in the landscape, hydroperiod, frequency of fire, type of substrate, and the degree of human-induced perturbation such as cattle grazing and drainage. Many of the marshes on the CF parcel have been degraded by grazing and/or drainage. The degree and extent of impact within a marsh varies based on numerous influences.

Some marshes included in this classification lack a full suite of diverse wetland species and are limited to dense stands of softrush with smartweed and carpet grass interspersed.

The appearance of shrubs, such as buttonbush, Carolina willow (*Salix caroliniana*), wax myrtle, or primrose willow often times indicates the reduced frequency or absence of fire.

6415 <u>Low Marsh Grasses</u>—This Level IV land use/cover classification was utilized in those areas that were not representative of either Wet Prairies (643) or Freshwater Marsh (641) vegetation. This classification was typically utilized for jurisdictional areas that are located between non-forested wetlands (FLUCFCS 641 or 643) and Improved Pasture (211). These transitional areas appear to be commonly maintained as part of the pasture. It is assumed that the lands are mowed or heavily grazed, resulting in typical vegetation common to disturbed areas. Bahiagrass, big carpetgrass, marsh pennywort, scattered smartweed, and Baldwin's spikerush (*Eleocharis baldwinii*), are common in these areas. If left un-maintained or under grazed, these areas could convert to either Wet Prairie or Freshwater Marsh.

This classification was utilized in an area that was claimed as jurisdictional within an electrical transmission line located on the western right-of-way of CR 663. This jurisdictional area is an elevated pole pad that is located within a marsh. Therefore this classification was deemed to be the closest appropriate category.

6417 <u>Shrub, Brush and Vines</u>—A Level IV FLUCFCS was utilized for shrub-dominated emergent wetland communities that occupy shallow still-water depressions or sloughs. The common species are buttonbush, Carolina willow (*Salix caroliniana*), wax myrtle, primrose willow, or immature tree samplings. This classification was also utilized when shrubs such as gallberry, saltbush, palmetto, wax myrtle, and tree saplings were included in the jurisdictional limits surrounding a marsh system. Emergent aquatic herbs typical of Freshwater Marshes (641) are generally present, often in abundance. Hydric and non-hydric trees notably swamp tupelo, red maple, oaks or pines may also be present, usually in a peripheral position. In many instances, shrub marshes represent former Freshwater Marshes (641) or Wet Prairies (643) from which fire had been suppressed, thus encouraging the establishment of shrubs. Alternatively, these marshes may have been ditched, which reduces hydroperiods that otherwise inhibit seedling establishment. Primrose willow dominated wetlands may vary greatly in cover and position within the landscape from year-to-year based on numerous factors including seasonal rainfall, winter freezes or fire. Wax myrtle dominated shrub swamps also exist on the property and are commonly widely spaced and intermixed with immature trees.

643 <u>Wet Prairies</u>—The Wet Prairie designation, as utilized on the CF project exists in two general forms. The first and most prevalent form occupies the grass-dominated upper transitional zones to deep water marshes and sometimes forested wetlands. The second wet prairie classification is shallow grassy areas that exist independently in the landscape. Both land forms were either a naturally occurring community or a result of past or continued agricultural disturbance. These areas are sometimes irregularly shaped and comprised of a variety of native prairie species, pioneer and/or transitional species. Wet Prairies typically consists of a dense growth of native species-rich grasses, sedges, and forbs that grow on wet soil. Hydroperiods are generally shorter and inundation shallower than in Freshwater Marshes (641). Although herbs predominate, a low-growing shrub, St. Johns-wort sometimes grows in abundance on sandy substrates in shallow water. Typically, bushy broomsedge, meadow beauty (*Rhexia* sp.), beaksedges, bahiagrass, slender flattop goldenrod, soft rush, carpetgrasses, scattered sand cordgrass, and redtop panicum (*Panicum rigidulum*) grow in these areas in differing combinations and coverages.

Infrequently the Wet Prairie designation was used to note pineland swales that are irregularly shaped herb-dominated areas adjacent to upland or wetland forests or Palmetto Prairies (321). They are characterized by the lack of saw palmettos and the prevalence of wiregrass, bottlebrush threeawn (*Aristida spiciformis)*, beakrushes, needlepod rush, meadow beauty, and dichanthelium grasses.

Some lands classified as Wet Prairie appear to have been historically altered by clearing activities and have regenerated with a species composition typical of the

Wet Prairie designation. Though not a naturally occurring land use/cover, the lands have been included in this classification based on species composition.

During several consecutive years of above or below normal rainfall, the boundary between wet prairie and adjacent Freshwater Marsh (641) can shift dramatically. At interface areas between Wet Prairie and Low Marsh Grasses (6415) changes in agricultural activities (grazing densities, mowing, and cultivation and/or hay production) can greatly influence boundary fluctuations between these related land use covers.

A large non-forested wetland system exists in Section 6 that has been severely altered by ditching. The hydrology of this wetland has been significantly altered and species composition consists of a mosaic of herbaceous vegetation. During low water periods cattle access the area and graze heavily on the vegetation. Much of the area has been designated as Wet Prairie but the vegetation in this system is not naturally occurring, but has become established as a result of the ditching, historic clearing and cattle grazing impacts.

743 **Spoil Areas—**This altered land classification is represented by spoil piles surrounding excavated cattle ponds. The vegetation is predominately weedy herbs such as bahiagrass, broomsedges, dog fennel, ragweed (*Ambrosia artemisiifolia*), and groundsel tree.

814 **Roads and Trails—**An elevated and maintained gravel/dirt roadway traverses across the project area from the southwest corner to the north and then east to exit on CR 663. Three other smaller segments have been included on the land use/cover map due to their visibility on the aerial photograph and significance in the landscape. Other minor dirt trails exist on the project but are not regularly maintained and are used more as trails for accessing remote portions of the site.

DESCRIPTION OF PLANT COMMUNITIES PRESENT ON THE CF SOUTH PASTURE EXTENSION 761-ACRE ADDITION

The Florida Department of Transportation's (FDOT) 1999 Level III Florida Land Use, Cover and Forms Classification System (FLUCFCS) was utilized to identify land use/covers. All lands meeting the criteria in Chapter 62-340, Florida Administrative Code (F.A.C.), as 'wetland' were identified with a 500 or 600-level FLUCFCS code. Non-wetland floodplain areas that are designated as other surface waters in accordance with Rule 62-340.600, F.A.C., were given the appropriate upland FLUCFCS code with the suffix of "O" indicating "other surface waters." Instances where jurisdictional wetland areas are currently dominated by upland vegetation (bahiagrass, palmetto, or various oaks) were identified with the closest appropriate 600-level FLUCFCS code. A site-specific narrative description was included to elucidate their actual character.

The aerial photograph available at the time of the field investigation was taken in 2004 and downloaded from Land Boundary Information System (LABINS), Bureau of Survey and Mapping, Florida Department of Environmental Protection (FDEP). The aerial was flown prior to Hurricane Charlie crossing through, or very near to, the site. The color aerial was plotted at a scale of 1 inch = 300 feet (ft). The project boundary was provided to Environmental Consulting & Technology, Inc. (ECT) from CF Industries. The wetland jurisdictional lines were provided by Biological Research Associates (BRA). ECT staff biologists familiar with FLUCFCS mapping and aerial interpretation classified the lands into different categories based on signatures.

Field verification of the aerial photography interpreted land use/cover classifications was then conducted by ECT staff biologists on July 25, 2007. Breaks in land use/cover were field investigated, as well as general verification of FLUCFCS classes (i.e., dominant species types and coverage). The field map and FLUCFCS codes as designated by the biologists were then digitized in ECT's Geographic Information System ArcMap 9.2. Subsequent quality assurance and quality control was conducted to review the maps and ensure that all areas have been mapped and coded accurately.

The following descriptions correspond to the FLUCFCS-99 Level III classifications and are reflected in the text, map, and table in this Environmental Resource Permit and Conceptual Reclamation Plan applications. One Level IV classification was utilized to provide a category for shrub dominated wetlands (Shrub, Brush and Vines–6417).

The CF South Pasture Extension property is divided into eastern and western portions by County Road 663 (Fort Green Road). This 761-acre addition is adjacent to the east boundary of the extension and is comprised of part of the southwest corner of Section 1 and all of Section 2, T 34S, R24E. The Soil Survey of Hardee County (Natural Resources Conservation Service, U.S. Department of Agriculture) indicates that two intermittent drainages crossed Section 2. Water from this area historically flowed to Troublesome Creek. The area has been altered for citrus and deep ditching has replaced the historic drainages.

221 Citrus Groves—Citrus groves are areas with specific soil qualities that have been altered for the cultivation of various *Citrus* species or hybrids. The trees are planted in rows along the center of wide berms which allows for rapid drainage. Furrows between the berms empty into relatively deep upland cut ditches that manage the surface water runoff. The upland cut ditches are generally saturated to inundated and are delineated under the 500 series FLUCFCS. The remainder of the groves is classified under 221–Citrus Groves with no separate mapping for support infrastructures like access roads and maintenance sheds. The groves present on the CF South Pasture additional acreage tract are currently undergoing clearing and replanting. This activity is not evident on the 2004 aerial photographs.

310 Herbaceous Rangeland—This grassland category includes grasses and forbs (herbaceous species other than grasses or grass-like plants) which, on this addition to the CF South Pasture Extension, is the result of historic clearing and land altering (primarily ditching) activities that have occurred in other land cover types. Only the northwest corner of Section 2 in the CF South Pasture additional acreage has this cover type. Part of the area was seeded with bahiagrass (*Paspalum notatum*) and, toward the south end of the area; smutgrass (*Sporobolus indicus*) has become established. The northern portion of the area has recruited low vegetation which was probably present in the area before clearing. The plant community found in the area is composed of broomsedge (*Andropogon virginicus*), blackroot (*Pterocaulon pycnostachyum*), Carolina yelloweyed grass (*Xyris caroliniana*), hatpins (*Syngonanthus flavidulus*), needlepod rush (*Juncus scirpoides*), slender flattop goldenrod (*Euthamia caroliniana*) and thin paspalum (*Paspalum setaceum*). Several low, woody shrubs are common in the rangeland: shiny blueberry (*Vaccinium myrsinites*), pawpaw (*Asimina reticulata*), gopher apple (*Licania michauxii*), running oak (*Quercus elliottii*) and fourpetal St. John'swort (*Hypericum tetrapetalum*). A few live oaks (*Quercus virginiana*) are scattered across the area. Cattle are not present anywhere within this additional acreage.

425 Temperate Hardwoods—The upland areas classified as this cover type are most commonly dominated by laurel oak (*Quercus laurifolia*). Other canopy trees such as live oak and water oak (*Quercus nigra*) are often present in various combinations and coverages. Cabbage palms (*Sabal palmetto*), slash pine (*Pinus elliottii*), and longleaf pine (*Pinus palustris*) may be present, but constitute minor cover. Wax myrtle (*Myrica cerifera*), persimmon (*Diospyros virginiana*), gallberry (*Ilex glabra*), saw palmetto (*Serenoa repens*), and beautyberry (*Callicarpa americana*) are common shrub species to this land use/cover type. Herbaceous species include broomsedge, bahiagrass, goldenrod (*Solidago* spp.), and carpetgrass (*Axonopus* spp.). Vines like saw greenbrier (*Smilax bona-nox*), muscadine grape (*Vitis rotundifolia*) and Carolina jessamine (*Gelsemium sempervirens*). Nuisance species like caesarweed (*Urena lobata*) and John Charles (*Hyptis verticillata*) may be heavy where cattle have used the area. On the CF South Pasture additional acreage tract, the largest area of temperate hardwoods is a young regenerating forest situated within the herbaceous rangeland.

427 Live Oak—This classification type is comprised of forests that are dominated by a canopy of live oaks with minor numbers of laurel and water oak. This community exists in two different eco-types on the CF South Pasture additional acreage; both are adjacent to the swamp system in the northwest corner of the additional acreage. The first area has relatively closed canopy of oaks with a heavy cover of saw palmettos in the understory. The second area is composed of large live oaks on well drained soils next to the citrus grove. This area has deadfall from wind damage, but is relatively free of shrub cover. The herbaceous layer dominated by guineagrass (*Panicum maximum*).

438 Mixed Hardwoods—This is an upland hardwood community in which no single species of hardwood appears to achieve a 66 percent dominance of the canopy. On the CF South Pasture additional acreage, this habitat is present next to the citrus grove and within the swamp system. The canopy in these areas is relatively closed and supports a mixture of water oak, live oak, laurel oak, sugarberry (*Celtis laevigata*), persimmon, cabbage palm, red maple (*Acer rubrum*), and sweet gum (*Liquidambar styraciflua*). The canopy gaps are apparently due to wind damage and the understory has old disturbance from cattle and feral hogs. The shrub layer supports saw palmetto, hog plum (*Ximenia americana*), gallberry, and wax myrtle. Herbaceous species include broomsedge, thin paspalum, frostweed (*Verbesina virginica*), wild coffee (*Psychotria nervosa*), and rougeplant (*Rivina humilis*). The edge adjacent to the grove shows habitat disturbance and is shrubby and overgrown.

510 Streams and Waterways—The category of Streams and Waterways (510) is not extended to Level III classifications in the 1999 FDOT FLUCFCS. To better define the different types of streams and waterways that may exist on the CF South Pasture Extension modified FLUCFCS codes shall be incorporated.

- 511 - Natural streams that have not been channelized;
- 512 - Natural streams that have been channelized;
- 513 - Ditches dug through wetlands; and
- 514 - Upland cut ditches.

The Level III series 500 classifications are best described by attributes other than the vegetation associated with these linear features. A principal secondary defining characteristic is the purpose of the waterway. Although vegetation is not the defining attribute, the species present within the FDEP jurisdictional area is provided. On this basis, the descriptions of the Level III watercourses are as follows: The location and dimensions of features not visible from the available aerial photography due to tree canopy were surveyed by staff members from BRA that walked the center line of the streams and ditches with a Global Positioning System receiver. Dimensions of the waterways were collected and the center lines buffered to better reflect the stream/ditch width. Other ditch locations and size were obtained from the wetland delineation limits. No natural or altered streams exist on the CF South Pasture additional acreage tract. Grove ditches are regular features on this portion of the property.

513 Wetland Ditches—Wetland ditches are artificial channels dug through herbaceous or forested wetland jurisdictional areas. These features are evident from aerial photographs and no evidence of flow or water is required to apply this classification.

The typical vegetation is herb-dominated, comprised primarily of species found in the deeper portions of the wetland traversed by the ditch. The composition of the vegetation varies in relationship to disturbance within the surrounding wetland. Species can include soft rush (*Juncus effusus*), manyflower marshpennywort (*Hydrocotyle umbellata)*, smartweed (*Polygonum* sp.), flatsedges (*Cyperus* spp.), rosy camphorweed (*Pluchea baccharis*), beggarticks (*Bidens mitis*), and other common wetland herbaceous species.

Within the CF South Pasture additional acreage area, the primary area of ditched wetlands exist within the citrus grove adjacent to an area of 6417-Shrub, brush and vines. This area was probably a marsh in the past which has been artificially shaped (roughly rectangular) and drained. Other ditched wetlands exist as the terminal ends of grove ditches.

514 Upland Cut Ditches—Upland cut ditches are linear artificial channels dug through uplands and connected to Waters of the State, whose purpose is to facilitate drainage. As with other ditches, the vegetation is predominantly herbaceous. Typical species include soft rush, smartweed, bahiagrass, manyflower marshpennywort, foxtail (*Setaria parviflora*) and bermudagrass (*Cynodon dactylon*). Commonly, primrose willow and wax myrtle are oftentimes found growing in the ditch or on the banks. Upland cut ditches surround and cross the citrus groves on the tract.

616 Inland Ponds and Sloughs (Popash)—This category was utilized to identify those forested wetlands that are dominated by pop ash (*Fraxinus caroliniana*). This species is normally dominant in the overstory and usually located at the deepest portions of larger systems. Because of the periods of extended deep water within these areas, understory vegetation is often times greatly reduced. When present, species such as pickerelweed (*Pontederia cordata*) and fireflag (*Thalia geniculata*) are noted in the deeper portions. At the wetland perimeters species diversity increases and various oaks may exist. Dixie iris is common with smartweed, softrush, fragrant flatsedge (*Cyperus odoratus*), horned beaksedge (*Rhynchospora inundata*), and savannah false pimpernel (*Lindernia grandiflora*) being present in varying degrees of cover.

617 Mixed Wetland Hardwoods—Jurisdictional forested wetlands that contain a variety of hardwood tree species are designated as Mixed Wetland Hardwood forests. A mixed wetland forest exists as part of a large wetland complex in the northwestern portion of the tract. There is considerable variation from east to west across this swamp due in part to topographic variation and past disturbances. The eastern portion has numerous large tupelo (*Nyssa sylvatica*), but due to severe wind damage, these trees no longer dominate the canopy. Red maple, sweetbay (*Magnolia virginiana*), and elm (*Ulmus americana*) are filling in the canopy gaps left from the breakage of the tupelo canopy. The swamp grades into hydric oaks and other

hardwoods toward the center, then mostly red maple, elm and wax myrtle on the western side. This variation across the swamp is apparently due to topography and hydroperiod with the deeper portions having a greater number of obligate species.

Other canopy species in the mixed hardwood swamp include dahoon (*Ilex cassine*), sweetgum, popash, various scattered oaks and slash pine. Shrubs include wax myrtle, highbush blueberry, Walter's viburnum (*Viburnum obovatum*), Peruvian primrosewillow (*Ludwigia peruviana*), and buttonbush. Herbs include soft rush, fireflag (*Thalia geniculata*), lizard's tail, pickerelweed, sawgrass, Dixie iris, manyflower marshpennywort, smartweeds, and maidencane. Ferns are usually present in the herb stratum, and in some forests form a dense ground cover. Common ferns include royal fern, swamp fern, net-vein chain fern, hottentot fern (*Thelypteris interrupta*), cinnamon fern, and Virginia chain fern.

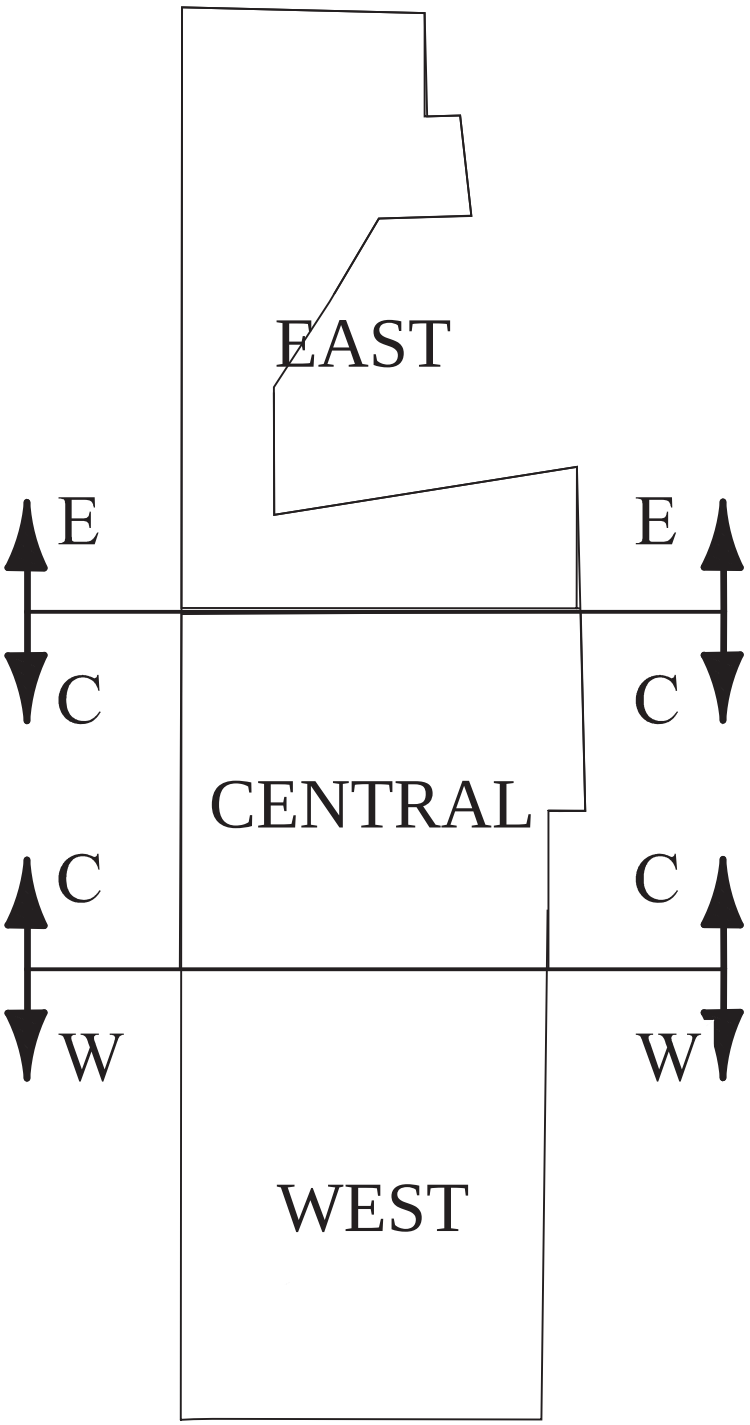
618 Willow—Two willow-dominated swamps were noted on the CF South Pasture addition acreage and appear to be the results of historic disturbances to areas that were probably marshes in the past. These areas are parts of the larger swamp system in the northwest corner of Section 2. Carolina willow (*Salix caroliniana*) comprises nearly the entire overstory and is generally greater than 1-inch diameter at breast height. The understory, where present is typical of a fireflag-pickerelweed marsh.

6417 Shrub, Brush and Vines—A Level IV FLUCFCS was utilized for shrub-dominated wetland communities that occupy shallow still-water depressions. On the CF South Pasture additional acreage tract, this community is generally present on areas that were probably 641-freshwater marshes and have had some disturbance to the community. Typical disturbances to marsh areas include cattle, ditching and secondary impacts from land alteration. Common species are Carolina willow, wax myrtle, or immature tree samplings; but this classification was also utilized when shrubs such as gallberry, saltbush, palmetto, and wax myrtle were included in the jurisdictional limits surrounding a marsh system. Most frequent, though, are areas that have been overgrown with Peruvian primrosewillow. Remnant wetland herbs are generally present, sometimes in abundance. Hydric and non-hydric trees, notably red maple and oaks, may also be present, usually in a peripheral position. Ditching these areas reduces the hydroperiod that otherwise inhibits seedling establishment. Primrosewillow-dominated wetlands may vary greatly in cover and position within the landscape from year-to-year based on numerous factors including seasonal rainfall, winter freezes, or fire. On the CF South Pasture additional acreage tract, a large primrosewillow swamp exists in the northwest corner of Section 2. The area has an aerial photographic signature of a freshwater marsh, but this aggressive exotic species has spread over the marsh since the photograph was taken in 2004. This category was also used to classify areas within or adjacent to the citrus grove which, due to disturbance and drainage, are now dominated by mixed shrubby vegetation.

643 Wet Prairies—The Wet Prairie designation is typically an area of grasses often adjacent to a freshwater marsh. One area of wet prairie on the CF project exists in the northwest corner of Section 2. It is a transitional zone between what was a deep water marsh (now a 6417–Shrub, Brush and Vines) and a forested upland. Wet

Prairies typically consists of a dense growth of native species-rich grasses, sedges, and forbs that grow on wet soil. Hydroperiods are generally shorter and inundation shallower than in Freshwater Marshes (641). Although herbs predominate, a low-growing shrub, St. Johns-wort, sometimes grows in abundance on sandy substrates in shallow water. Typically, sand cordgrass (*Spartina bakeri*), bushy broomsedge, meadow beauty (*Rhexia* sp.), beaksedges, bahiagrass, slender flattop goldenrod, soft rush, carpetgrasses, and redtop panicum (*Panicum rigidulum*) grow in these areas in differing combinations and coverages. During several consecutive years of above or below normal rainfall, the boundary between wet prairie and adjacent Freshwater Marsh (641) can shift dramatically.

ATTACHMENT 2
EXISTING WETLAND TRACT MAPS



0 5000' 10000' feet

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Wetland Transect Location Map

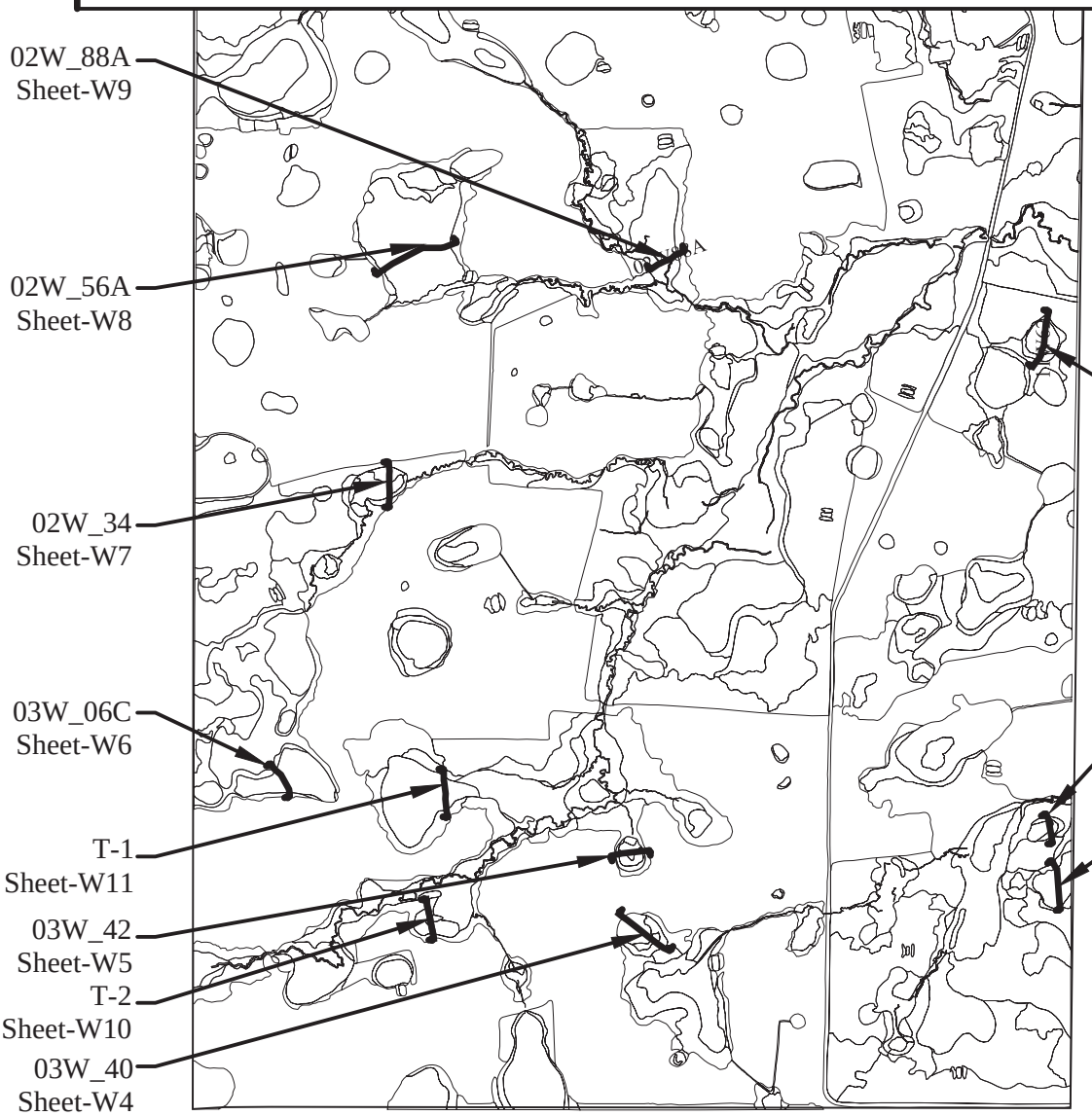
Wetland Transect Location Map
Center Sec 07
Twp 34 S
Rng 24 E
Overall

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West Wetland Transect Location Map



0 2000' 4000' feet

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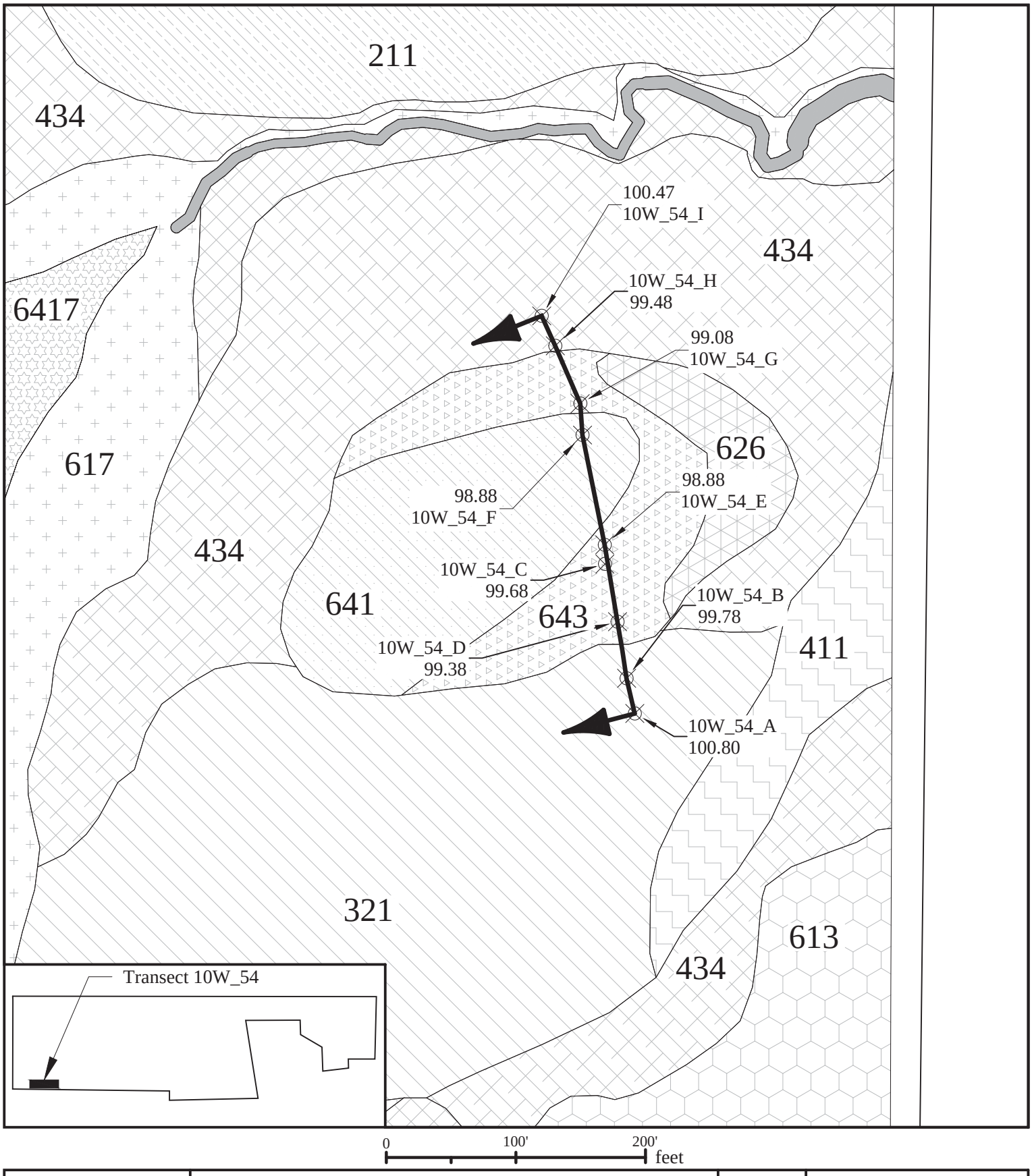
West Wetland Transect Location Map

West Wetland Transect Location Map
Center Sec 07
Twp 34 S
Rng 24 E
Overall West

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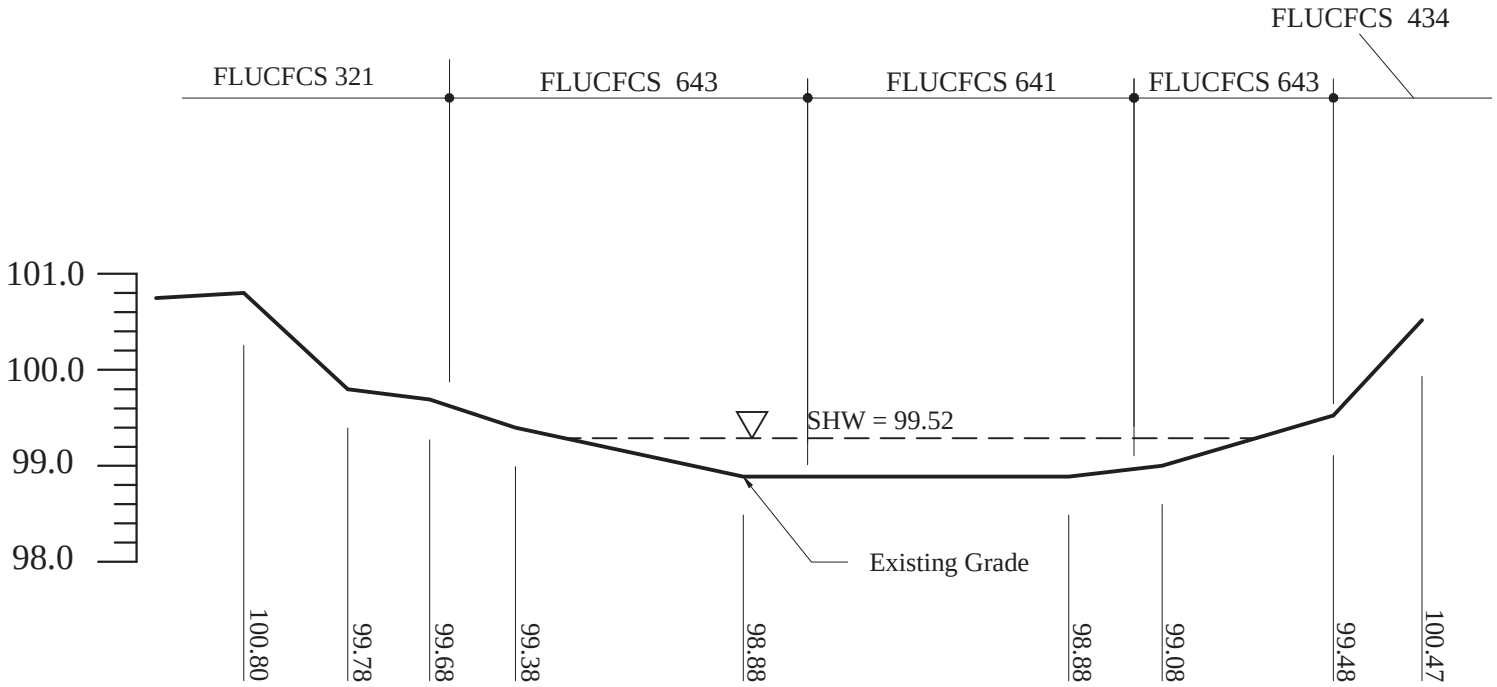
West Wetland Transect 10W_54

West Wetland
Transect 10W_54
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W1

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Cross Section 10W_54

VERT 1" = 3' HORZ 1" =50'

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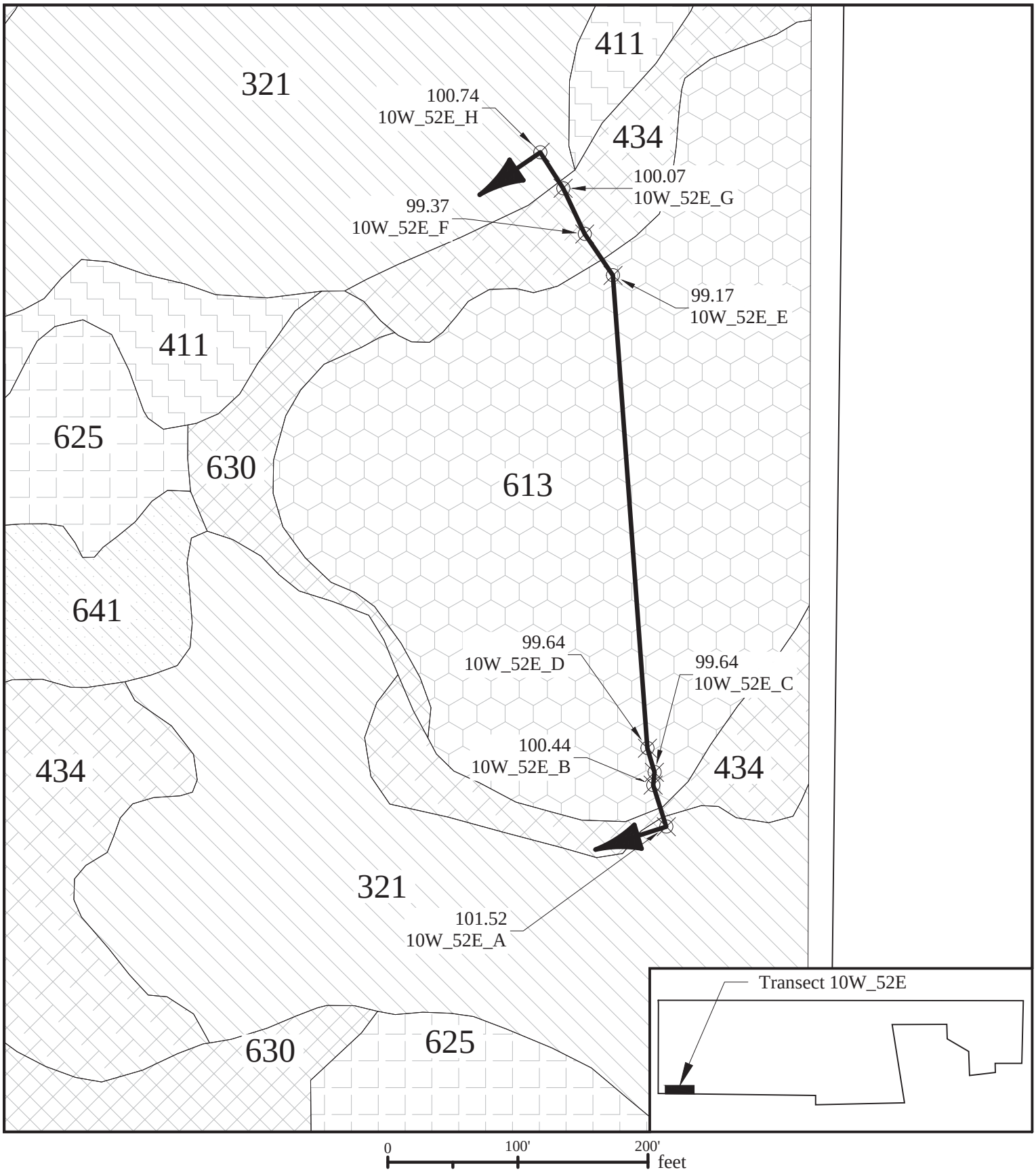
West Wetland Transect 10W_54

West Wetland Transect 10W_54
Center Sec 07 Twp 34 S Rng 24 E
Sheet - W1a

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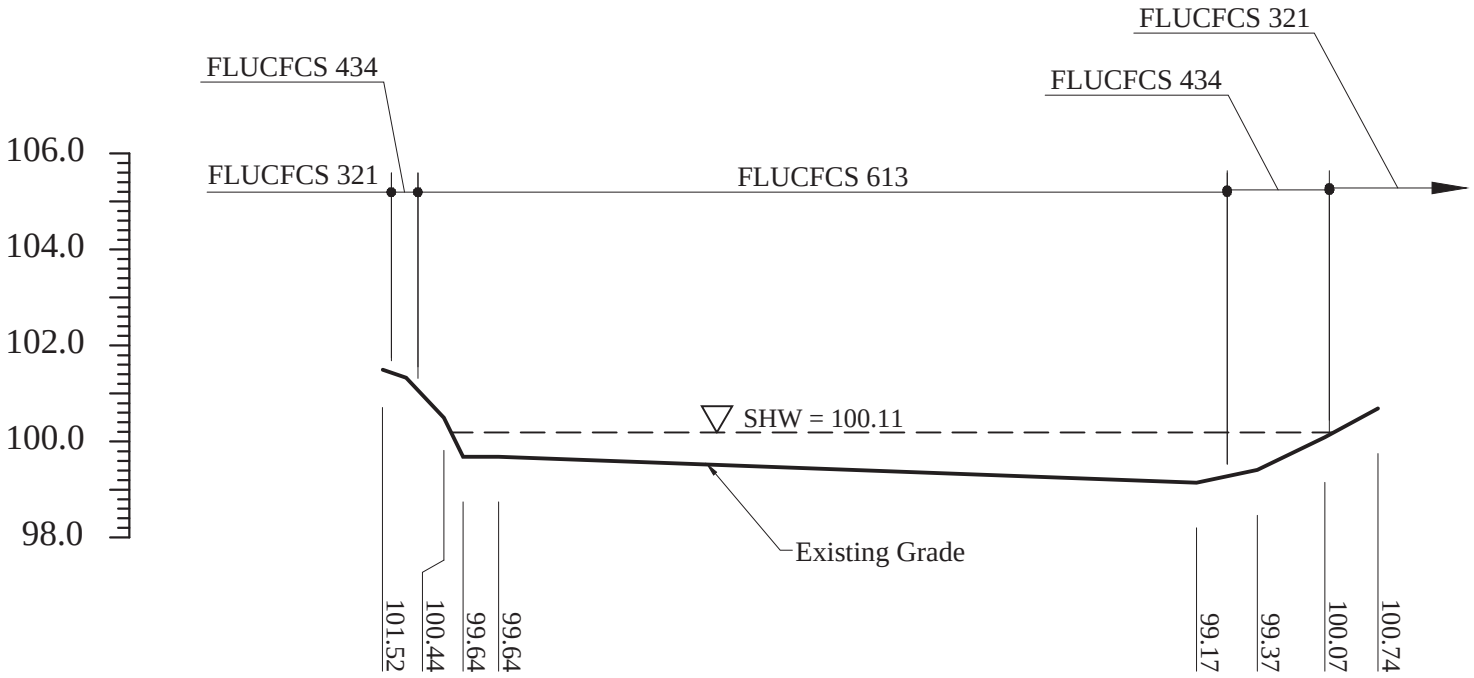
West Wetland Transect 10W_52E

West Wetland
Transect 10W_52E
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W2

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Cross Section 10W_52E

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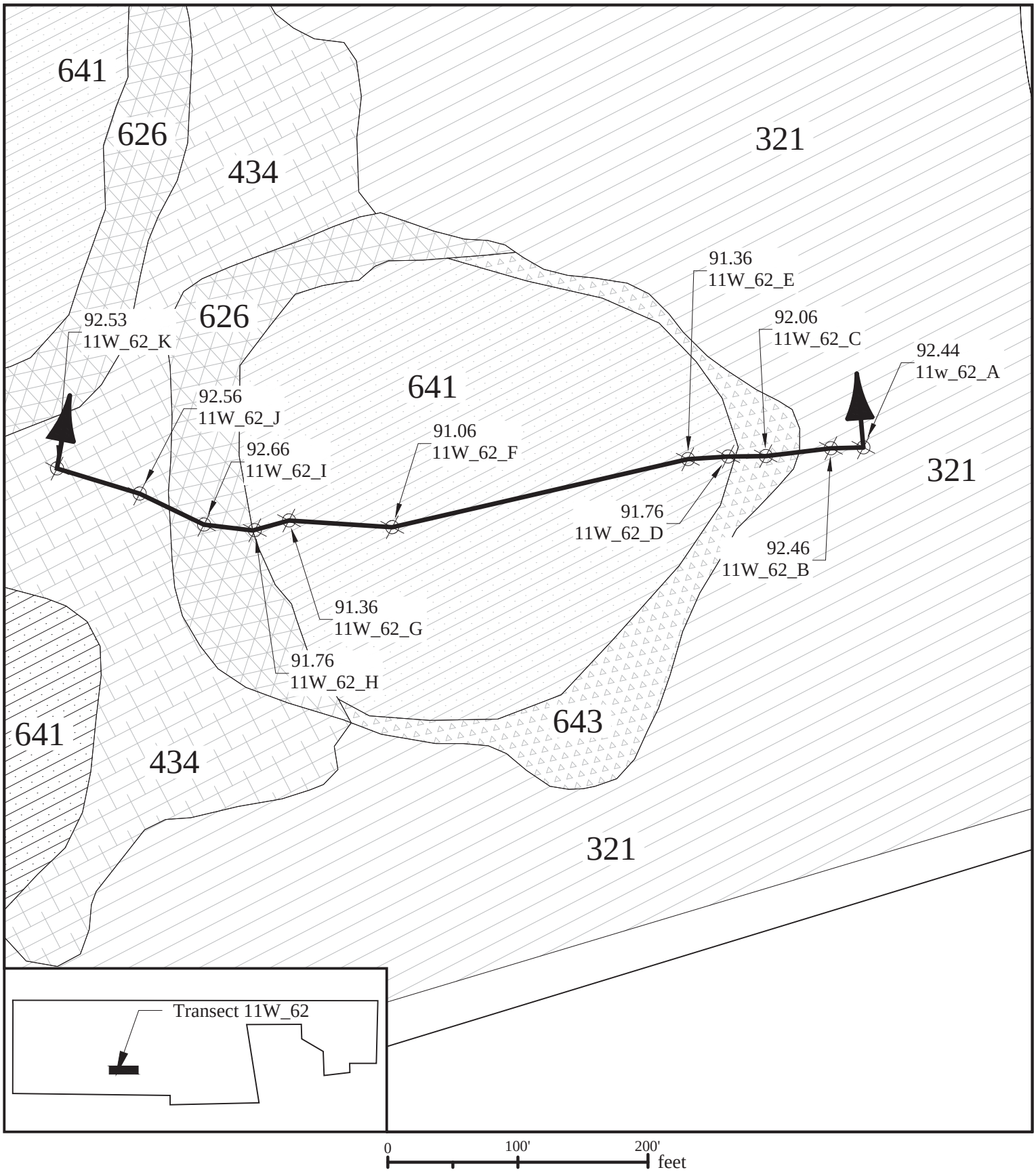
West Wetland Transect 10W_52E

West Wetland Transect 10W 52E
Center Sec 07 Twp 34 S Rng 24 E
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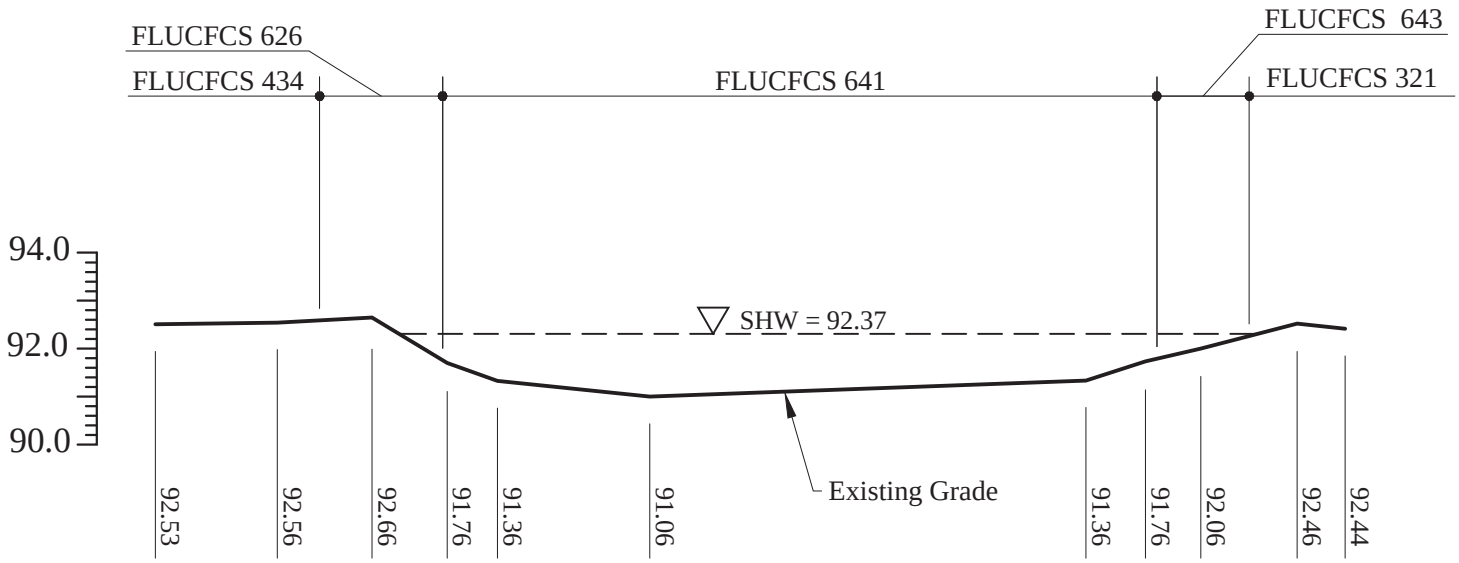
West Wetland Transect 11W_62

West Wetland
Transect 11W_62
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W3

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Cross Section 11W_62

VERT 1" = 6' HORZ 1" =100'

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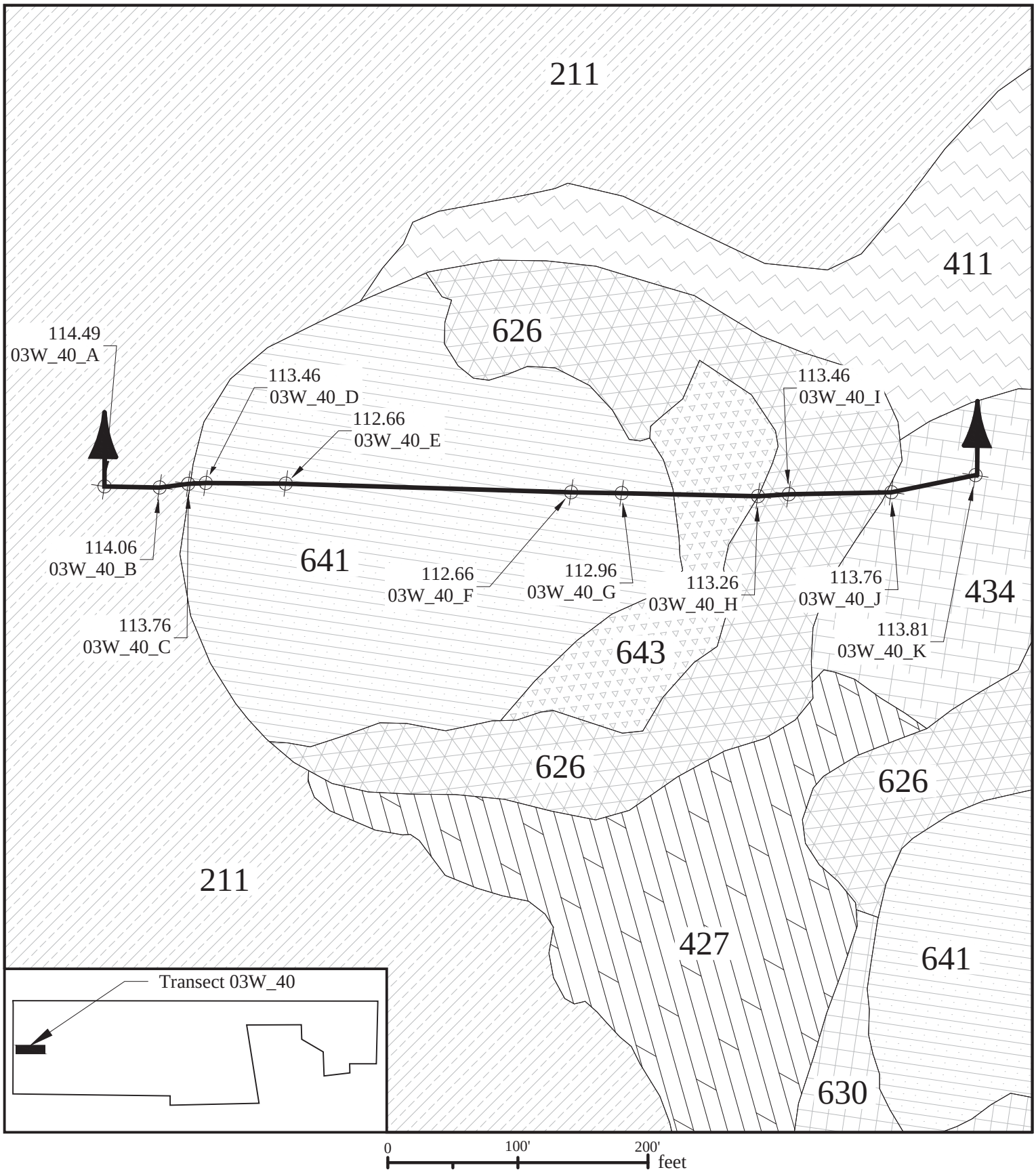
West Wetland Transect 11W_62

West Wetland
Transect 11W_62
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W3a

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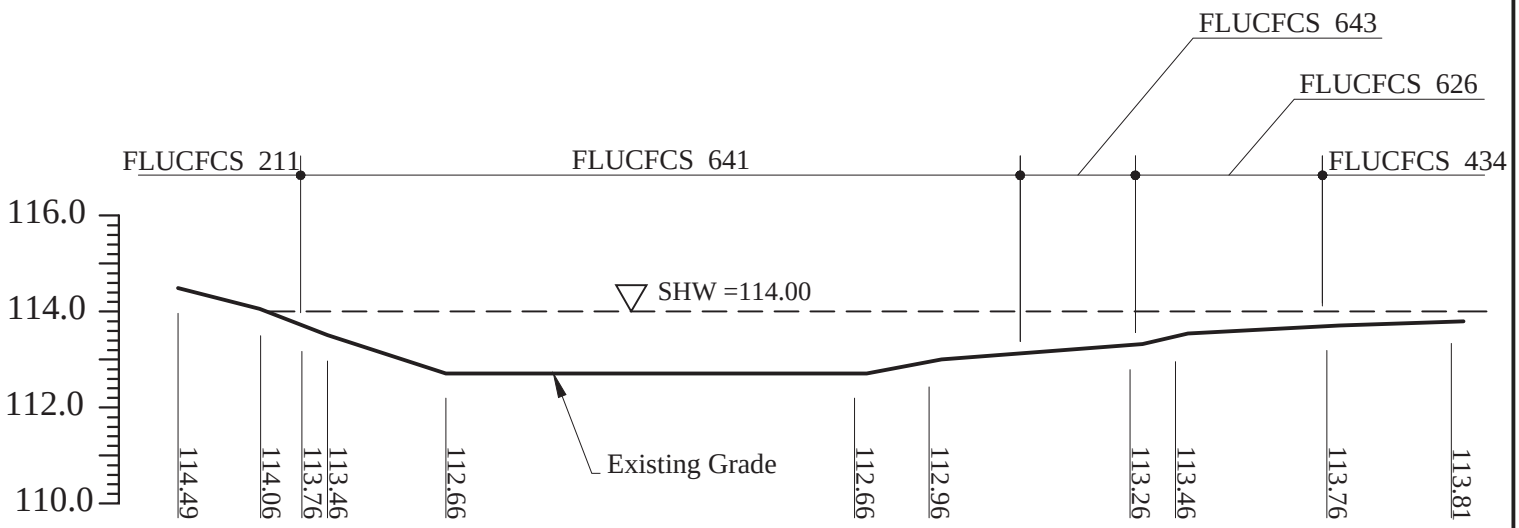
West Wetland Transect 03W_40

West Wetland
Transect 03W_40
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W4

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Cross Section 03W_40

VERT 1" = 4' HORZ 1" = 150'

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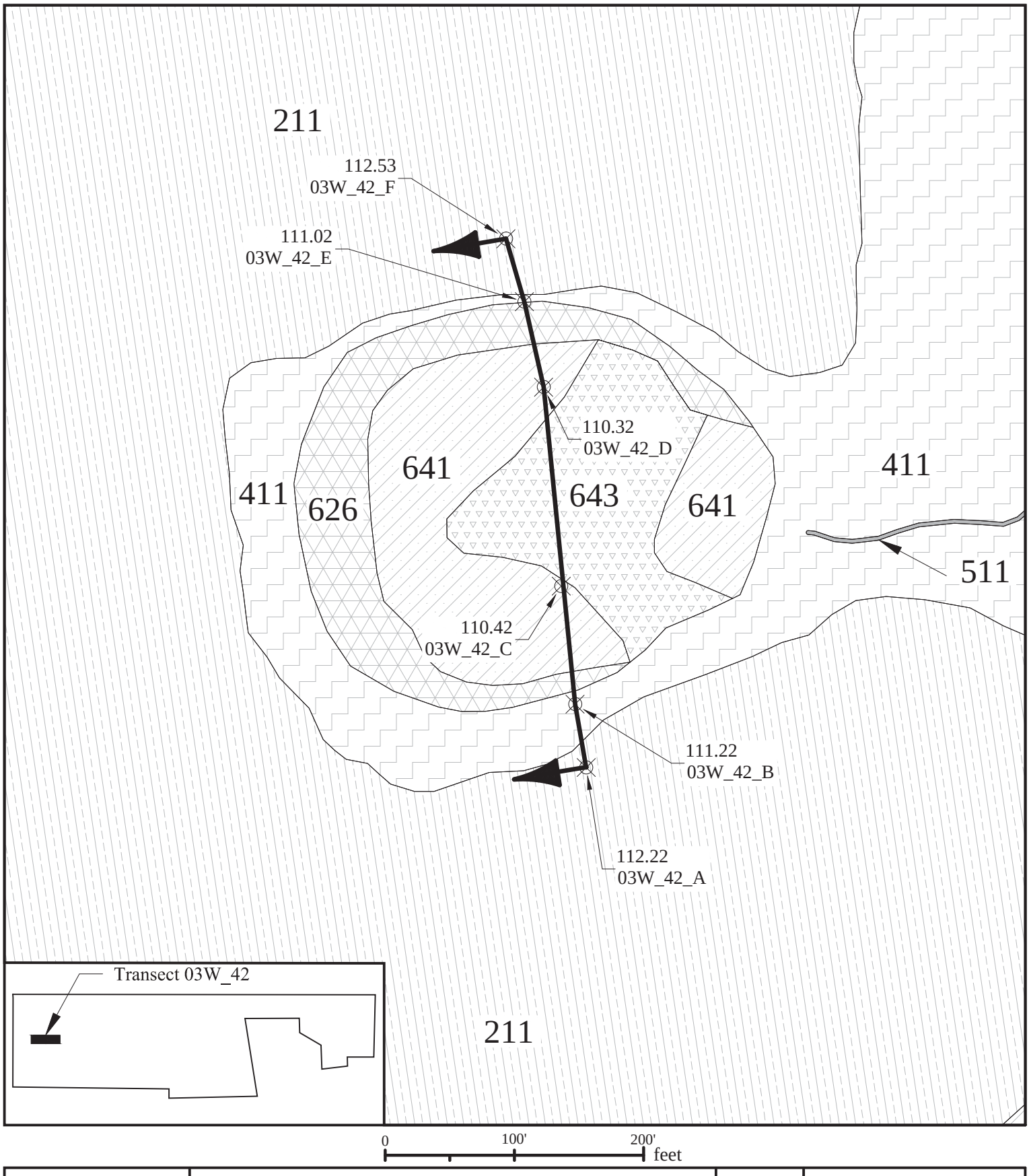
West Wetland Transect 03W_40

West Wetland
Transect 03W_40
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W4a

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CF Industries

South Pasture Extension

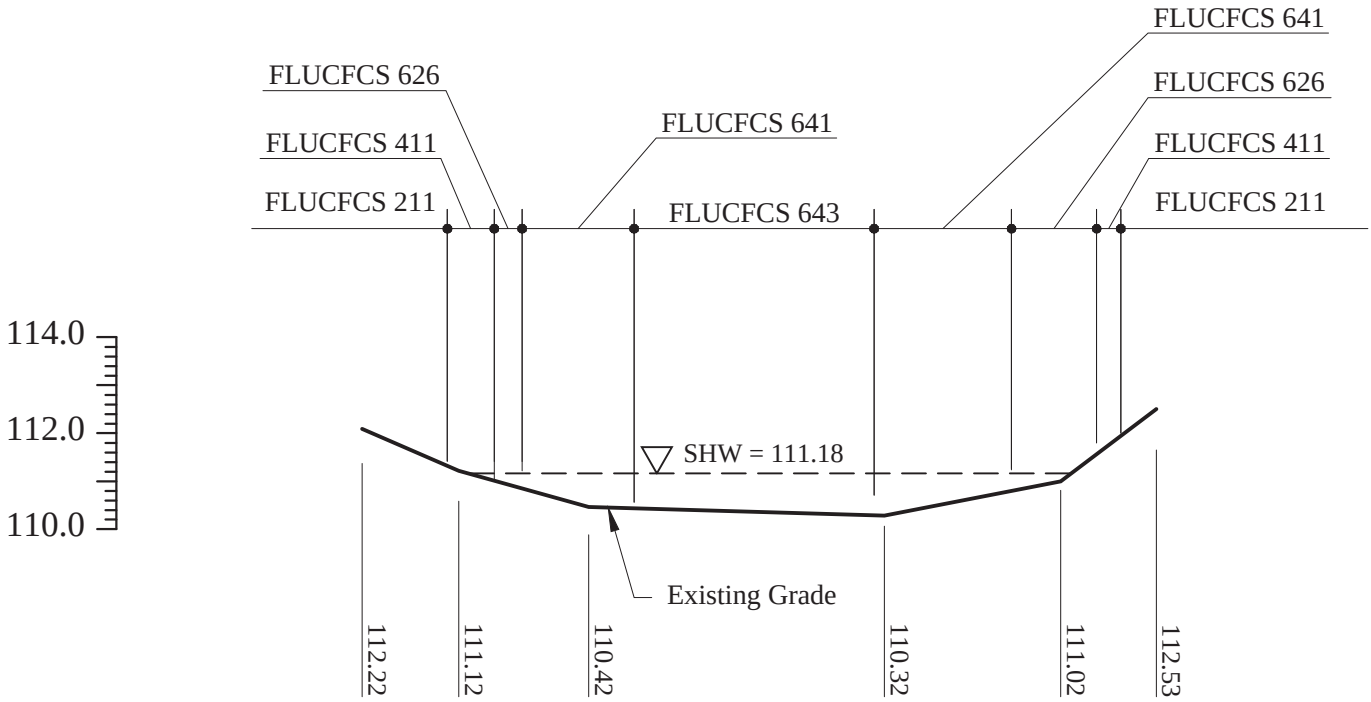
West Wetland Transect 03W_42

West Wetland
Transect 03W_42
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W5

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Coordinate System:
NAD 1983 Florida State Planes west feet

Date: 05/30/06 Rev. Date: 04/15/08 PM: DJD CAD Operator: MAB Project # : 0675-041 File Location: C:\Users\jamesb\appdata\local\temp\AcPublish_9528\ERP_CF_wetland_transects_2010.dwg



Cross Section 03W_42

VERT 1" = 4' HORZ 1" = 100'

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CF Industries

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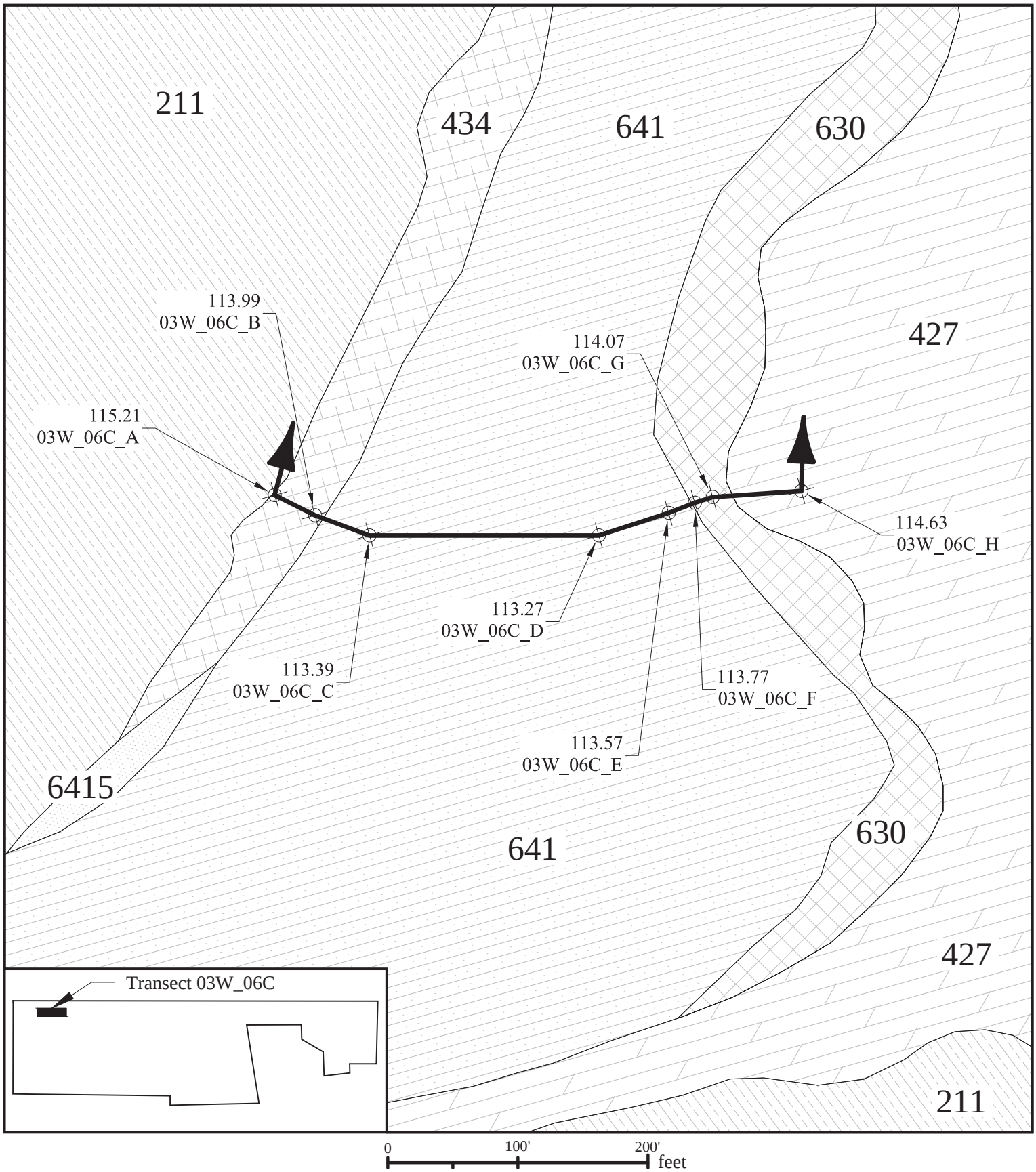
West Wetland Transect 03W_42

West Wetland Transect 03W_42
Center Sec 07 Twp 34 S Rng 24 E
Sheet - W5a

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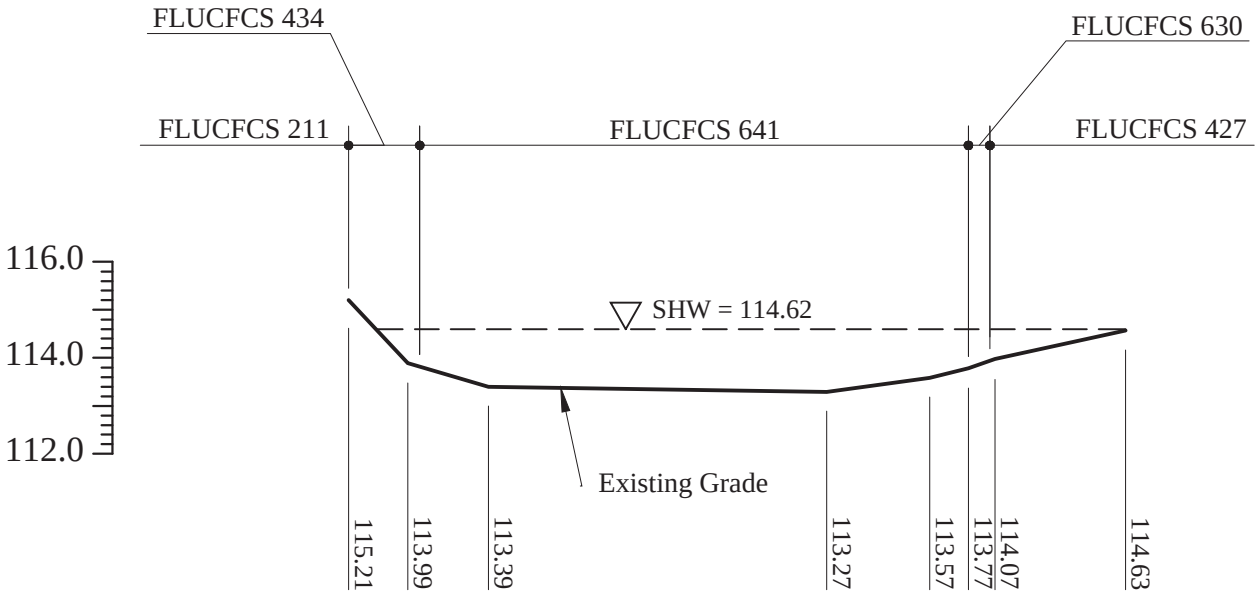
West Wetland Transect 03W_06C

West Wetland
Transect 03W_06C
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W6

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Cross Section 03W_06C

VERT 1" = 4' HORZ 1" = 100'

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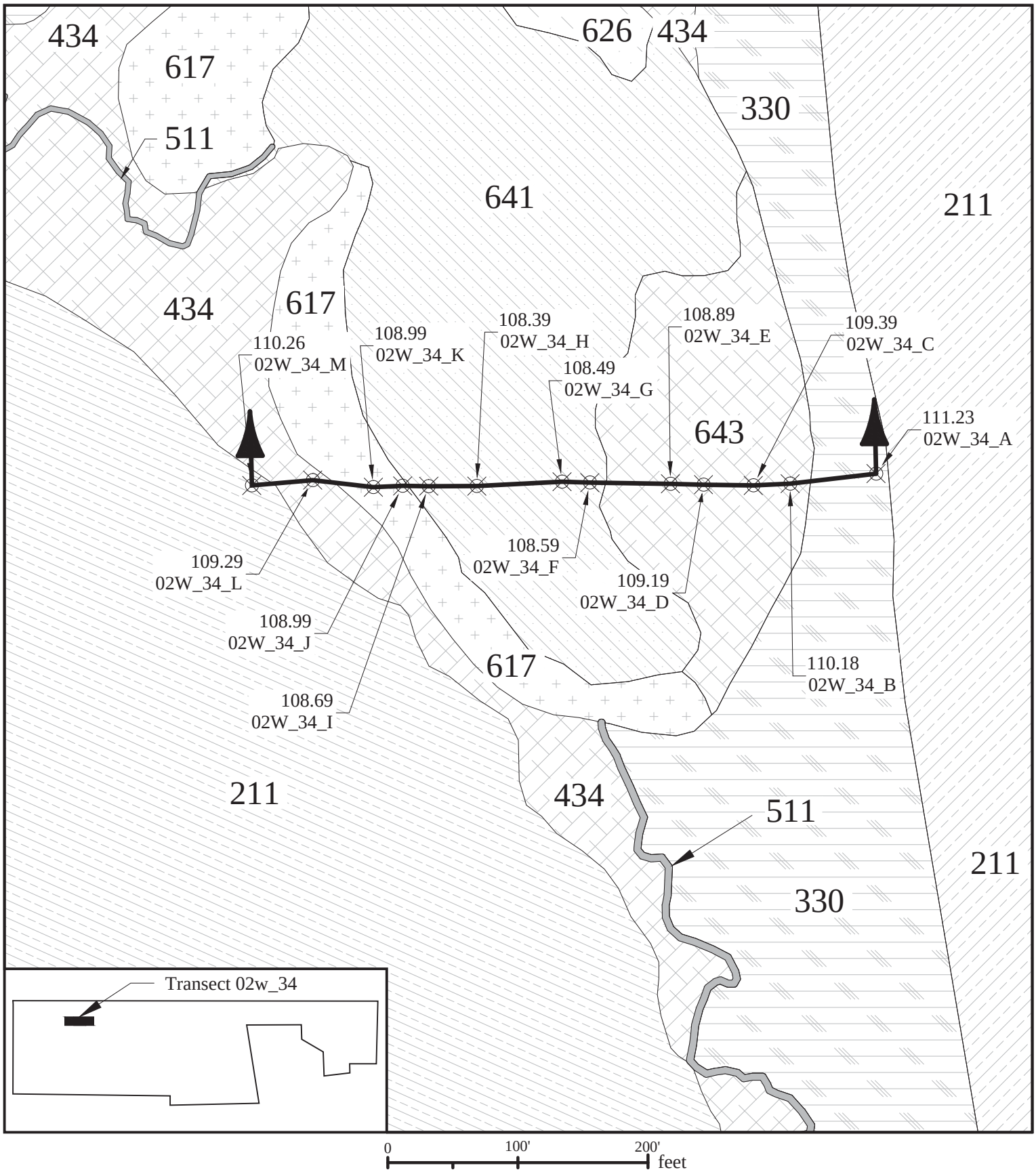
West Wetland Transect 03W_06C

West Wetland
Transect 03W_06C
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W6a

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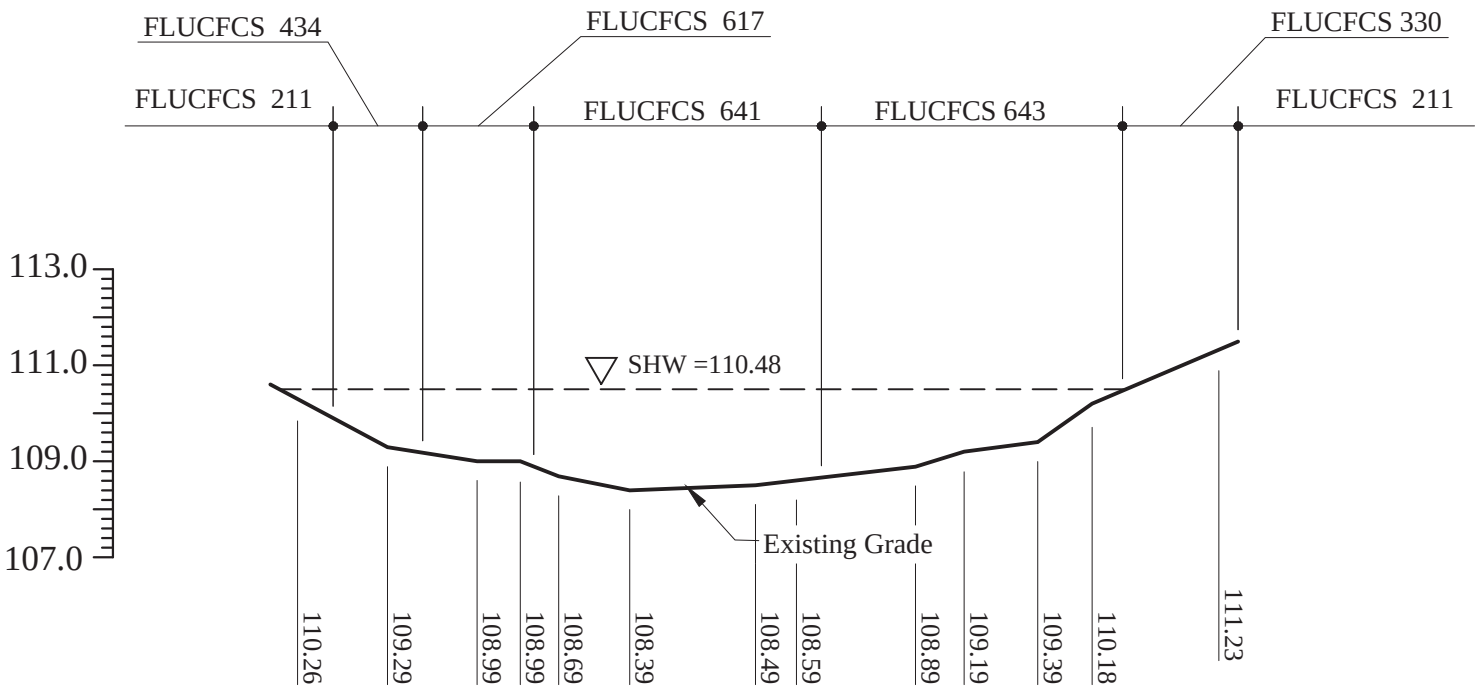
West Wetland Transect 02W_34

West Wetland
Transect 02W_34
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W7

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Cross Section 02W_34

VERT 1" = 4' HORZ 1" = 100'

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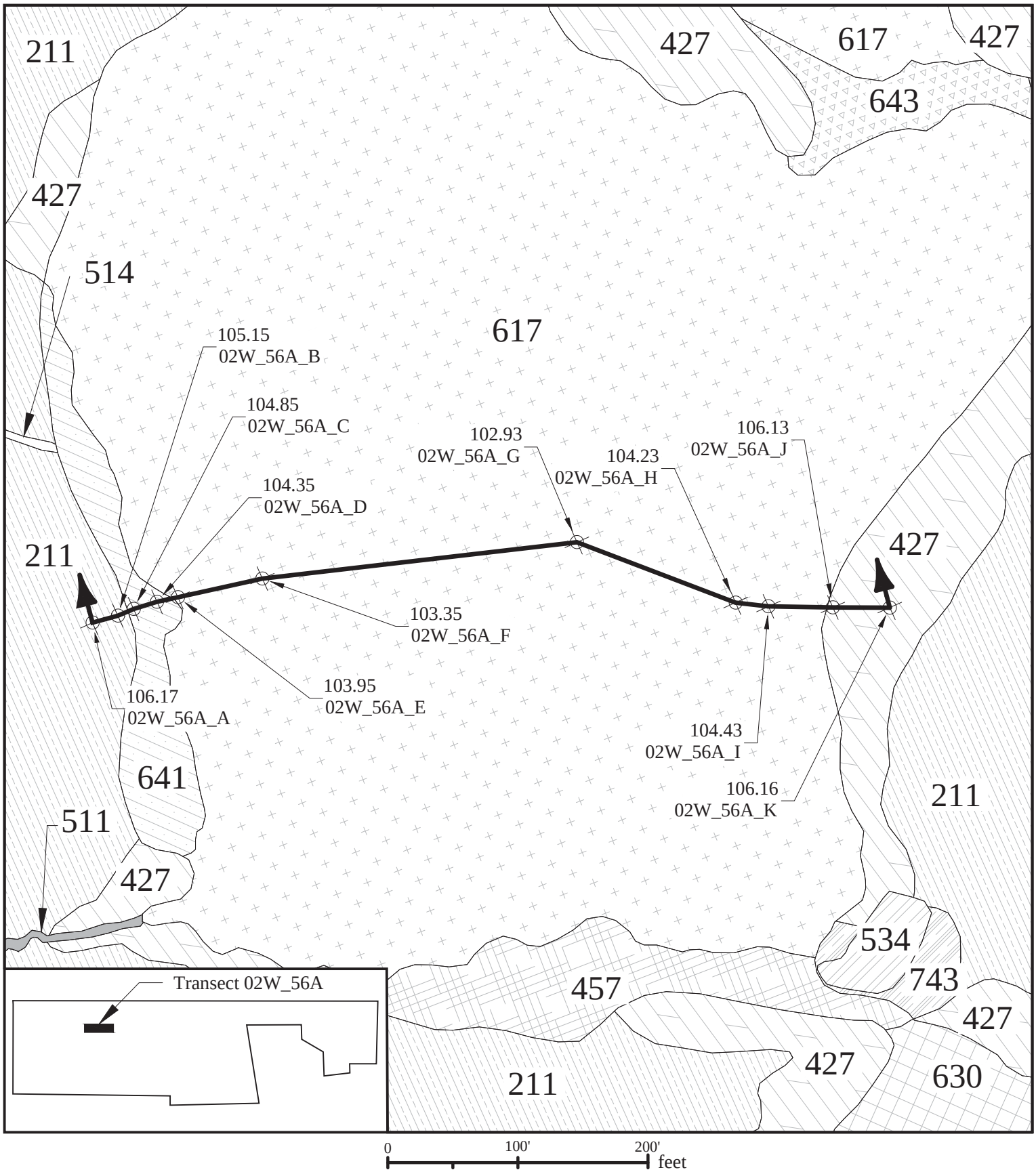
West Wetland Transect 02W_34

West Wetland
Transect 02W_34
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W7a

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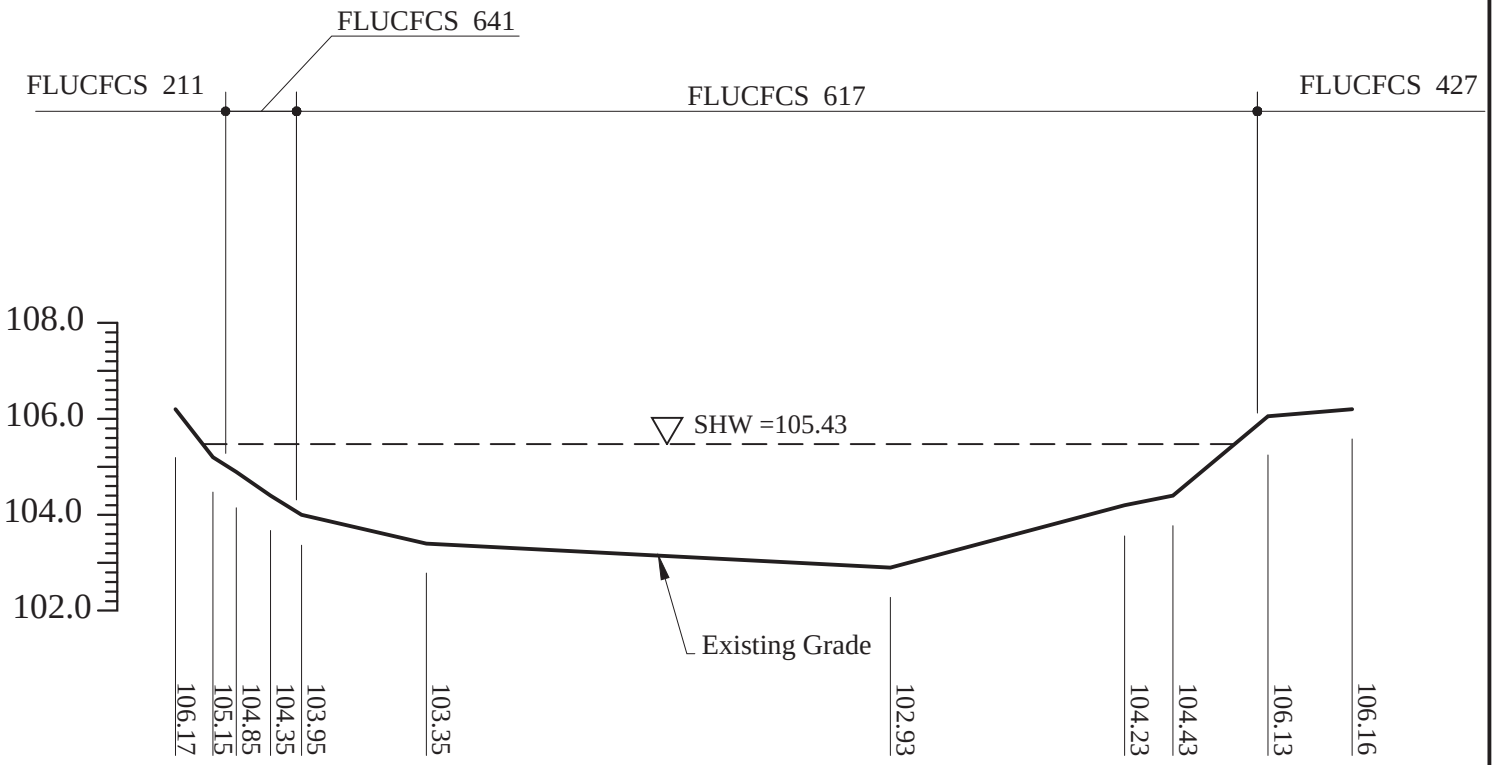
West Wetland Transect 02W_56a

West Wetland
Transect 02W_56a
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W8

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Cross Section 02W_56A

VERT 1" = 4' HORZ 1" = 150'

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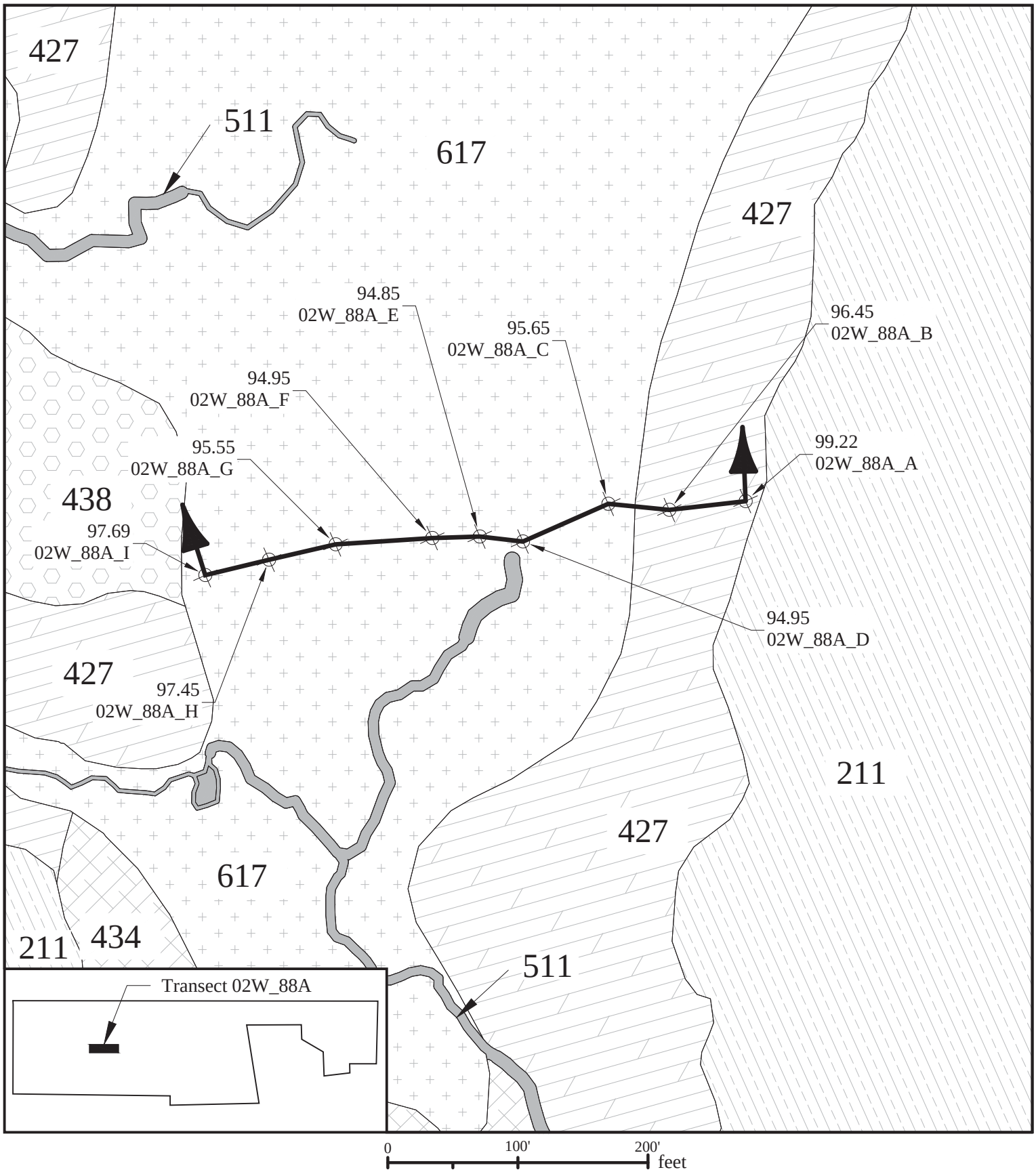
West Wetland Transect 02W_56A

West Wetland Transect 02W_56A
Center Sec 07 Twp 34 S Rng 24 E
Sheet - W8a

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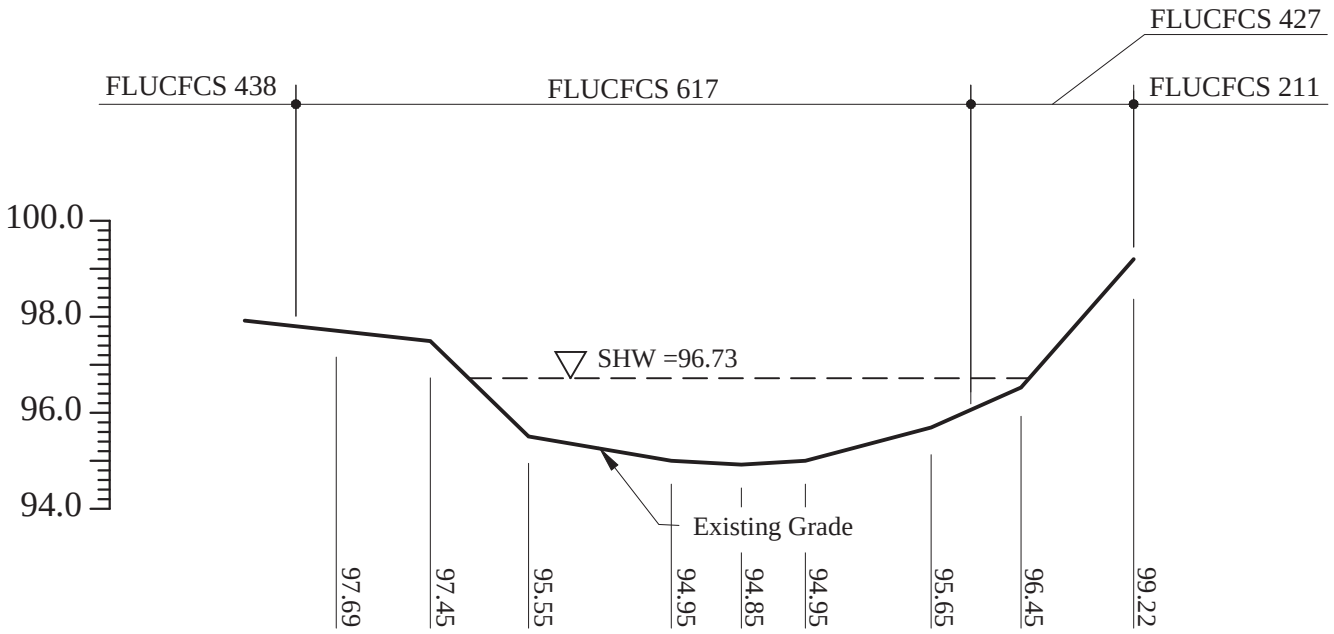
West Wetland Transect 02W_88A

West Wetland
Transect 02W_88A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W9

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Cross Section 02W_88A

VERT 1" = 6' HORZ 1" =100'

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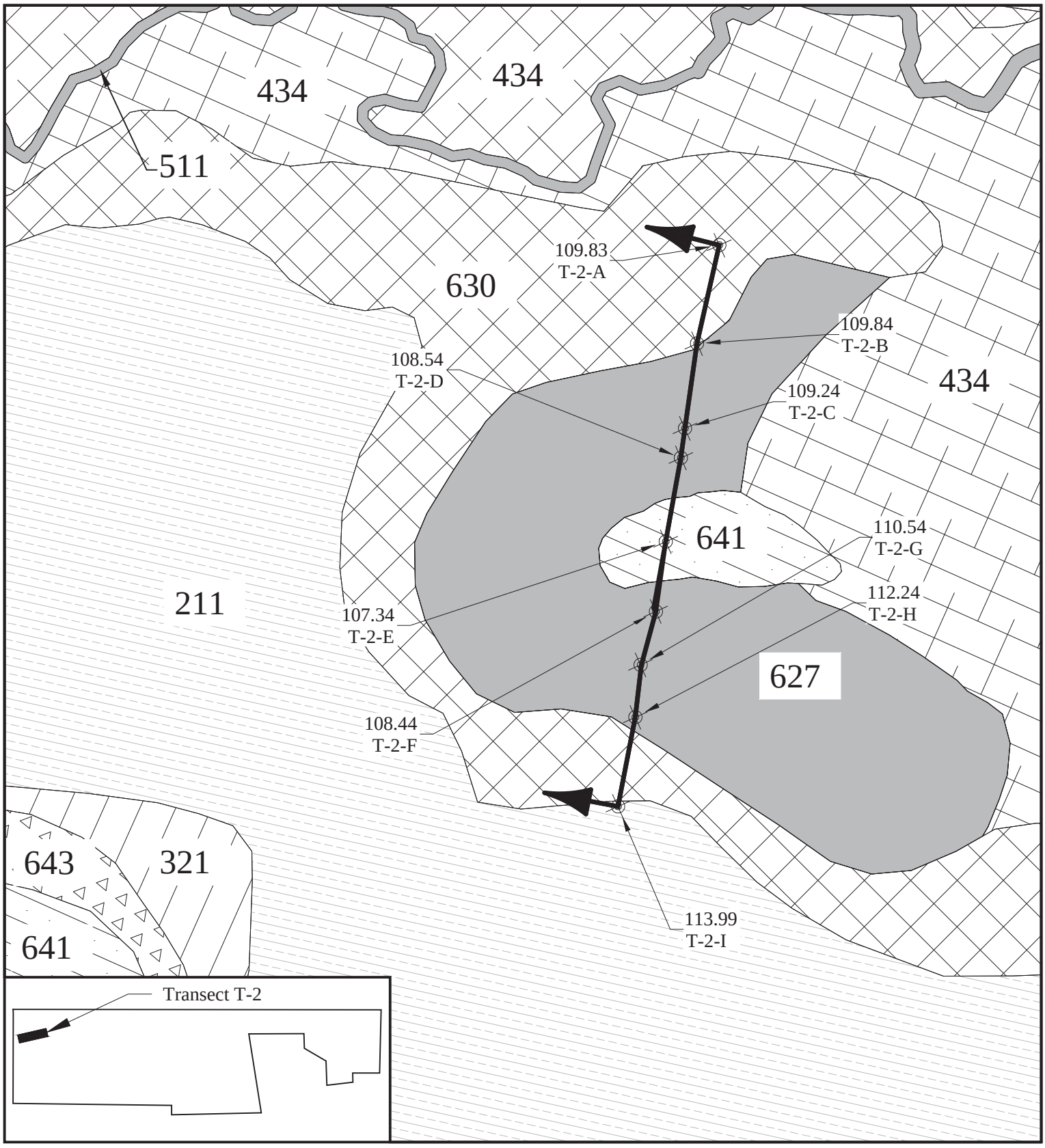
West Wetland Transect 02W_88A

West Wetland Transect 02W_88A
Center Sec 07 Twp 34 S Rng 24 E
Sheet - W9a

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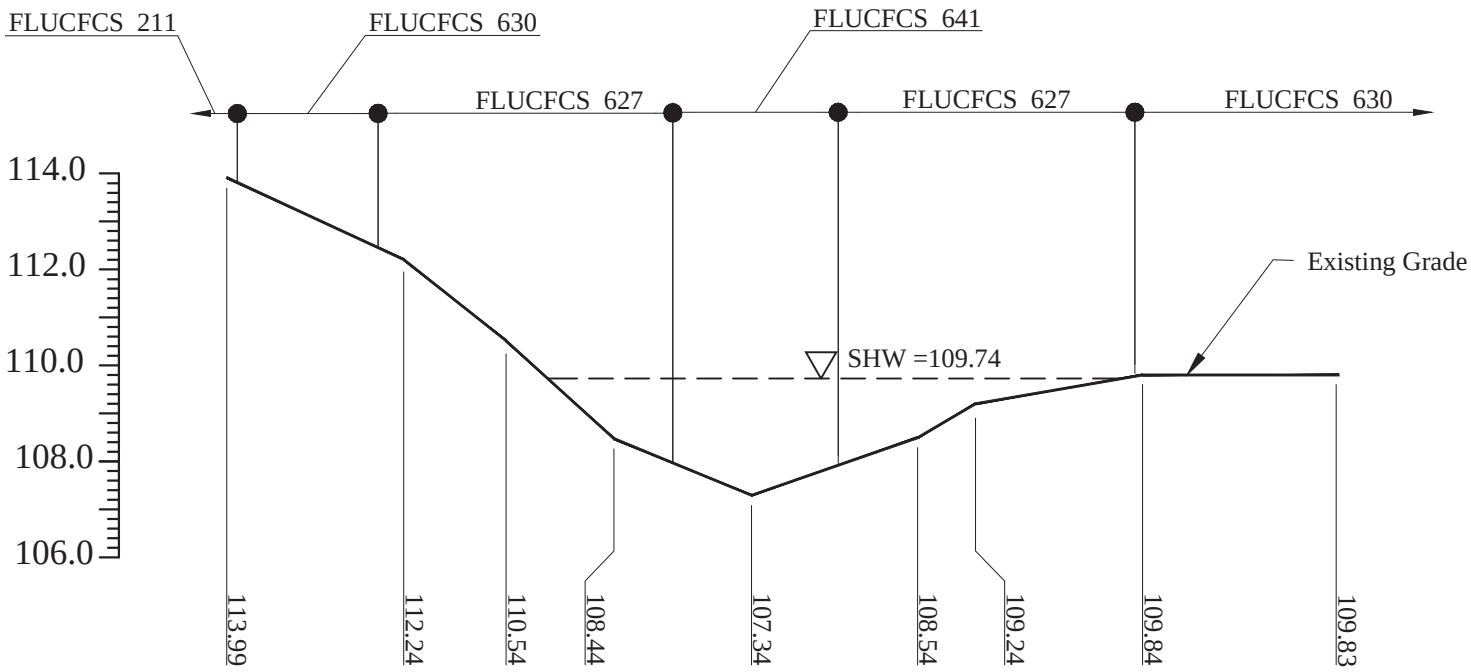
West Wetland Transect T-2

West Wetland
Transect T-2
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W10

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Cross Section T-2

VERT 1" = 6' HORZ 1" =150'

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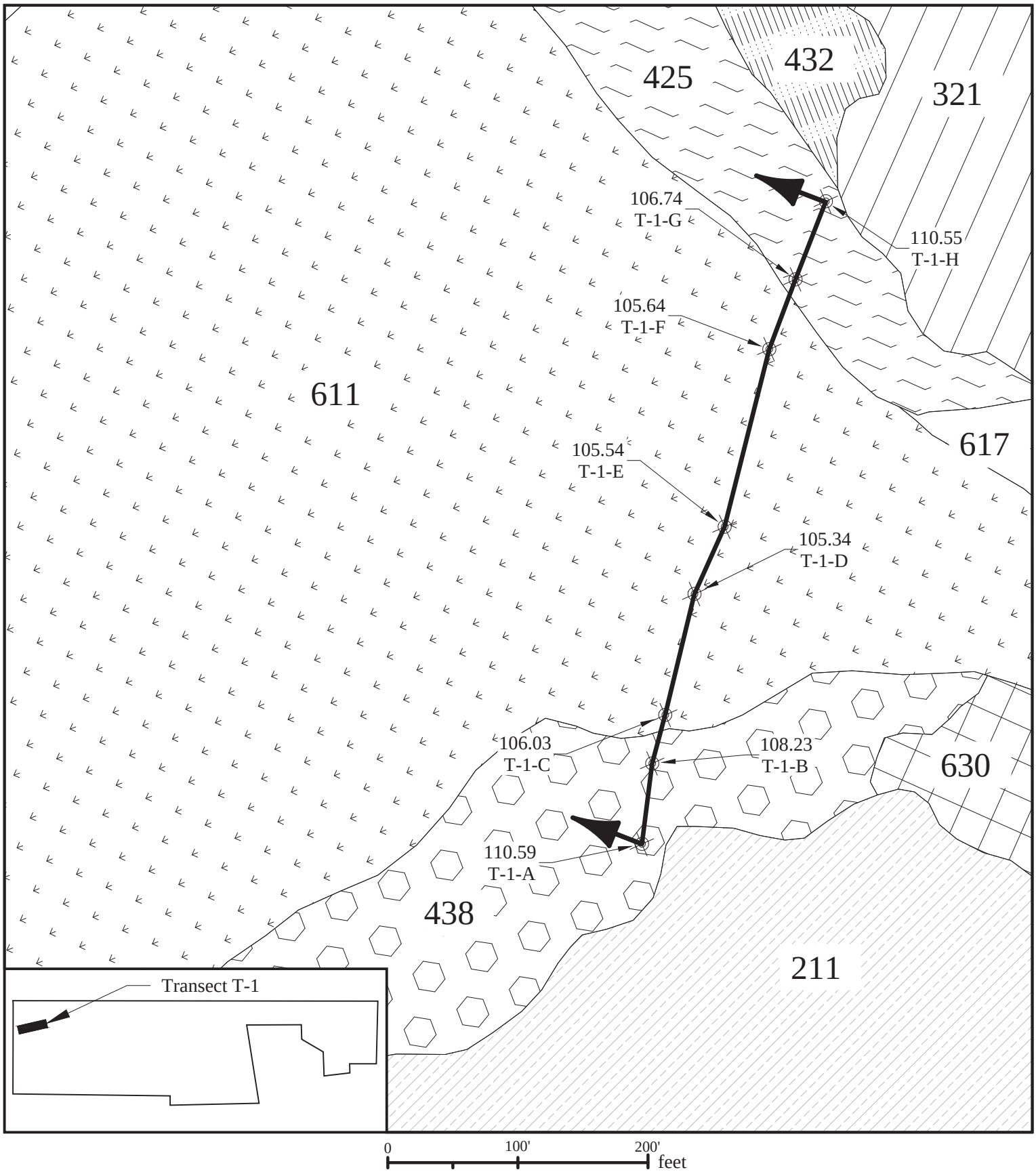
West Wetland Transect T-2

West Wetland
Transect T-2
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W10a

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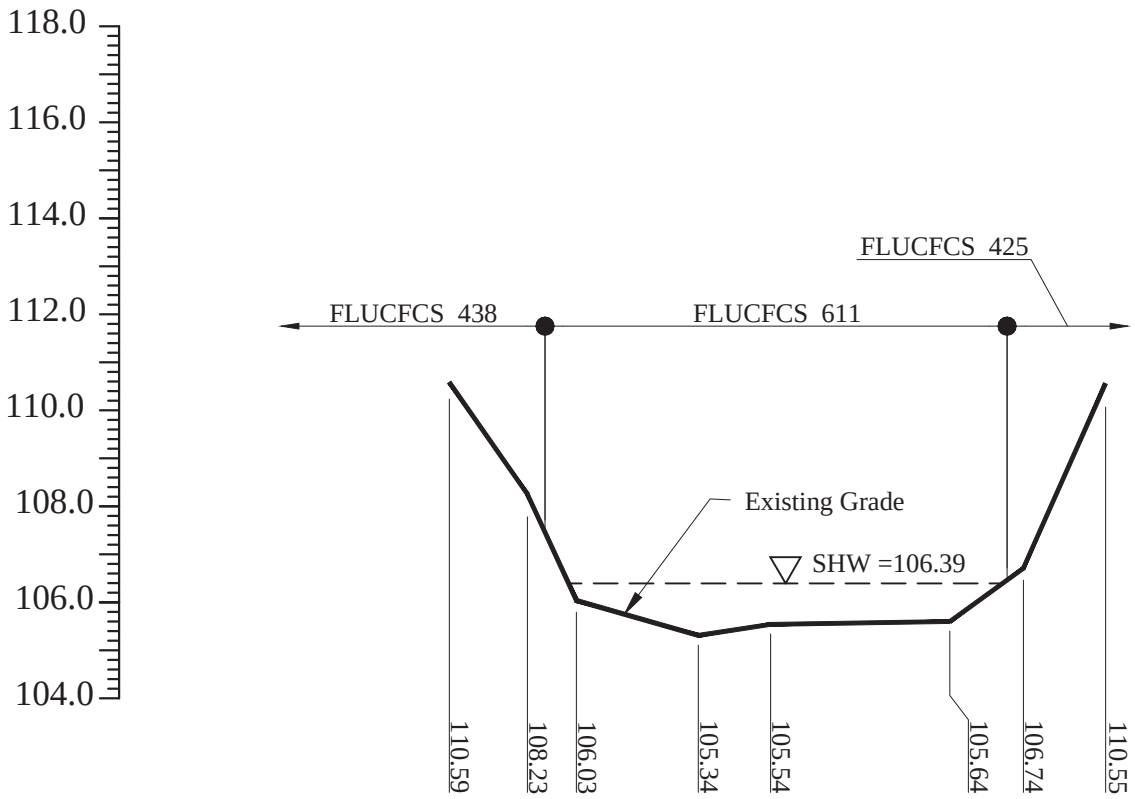
West Wetland Transect T-1

West Wetland
Transect T-1
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - W11

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Cross Section T-1

VERT 1" = 6' HORZ 1" =150'

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West Wetland Transect T-1

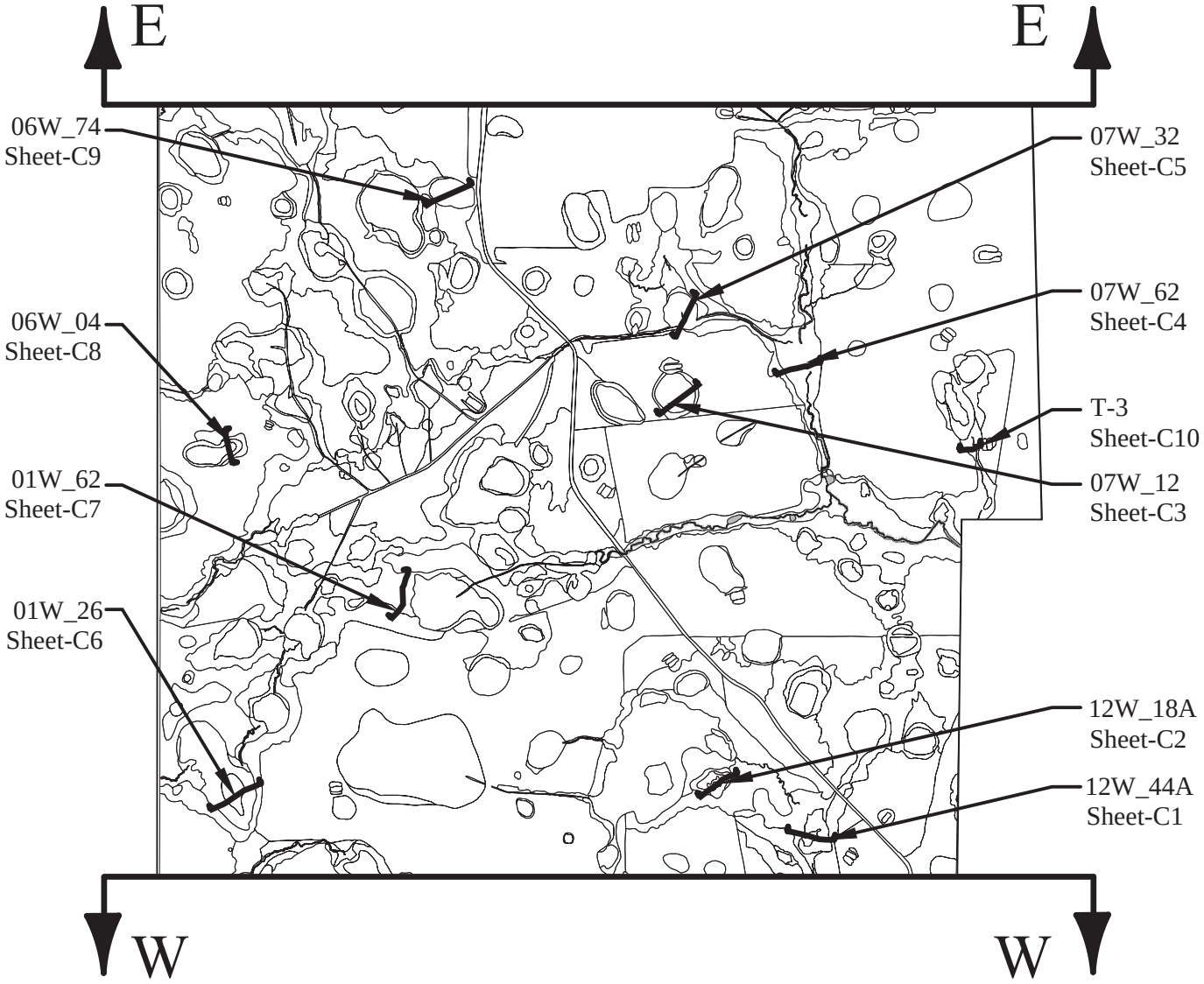
West Wetland Transect T-1
Center Sec 07 Twp 34 S Rng 24 E
Sheet - W11a

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Central Wetland Transect Location Map



0 2000' 4000' feet

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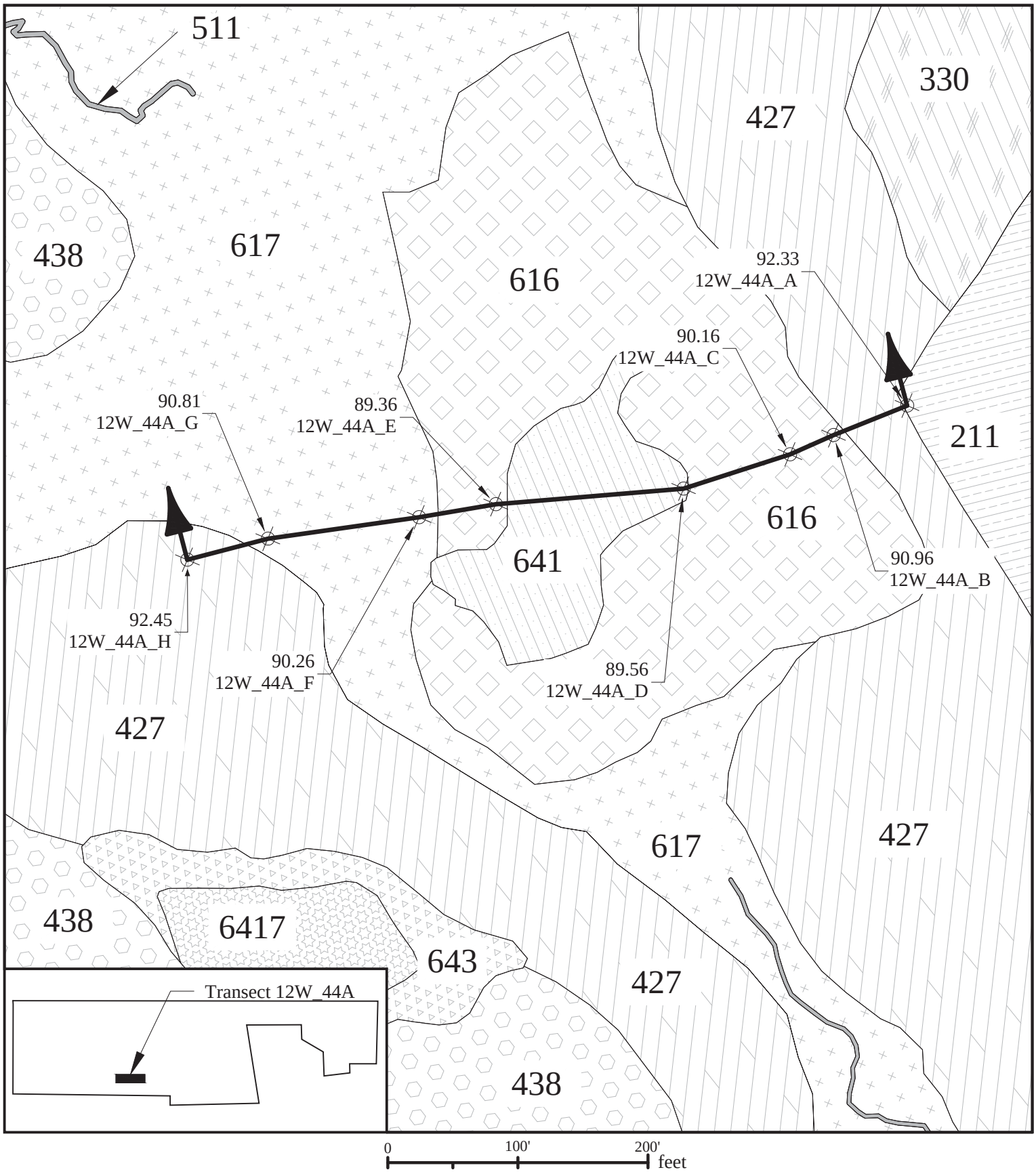
Central Wetland Transect Location Map

Cental Wetland Transect Location Map
Center Sec 07
Twp 34 S
Rng 24 E
Overall Central

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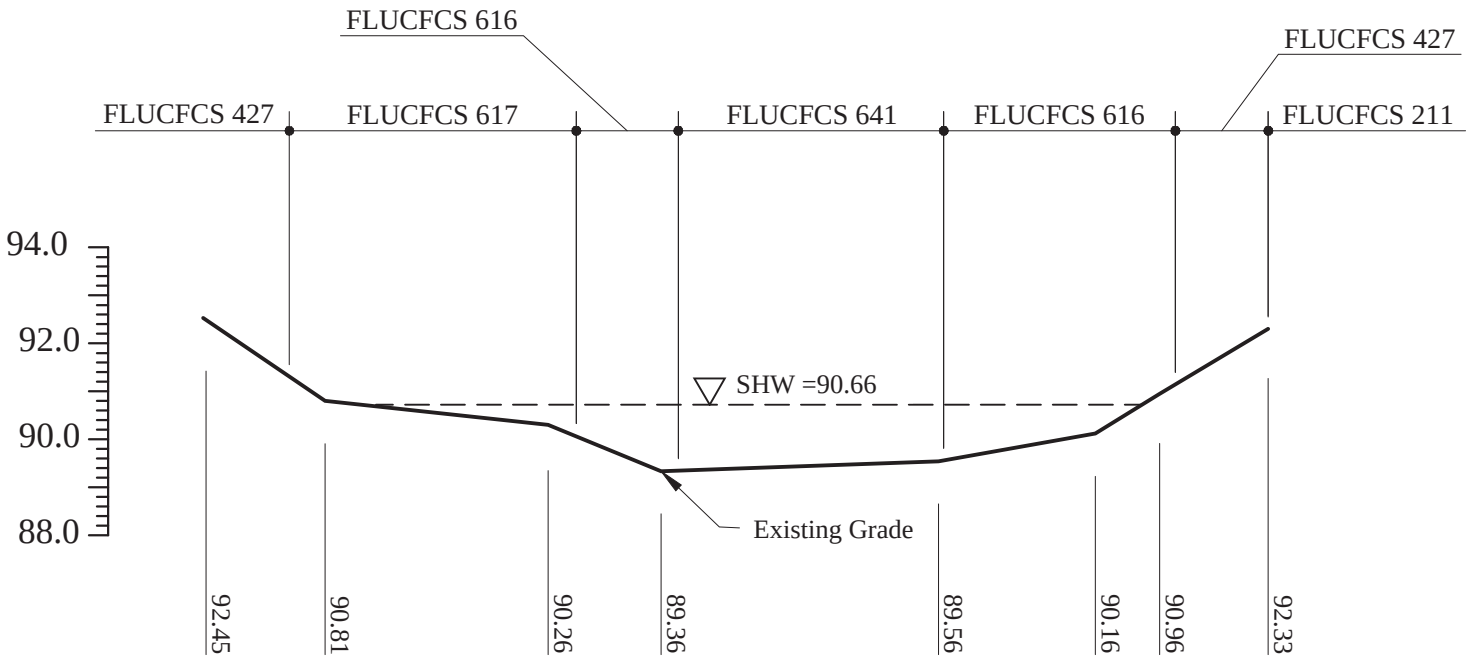
Central Wetland Transect 12W_44A

Cental Wetland
Transect 12W_44A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C1

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Cross Section 12W_44A

VERT 1" = 6' HORZ 1" =100'

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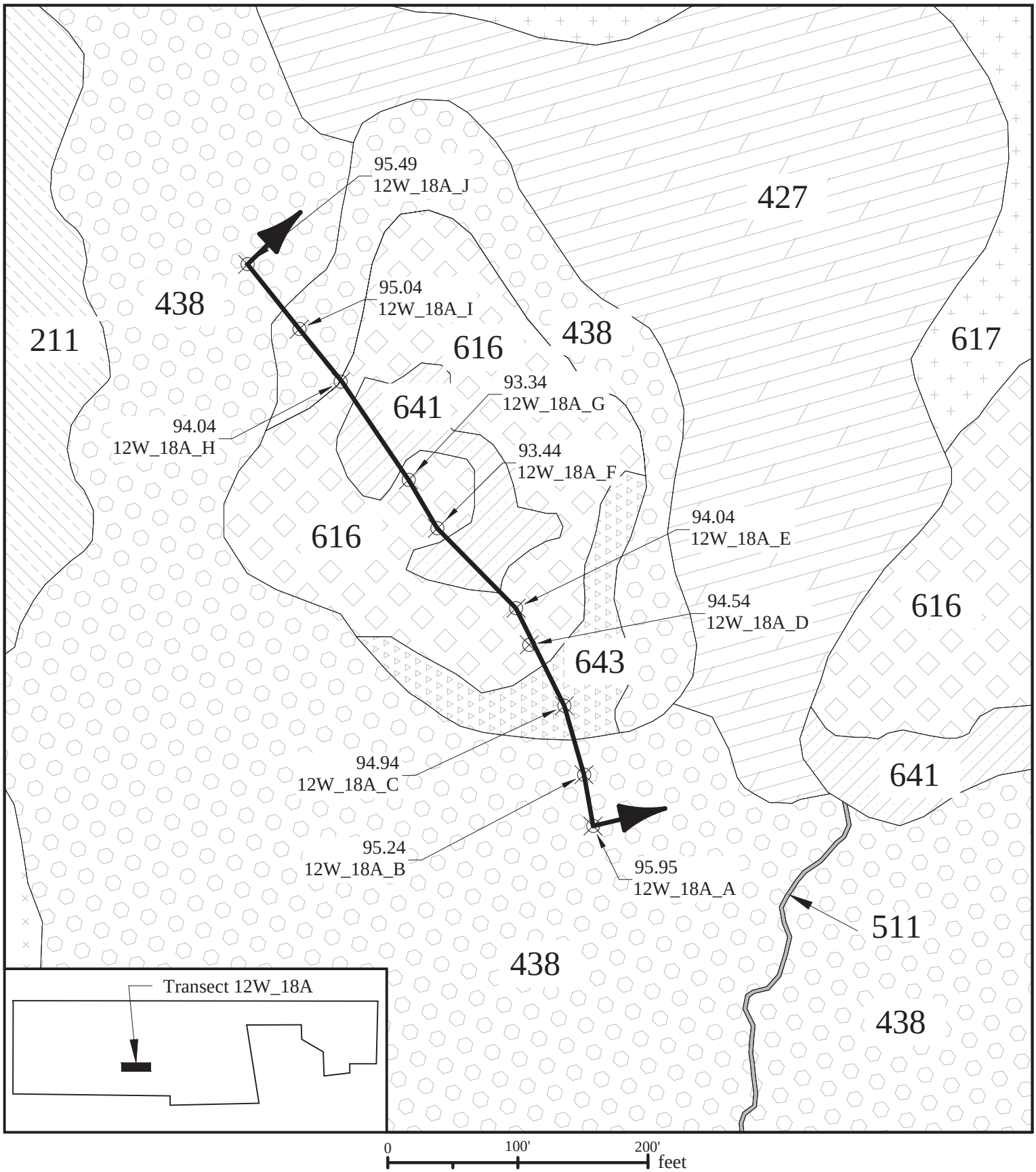
Central Wetland Transect 12W_44A

Cental Wetland
Transect 12W_44A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C1a

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CF Industries

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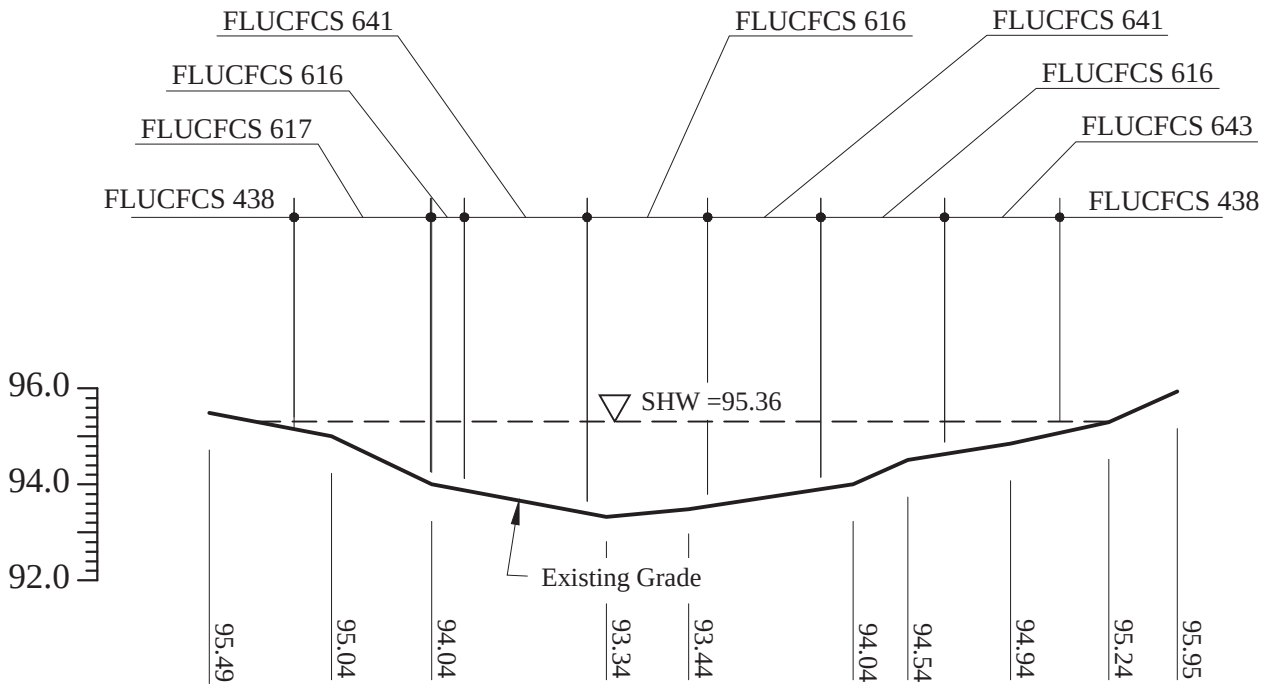
Central Wetland Transect 12W_18A

Cental Wetland
Transect 12W_18A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C2

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Date: 05/30/06 Rev. Date: 04/15/08 PM: DJD CAD Operator: MAB Project # : 0675-041 File Location: C:\Users\jamesb\appdata\local\temp\AcPublish_9528\ERP_CF_wetland_transects_2010.dwg



Cross Section 12W_18A

VERT 1" = 6' HORZ 1" =100'

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CF Industries

South Pasture Extension

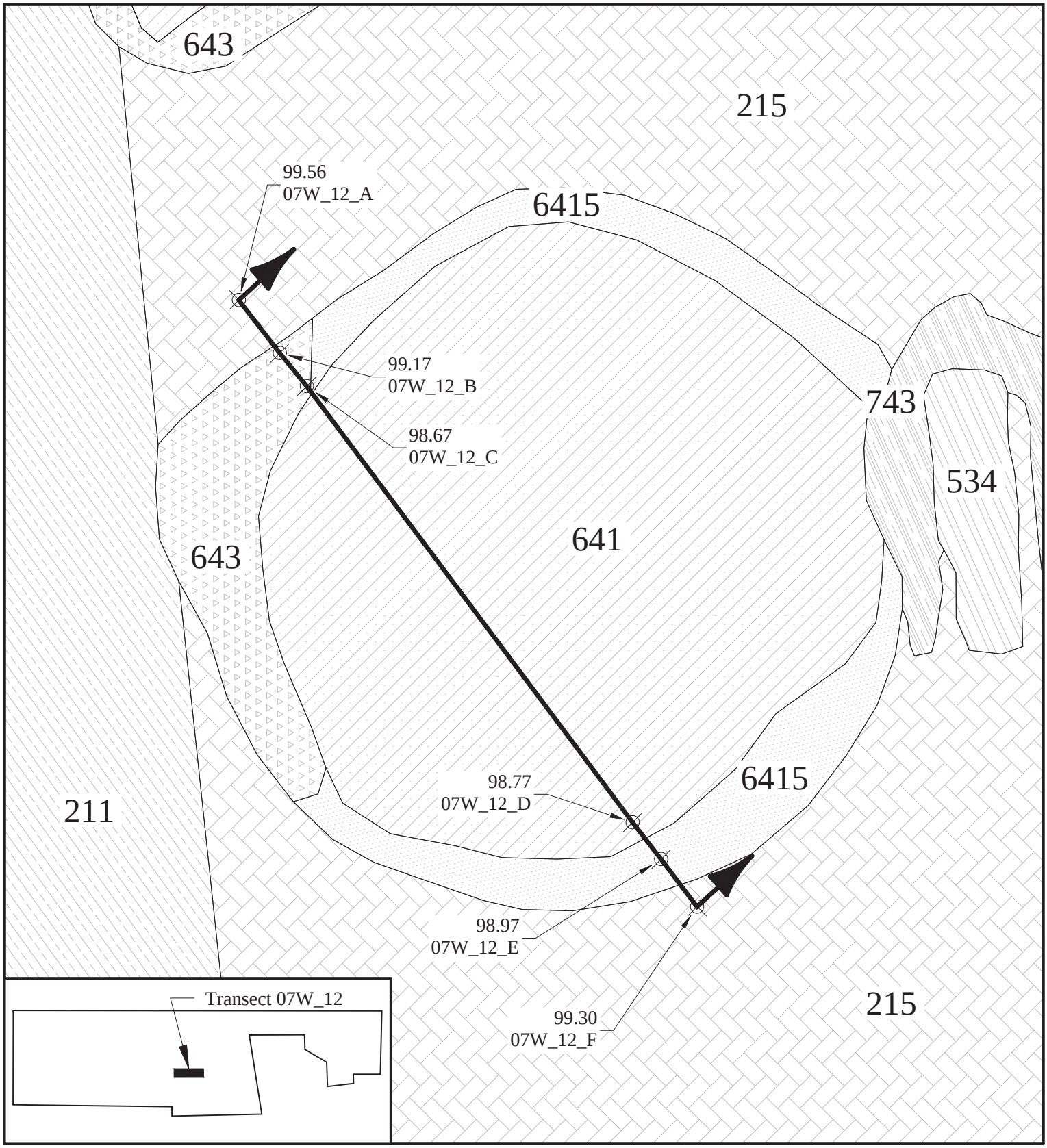
Central Wetland Transect 12W_18A

Cental Wetland
Transect 12W_18A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C2a

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CF Industries

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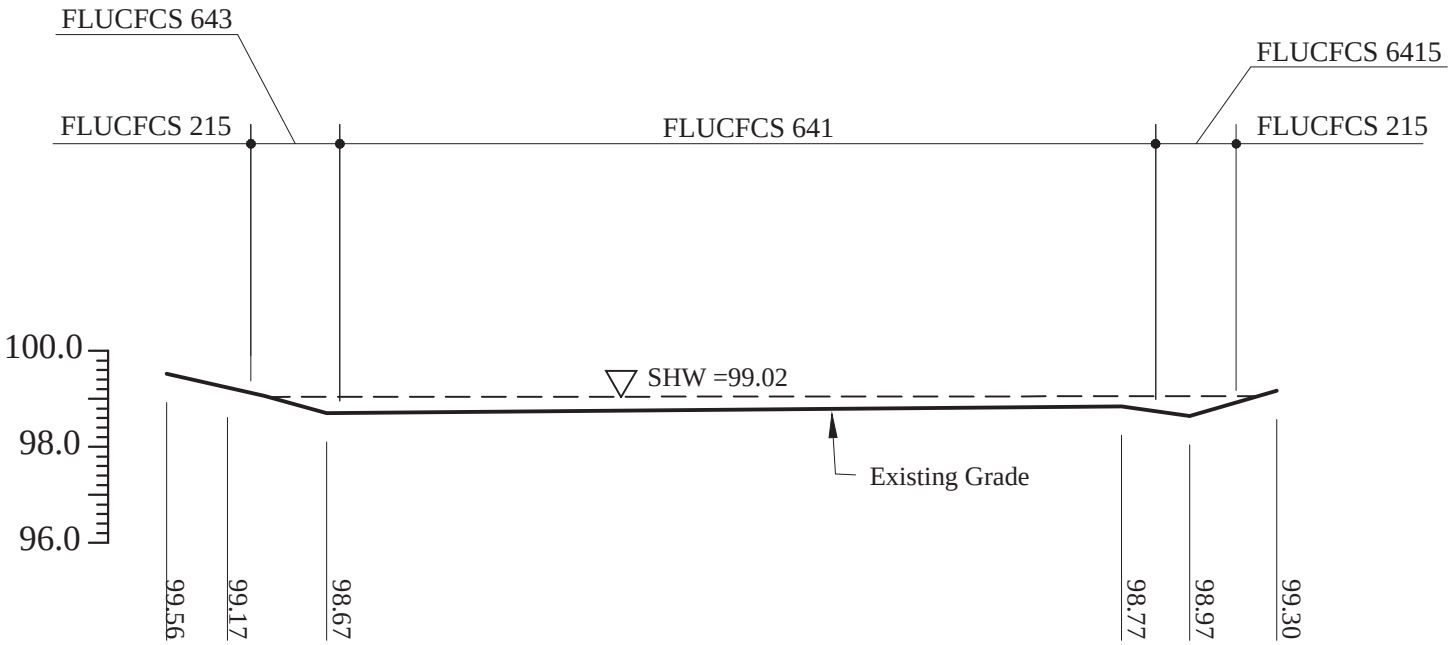
Central Wetland Transect 07W_12

Cental Wetland
Transect 07W_12
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C3

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Cross Section 07W_12

VERT 1" = 6' HORZ 1" =100'

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CF Industries

South Pasture Extension

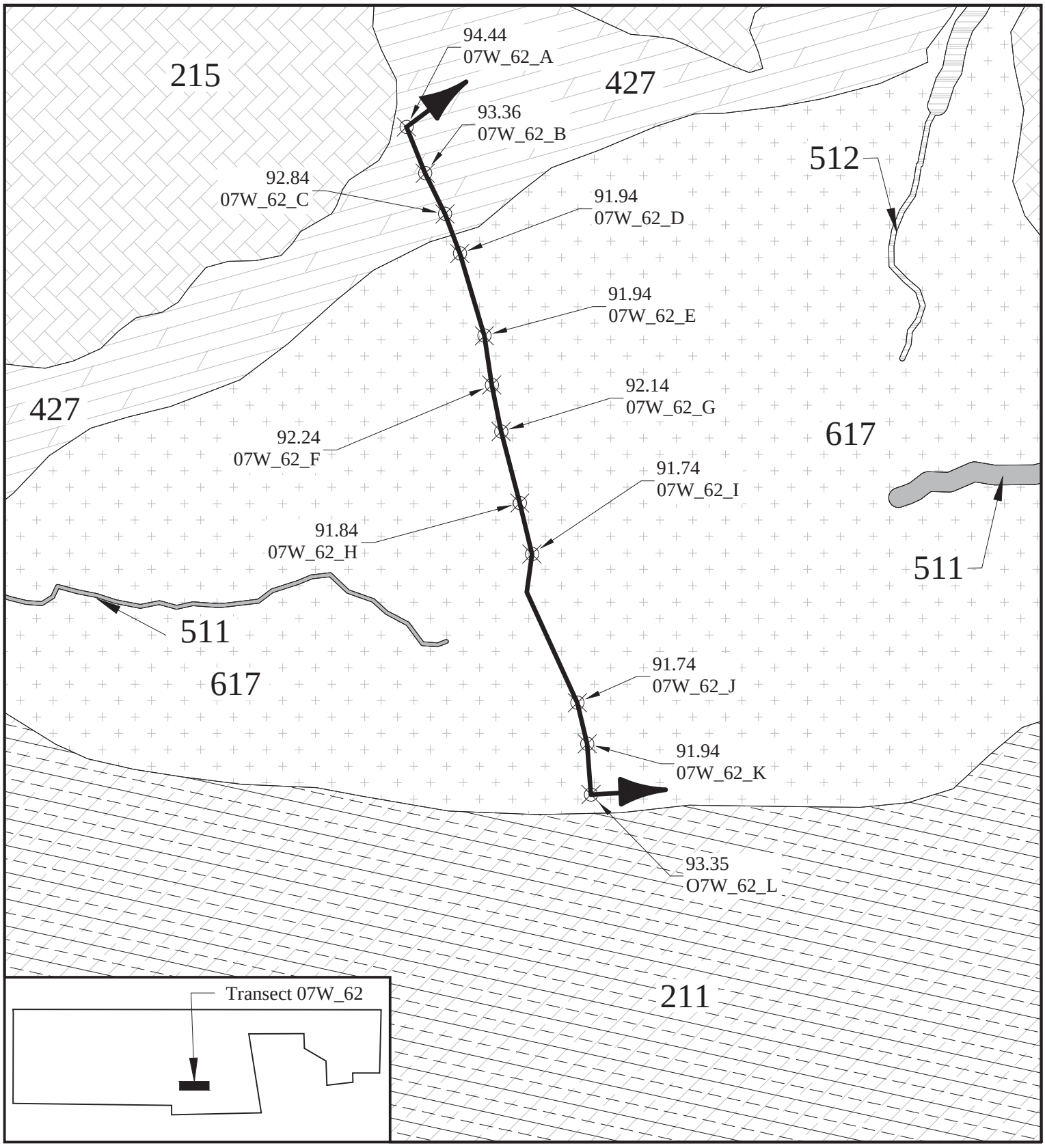
Central Wetland Transect 07W_12

Cental Wetland
Transect 07W_12
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C3a

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CF Industries

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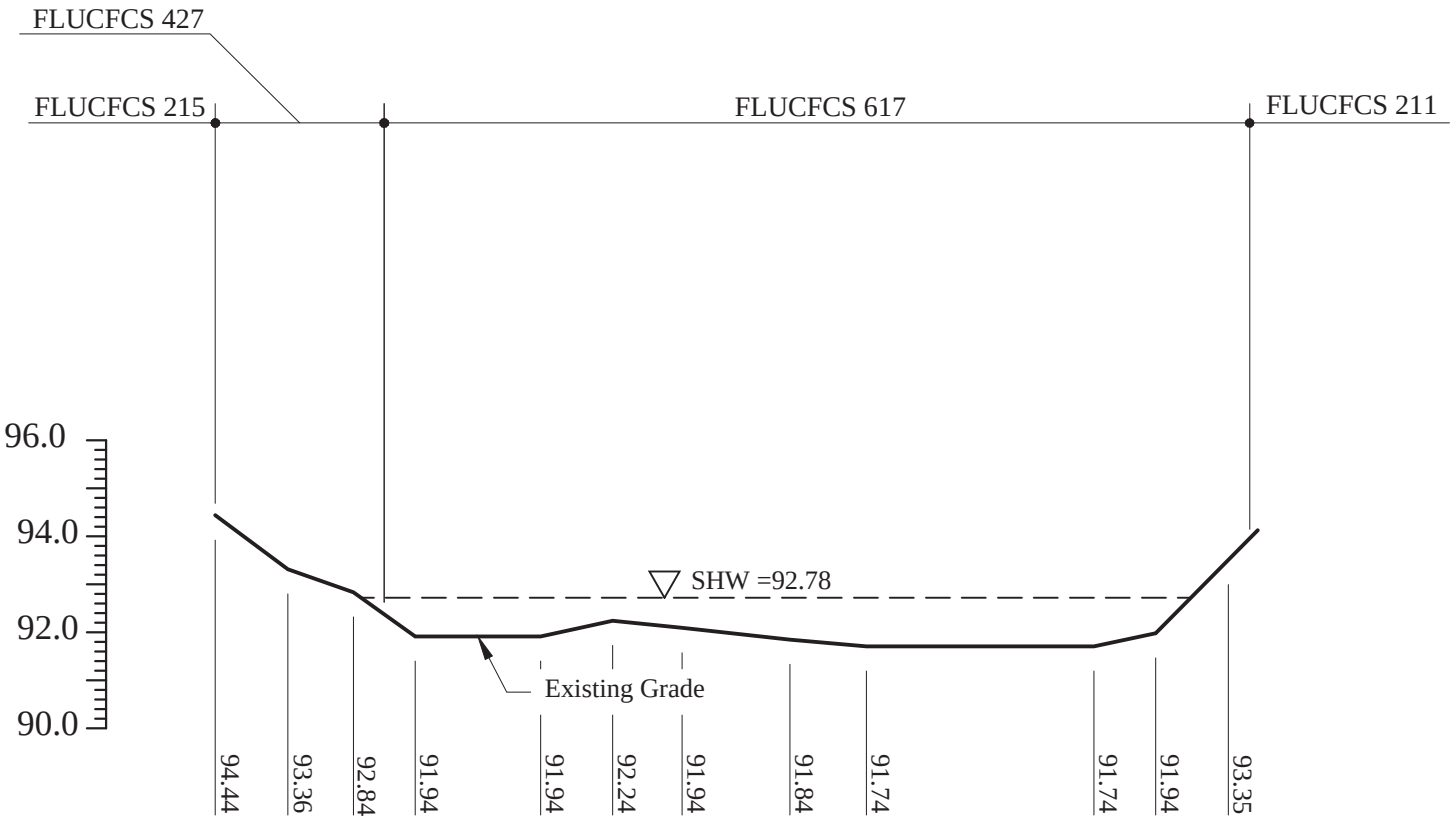
Central Wetland Transect 07W_62

Cental Wetland
Transect 07W_62
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C4

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Cross Section 07W_62

VERT 1" = 6' HORZ 1" =100'

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CF Industries

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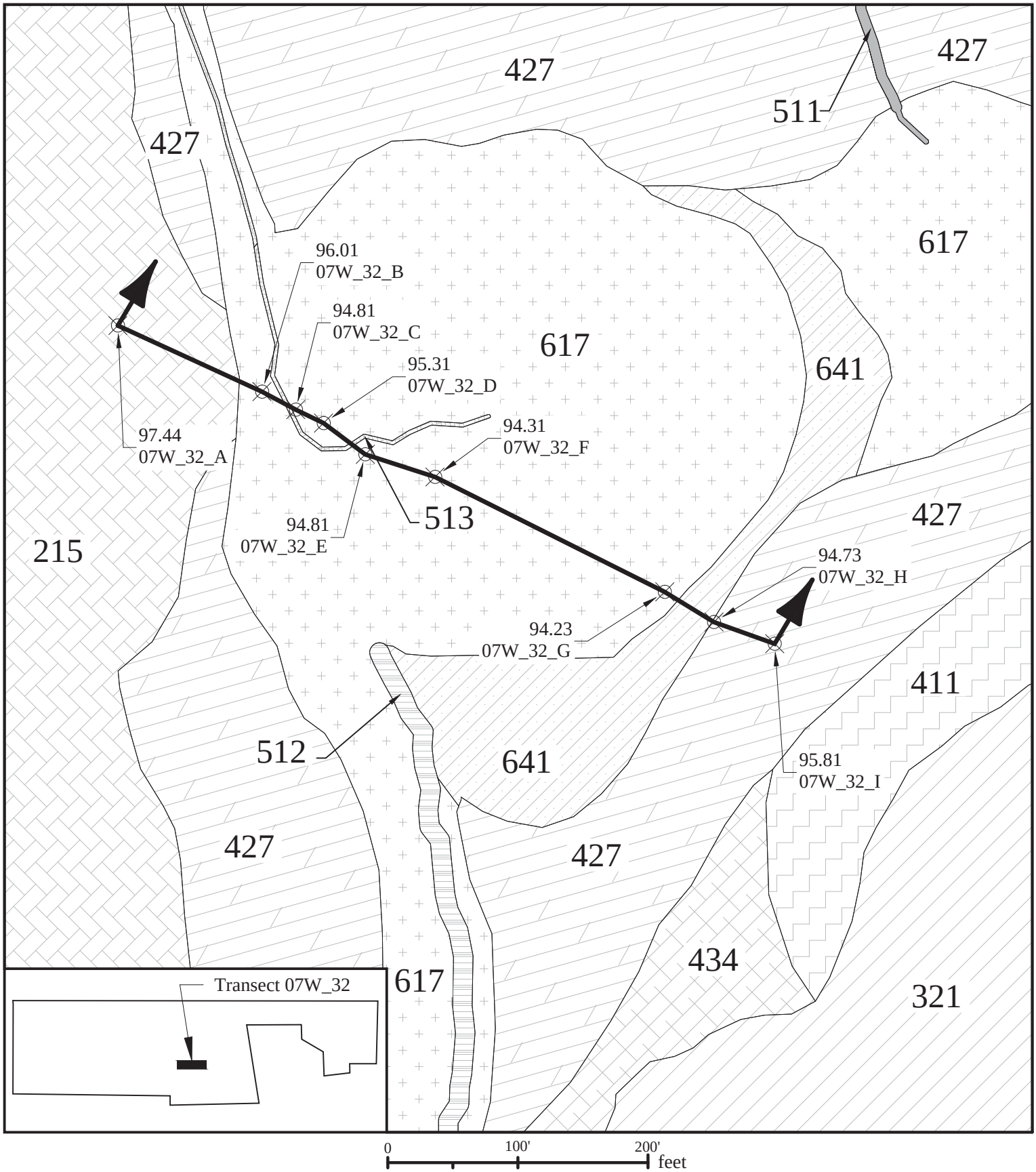
Central Wetland Transect 07W_62

Cental Wetland
Transect 07W_62
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C4a

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CF Industries

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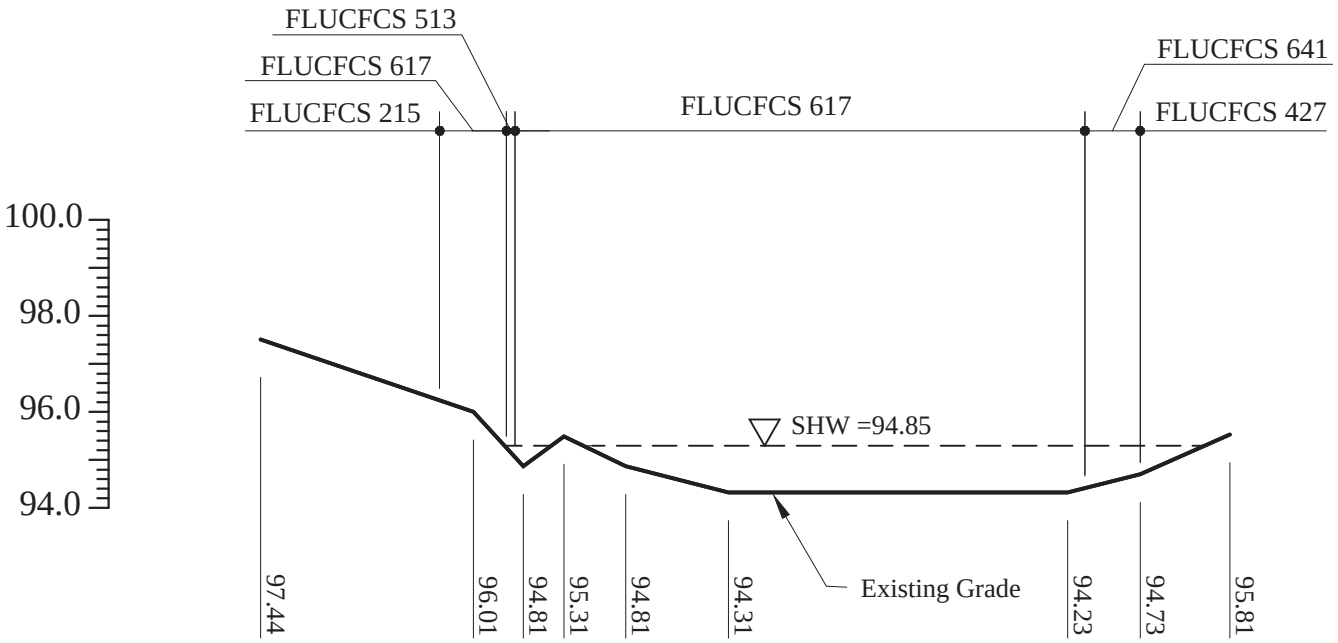
Central Wetland Transect 07W_32

Cental Wetland
Transect 07W_32
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C5

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Cross Section 07W_32

VERT 1" = 6' HORZ 1" =100'

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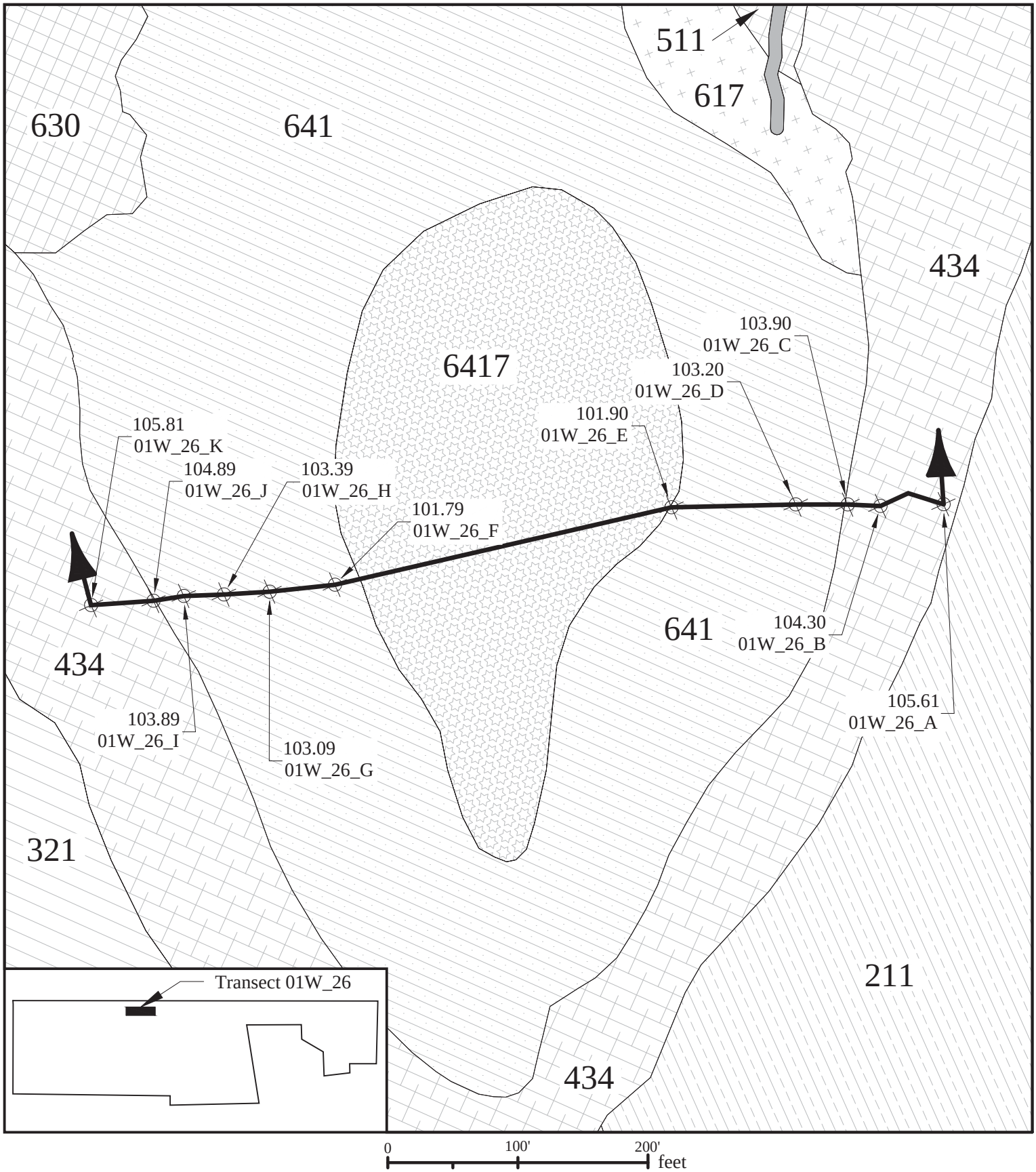
Central Wetland Transect 07W_32

Cental Wetland
Transect 07W_32
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C5a

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CF Industries

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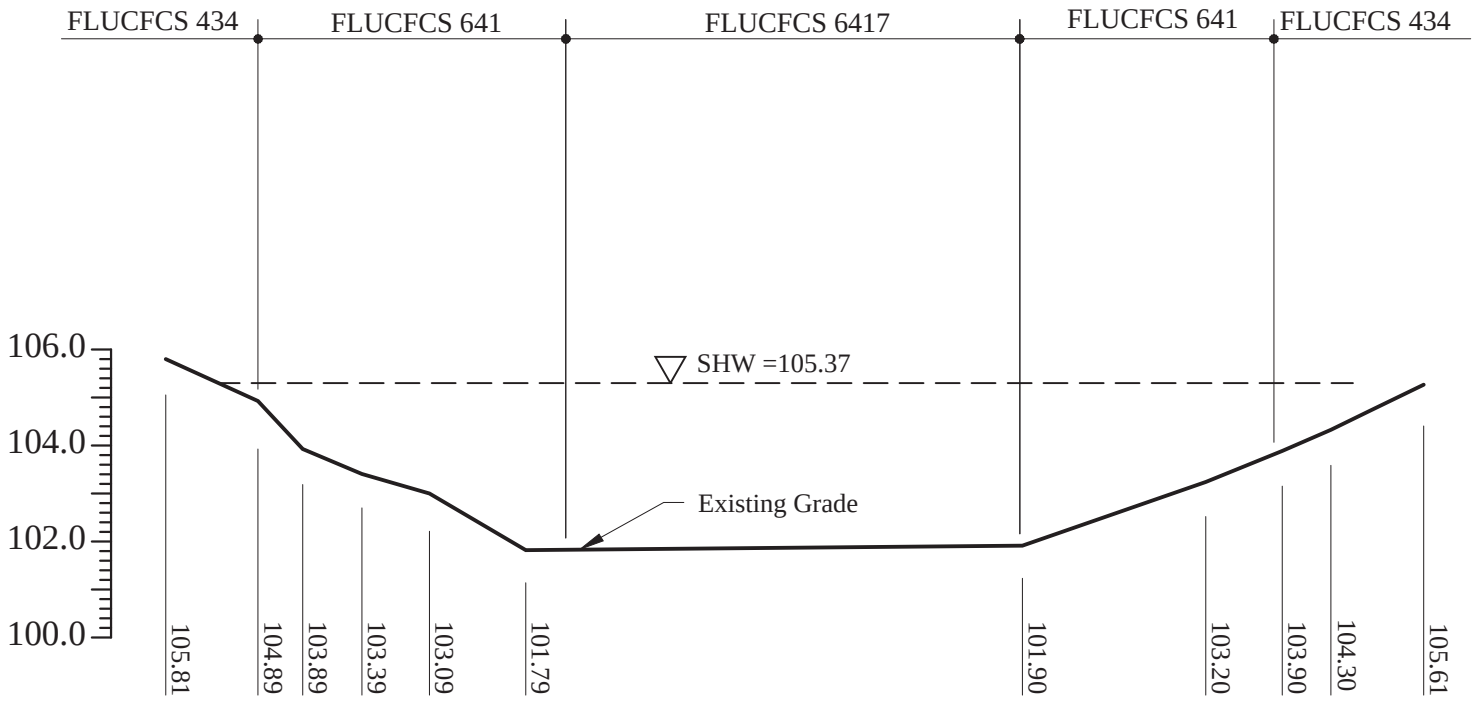
Central Wetland Transect 01W_26

Cental Wetland
Transect 01W_26
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C6

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Cross Section 01W_26

VERT 1" = 6' HORZ 1" =100'

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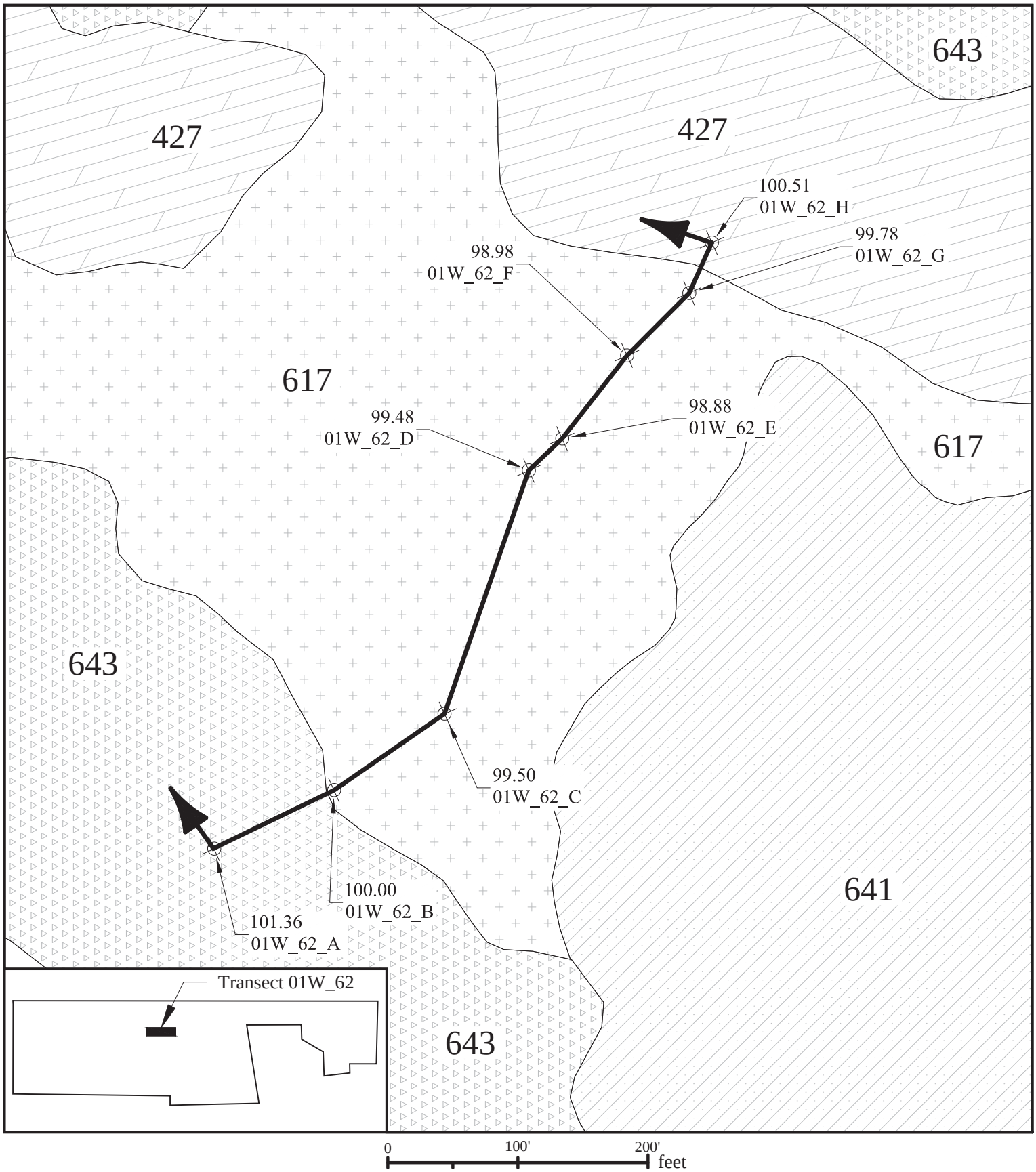
Central Wetland Transect 01W_26

Cental Wetland
Transect 01W_26
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C6a

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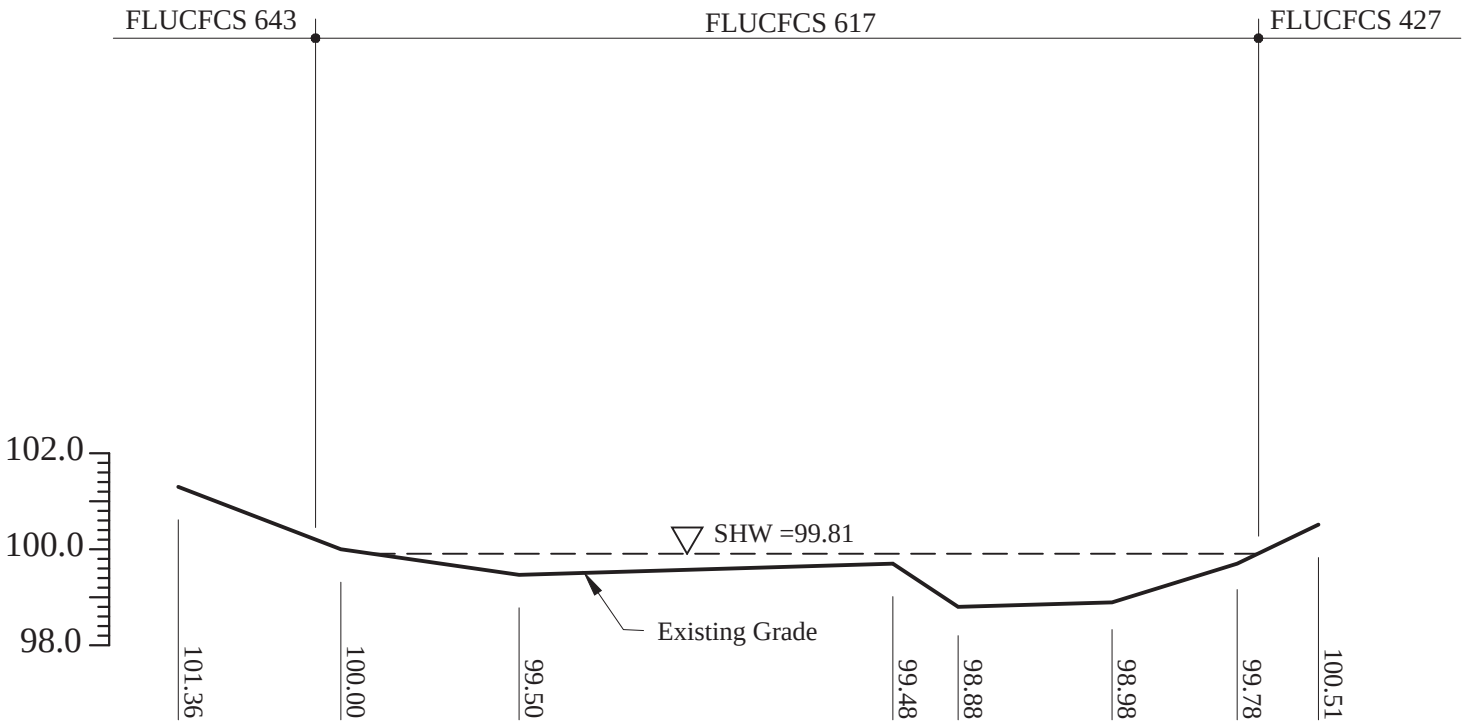
Central Wetland Transect 01W_62

Cental Wetland
Transect 01W_62
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C7

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Cross Section 01W_62

VERT 1" = 6' HORZ 1" =100'

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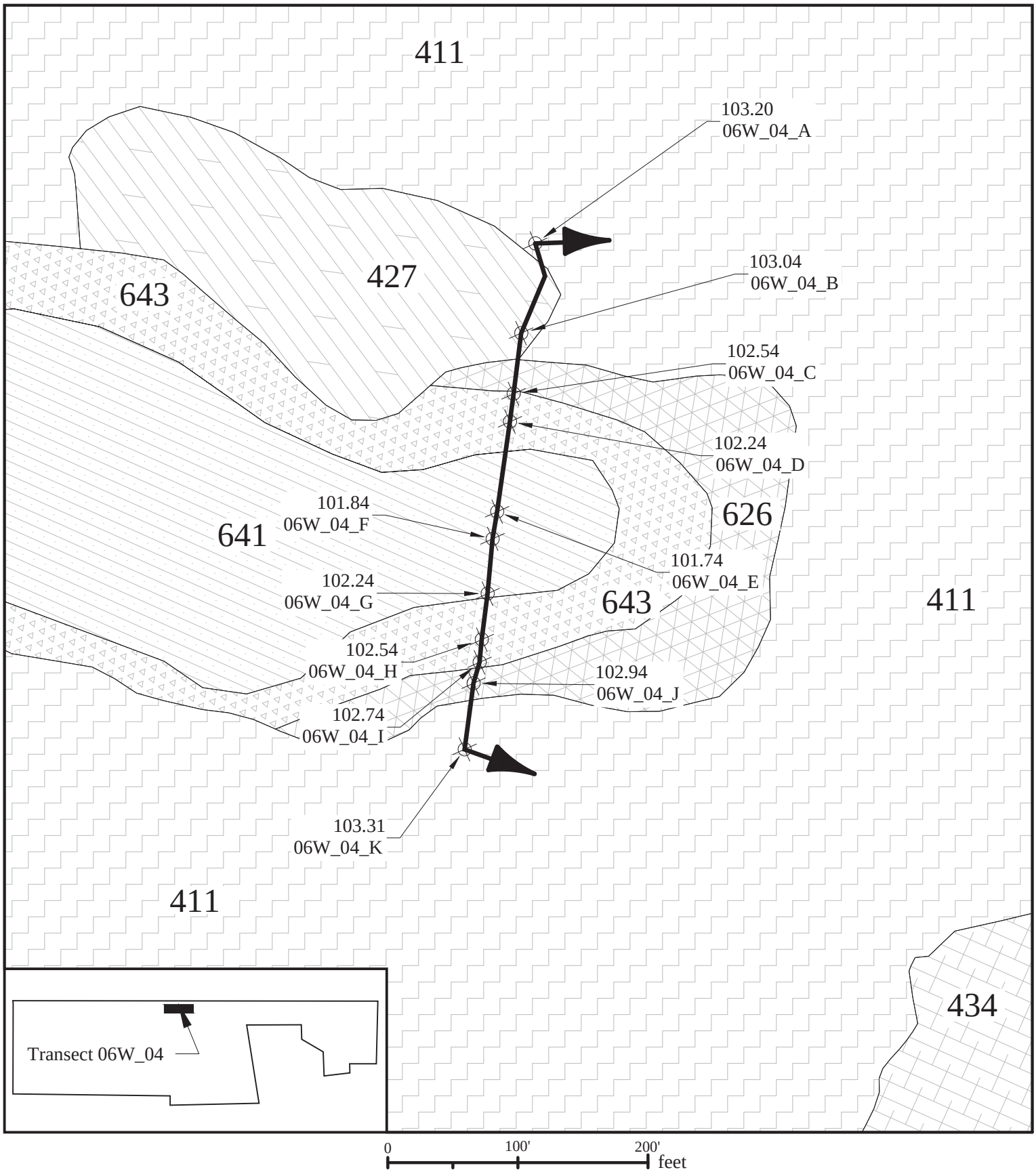
Central Wetland Transect 01W_62

Cental Wetland
Transect 01W_62
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C7a

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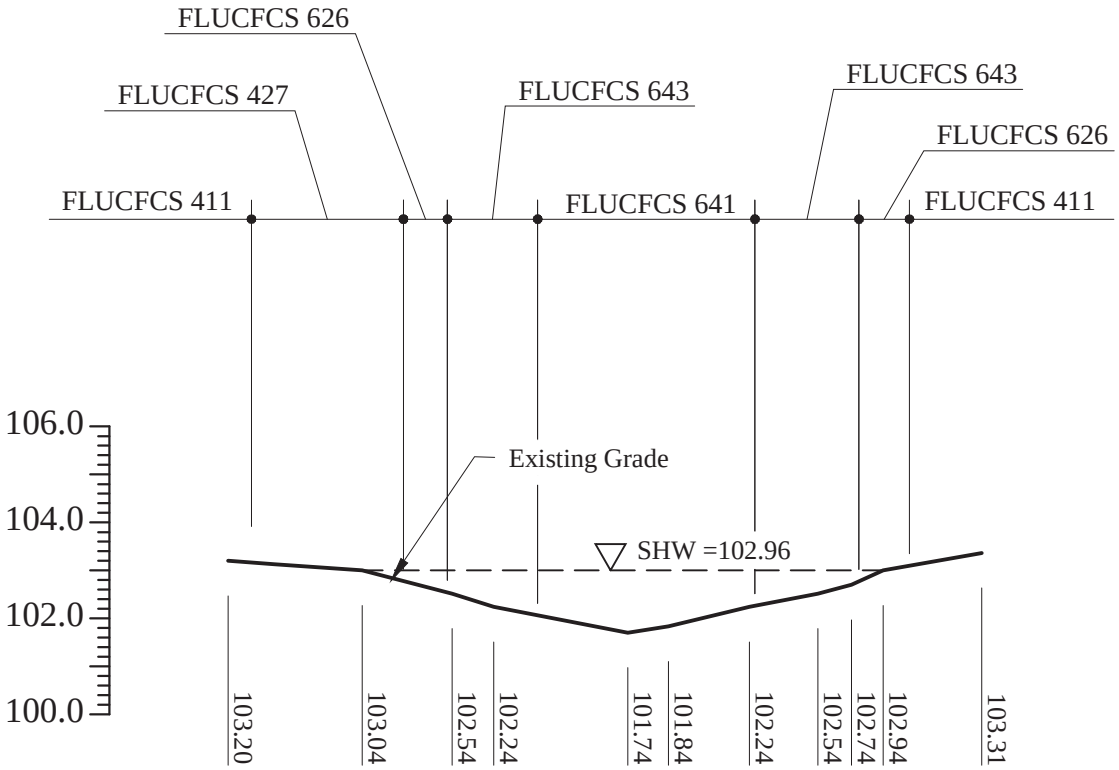
Central Wetland Transect 06W_04

Cental Wetland
Transect 06W_04
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C8

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Cross Section 06W_04

VERT 1" = 6' HORZ 1" =100'

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CF Industries

South Pasture Extension

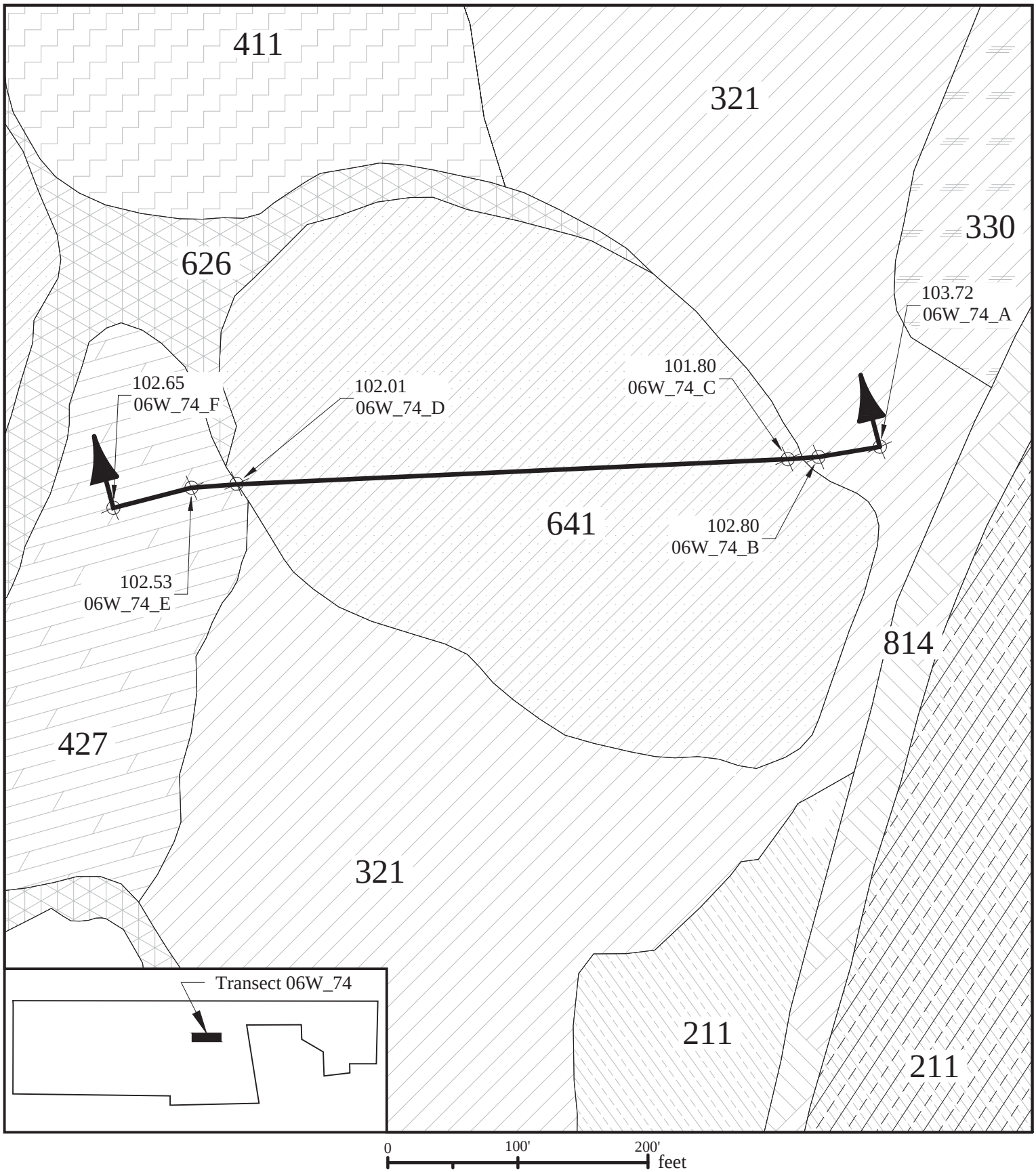
Central Wetland Transect 06W_04

Cental Wetland
Transect 06W_04
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C8a

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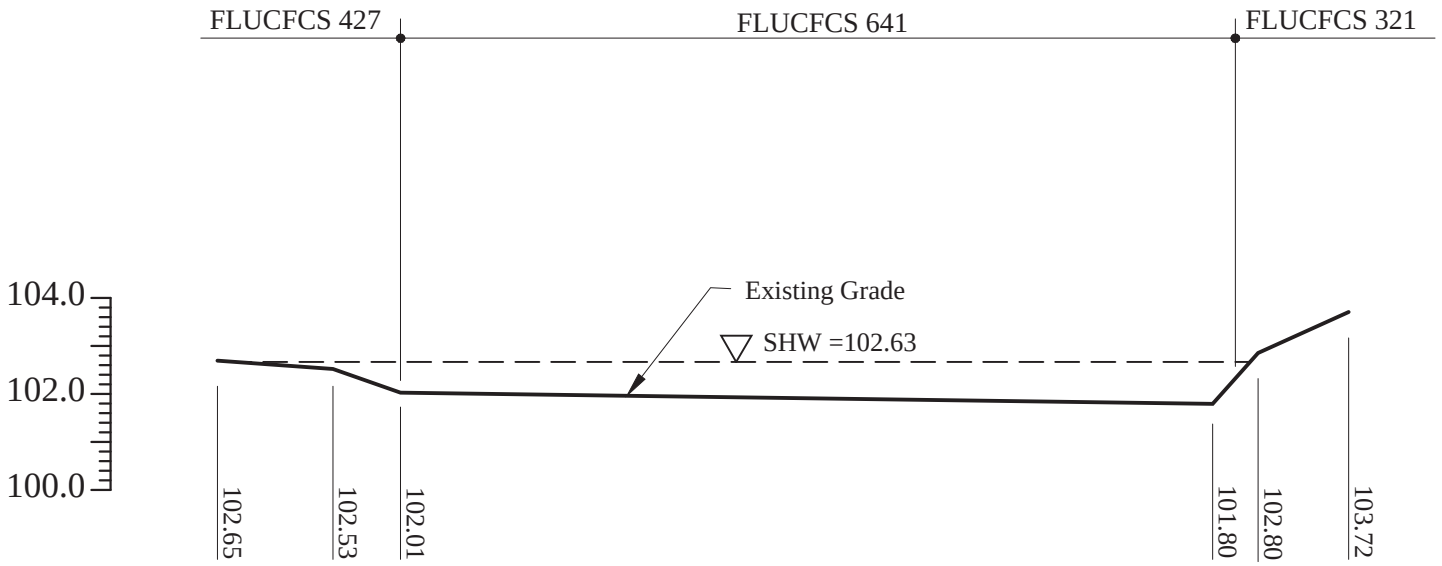
Central Wetland Transect 06W_74

Cental Wetland
Transect 06W_74
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C9

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Cross Section 06W_74

VERT 1" = 6' HORZ 1" =100'

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CF Industries

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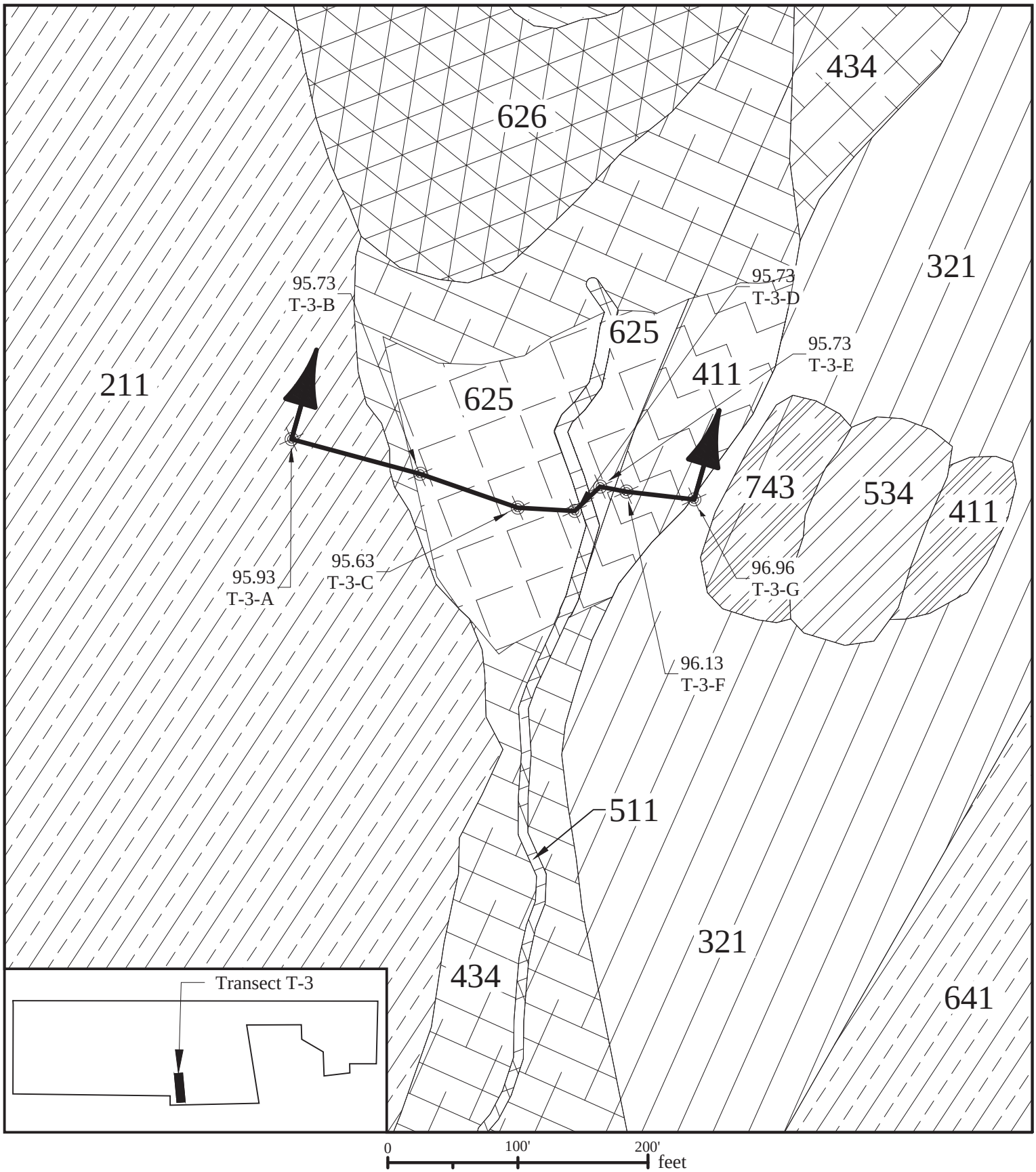
Central Wetland Transect 06W_74

Cental Wetland
Transect 06W_74
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C9a

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CF Industries

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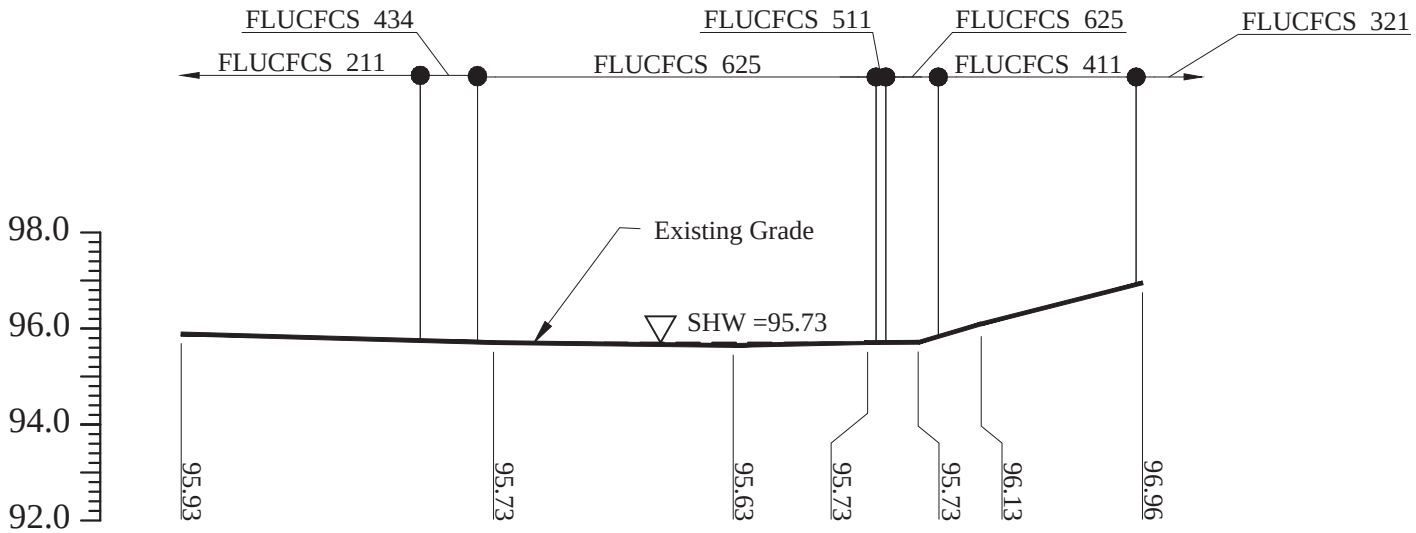
Central Wetland Transect T-3

Cental Wetland
Transect T-3
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C10

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Cross Section T-3

VERT 1" = 6' HORZ 1" =50'

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CF Industries

South Pasture Extension

Central Wetland Transect T-3

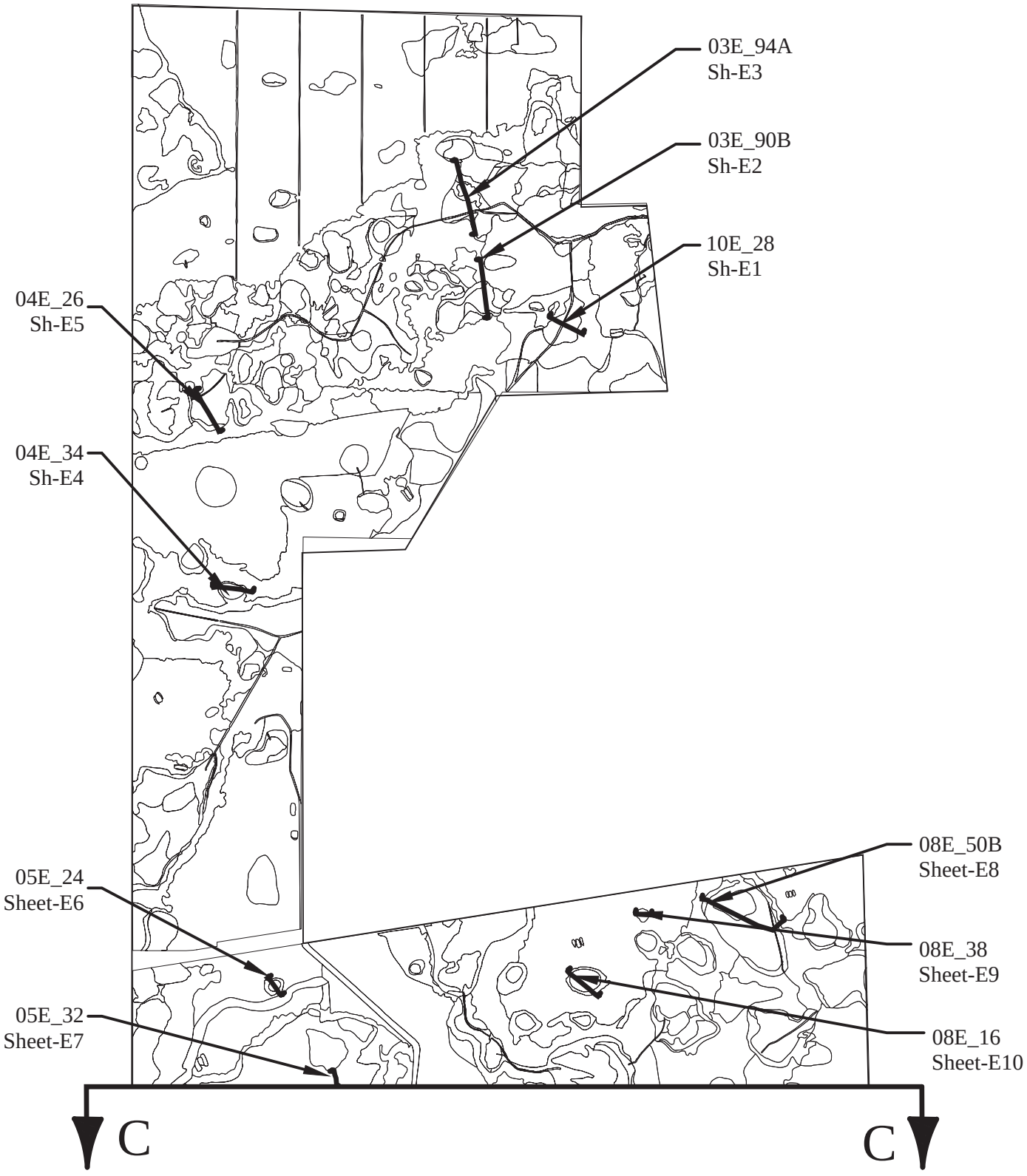
Cental Wetland
Transect T-3
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - C10a

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Coordinate System:
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Date: 05/30/06 Rev. Date: 04/15/08 PM: DJD CAD Operator: MAB Project # : 0675-041 File Location: C:\Users\jamesb\appdata\local\temp\AcPublish_9528\ERP_CF_wetland_transects_2010.dwg

East Wetland Transect Location Map



0 2000' 4000' feet

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CF Industries

South Pasture Extension

East Wetland Location Map

East Wetland Transect Location Map

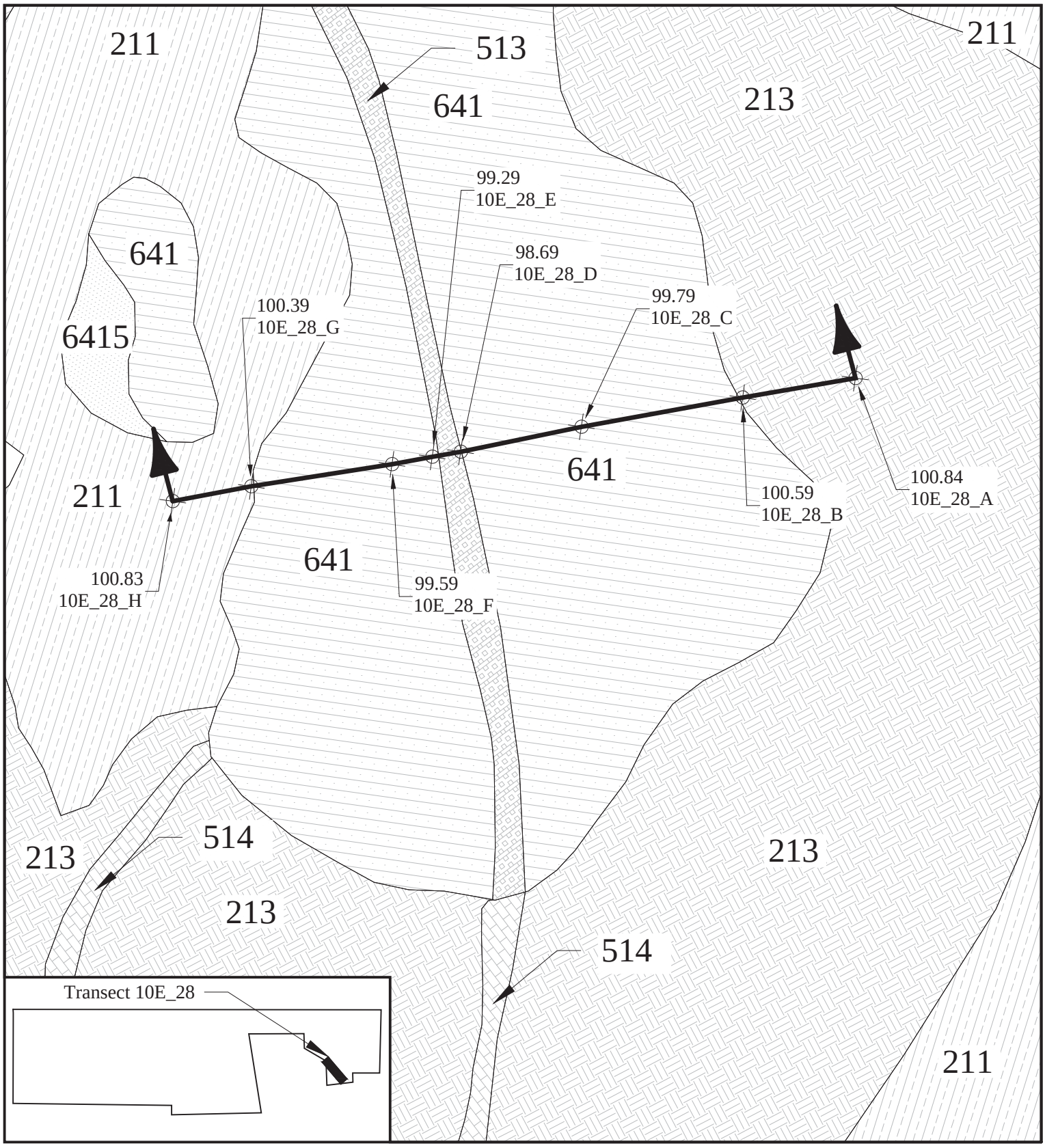
Center Sec 07
Twp 34 S
Rng 24 E

Overall East

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Coordinate System:
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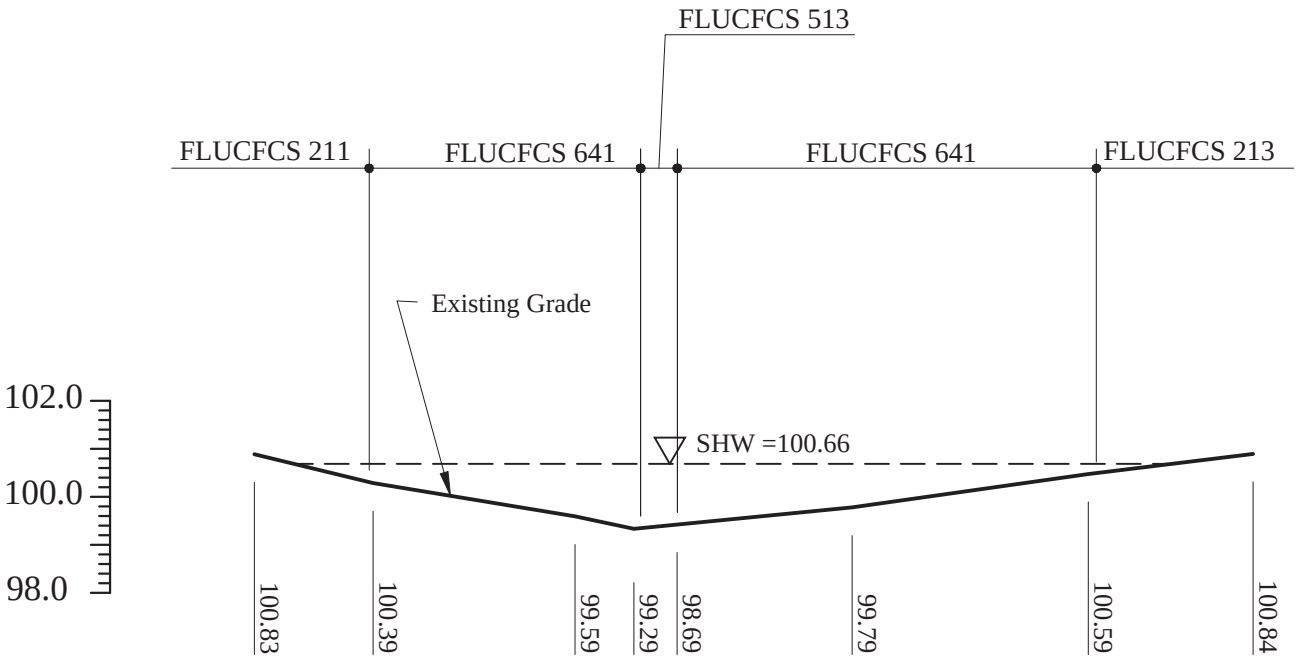
East Wetland Transect 10E_28

East Wetland
Transect 10E_28
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E1

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Cross Section 10E_28

VERT 1" = 6' HORZ 1" =100'

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CF Industries

South Pasture Extension

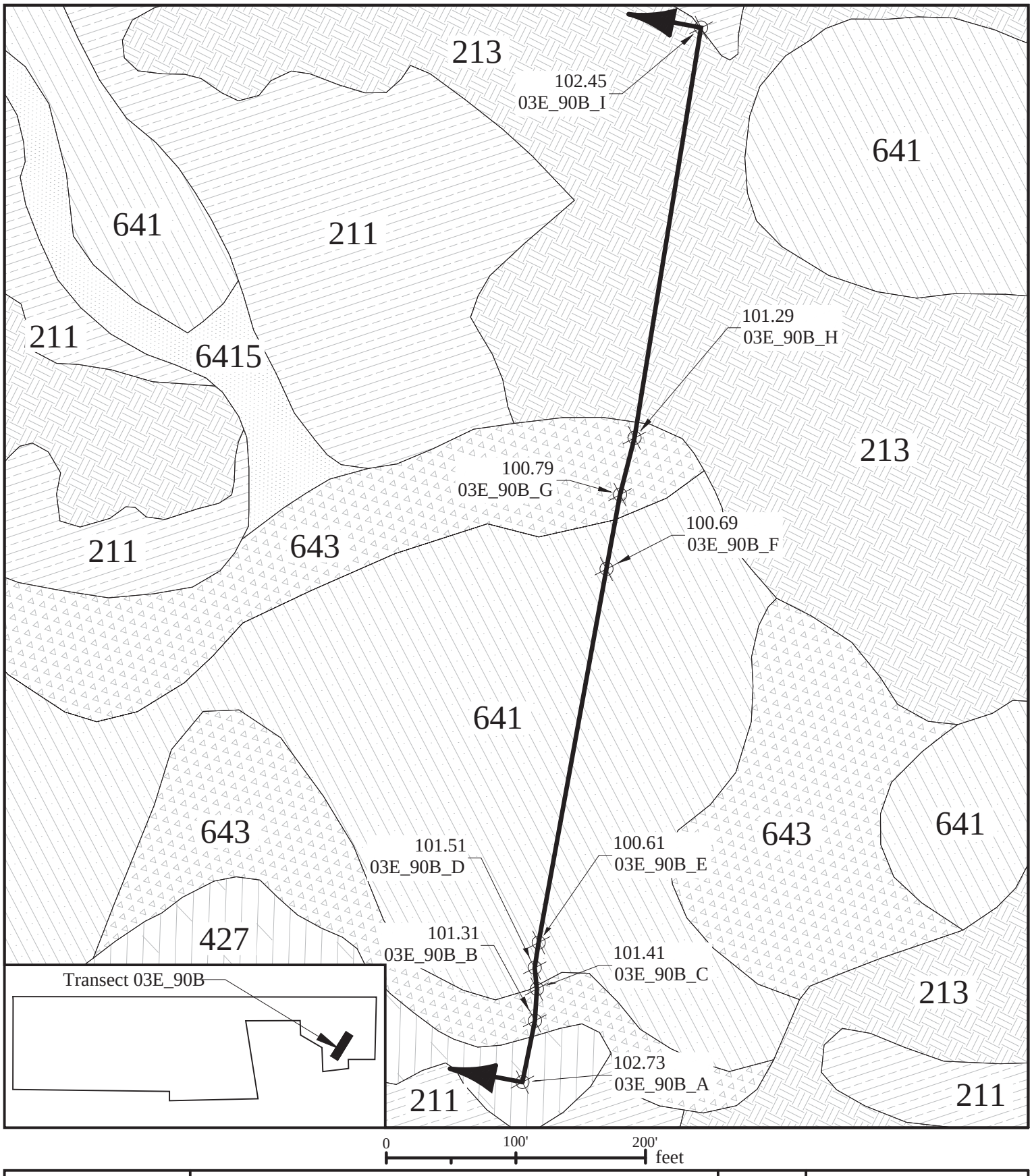
East Wetland Transect 10E_28

East Wetland
Transect 10E_28
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E1a

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CF Industries

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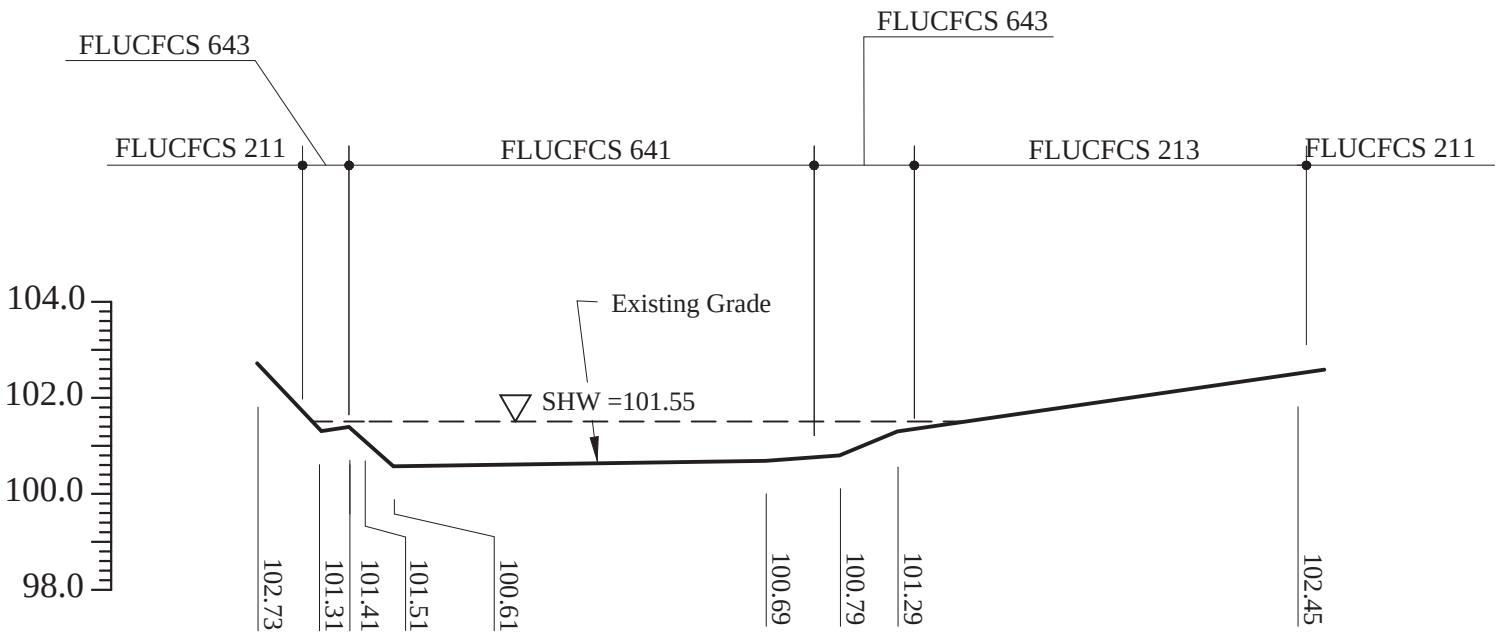
East Wetland Transect 03E_90B

East Wetland
Transect 03E_90B
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E2

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Cross Section 03E_90B

VERT 1" = 6' HORZ 1" =100'

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CF Industries

South Pasture Extension

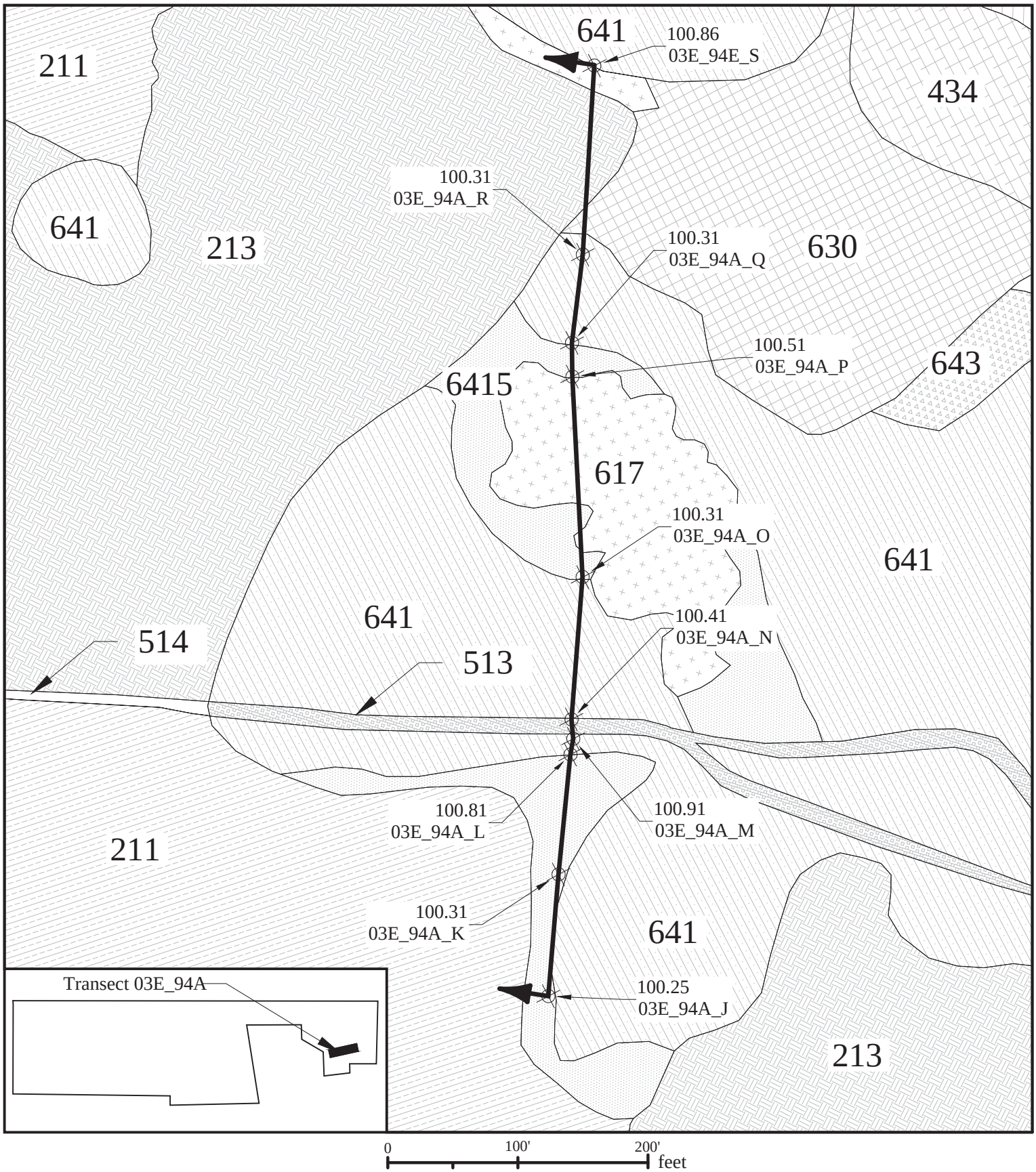
East Wetland Transect 03E_90B

East Wetland
Transect 03E_90B
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E2a

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CF Industries

South Pasture Extension

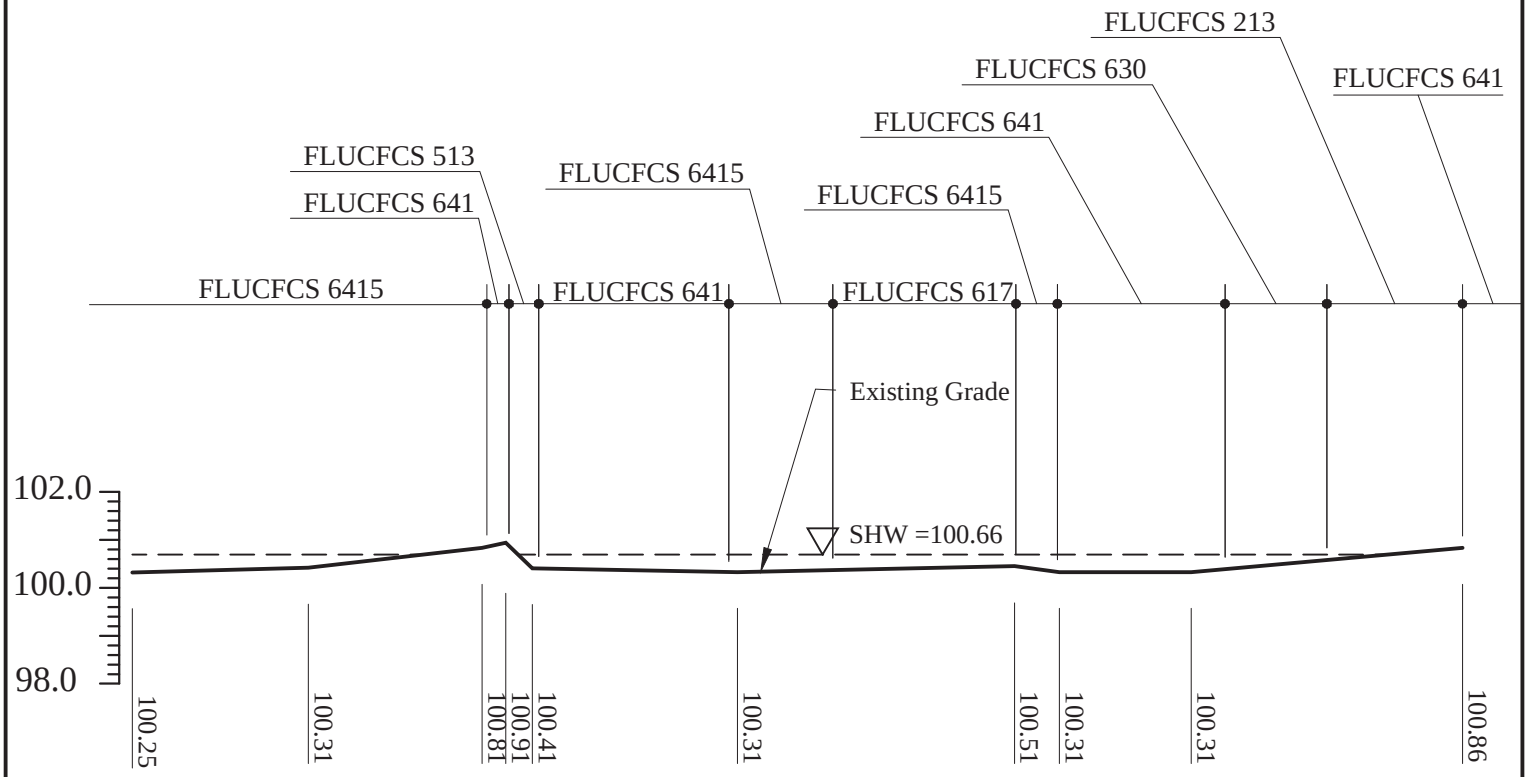
East Wetland Transect 03E_94A

East Wetland
Transect 03E_94A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E3

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Coordinate System:
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Cross Section 03E_94A

VERT 1" = 6' HORZ 1" =150'

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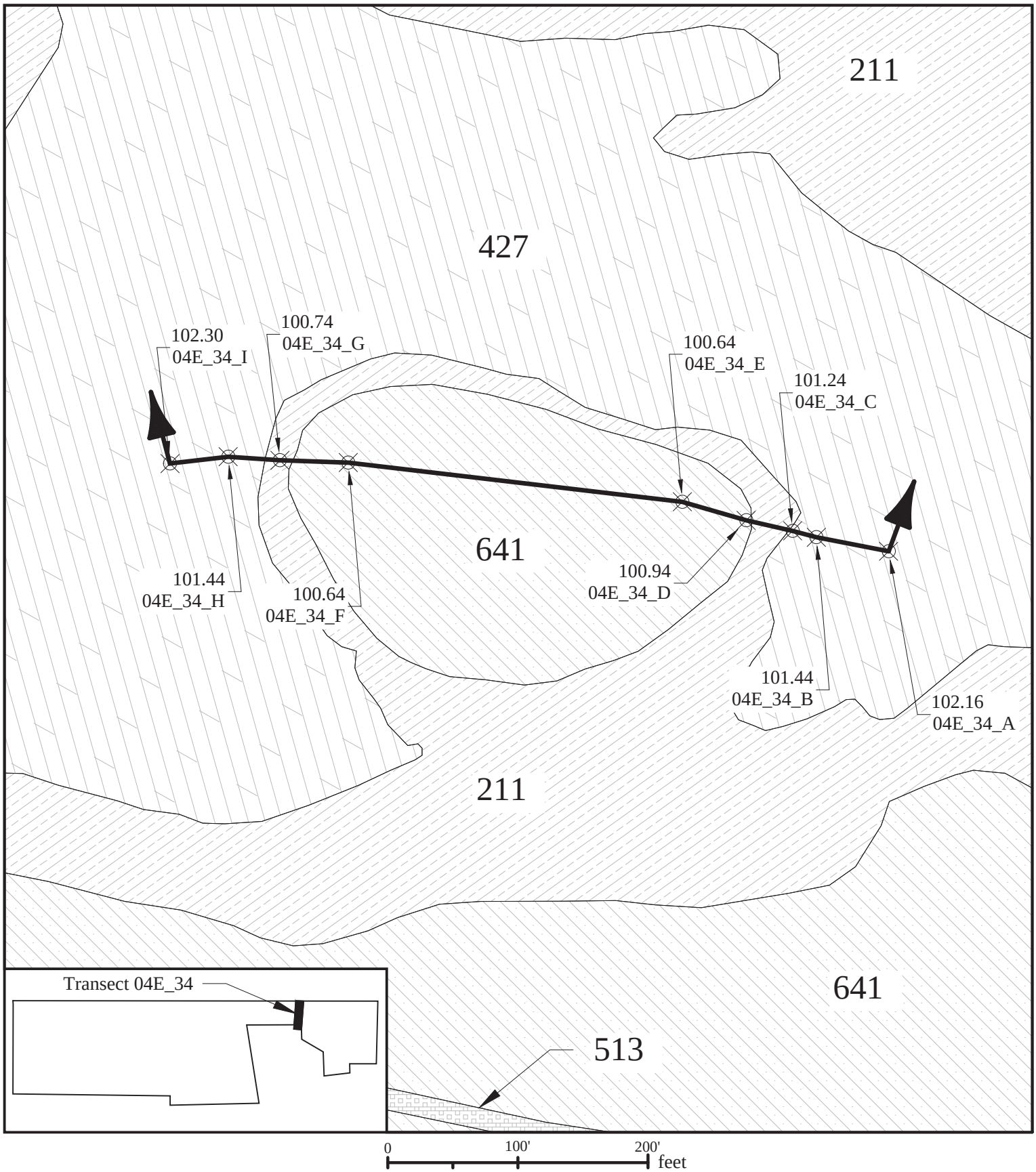
East Wetland Transect 03E_94A

East Wetland
Transect 03E_94A
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E3a

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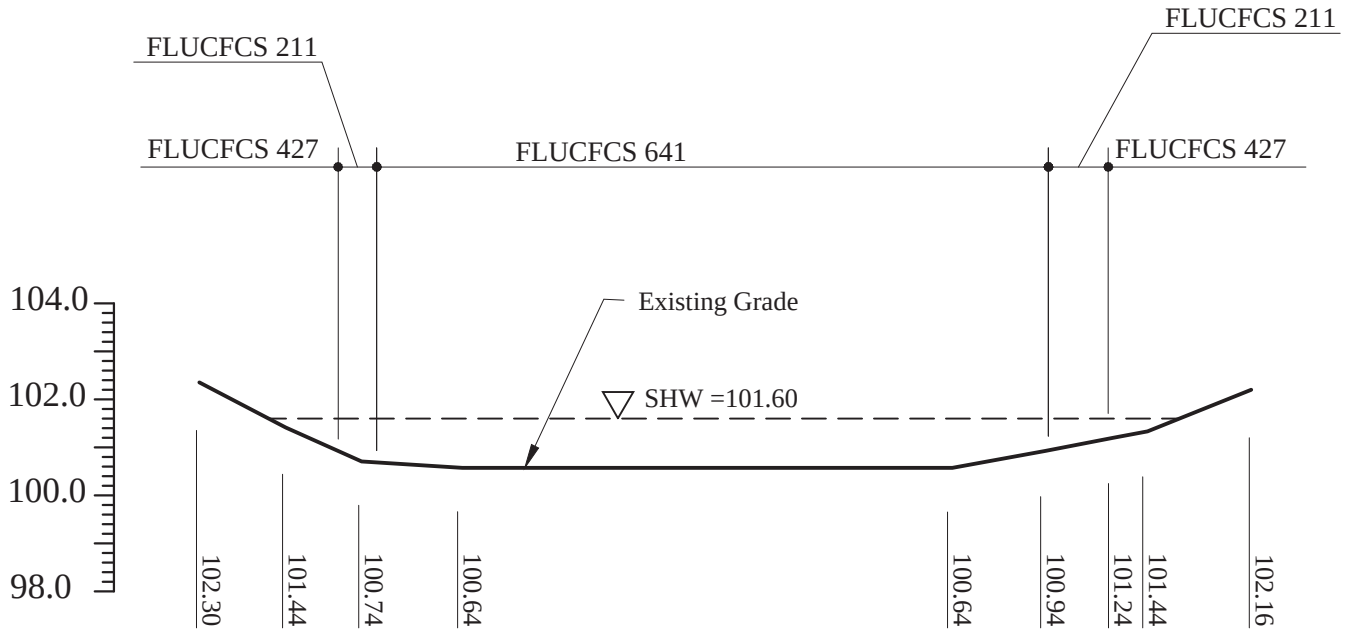
East Wetland Transect 04E_34

East Wetland
Transect 04E_34
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E4

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Cross Section 04E_34

VERT 1" = 6' HORZ 1" =100'

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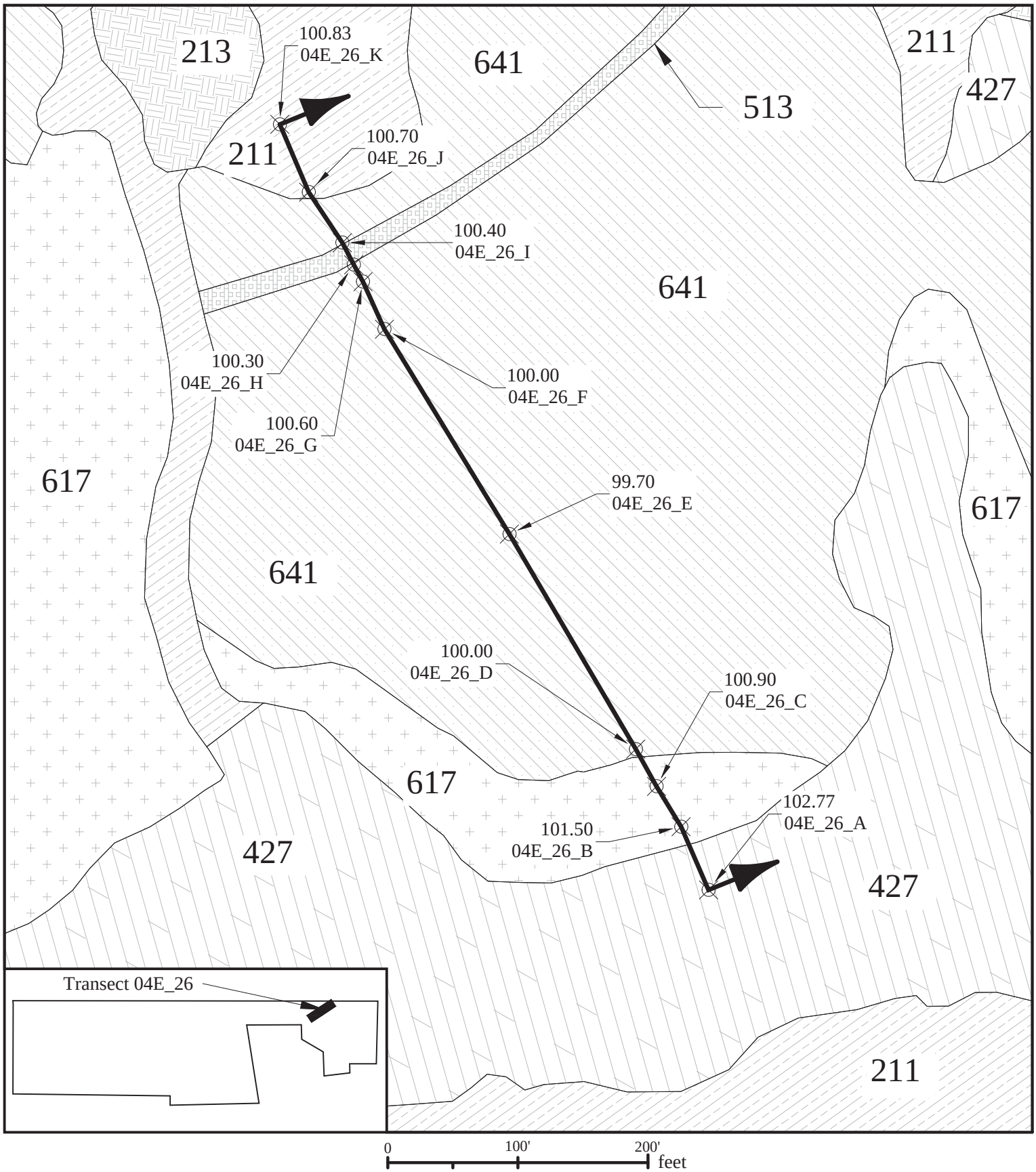
East Wetland Transect 04E_34

East Wetland
Transect 04E_34
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E4a

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CF Industries

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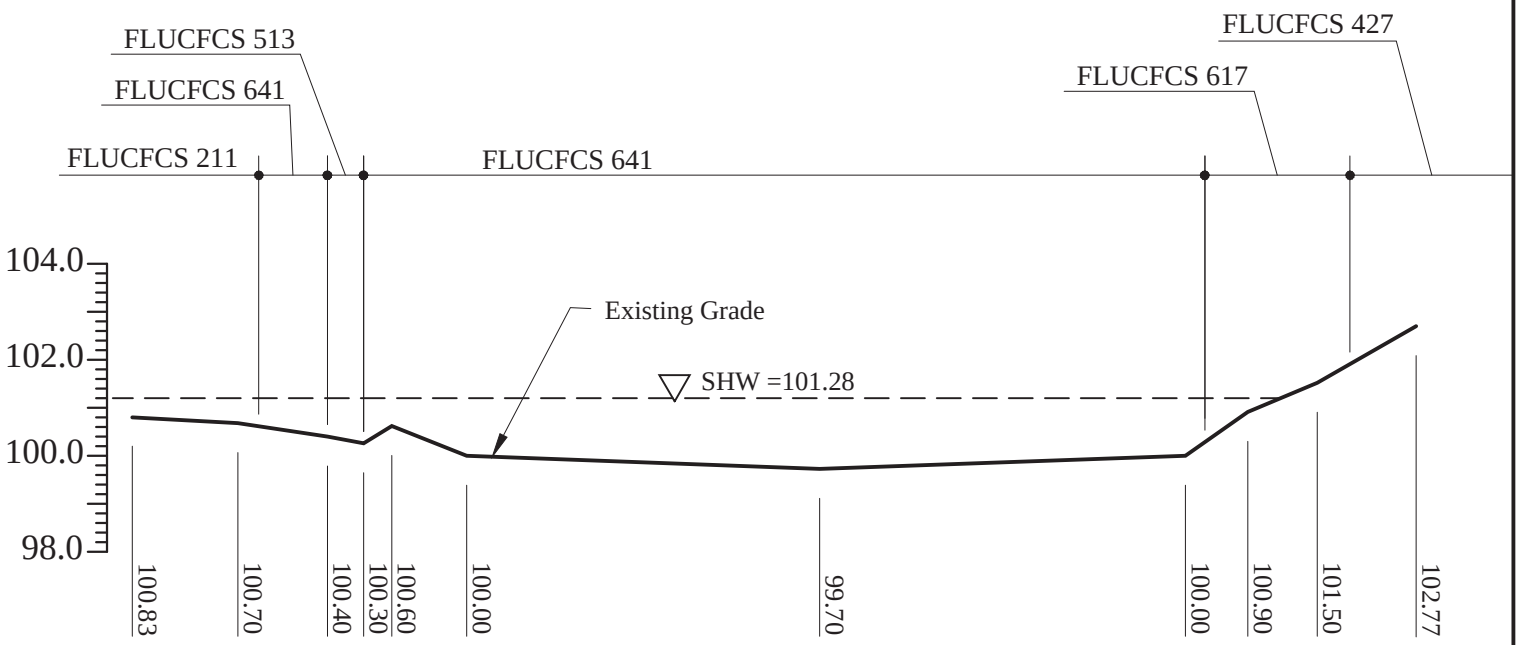
East Wetland Transect 04E_26

East Wetland
Transect 04E_26
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E5

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Cross Section 04E_26

VERT 1" = 6' HORZ 1" =100'

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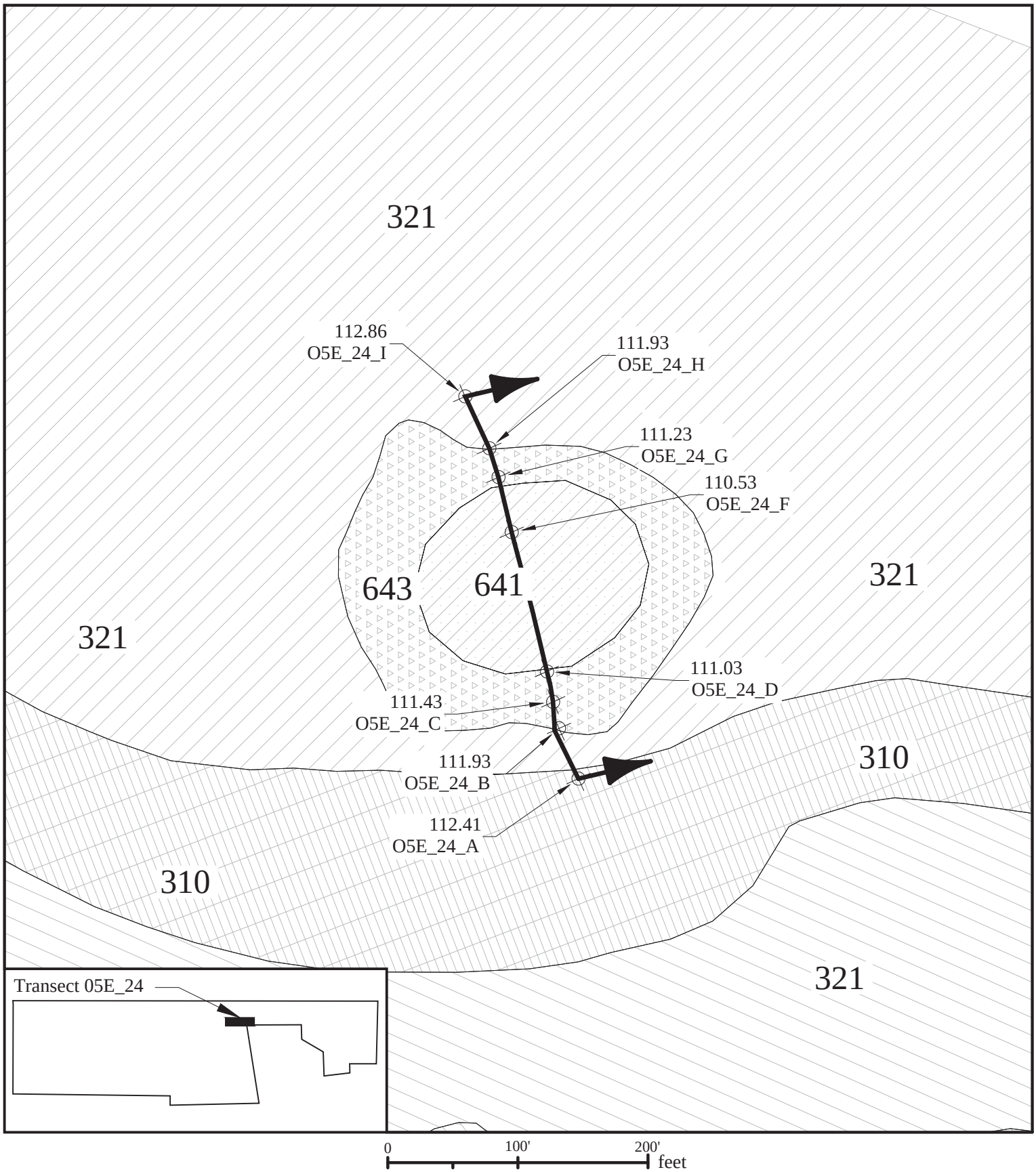
East Wetland Transect 04E_26

East Wetland
Transect 04E_26
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E5a

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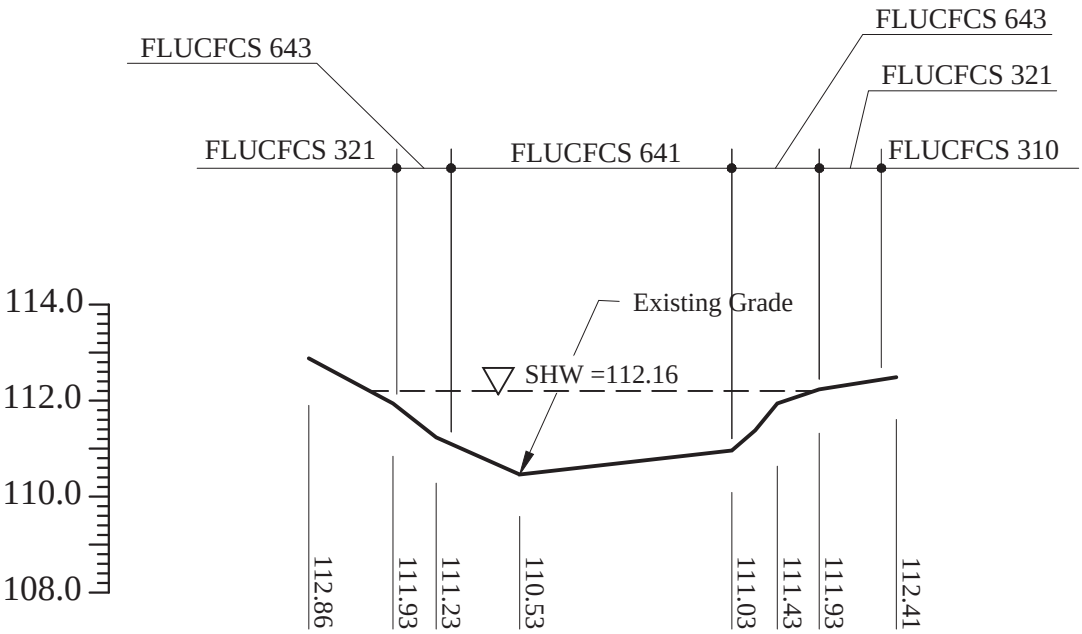
East Wetland Transect 05E_24

East Wetland
Transect 05E_24
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E6

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Cross Section 05E_24

VERT 1" = 6' HORZ 1" =100'

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CF Industries

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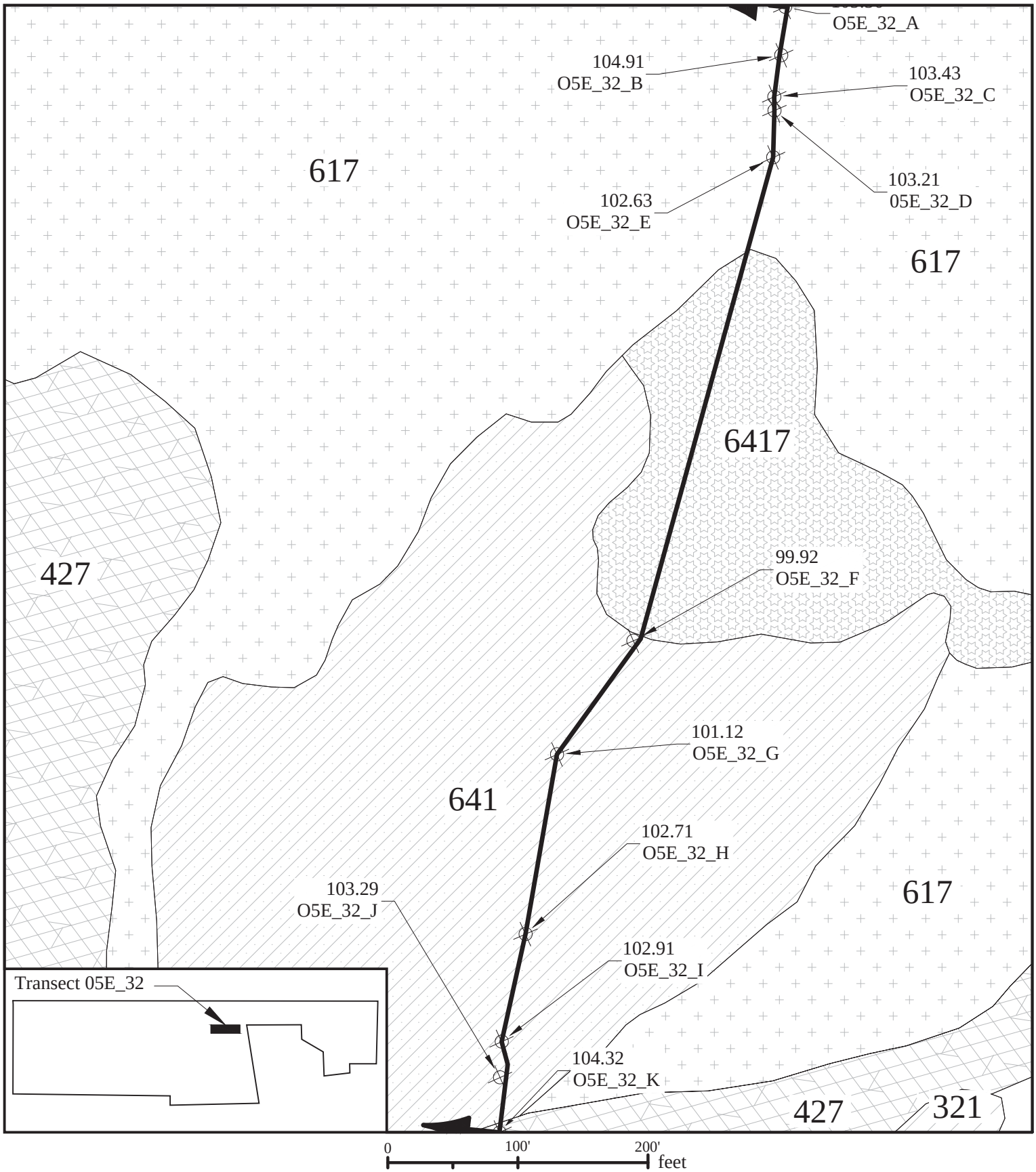
East Wetland Transect 05E_24

East Wetland
Transect 05E_24
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E6a

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CF Industries

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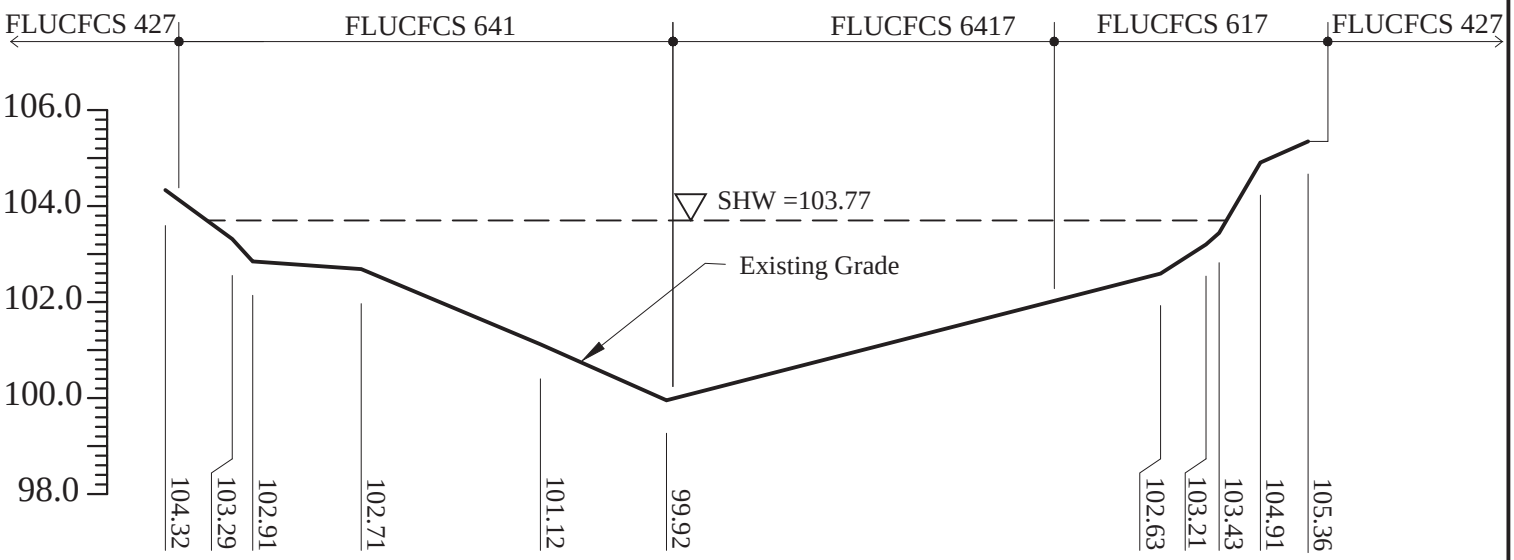
East Wetland Transect 05E_32

East Wetland
Transect 05E_32
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E7

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Cross Section 05E_32

VERT 1" = 6' HORZ 1" =150'

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CF Industries

South Pasture Extension

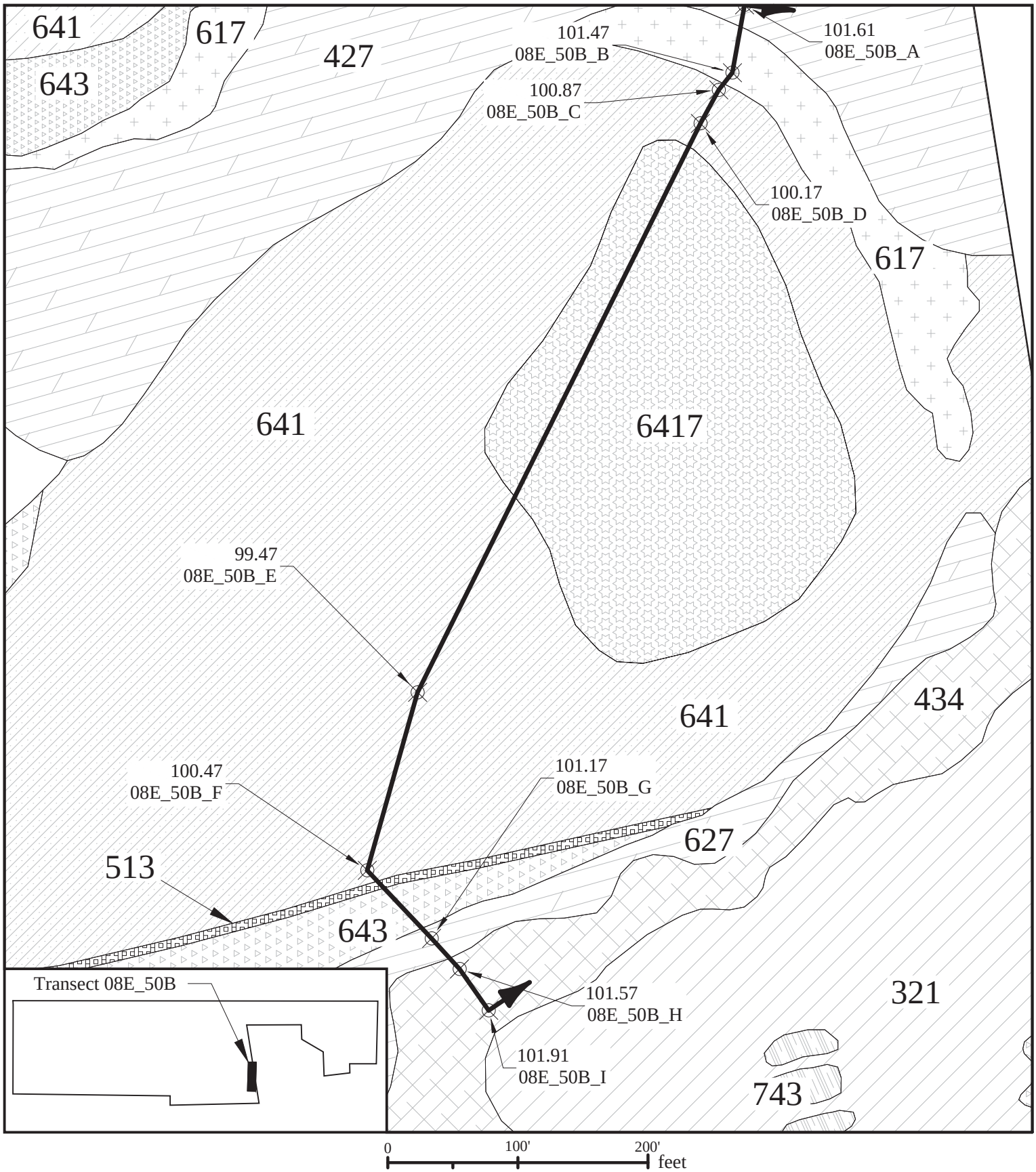
East Wetland Transect 05E_32

East Wetland
Transect 05E_32
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E7a

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CF Industries

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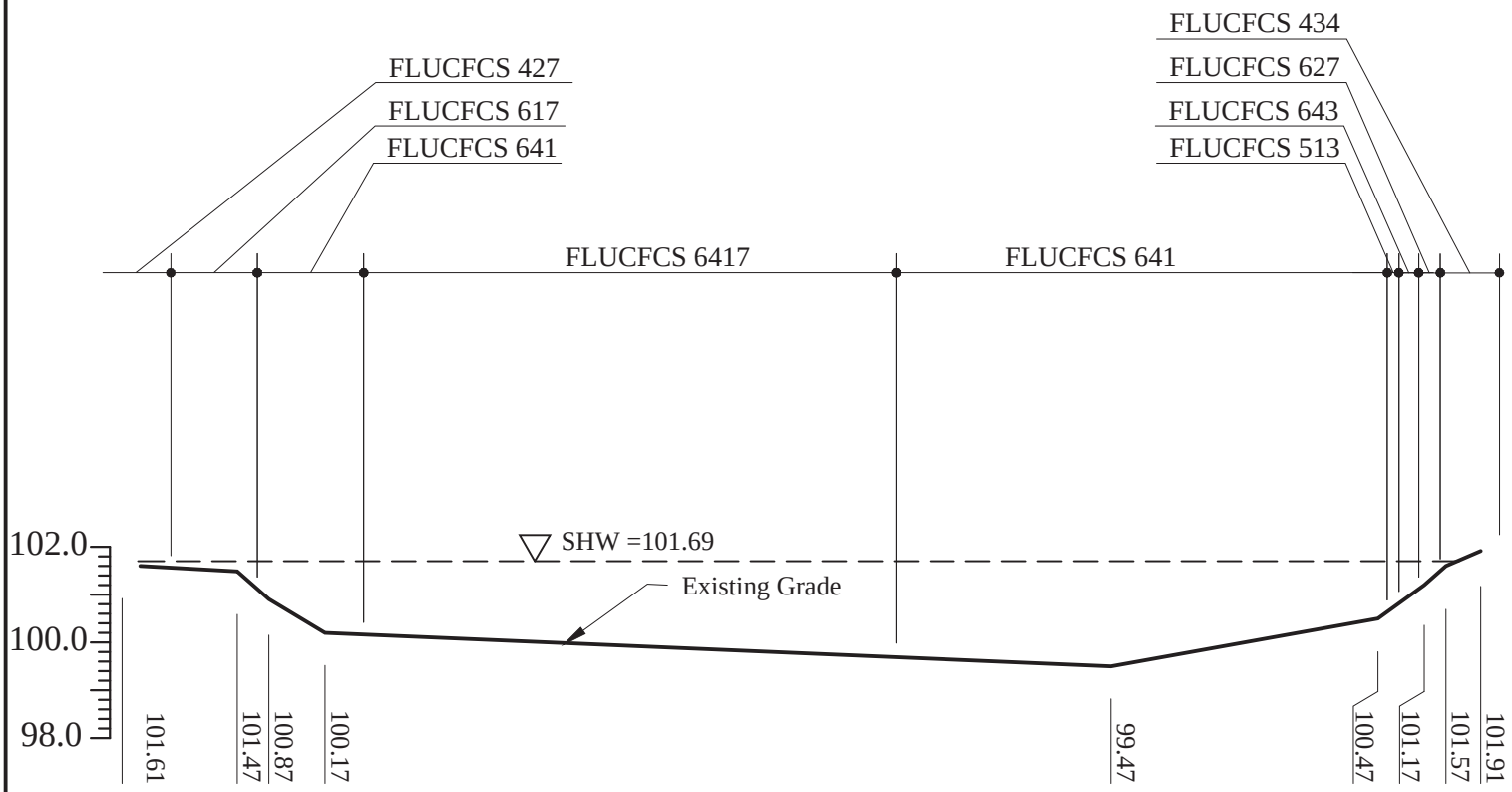
East Wetland Transect 08E_50B

East Wetland
Transect 08E_50B
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E8

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Cross Section 08E_50B

VERT 1" = 6' HORZ 1" =100'

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CF Industries

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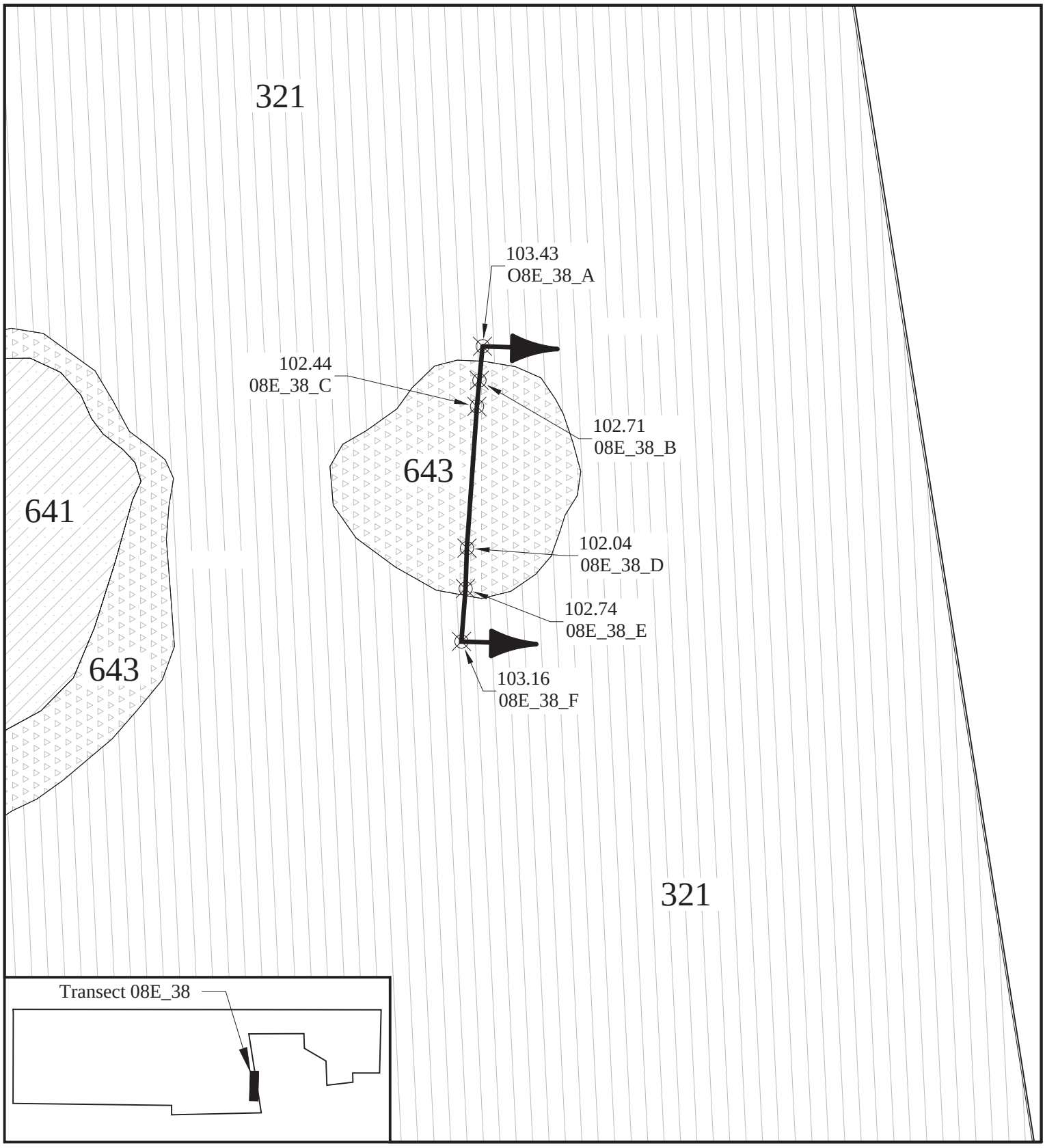
East Wetland Transect 08E_50B

East Wetland
Transect 08E_50B
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E8a

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NAD 1983 Florida State Planes west feet

Date: 05/30/06 Rev. Date: 04/15/08 PM: DJD CAD Operator: MAB Project # : 0675-041 File Location: C:\Users\jamesb\appdata\local\temp\AcPublish_9528\ERP_CF_wetland_transects_2010.dwg



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CF Industries

South Pasture Extension

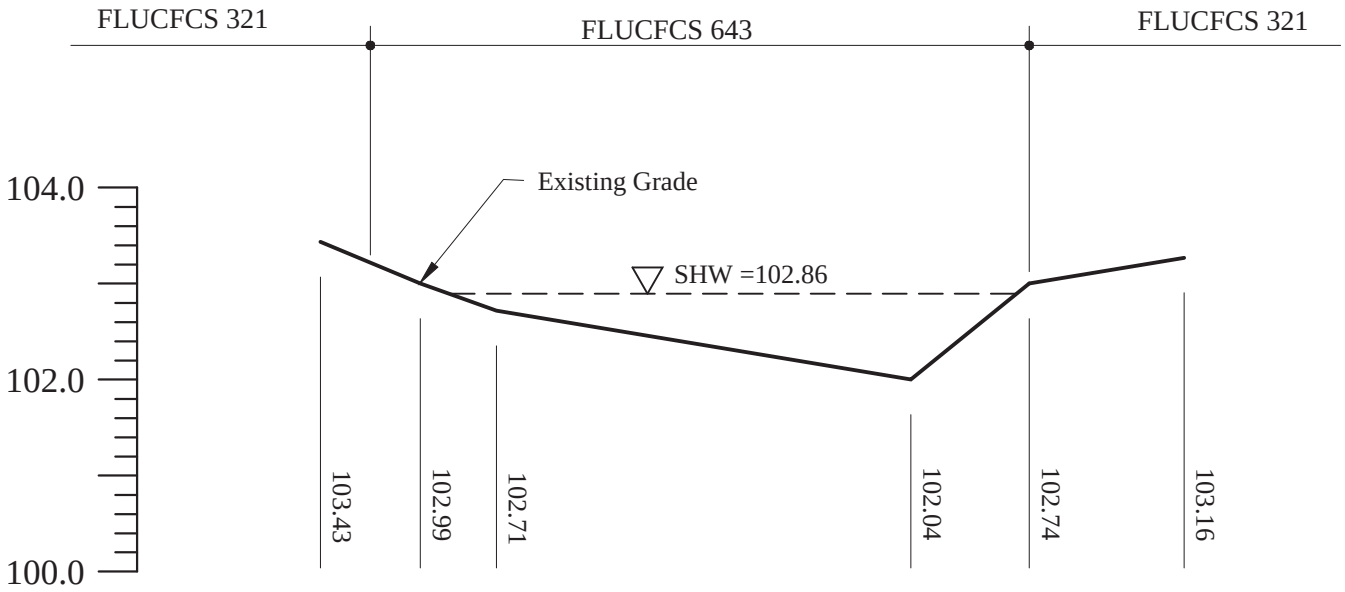
East Wetland Transect 08E_38

East Wetland
Transect 08E_38
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E9

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Cross Section 08E_38

VERT 1" = 6' HORZ 1" =50'

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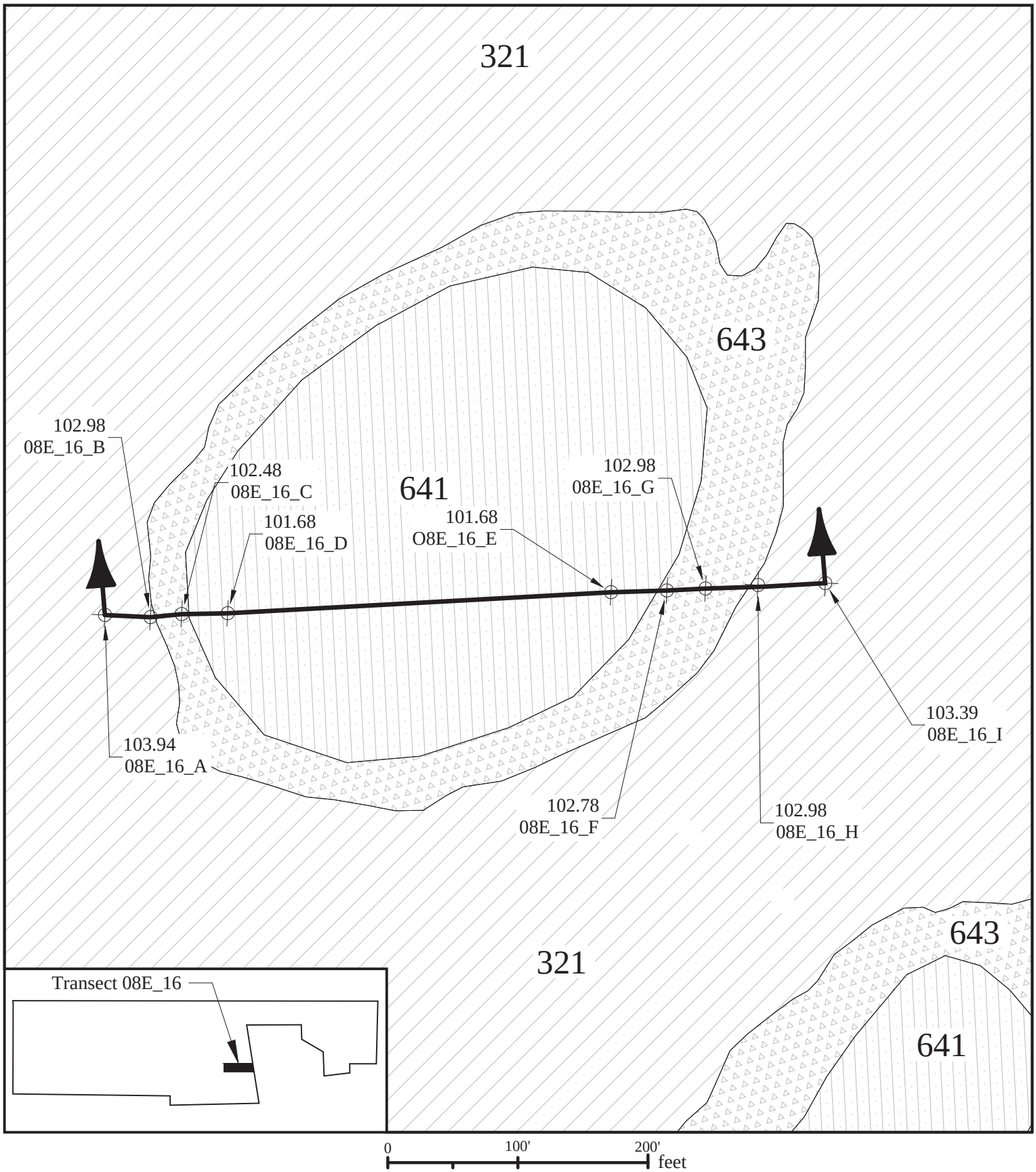
East Wetland Transect 08E_38

East Wetland
Transect 08E_38
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E9a

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CF Industries

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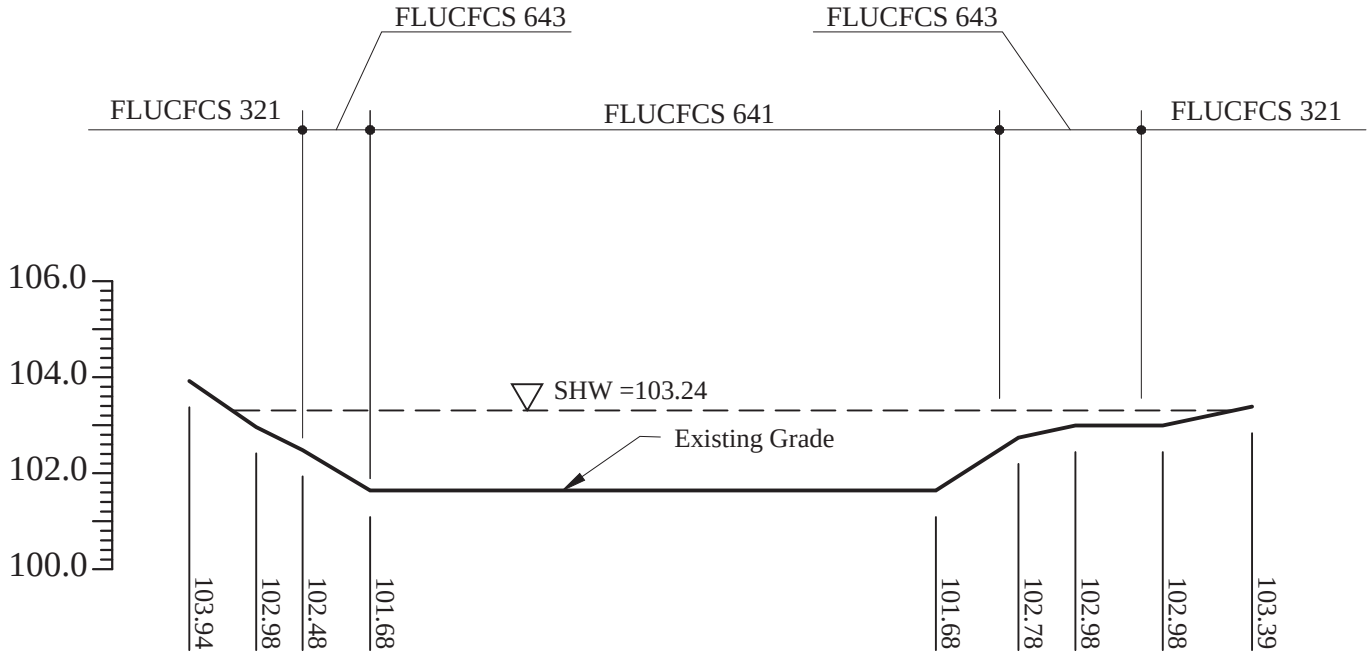
East Wetland Transect 08E_16

East Wetland
Transect 08E_16
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E10

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Cross Section 08E_16

VERT 1" = 6' HORZ 1" =100'

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East Wetland Transect 08E_16

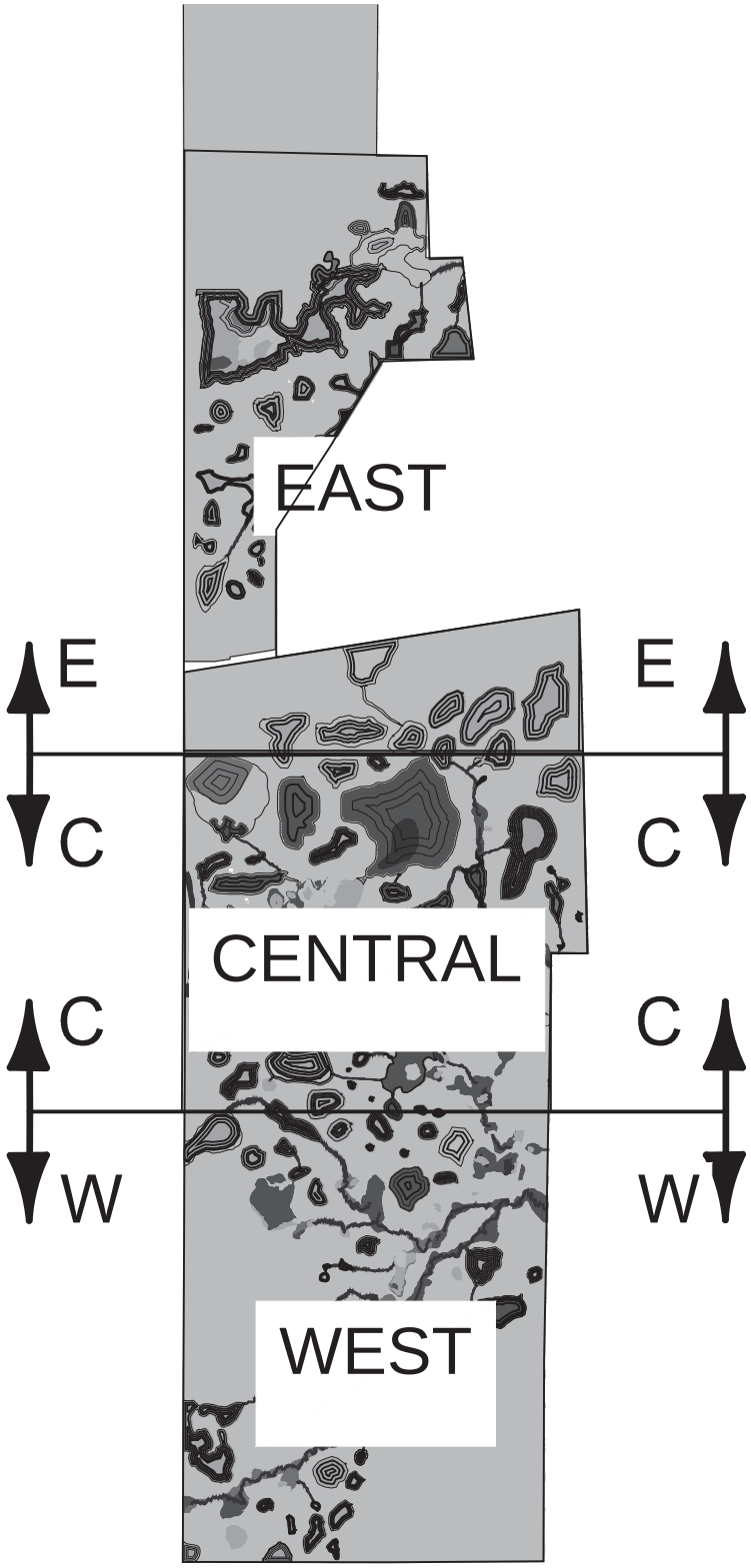
East Wetland
Transect 08E_16
Center Sec 07
Twp 34 S
Rng 24 E
Sheet - E10a

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ATTACHMENT 3
POST RECLAMATION



East Wetland Transect Location Map

0 5,000' 10,000' feet

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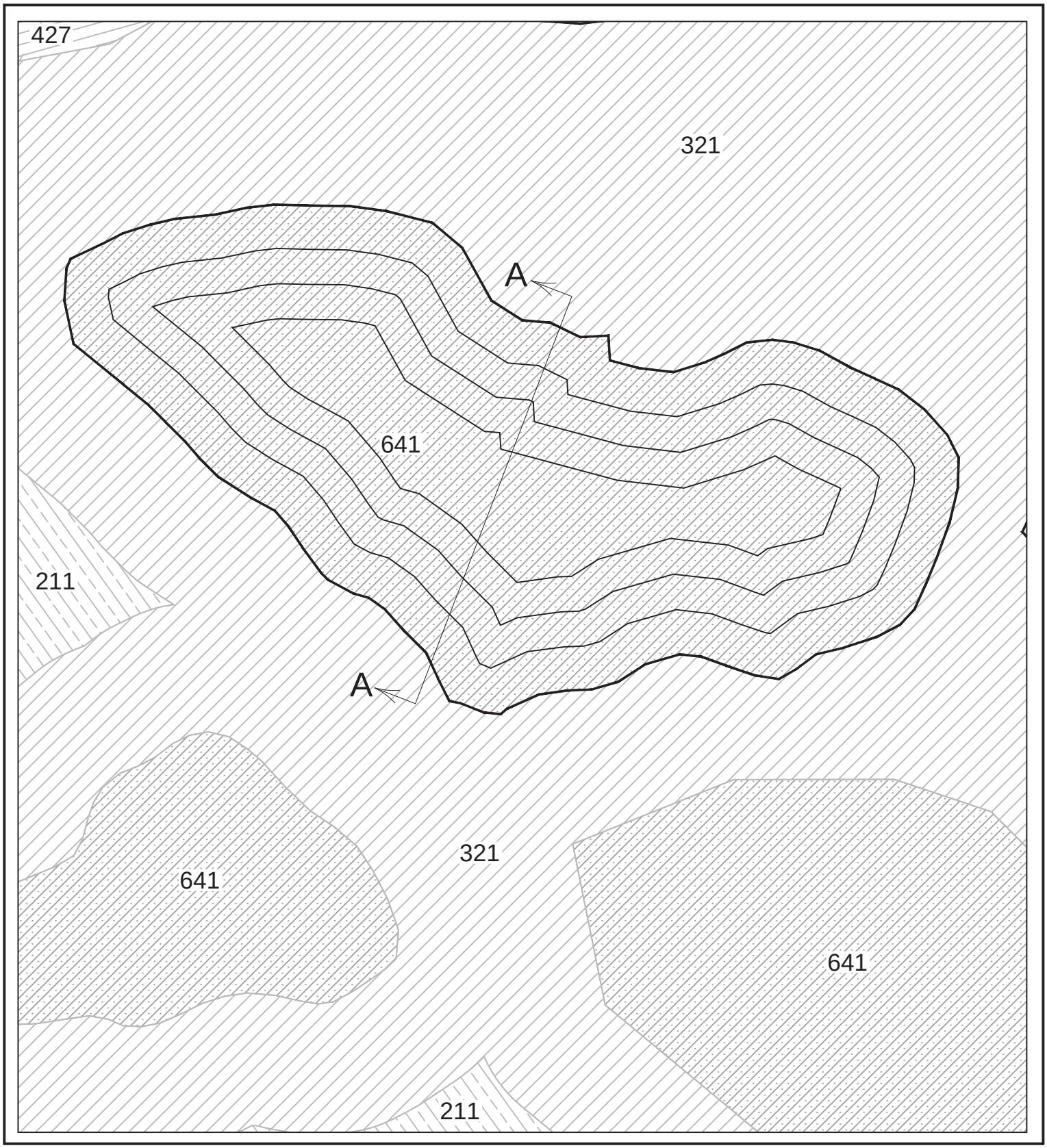
Wetland Transect Location Map

Overall

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Coordinate System:
NAD 1983 Florida State Planes (US) feet

Date: 01/01/01 Rev. Date: 09/01/11 PM: DES CAD Operator: MAB Project # : 0675-041 File Location: Q:\UnitedStates\Florida\Tampa\0675\041\working\cad\CF_post-reclamation_basic_revised_20110901.dwg



150 0 75 150 1 inch = 150 ft.

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CF Industries

South Pasture Extension

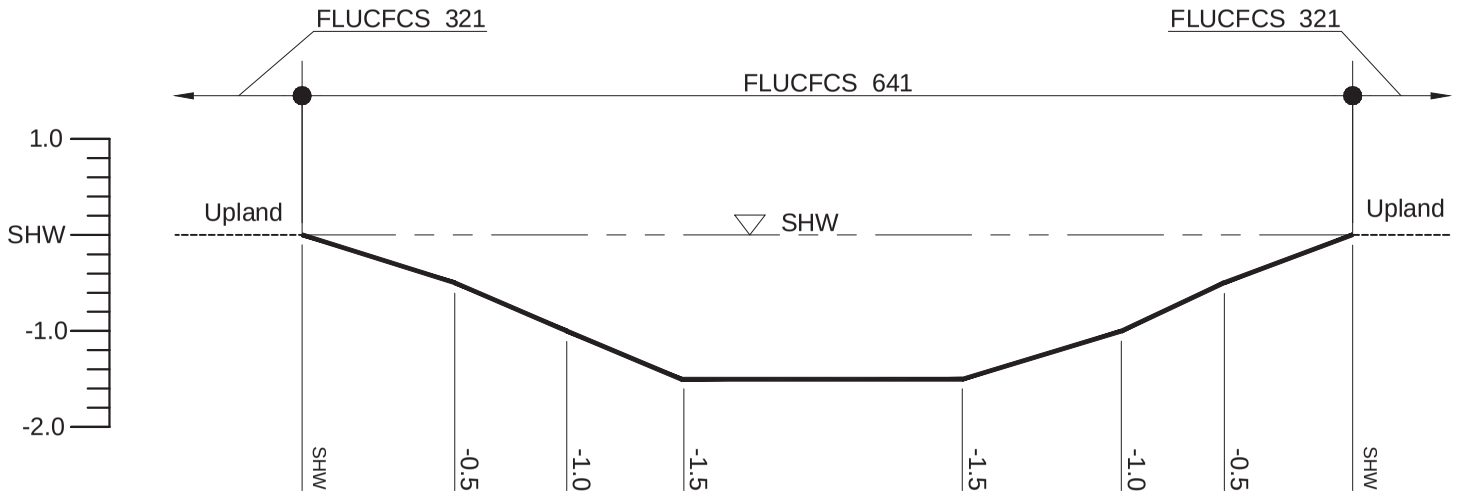
Shallow Freshwater Marsh

(FLUCFCS 641) up to 1.5 ft depth (below SHW)

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PM: AEB CAD Operator: MAB Creation Date: 9/1/2011 Rev. Date: 4/10/2014 Revised By: Mbarrett File Location: Q:\UnitedStates\Florida\Tampa\0675\041\working\cad\CF_post-reclamation_basic_revised_20110901.dwg



Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section A-A
(FLUCFCS 641) up to 1.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =75'

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CF Industries

South Pasture Extension

Shallow Freshwater Marsh

(FLUCFCS 641) up to 1.5 ft depth (below SHW)

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Date:AEB Rev. Date:MAB PM: CAD Operator: Project # : File Location: Q:\UnitedStates\Florida\Tampa\0675\041\working\cad\CF_post-reclamation_basic_revised_20110901.dwg

Shallow Freshwater Marsh Planting Scheme (FLUCFCS 641) up to 1.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Shrubs	Walter's viburnum	*Viburnum obovatum*	SHW	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.25 to -1.5’	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25’ to -0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Jointed spike rush	*Eleocharis intertincta*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to -1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to 1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –1.5’	1 qt or bare root equiv.
Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.				

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CF Industries

South Pasture Extension

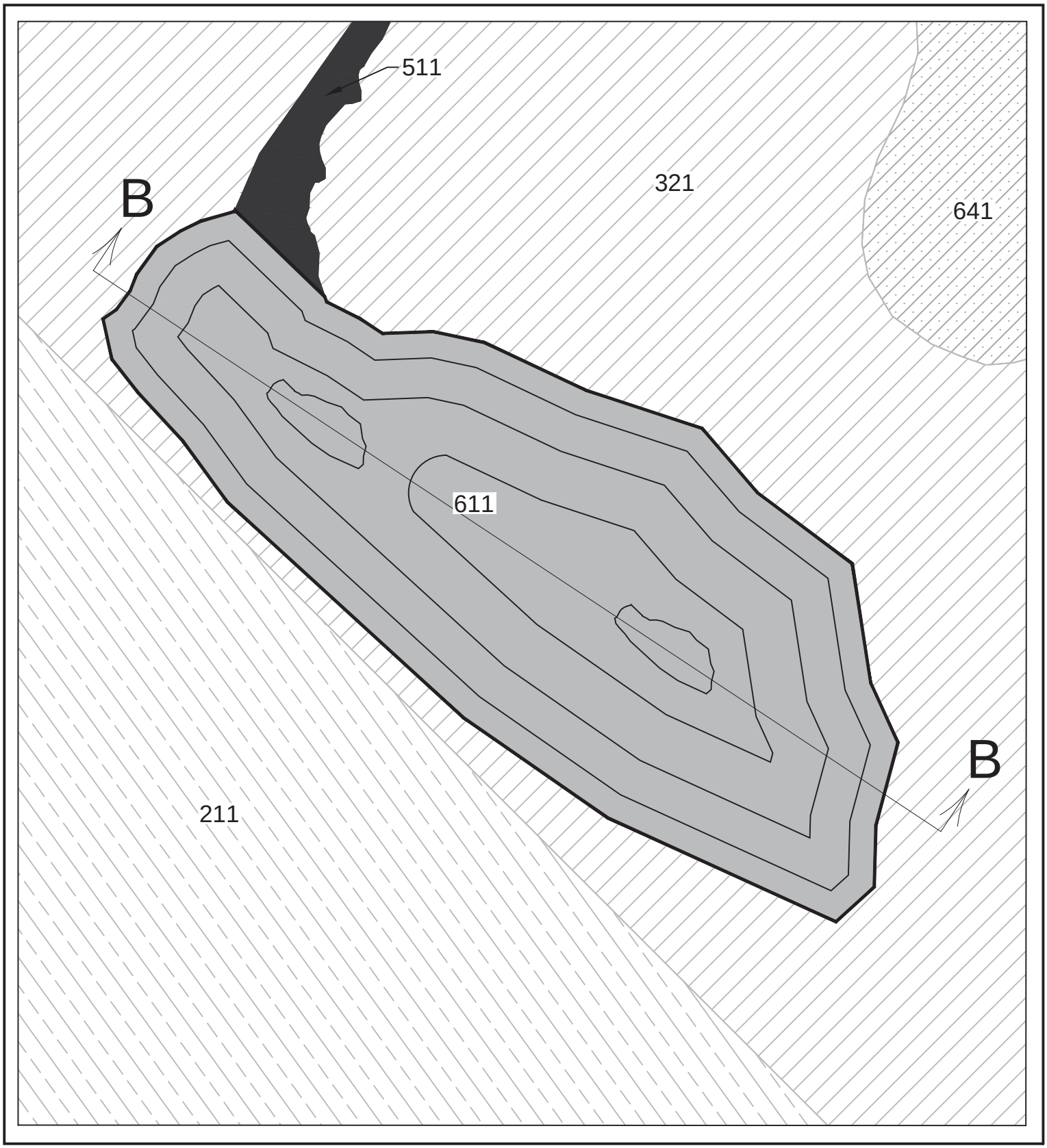
Shallow Freshwater Marsh Planting Scheme

(FLUCFCS 641) up to 1.5 ft depth (below SHW)

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100 0 50 100 1 inch = 100 ft.

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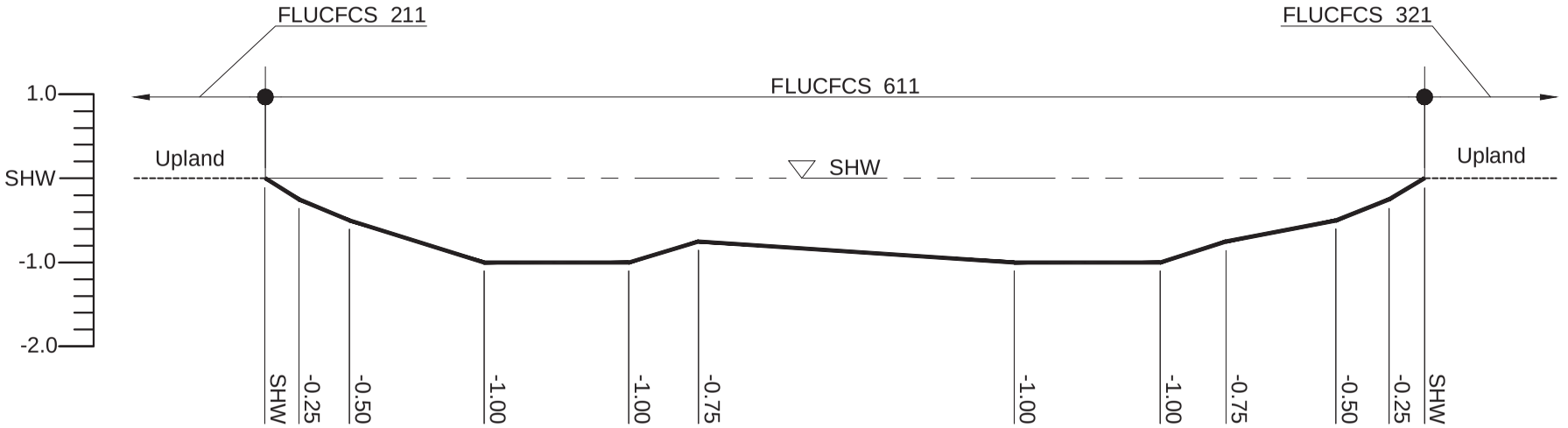
Bay Swamp

(FLUCFCS 611) up to 1.0 ft depth (below SHW)

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Note: Irregular bottom will vary +\- 0.50 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section B-B
(FLUCFCS 611) up to 1.0 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =100'

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Bay Swamp Planting Scheme

(FLUCFCS 611) up to 1.0 ft depth (below SHW)

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Bay Swamp Planting Scheme (FLUCFCS 611) up to 1.0 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Loblolly Bay	*Gordonia lasianthus*	SHW	3 gallon
	Water oak	*Quercus nigra*	SHW	3 gallon
	Laurel oak	*Quercus laurifolia*	SHW to –0.10’	3 gallon
	Red maple	*Acer rubrum*	SHW to –0.25’	3 gallon
	American elm	*Ulmus americana*	SHW to –0.5’	3 gallon
	Sweetbay	*Magnolia virginiana*	SHW to –0.5’	3 gallon
	Swamp Bay	*Persea palustris*	SHW to –0.5’	3 gallon
	Pop ash	*Fraxinus caroliniana*	SHW to –1.0’	3 gallon
	Black Gum	*Nyssa sylvatica var. biflora*	-0.1’ to –1.0’	3 gallon
Shrubs	Gallberry	*Ilex glabra*	Above SHW	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Walter’s viburnum	*Viburnum obovatum*	SHW to –0.25’	1 gallon
	Highbush blueberry	*Vaccinum corymbosum*	SHW to –0.25’	1 gallon
	Virginia willow	*Itea virginica*	SHW to –0.5’	1 gallon
Herbaceous Groundcover**	Redtop Panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Swamp fern***	*Blechnum serrulatum*	SHW to –0.25’	1 qt or bare root equiv.
	Cinnamon fern***	*Osmunda cinnamomea*	SHW to –0.25’	1 qt or bare root equiv.
	Virginia chain fern***	*Woodwardia virginica*	SHW to –0.25’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Beakrush	*Rhynchospora spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Flat Sedge	*Cyperus spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Lizard's-tail***	*Saururus cernuus*	-0.25’ to –0.5’	1 qt or bare root equiv.
	Saw grass	*Cladium jamaincense*	-0.25’ to –1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –1.0’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.
Shade Tolerant Species*** = Shade tolerant species are expected to become established from seed source as a result of muck transfer; if after 5-7 years, shade tolerant species have not become established, they will be planted in shaded areas where suitable canopy coverage exists.

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CF Industries

South Pasture Extension

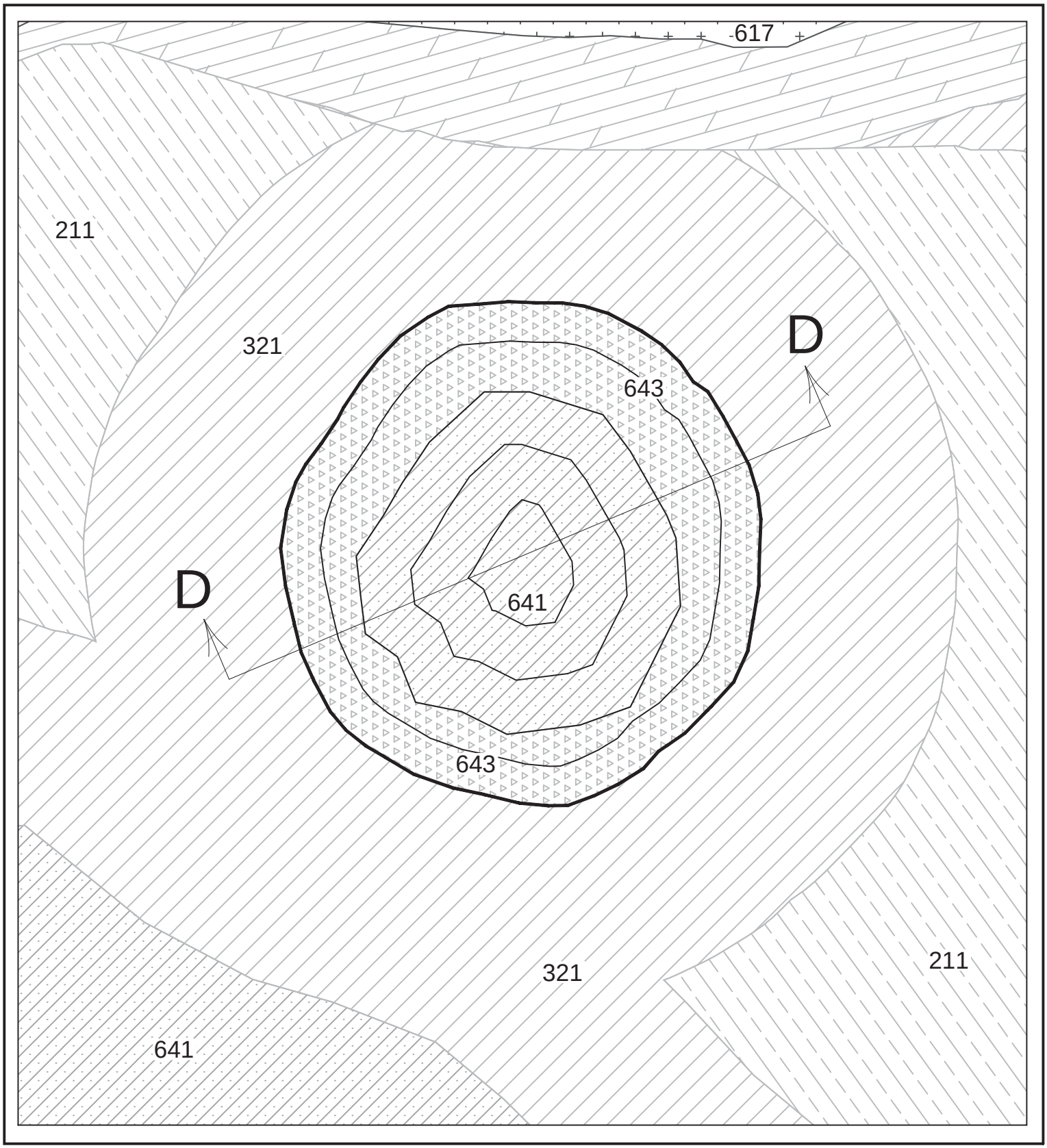
Bay Swamp Planting Scheme

(FLUCFCS 611) up to 1.0 ft depth (below SHW)

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100 0 50 100 1 inch = 100 ft.

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Wet Prairie

(FLUCFCS 643) up to 1.0 ft depth (below SHW) &

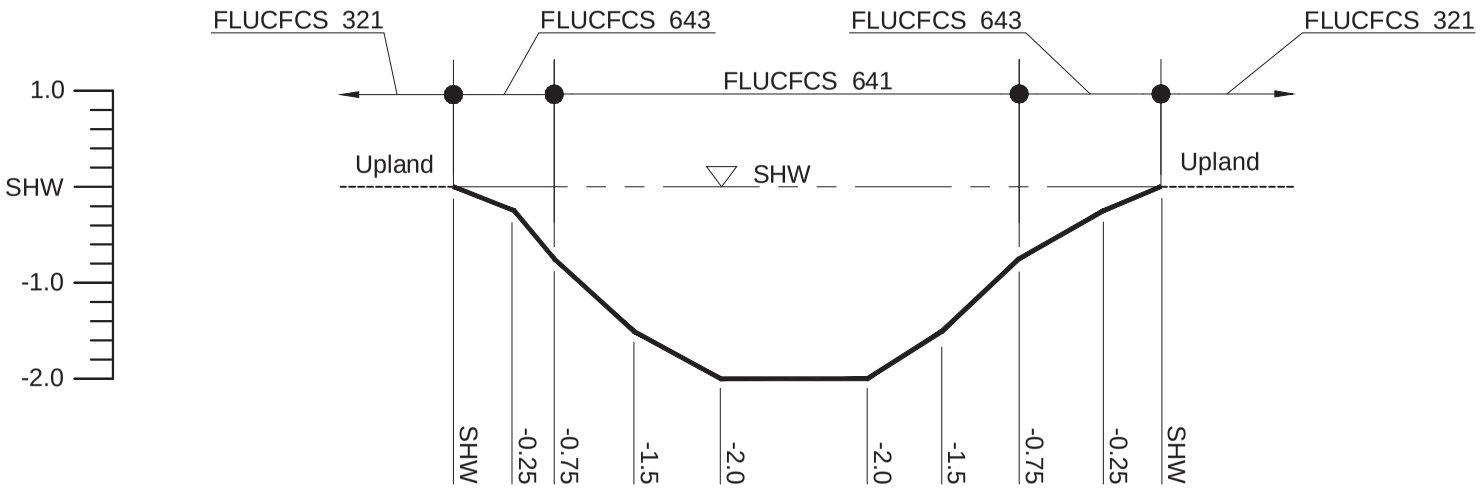
Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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PM: MAB CAD Operator: AEB Creation Date: 9/1/2011 Rev. Date: 4/10/2014 Revised By: Mbarrett File Location: Q:\UnitedStates\Florida\Tampa\0675\041\working\cad\CF_post-reclamation_basic_revised_20110901.dwg



Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section D-D
(FLUCFCS 643) up to 1.0 ft depth (below SHW) & (FLUCFCS 641) up to 2.0 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =100'

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Wet Prairie

(FLUCFCS 643) up to 1.0 ft depth (below SHW) &

Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Shrubs	Walter's viburnum	*Viburnum obovatum*	SHW	1 gallon
	Gallberry	*Ilex glabra*	Above SHW	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to -0.25'	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to -0.25'	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Wire grass	*Aristida beyrichiana*	SHW to -0.1'	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1'	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5'	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5'	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5'	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5'	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25' to -0.5'	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to –1.0'	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to –1.0'	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to –1.0'	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25' to –1.0'	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5' to –1.0	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities..

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CF Industries

South Pasture Extension

Wet Prairie

(FLUCFCS 643) up to 1.0 ft depth (below SHW) &

Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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Intermediate Freshwater Marsh Planting Scheme (FLUCFCS 641) up to 2.0 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Shrubs	Buttonbush	*Cephalanthus occidentalis*	-0.25 to -1.5’	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25’ to -0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Jointed spike rush	*Eleocharis intertincta*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to -1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to 1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –2.0’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –2.0’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –2.0’	1 qt or bare root equiv.
Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.				

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CF Industries

South Pasture Extension

Wet Prairie

(FLUCFCS 643) up to 1.0 ft depth (below SHW) &

Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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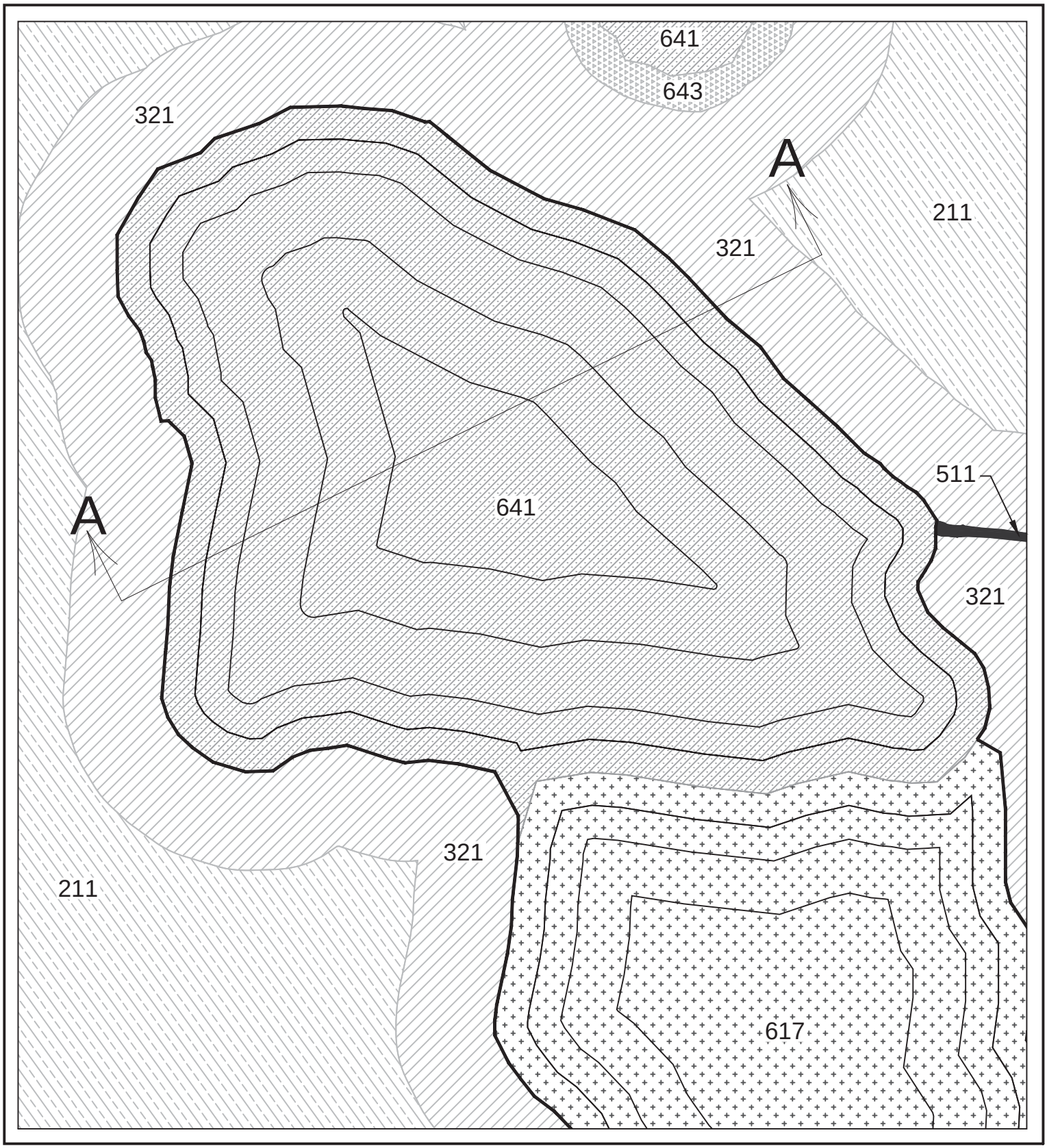
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200 0 100 200 1 inch = 200 ft.

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South Pasture Extension

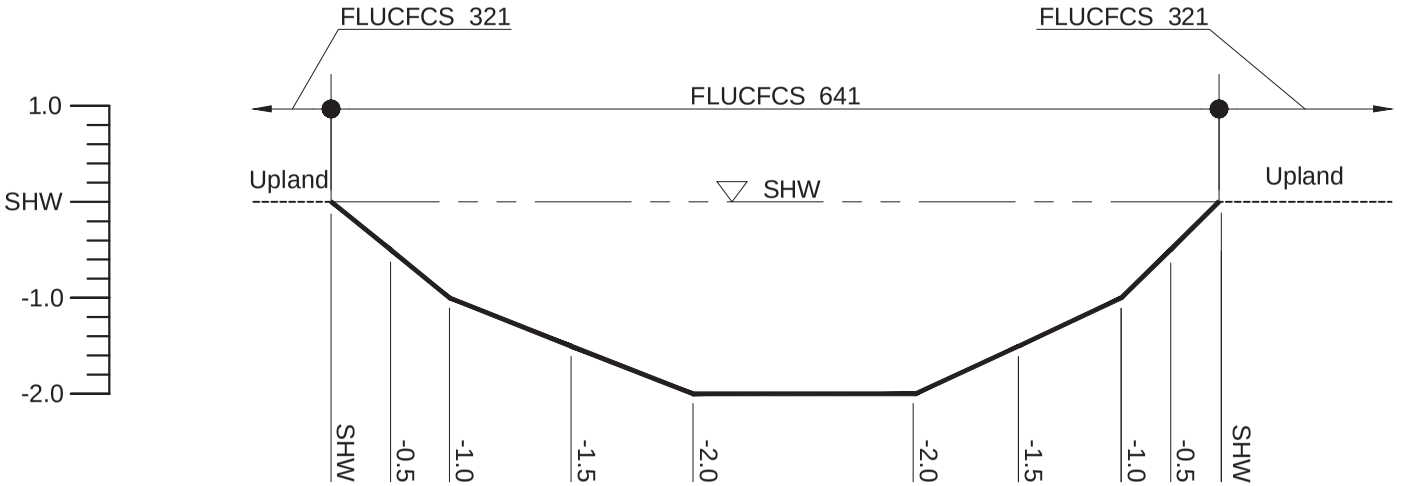
Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section A-A
(FLUCFCS 641) up to 2.0 ft depth (below SHW)

VERT 1" = 3' HORZ 1" = 200'

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South Pasture Extension

Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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Intermediate Freshwater Marsh Planting Scheme (FLUCFCS 641) up to 2.0 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.25 to -1.5’	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25’ to -0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Jointed spike rush	*Eleocharis intertincta*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to -1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to 1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –2.0’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –2.0’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –2.0’	1 qt or bare root equiv.
Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.				

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South Pasture Extension

Intermediate Freshwater Marsh Planting Scheme

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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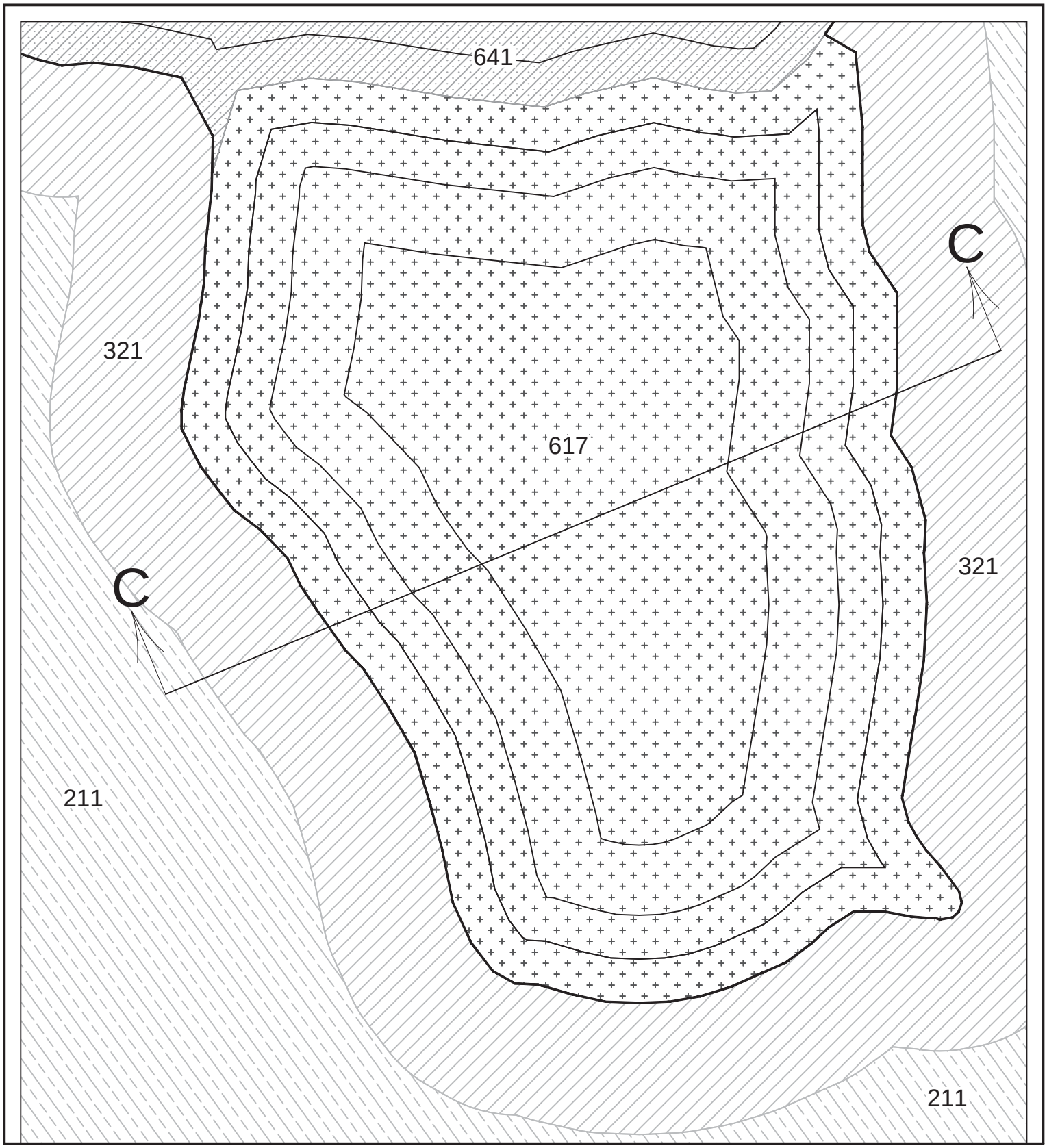
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150 0 75 150 1 inch = 150 ft.

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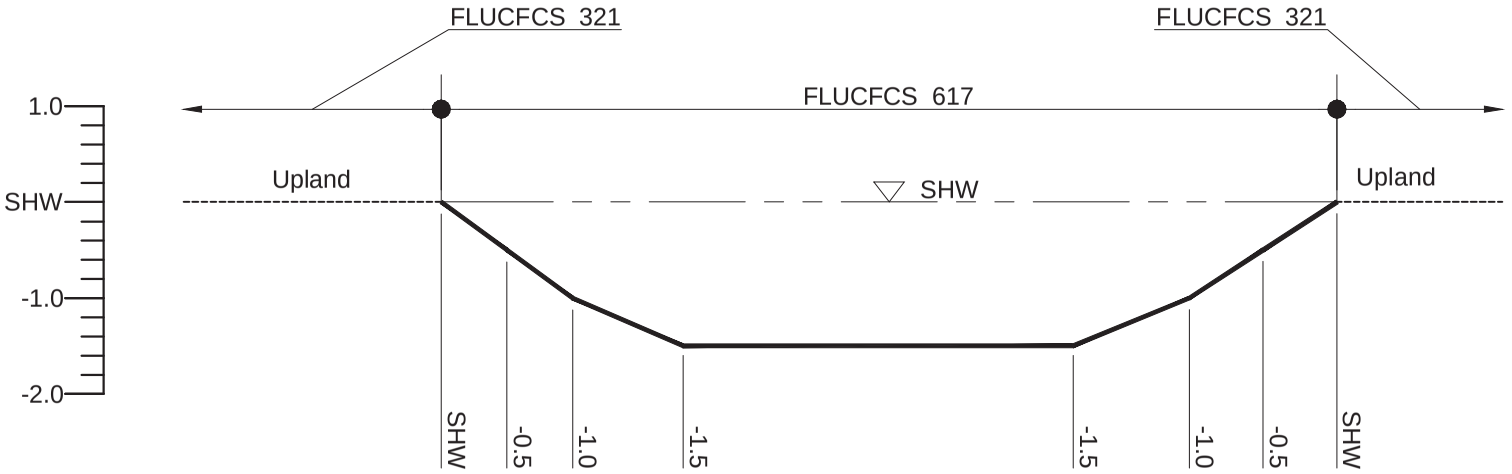
Mixed wetland Hardwoods

(FLUCFCS 617) up to 1.5 ft depth (below SHW)

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Note: Irregular bottom will vary +0.75 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section C-C
(FLUCFCS 617) up to 1.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =150'

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CF Industries

South Pasture Extension

Mixed Wetland Hardwoods

(FLUCFCS 617) up to 1.5 ft depth (below SHW)

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Mixed Wetland Hardwoods Planting Scheme (FLUCFCS 617) up to 1.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Water oak	*Quercus nigra*	SHW	3 gallon
	Cabbage palm	*Sabal palmetto*	SHW	3 gallon
	Loblolly bay	*Gordonia lasianthus*	SHW	3 gallon
	Laurel oak	*Quercus laurifolia*	SHW to –0.1’	3 gallon
	Water hickory	*Carya aquatica*	SHW to –0.25’	3 gallon
	Red maple	*Acer rubrum*	SHW to –0.25’	3 gallon
	Swamp bay	*Persea palustris*	SHW to –0.5’	3 gallon
	American elm	*Ulmus Americana*	SHW to –0.5’	3 gallon
	Sweetbay	*Magnolia virginiana*	SHW to –0.5’	3 gallon
	Black gum	*Nyssa sylvaticia*	-0.1 to –1.0’	3 gallon
	Pop ash	*Fraxinus caroliniana*	SHW to –1.5’	3 gallon
	Pond cypress	*Taxodium ascendens*	-1.0’ to –1.5’	3 gallon
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Highbush blueberry	*Vaccinum corymbosum*	SHW to –0.25’	1 gallon
	Possom haw	*Viburnum nudum*	SHW to –0.25’	1 gallon
	Dahoon holly	*Ilex cassine*	SHW to –0.25’	1 gallon
	Virginia willow	*Itea virginica*	SHW to –0.5’	1 gallon
	Swamp dogwood	*Cornus foemina*	SHW to –0.5’	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.5’ to –1.5’	1 gallon
Herbaceous Groundcover**	Redtop panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Swamp fern***	*Blechnum serrulatum*	SHW to –0.25’	1 qt or bare root equiv.
	Cinnamon fern***	*Osmunda cinnamomea*	SHW to –0.25’	1 qt or bare root equiv.
	Virginia chain fern***	*Woodwardia virginica*	SHW to –0.25’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Beakrush	*Rhynchospora spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Lizard's-tail***	*Saururus cernuus*	-0.25’ to –0.5’	1 qt or bare root equiv.
	Saw grass	*Cladium jamaincense*	-0.25’ to –1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Soft Rush	*Juncus effuses*	SHW to -1.5’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –1.5’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.
Shade Tolerant Species*** = Shade tolerant species are expected to become established from seed source as a result of muck transfer; if after 5-7 years, shade tolerant species have not become established, they will be planted in shaded areas where suitable canopy coverage exists.

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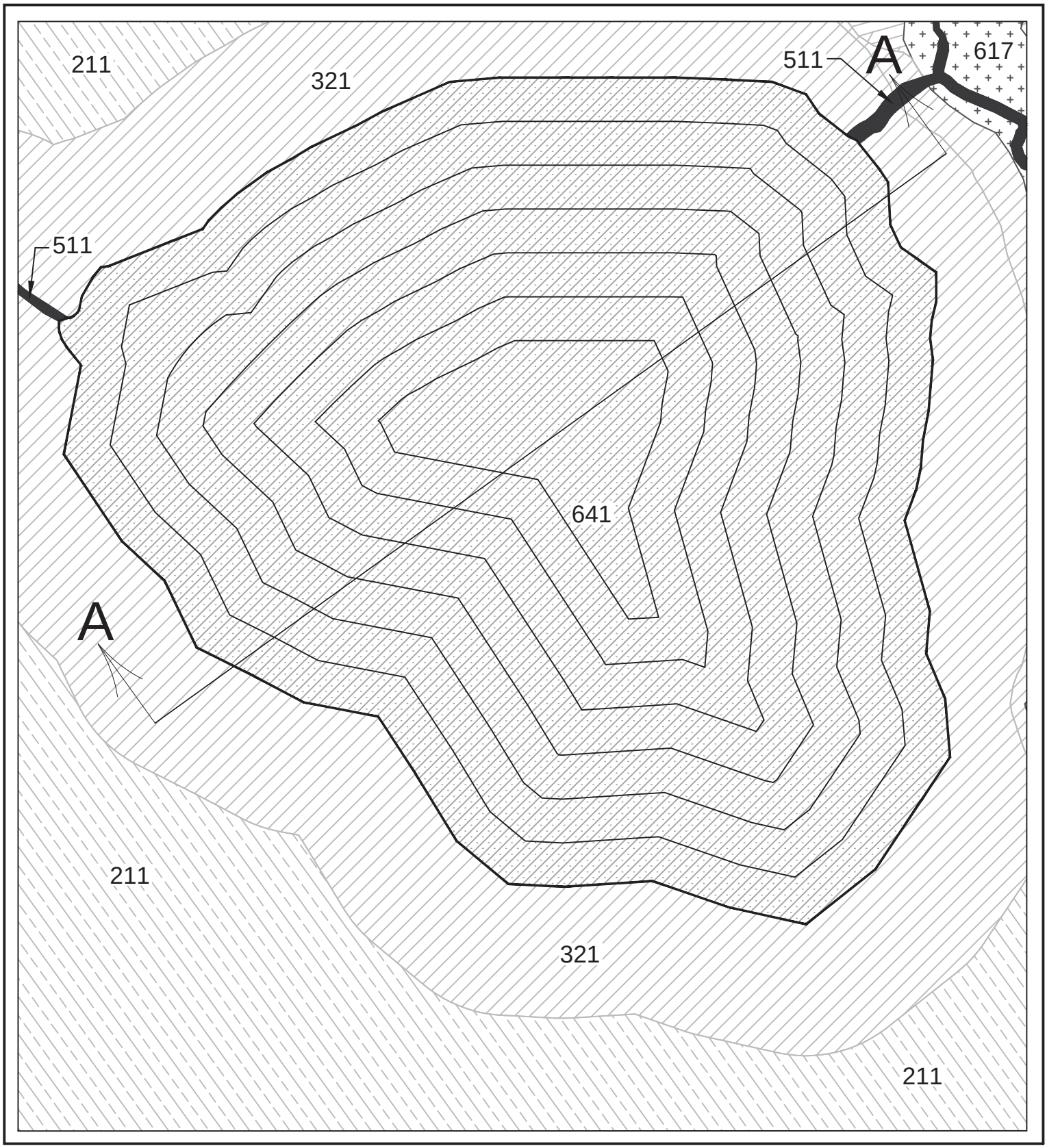
South Pasture Extension

Mixed Wetland Hardwoods Planting Scheme

(FLUCFCS 617) up to 1.5 ft depth (below SHW)

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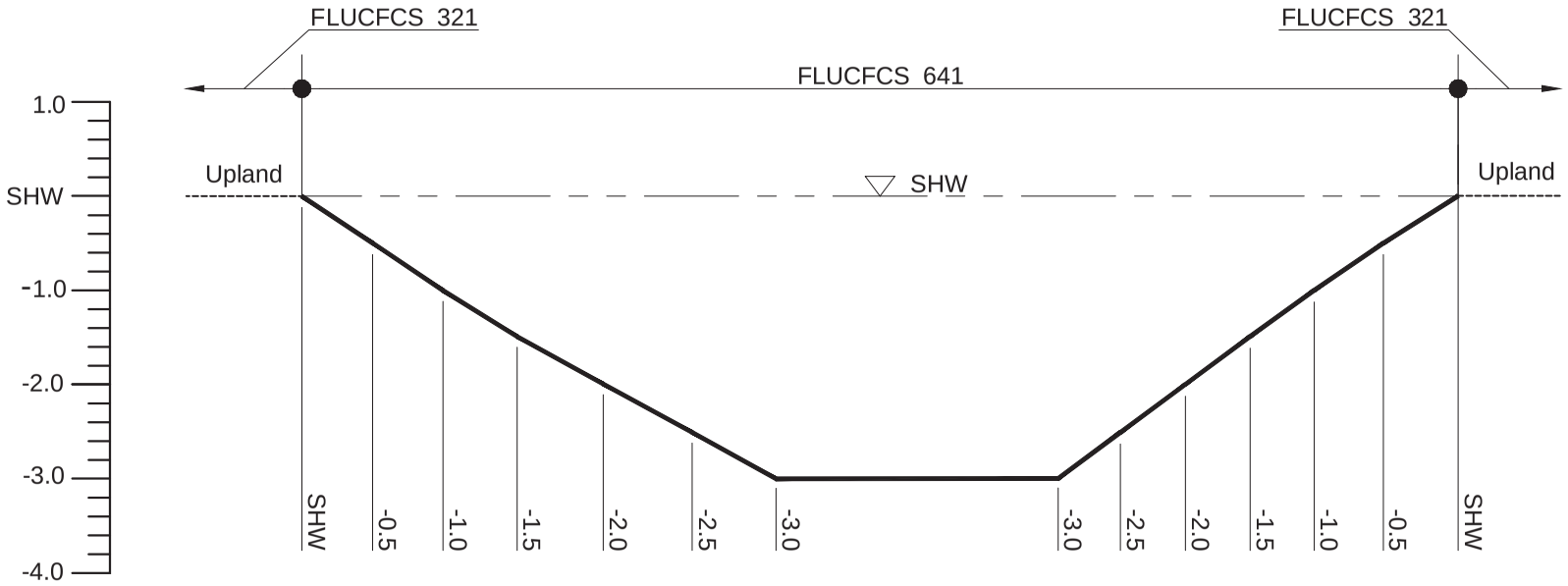
Deep Freshwater Marsh

(FLUCFCS 641) up to 3 ft depth (below SHW)

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Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section A-A
(FLUCFCS 641) up to 3 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =150'

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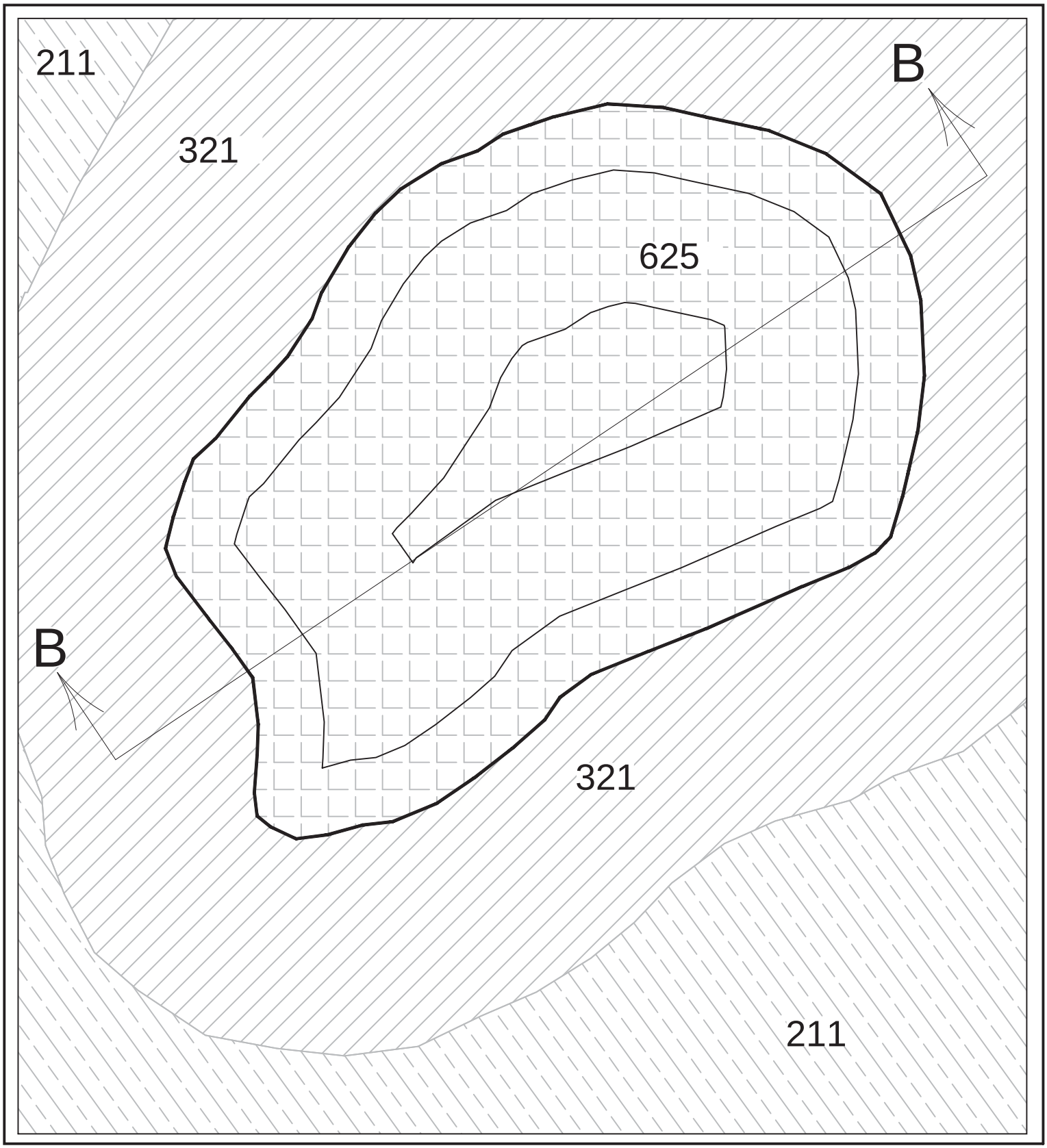
Deep Freshwater Marsh

(FLUCFCS 641) up to 3 ft depth (below SHW)

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100 0 50 100 1 inch = 100 ft.

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CF Industries

South Pasture Extension

Hydric Pine Flatwoods

(FLUCFCS 625) up to 0.5 ft depth (below SHW)

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Deep Freshwater Marsh Planting Scheme (FLUCFCS 641) up to 3 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.25 to -1.5’	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25’ to -0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Jointed spike rush	*Eleocharis intertincta*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to -1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to 1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to -2.0’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to -2.0’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –3.0’	1 qt or bare root equiv.
	Water lily	*Nympha odorata*	-1.5’ to -3.0’	1 qt or bare root equiv.
Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.				

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Deep Freshwater Marsh Planting Scheme

(FLUCFCS 641) up to 3 ft depth (below SHW)

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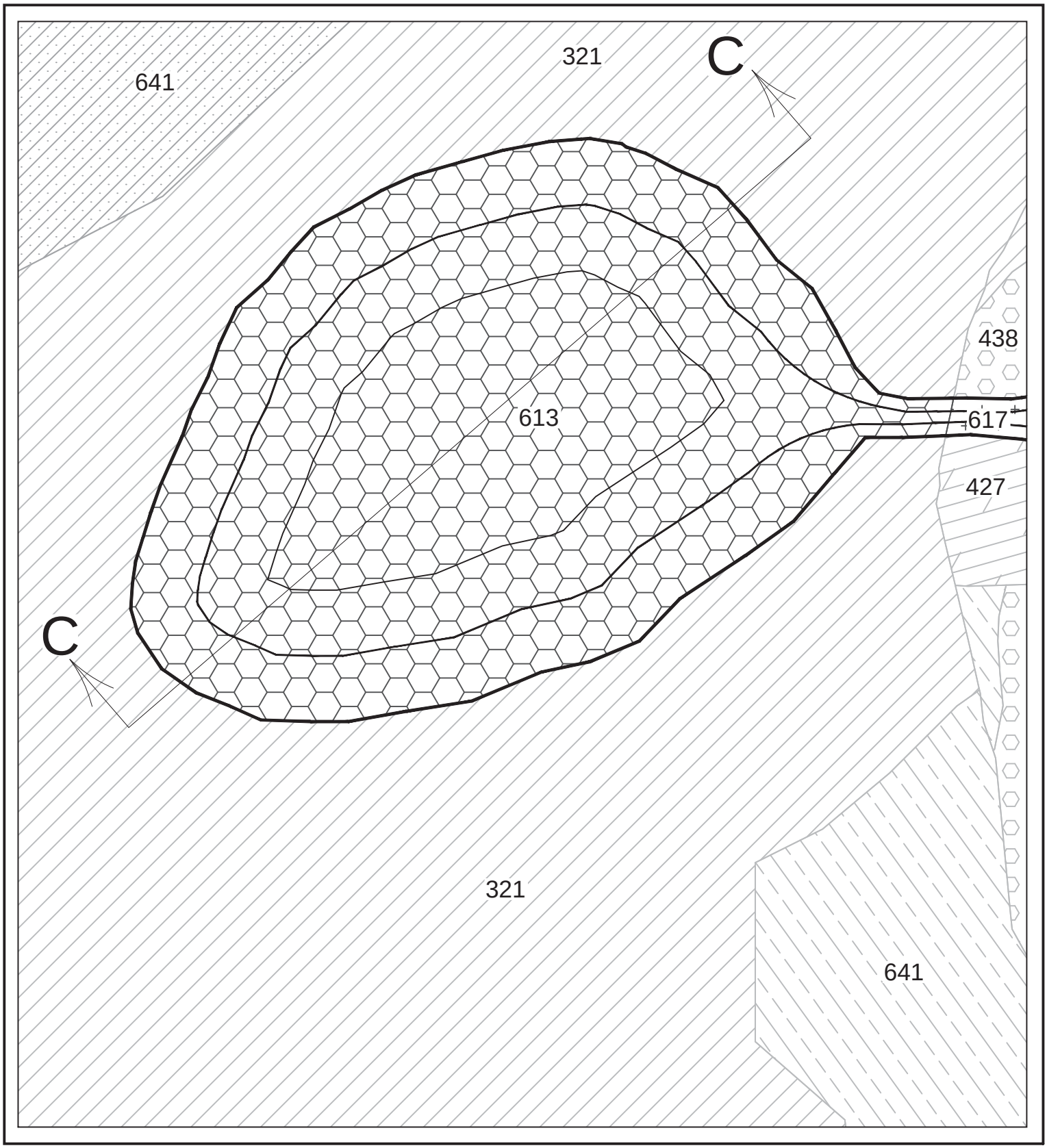
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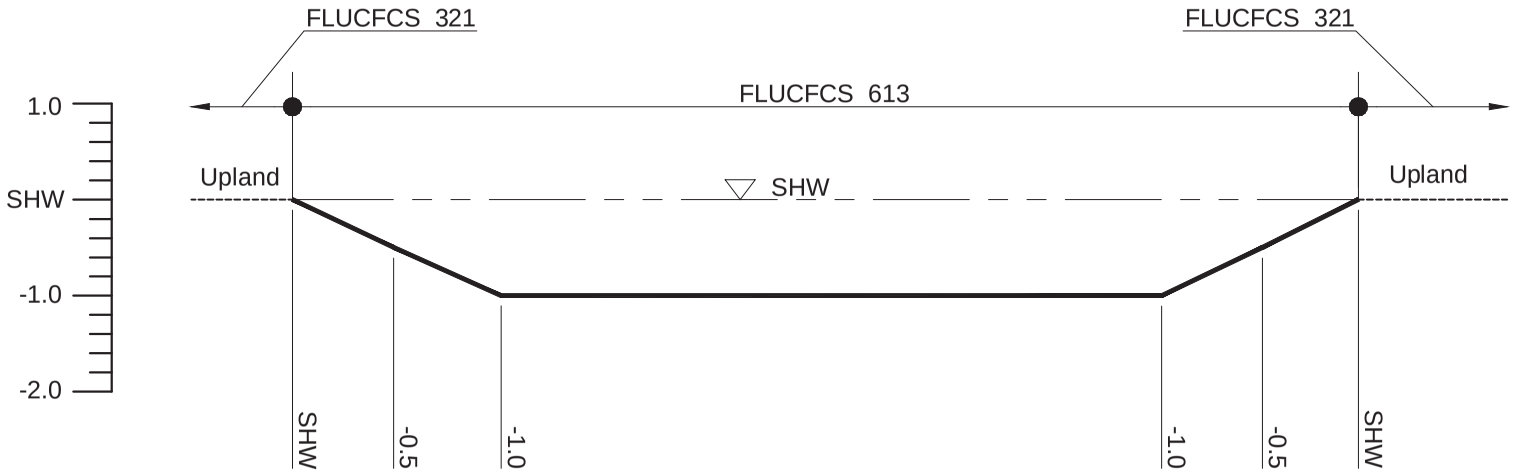
Gum Swamp

(FLUCFCS 613) up to 1 ft depth (below SHW)

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Note: Irregular bottom will vary +0.50 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section C-C
(FLUCFCS 613) up to 1 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =100'

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South Pasture Extension

Gum Swamp

(FLUCFCS 613) up to 1 ft depth (below SHW)

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Gum Swamp Planting Scheme (FLUCFCS 613) up to 1 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Slash Pine	Pinus elliotii	Above SHW	3 gallon
	Sweetgum	*Liquidambar styraciflua*	SHW to –0.1’	3 gallon
	Laurel Oak	*Quercus laurifolia*	SHW to –0.1’	3 gallon
	Red maple	*Acer rubrum*	SHW to –0.25’	3 gallon
	Black Gum	*Nyssa biflora*	-0.1’ to –1.0’	3 gallon
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Walter’s viburnum	*Viburnum obovatum*	SHW to –0.25’	1 gallon
	Highbush blueberry	*Vaccinum corymbosum*	SHW to –0.25’	1 gallon
	Virginia willow	*Itea virginica*	SHW to –0.5’	1 gallon
Herbaceous Groundcover**	Redtop Panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Beakrush	*Rhynchospora spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Elecoharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Flat Sedge	*Cyperus spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Saw grass	*Cladium jamaincense*	-0.25’ to –1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	At –1.0’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.

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South Pasture Extension

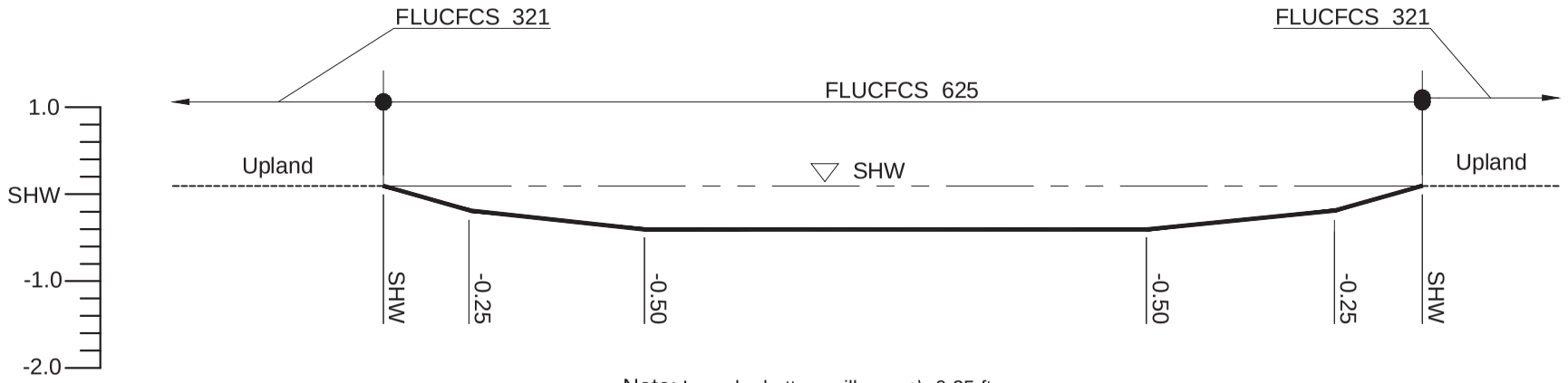
Gum Swamp Planting Scheme

(FLUCFCS 613) up to 1 ft depth (below SHW)

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Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section B-B
(FLUCFCS 625) up to 0.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =100'

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South Pasture Extension

Hydric Pine Flatwoods

(FLUCFCS 625) up to 0.5 ft depth (below SHW)

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Hydric Pine Flatwoods Planting Scheme (FLUCFCS 625) up to 0.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Slash pine	*Pinus elliottii*	Above SHW	3 gallon
Shrubs	Saw palmetto	*Serenoa repens*	Above SHW	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
Herbaceous Groundcover**	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Wiregrass	*Aristida berychiana*	SHW to –0.1’	1 qt or bare root equiv.
	Blue Maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to –0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –0.5’	1 qt or bare root equiv.
Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities. Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.				

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Hydric Pine Flatwoods Planting Scheme

(FLUCFCS 625) up to 0.5 ft depth (below SHW)

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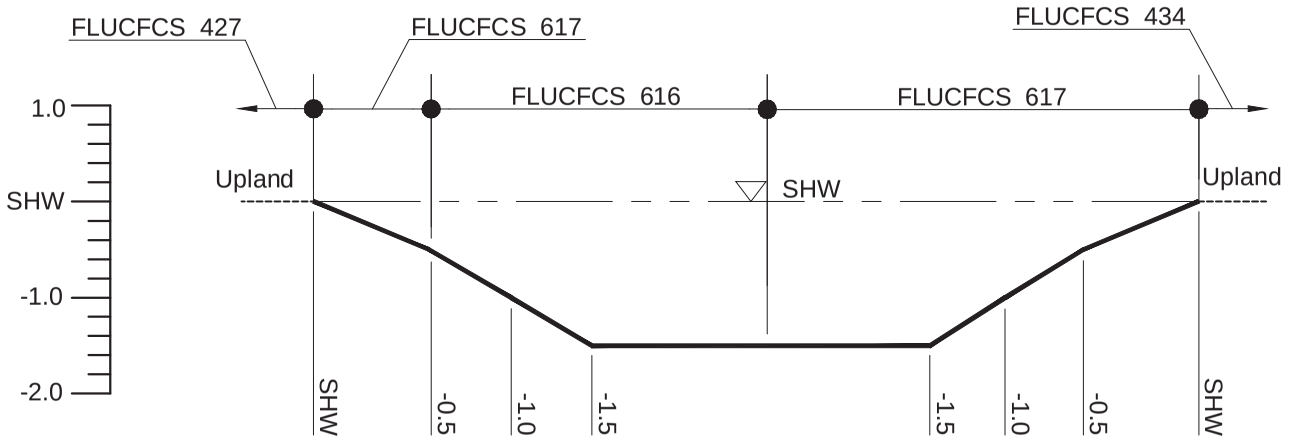
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Note: Irregular bottom will vary +0.75 ft.

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Post Reclamation Typical Cross Section C-C
(FLUCFCS 617) & (FLUCFCS 616) up to 1.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =500'

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South Pasture Extension

Mixed Wetland Hardwoods
(FLUCFCS 617) up to 1.5 ft depth (below SHW) &
Inland Ponds and Sloughs
(FLUCFCS 616) up to 1.5 ft depth (below SHW)

Agency

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Inland Ponds and Sloughs Planting Scheme (FLUCFCS 616) up to 1.5 ft depth (below SHW)				
Strata	Plant Species*		Planting Depth	Size
	Common Name	Scientific Name		
Canopy	Black Gum	*Nyssa sylvatica var. biflora*	-0.1' to –1.0'	3 gallon
	Pop ash	*Fraxinus caroliniana*	SHW to –1.5'	3 gallon
	Pond Cypress	*Taxodium ascendens*	-1.0' to –1.5'	3 gallon
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25'	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25'	1 gallon
	Dahoon holly	*Ilex cassine*	SHW to –0.25'	1 gallon
	Virginia willow	*Itea virginica*	SHW to –0.5'	1 gallon
	Swamp dogwood	*Cornus foemina*	SHW to –0.5'	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.5' to –1.5'	1 gallon
Herbaceous Groundcover**	Redtop Panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to –0.5'	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5'	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5'	1 qt or bare root equiv.
	Beakrush	*Rhynchospora spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Flat Sedge	*Cyperus spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to –1.0'	1 qt or bare root equiv.
	Saw grass	*Cladium jamaincense*	-0.25' to –1.0'	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5' to –1.0'	1 qt or bare root equiv.
	Soft Rush	*Juncus effuses*	SHW to –1.5'	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5' to –1.5'	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5' to –1.5'	1 qt or bare root equiv.
	Alligator Flag	*Thalia geniculata*	-1.0' to -1.5'	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.

Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.

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South Pasture Extension

Inland Ponds and Sloughs

(FLUCFCS 616) up to 1.5 ft depth (below SHW)

Mixes Wetland Hardwoods Planting

(FLUCFCS 617) up to 1.5 ft depth (below SHW)

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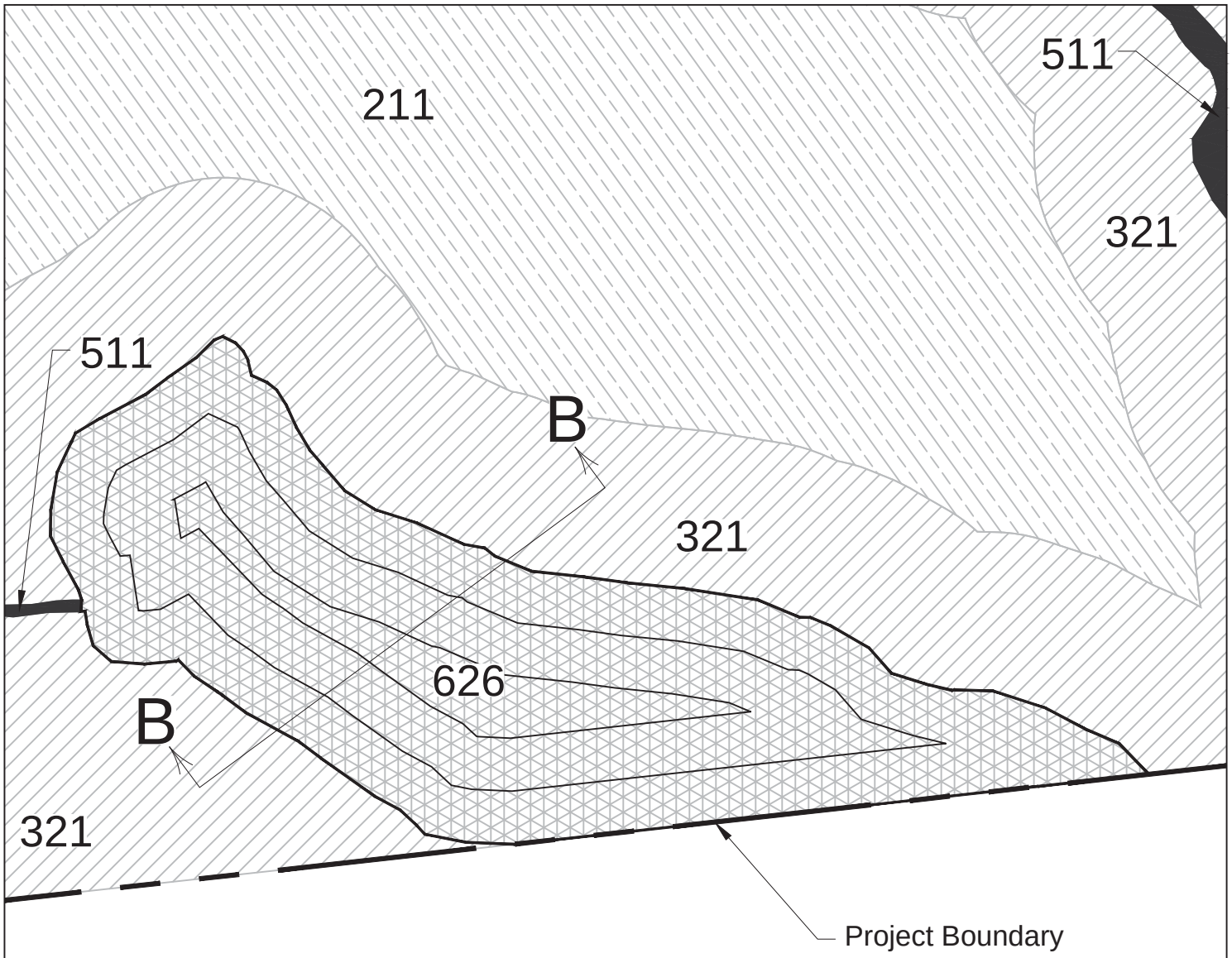
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150 0 75 150 1 inch = 150 ft.

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Hydric Pine Savanna

(FLUCFCS 626) up to 0.5 ft depth (below SHW)

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Mixed Wetland Hardwoods Planting Scheme (FLUCFCS 617) up to 1.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Water oak	*Quercus nigra*	SHW	3 gallon
	Cabbage palm	*Sabal palmetto*	SHW	3 gallon
	Loblolly bay	*Gordonia lasianthus*	SHW	3 gallon
	Laurel oak	*Quercus laurifolia*	SHW to –0.1'	3 gallon
	Water hickory	*Carya aquatica*	SHW to –0.25'	3 gallon
	Red maple	*Acer rubrum*	SHW to –0.25'	3 gallon
	Swamp bay	*Persea palustris*	SHW to –0.5'	3 gallon
	American elm	*Ulmus Americana*	SHW to –0.5'	3 gallon
	Sweetbay	*Magnolia virginiana*	SHW to –0.5'	3 gallon
	Black gum	*Nyssa sylvaticia*	-0.1 to –1.0'	3 gallon
	Pop ash	*Fraxinus caroliniana*	SHW to –1.5'	3 gallon
	Pond cypress	*Taxodium ascendens*	-1.0' to –1.5'	3 gallon
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25'	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25'	1 gallon
	Highbush blueberry	*Vaccinum corymbosum*	SHW to –0.25'	1 gallon
	Possom haw	*Viburnum nudum*	SHW to –0.25'	1 gallon
	Dahoon holly	*Ilex cassine*	SHW to –0.25'	1 gallon
	Virginia willow	*Itea virginica*	SHW to –0.5'	1 gallon
	Swamp dogwood	*Cornus foemina*	SHW to –0.5'	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.5' to –1.5'	1 gallon
Herbaceous Groundcover**	Redtop panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1'	1 qt or bare root equiv.
	Swamp fern***	*Blechnum serrulatum*	SHW to –0.25'	1 qt or bare root equiv.
	Cinnamon fern***	*Osmunda cinnamomea*	SHW to –0.25'	1 qt or bare root equiv.
	Virginia chain fern***	*Woodwardia virginica*	SHW to –0.25'	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to –0.5'	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5'	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5'	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5'	1 qt or bare root equiv.
	Beakrush	*Rhynchospora spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0'	1 qt or bare root equiv.
	Lizard's-tail***	*Saururus cernuus*	-0.25' to –0.5'	1 qt or bare root equiv.
	Saw grass	*Cladium jamaincense*	-0.25' to –1.0'	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5' to –1.0'	1 qt or bare root equiv.
	Soft Rush	*Juncus effuses*	SHW to -1.5'	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5' to –1.5'	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5' to –1.5'	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0' to –1.5'	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.
Shade Tolerant Species*** = Shade tolerant species are expected to become established from seed source as a result of muck transfer; if after 5-7 years, shade tolerant species have not become established, they will be planted in shaded areas where suitable canopy coverage exists.

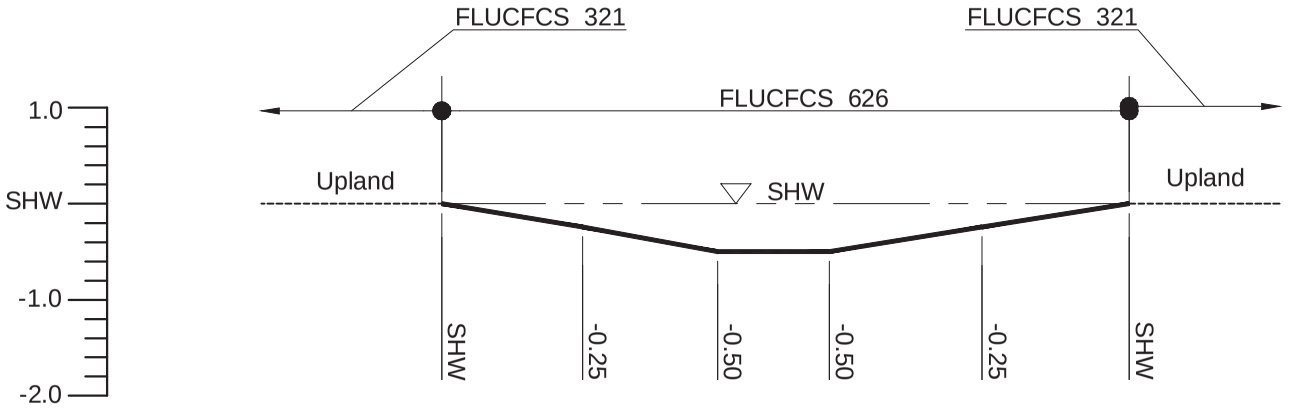
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CF Industries
South Pasture Extension
Inland Ponds and Sloughs
(FLUCFCS 616) up to 1.5 ft depth (below SHW)
Mixes Wetland Hardwoods Planting
(FLUCFCS 617) up to 1.5 ft depth (below SHW)

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Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section B-B
(FLUCFCS 626) up to 0.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" =75'

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CF Industries

South Pasture Extension

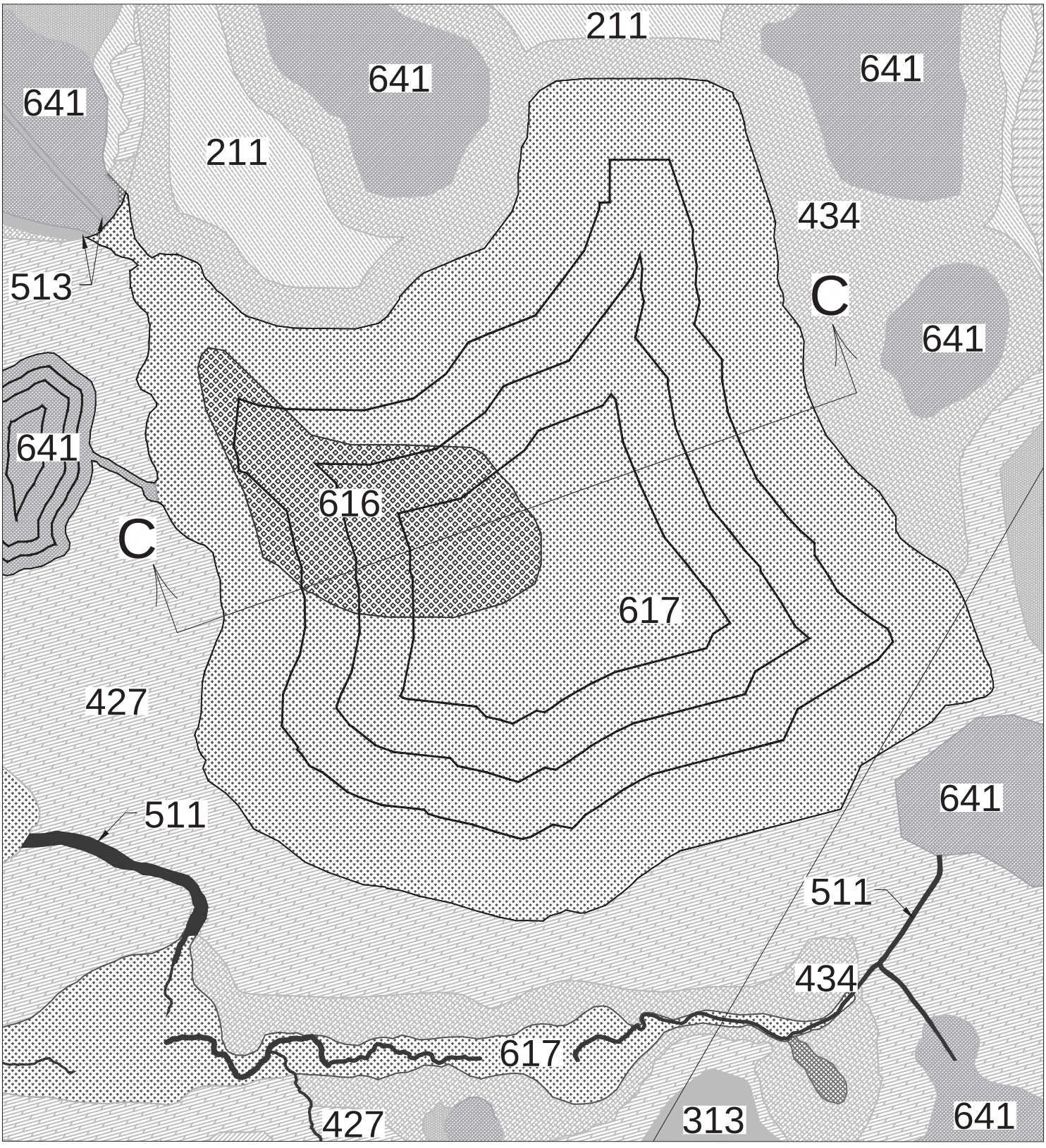
Hydric Pine Savanna

(FLUCFCS 626) up to 0.5 ft depth (below SHW)

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500 0 250 500 1 inch = 500 ft.

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CF Industries

South Pasture Extension

Mixed Wetland Hardwoods
(FLUCFCS 617) up to 1.5 ft depth (below SHW)
Inland Ponds and Sloughs
(FLUCFCS 616) up to 1.5 ft depth (below SHW)

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Planting Scheme (FLUCFCS 626) up to 0.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Slash pine	*Pinus elliottii*	Above SHW	3 gallon
	Longleaf pine	*Pinus palustris*	Above SHW	3 gallon
Shrubs	Saw palmetto	*Serenoa repens*	Above SHW	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
Herbaceous Groundcover**	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Wiregrass	*Aristida berychiana*	SHW to –0.1’	1 qt or bare root equiv.
	Blue Maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to –0.5’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to –0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Soft Rush	*Juncus effuses*	SHW to -0.5’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.

Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.

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CF Industries

South Pasture Extension

Hydric Pine Savanna Planting Scheme

(FLUCFCS 626) up to 0.5 ft depth (below SHW)

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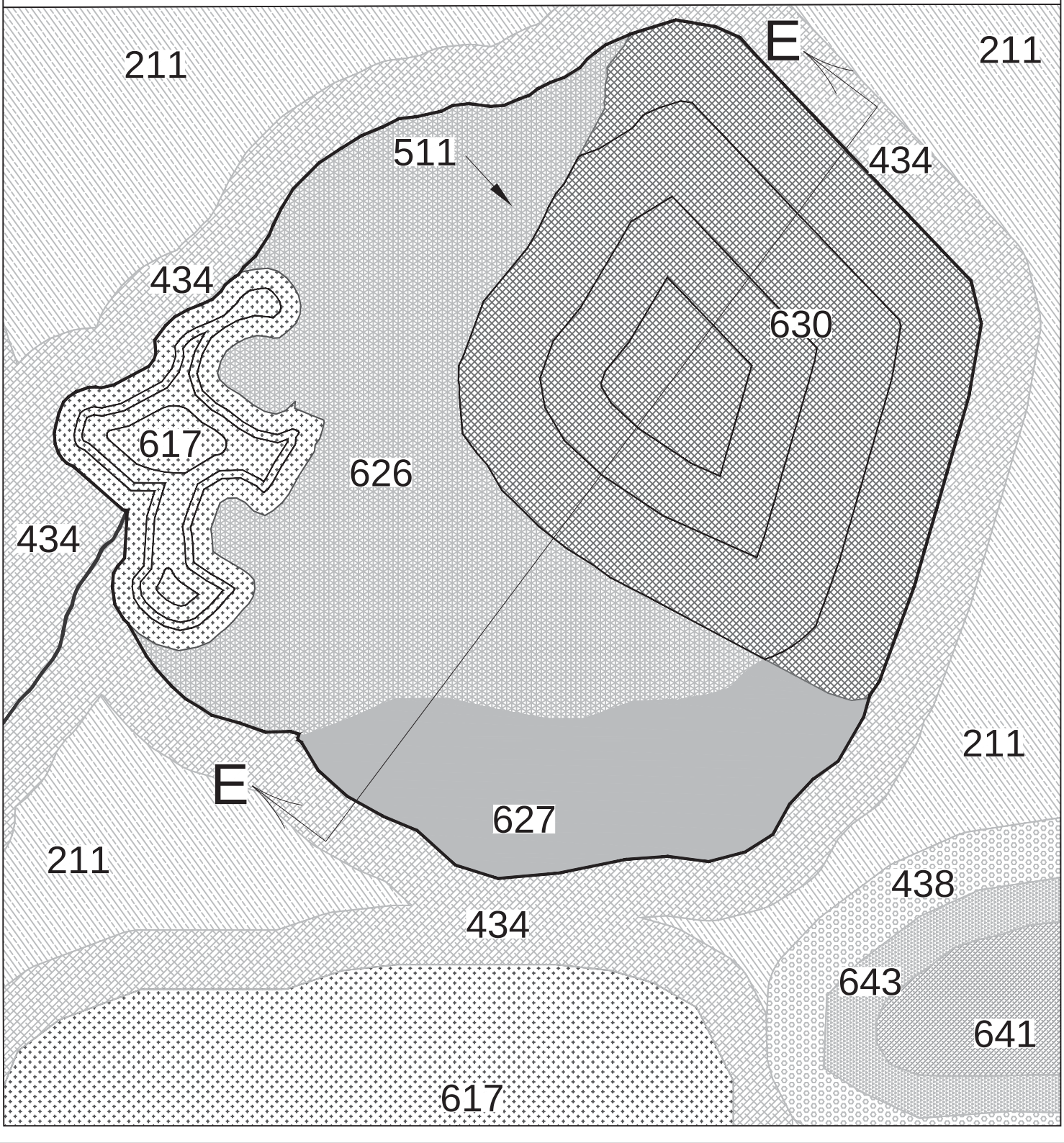
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350 0 175 350 1 inch = 350 ft.

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CF Industries

South Pasture Extension

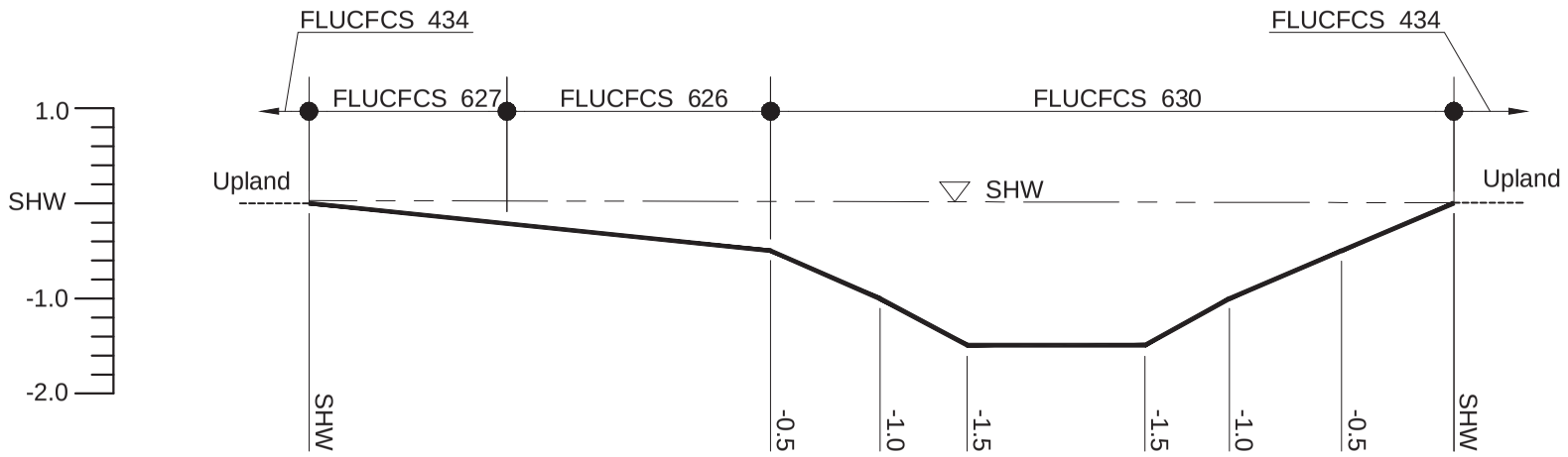
Slash Pine Swamp Forest,Hydric Pine Savanna & Wetland Forested Mixed Communities

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33578



Note: Irregular bottom for FLUCFCS 626 will vary +\- 0.25 ft.
Irregular bottom for FLUCFCS 627 & 630 will vary + 0.75 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section E-E
(FLUCFCS 627) up to 1.0' foot depth,(FLUCFCS 626) up to 0.5 ft depth (below SHW) & (FLUCFCS 630) up to 1.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" = 350'

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CF Industries

South Pasture Extension

Slash Pine Swamp Forest (FLUCFCS 627) up to 1.0 ft depth
Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)
Wetland Forested Mixed (FLUCFCS 630) up to 1.5 ft depth (below SHW)

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Slash Pine Swamp Forest Planting Scheme (FLUCFCS 627) up to 1.0 ft depth				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Slash pine	*Pinus elliottii*	Above SHW	3 gallon
	Loblolly bay	*Gordonia lasianthus*	SHW	3 gallon
	Swamp bay	*Persea palustris*	SHW to –0.5’	3 gallon
	Sweetbay	*Magnolia virginiana*	SHW to –0.5’	3 gallon
	Black gum	*Nyssa sylvatica*	-0.1 to –1.0’	3 gallon
	Pond cypress	*Taxodium ascendens*	-1.0’ to –1.0’	3 gallon
Shrubs	Saw palmetto	*Serenoa repens*	Above SHW	1 gallon
	Walter's viburnum	*Viburnum Obovatum*	SHW	1 gallon
	Dahoon holly	*Ilex cassine*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
Herbaceous Groundcover**	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	Xyris spp.	SHW	1 qt or bare root equiv.
	Wiregrass	*Aristida berychiana*	SHW to –0.1’	1 qt or bare root equiv.
	Blue Maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Hair grass	*Eleocharis baldwinii*	SHW to –1.0’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –1.0’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.

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CF Industries

South Pasture Extension

Slash Pine Swamp Forest (FLUCFCS 627) up to 1.0 ft depth

Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)

Wetland Forested Mixed (FLUCFCS 630) up to 1.5 ft depth (below SHW)

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Hydric Pine Savanna Planting Scheme (FLUCFCS 626) up to 0.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Slash pine	*Pinus elliottii*	Above SHW	3 gallon
	Longleaf pine	*Pinus palustris*	Above SHW	3 gallon
	Saw palmetto	*Serenoa repens*	Above SHW	1 gallon
Shrubs	Saw palmetto	*Serenoa repens*	SHW	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
Herbaceous Groundcover**	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Wiregrass	*Aristida berychiana*	SHW to –0.1’	1 qt or bare root equiv.
	Blue Maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to –0.5’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to –0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Soft Rush	*Juncus effuses*	SHW to -0.5’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.

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CF Industries

South Pasture Extension

Slash Pine Swamp Forest (FLUCFCS 627) up to 1.0 ft depth

Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)

Wetland Forested Mixed (FLUCFCS 630) up to 1.5 ft depth (below SHW)

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Wetland Forested Mixed Planting Scheme (FLUCFCS 630) up to 1.5 ft depth				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Sand pine	*Pinus clausa*	Above SHW	3 gallon
	Slash pine	*Pinus elliottii*	Above SHW	3 gallon
	Water oak	*Quercus nigra*	SHW	3 gallon
	Cabbage palm	*Sabal palmetto*	SHW	3 gallon
	Laurel oak	*Quercus laurifolia*	SHW to –0.1’	3 gallon
	Water hickory	*Carya aquatica*	SHW to –0.25’	3 gallon
	Red maple	*Acer rubrum*	SHW to –0.25’	3 gallon
	Swamp bay	*Persea palustris*	SHW to –0.5’	3 gallon
	Sweetbay	*Magnolia virginiana*	SHW to –0.5’	3 gallon
	American elm	*Ulmus Americana*	SHW to –0.5’	3 gallon
	Black gum	*Nyssa sylvaticia*	-0.1 to –1.0’	3 gallon
	Pop ash	*Fraxinus caroliniana*	SHW to –1.5’	3 gallon
	Pond cypress	*Taxodium ascendens*	-1.0’ to –1.5’	3 gallon
Shrubs	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Dahoon holly	*Ilex cassine*	SHW to –0.25’	1 gallon
	Virginia willow	*Itea virginica*	SHW to –0.5’	1 gallon
	Swamp dogwood	*Cornus foemina*	SHW to –0.5’	1 gallon
Herbaceous Groundcover**	Redtop panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Swamp fern***	*Blechnum serrulatum*	SHW to –0.25’	1 qt or bare root equiv.
	Cinnamon fern***	*Osmunda cinnamomea*	SHW to –0.25’	1 qt or bare root equiv.
	Virginia chain fern***	*Woodwardia virginica*	SHW to –0.25’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Beakrush	*Rhynchospora spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Lizard's-tail***	*Saururus cernuus*	-0.25’ to –0.5’	1 qt or bare root equiv.
	Saw grass	*Cladium jamaincense*	-0.25’ to –1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to –1.0’	1 qt or bare root equiv.
	Soft Rush	*Juncus effusus*	SHW to -1.5’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –1.5’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.
Shade Tolerant Species*** = Shade tolerant species are expected to become established from seed source as a result of muck transfer; if after 5-7 years, shade tolerant species have not become established, they will be planted in shaded areas where suitable canopy coverage exists.

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CF Industries

South Pasture Extension

Slash Pine Swamp Forest (FLUCFCS 627) up to 1.0 ft depth

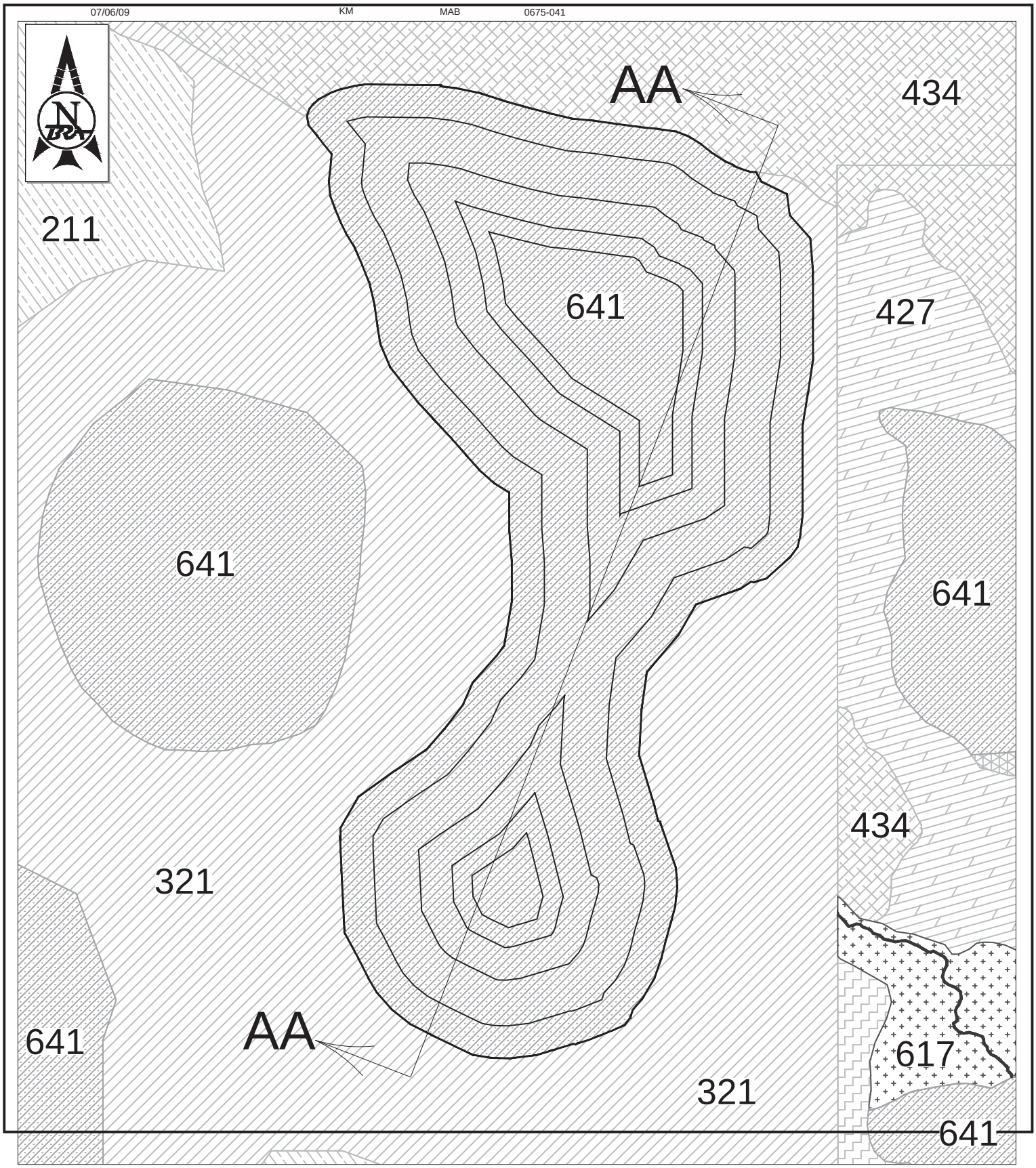
Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)

Wetland Forested Mixed (FLUCFCS 630) up to 1.5 ft depth (below SHW)

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200 0 100 200 1 inch = 200 ft.

CF Industries

South Pasture Extension

Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

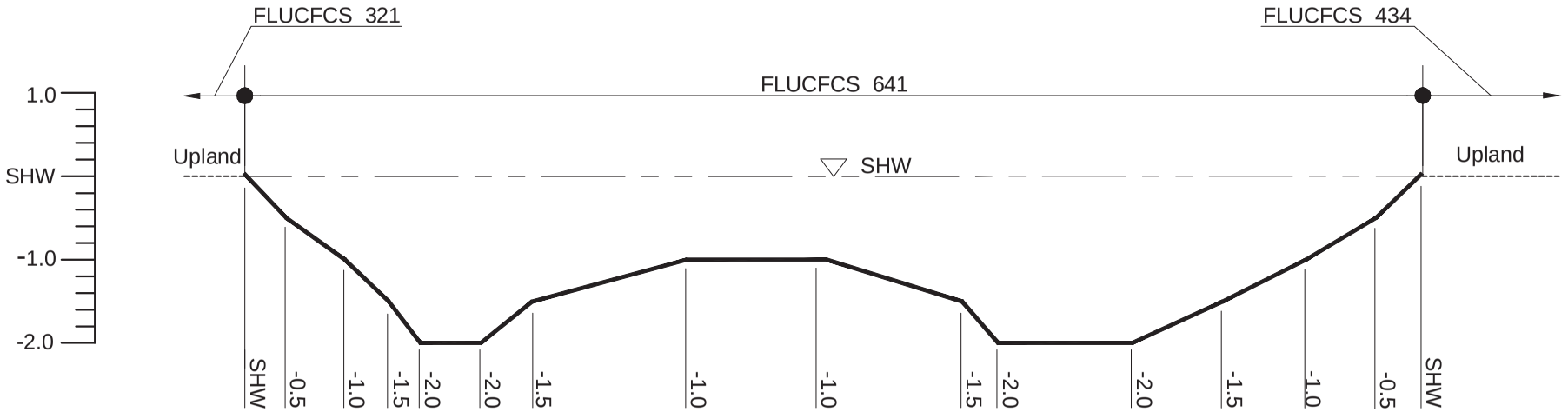
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Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section AA-AA (FLUCFCS 641) up to 2.0 ft depth (below SHW)

VERT 1" = 3' HORZ 1" = 200'

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CF Industries

South Pasture Extension

Intermediate Freshwater Marsh

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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Intermediate Freshwater Marsh Planting Scheme (FLUCFCS 641) up to 2.0 ft depth (below SHW)

Strata	Plant Species*		Planting Depth	Size
	Common Name	Scientific Name		
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.25 to -1.5’	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25’ to -0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Jointed spike rush	*Eleocharis intertincta*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to -1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to 1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –2.0’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –2.0’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –2.0’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.

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Intermediate Freshwater Marsh Planting Scheme

(FLUCFCS 641) up to 2.0 ft depth (below SHW)

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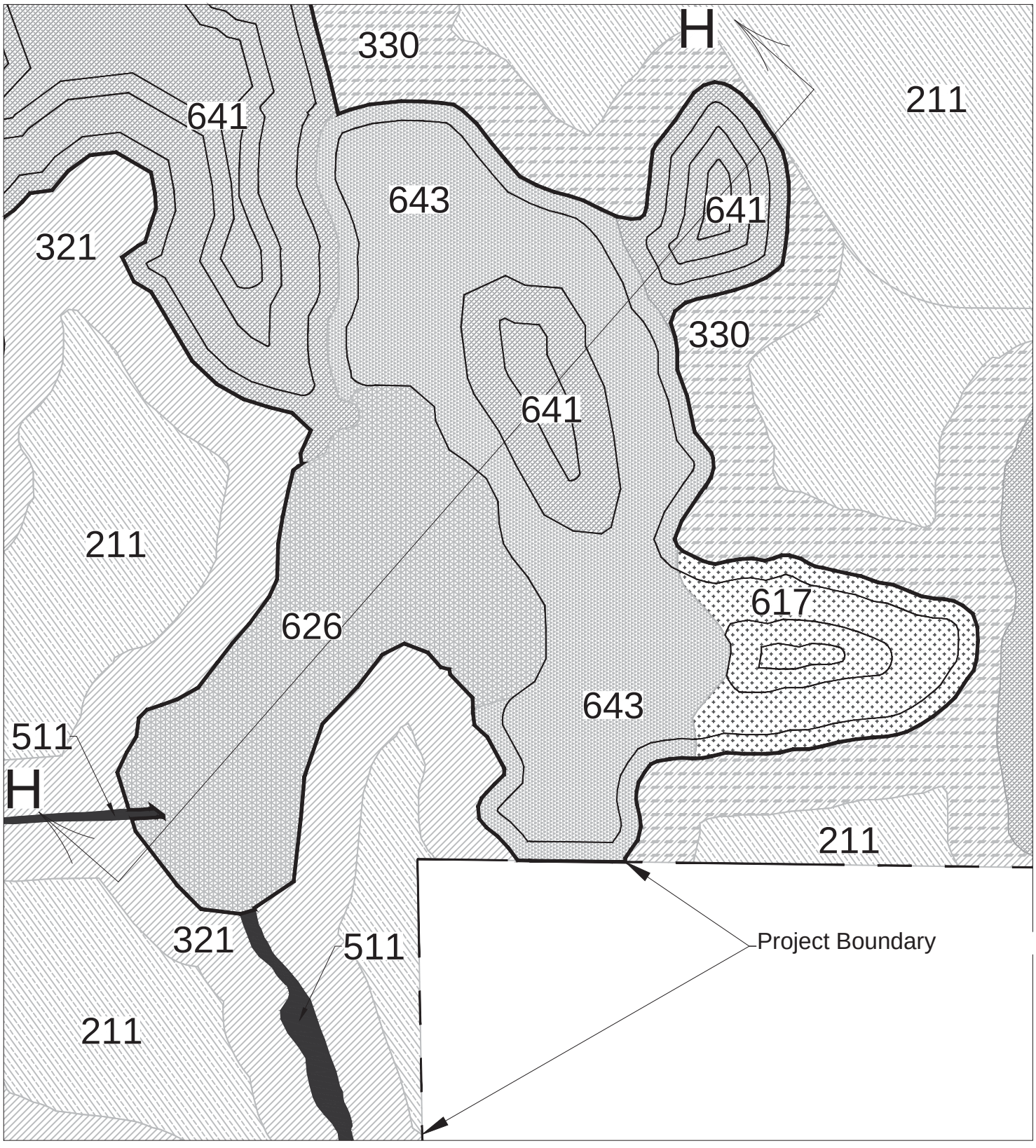
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350 0 175 350 1 inch = 350 ft.

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South Pasture Extension

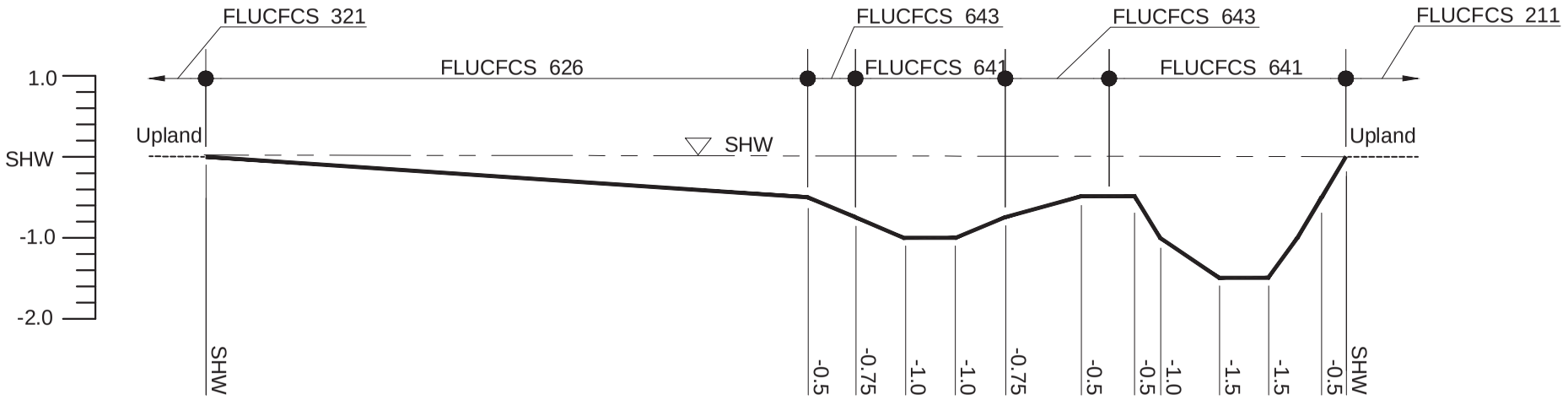
Hydric Pine Savanna,Wet Prairie &

Shallow Freshwater Marsh Mixed Communities

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Note: Irregular bottom will vary +\- 0.25 ft.

Note: The elevations shown on the cross sections are relative to seasonal high water estimated to be at the same elevation of the wetland/upland interface, and are not true elevations. True elevations for grading will be determined by post reclamation topography and SHW elevations will be determined by the integrated watershed model.

Post Reclamation Typical Cross Section H-H
Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)
Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)
Shallow Freshwater Marsh (FLUCFCS 641) up to 1.5 ft depth (below SHW)

VERT 1" = 3' HORZ 1" = 350'

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South Pasture Extension

Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)
Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)
Shallow Freshwater Marsh (FLUCFCS 641) up to 1.5 ft depth (below SHW)

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Hydric Pine Savanna Planting Scheme (FLUCFCS 626) up to 0.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Canopy	Slash pine	*Pinus elliottii*	Above SHW	3 gallon
	Longleaf pine	*Pinus palustris*	Above SHW	3 gallon
	Saw palmetto	*Serenoa repens*	Above SHW	1 gallon
Shrubs	Saw palmetto	*Serenoa repens*	SHW	1 gallon
	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
Herbaceous Groundcover**	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Wiregrass	*Aristida berychiana*	SHW to –0.1’	1 qt or bare root equiv.
	Blue Maidencane	*Amphicarpum muhlenbergianum*	SHW to –0.5’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to –0.5’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to –0.5’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to –0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –0.5’	1 qt or bare root equiv.
	Soft Rush	*Juncus effuses*	SHW to -0.5’	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.
Herbaceous Cover** = Herbaceous groundcover will be planted to help reestablish native vegetation in the wetland; however, herbaceous cover will be expected to decrease over time as a result of shading.

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South Pasture Extension

Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)
Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)
Shallow Freshwater Marsh (FLUCFCS 641) up to 1.5 ft depth (below SHW)

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Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)

Strata	Plant Species*		Planting Depth	Size
	Common Name	**Scientific Name**		
Shrubs	Walter's viburnum	Viburnum obobatum	SHW	1 gallon
	Gallberry	*Ilex glabra*	Above SHW	1 gallon
	Wax myrtle	Myrica cerifera	SHW to -0.25'	1 gallon
	Fetterbush	Lyonia	SHW to -0.25'	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Wire grass	*Aristida beyrichiana*	SHW to -0.1'	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1'	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5'	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5'	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5'	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5'	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25' to -0.5'	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to –1.0'	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to –1.0'	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to –1.0'	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to –1.0'	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25' to –1.0'	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5' to –1.0	1 qt or bare root equiv.

Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.

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South Pasture Extension

Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)

Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)

Shallow Freshwater Marsh (FLUCFCS 641) up to 1.5 ft depth (below SHW)

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Shallow Freshwater Marsh Planting Scheme (FLUCFCS 641) up to 1.5 ft depth (below SHW)				
Strata	**Plant Species***		**Planting Depth**	**Size**
	Common Name	**Scientific Name**		
Shrubs	Fetterbush	*Lyonia lucida*	SHW to –0.25’	1 gallon
	Wax myrtle	*Myrica cerifera*	SHW to –0.25’	1 gallon
	Buttonbush	*Cephalanthus occidentalis*	-0.25 to -1.5’	1 gallon
Herbaceous Groundcover	Andropogons	*Andropogon spp.*	SHW	1 qt or bare root equiv.
	Yellow-eyed grass	*Xyris spp.*	SHW	1 qt or bare root equiv.
	Red top panicum	*Panicum rigidulum*	SHW	1 qt or bare root equiv.
	Iris	*Iris spp.*	SHW to -0.1’	1 qt or bare root equiv.
	Sand cordgrass	*Spartina bakeri*	SHW to -0.5’	1 qt or bare root equiv.
	Carex	*Carex spp.*	SHW to -0.5’	1 qt or bare root equiv.
	Blue maidencane	*Amphicarpum muhlenbergianum*	SHW to -0.5’	1 qt or bare root equiv.
	Low panicums	*Dicanthelium spp.*	Above SHW to -0.5’	1 qt or bare root equiv.
	Golden canna	*Canna flaccida*	-0.25’ to -0.5’	1 qt or bare root equiv.
	Flat sedge	*Cyperus spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Hairgrass	*Eleocharis baldwinii*	SHW to -1.0’	1 qt or bare root equiv.
	Beak rush	*Rhynchospora spp.*	SHW to -1.0’	1 qt or bare root equiv.
	Jointed spike rush	*Eleocharis intertincta*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Sawgrass	*Cladium jamaicense*	-0.25’ to -1.0’	1 qt or bare root equiv.
	Spider lily	*Crinum americanum*	-0.5’ to -1.0’	1 qt or bare root equiv.
	Maidencane	*Panicum hemitomon*	SHW to -1.0’	1 qt or bare root equiv.
	Soft rush	*Juncus effusus*	SHW to 1.5’	1 qt or bare root equiv.
	Lance-leaf arrowhead	*Sagittaria lancifolia*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Pickerelweed	*Pontederia cordata*	-0.5’ to –1.5’	1 qt or bare root equiv.
	Alligator flag	*Thalia geniculata*	-1.0’ to –1.5’	1 qt or bare root equiv.
Plant Species* = A variety of desirable native species be selected from the planting scheme and may not be inclusive of all the species listed. Other suitable native species may be also substituted, where appropriate, for those listed the planting scheme. All plants will be installed in groupings representative of natural plant communities.				

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South Pasture Extension

Hydric Pine Savanna (FLUCFCS 626) up to 0.5 ft depth (below SHW)

Wet Prairie Planting Scheme (FLUCFCS 643) up to 1.0 ft depth (below SHW)

Shallow Freshwater Marsh (FLUCFCS 641) up to 1.5 ft depth (below SHW)

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APPENDIX 3 INTERGRATED MODELING REPORT (PREPARED BY BCI)

INTEGRATED SIMULATIONS FOR THE SOUTH PASTURE EXTENSION MINE FOR PRE-MINING AND POST-RECLAMATION CONDITIONS

Prepared for

CF INDUSTRIES, INC.
Wauchula, FL

Prepared by

AMEC-BCI
2000 E. Edgewood Drive, Suite 215
Lakeland, Florida 33803

AMEC-BCI Project No: 3-16268

March 2011
(Revised)

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 STUDY AREA 1
2.1 Stream and Drainage Area Characteristics 2
2.2 Precipitation and Evapotranspiration 2
2.3 Hydrogeology 3
Surficial Aquifer System 4
Intermediate Aquifer System 4
Floridan Aquifer System 5
Hydrological Characteristics of Aquifers and Confining Beds 6
The Surficial Aquifer System 6
First Confining Bed 6
Intermediate Aquifer System 6
Second Confining Bed 6
Floridan Aquifer System 6
3.0 MODEL SELECTION AND DESCRIPTION 7
3.1 Model Domain, Grid Spacing, and Period of Simulation 7
3.2 Topography 8
Pre-mining Topography 8
Post-Reclamation Topography 9
Meteorological Dataset 10
Precipitation 10
Evapotranspiration 11
3.3 Land Use 11
Leaf Area Index 12
Root Depth 12
3.4 Overland Flow 13
Manning’s Number 13
Detention Storage 13
Initial Water Depth 14
Separated Flow Areas 14
3.4 Unsaturated Flow 15
Soils Description 15

TABLE OF CONTENTS
(continued)

3.6 Saturated Zone 17
Geological Layers 17
Layer Thickness 18
Hydraulic Conductivities 18
Specific Yield and Specific Storage 18
Geological Lenses 19
Computational Layers 19
3.7 MIKE 11 (Rivers and Lakes Set up) 20
River Network 20
Structures 20
Initial and Boundary Conditions 21
Initial Conditions 21
Boundary Conditions 21
3.8 MIKE SHE and MIKE 11 Interaction 22
4.0 RESULTS 22
5.0 REFERENCES 27

LIST OF TABLES

Table IMR-1 -	Average Streamflow and Basin Yield at Selected USGS Stream Gages
Table IMR-2 -	Landform Descriptions Based on Second Level FLUCCS
Table IMR-3 -	Assigned Rooting Depths for Different Land Use Groups
Table IMR-4 -	Overland Flow Manning's Roughness Coefficients
Table IMR-5 -	Assigned Manning's Coefficients and Depression Storage Based on FLUCCS Code
Table IMR-6 -	Soils Composition for the Pre-Mining Model Domain
Table IMR-7 -	Hydraulic Soil Properties for Generalized and Mined-Soil Types
Table IMR-8 -	Aquifer Properties Defined for Pre-Mining and Post-Reclamation Simulations
Table IMR-9 -	Hydraulic Specification for the Structures Modeled under Pre-Mining Conditions
Table IMR-10-	Hydraulic Specification for the Structures Modeled under Post-Reclamation Conditions
Table IMR-11-	Pre-Mining Total Water Budget and Aquifer Recharge Summary for Hardee Phosphate Complex 1/1/1990-1/1/2010
Table IMR-12-	Post-Reclamation Total Water Budget and Aquifer Recharge Summary for Hardee Phosphate Complex 1/1/1990-1/1/2010
Table IMR-13-	Water Budget Comparison for Pre-Mining and Post-Reclamation Discharge
Table IMR-14-	Wetland Hydropattern Summary Pre-Mining Conditions
Table IMR-15-	Wetland Hydropattern Summary for Post-Reclamation Conditions

LIST OF FIGURES

Figure IMR-1 - South Pasture Extension Integrated Model Location Map (1 of 5)

Figure IMR-2 - South Pasture Extension Integrated Model Domain

Figure IMR-3 - South Pasture Extension Integrated Model Domain Pre-Mining Topography

Figure IMR-4 - South Pasture Extension Integrated Model Domain Post-Reclamation Topography

Figure IMR-5 - Rainfall Time-Series used in the model simulation 1985 through 2009

Figure IMR-6 - Reference ET time-series used in the model simulation 1985 through 2009

Figure IMR-7 - South Pasture Extension Integrated Model Domain Pre-Mining Land Use

Figure IMR-8 - South Pasture Extension Integrated Model Domain Post-Reclamation Land Use

Figure IMR-9 - South Pasture Extension Integrated Model Pre-Mining Separated Flow Areas

Figure IMR-10 - South Pasture Extension Integrated Model Post-Reclamation Separated Flow Areas

Figure IMR-11 - South Pasture Extension Integrated Model Domain Pre-Mining Soil Distribution

Figure IMR-12 - South Pasture Extension Integrated Model Domain Post-Reclamation Soils Distribution Hardee County, Florida

Figure IMR-13a - South Pasture Extension Integrated Model Pre-Mining Horizontal Hydraulic Conductivity

Figure IMR-13b - South Pasture Extension Integrated Model Post-Reclamation Horizontal Hydraulic Conductivity

Figure IMR-13c - South Pasture Extension Integrated Model Post-Reclamation Vertical Hydraulic Conductivity

Figure IMR-13d - South Pasture Extension Integrated Model Pre-Mining Specific Yield

Figure IMR-13e - South Pasture Extension Integrated Model Post-Reclamation Specific Yield

Figure IMR-14 - South Pasture Extension Integrated Model Typical Geological Lens

Figure IMR-15 - South Pasture Extension Integrated Model Post-Reclamation Horizontal Hydraulic Conductivity of Geological Lens

Figure IMR-16 - South Pasture Extension Integrated Model Post-Reclamation Vertical Hydraulic Conductivity of Geological Lens

Figure IMR-17 - South Pasture Extension Integrated Model Pre-Mining Drainage Network

LIST OF FIGURES
(continued)

Figure IMR-18 -	South Pasture Extension Integrated Model Post-Reclamation Drainage Network
Figure IMR-19a –	South Pasture Extension Integrated Pre-Mining Hydraulic Structures
Figure IMR-19b –	South Pasture Extension Integrated Post Reclamation Hydraulic Structures
Figure IMR-20a –	Wetland Cross Section Location Map South Pasture Extension Integrated Pre-Mining
Figure IMR-20b –	Wetland Cross Section Location Map South Pasture Extension Integrated Pre-Mining
Figure IMR-21a –	Wetland Cross Section Location Map South Pasture Extension Integrated Post-Reclamation
Figure IMR-21b–	Wetland Cross Section Location Map South Pasture Extension Integrated Post-Reclamation
Figure IMR-22 –	Pre-Mining Maximum Phreatioc Surface Elevation South Pasture Extension
Figure IMR-23 –	Post Reclamation Maximum Phreatic Surface Elevation South Pasture Extension
Figure IMR-24a -	Frequency-Discharge Curves for Brushy Creek
Figure IMR-24b-	Frequency-Discharge Curves for Lettis Creek
Figure IMR-24c-	Frequency-Discharge Curves for Troublesome Creek
Figure IMR-24d-	Frequency-Discharge Curves for Total Combined Flow Leaving South Pasture Extension

1.0 INTRODUCTION

CF Industries (CF) contracted BCI Engineers and Scientists Inc. (BCI) to develop an integrated surface and groundwater model for the Hardee Phosphate Complex, South Pasture Extension (SPE) mine. Integrated modeling was performed to provide continuous, long-term time-series projections of the current conditions as a validation step and then to apply the proposed post-reclamation lithology, topography, vegetative cover, and other conditions to the validated model to project whether the reclamation design will result in hydrologic conditions that support the wetlands and streams to be preserved or created, as well as to maintain the downstream flow regime.

MIKE SHE, an integrated hydrological model developed by DHI Water and Environment, Inc., Portland, OR (www.dhi.us) was used to perform the hydrologic simulations discussed in this report. MIKE SHE was chosen due to its versatility in specification of modeling parameters as well as its integration with MIKE 11, a one dimensional surface water model, for the simulation of lakes and stream drainage networks.

This report describes the model set up and the results that were subsequently obtained. Details about the type and source of input data, all relevant pre- and post-processing steps, and the results in form of seasonal high water elevations, seasonal high water depths, and hydroperiods for both pre-mining and post-reclamation conditions are presented in this report.

2.0 STUDY AREA

The Hardee Phosphate Complex owned by CF Industries is located within northwestern Hardee County. The Complex comprises two adjacent mine properties, the South Pasture Mine (SP) in the north and South Pasture Extension (SPE) in the south. The SP has an approximate area of 15,390 acres and is located in Townships 33S and 34S and Ranges 23E and 24E. The SPE has an area of 7,512.8 acres and is primarily located in Township 34S and Ranges 23E and 24E. **Figure IMR-1** shows the location of the South Pasture and South Pasture Extension along with the streams that run through the property.

Much of the drainage network in the SPE originates from the SP, so the SP is included in the model to ensure that potential artifacts of local boundary conditions are minimized. For the remainder of the report the combined SP and SPE properties will be referred to as the Hardee Phosphate Complex. The following sections describe the hydrogeological characteristics of the Hardee Phosphate Complex.

2.1 Stream and Drainage Area Characteristics

The Hardee Phosphate Complex lies on flat ground in the west-central part of the Peace River Basin and is primarily drained by various small tributaries onsite to larger streams located offsite including Payne Creek, Horse Creek, and Troublesome Creek. The mining property does not have any major stream flowing across it. No perennial streams originate from or flow across the Complex because it sits upon a flat interfluvial area straddling a comparably small fraction of the larger Payne Creek and Horse Creek watersheds. The low-order streams draining the property typically flow in response to sustained wet season rainfall and do not flow during most of the dry season. These include Coons Bay Branch, Plunder Branch, Doe Branch, and Shirttail Branch all of which discharge north to Payne Creek. Also included are Brushy Creek and Lettis Creek which discharge to Horse Creek. Originating primarily in the SPE is Troublesome Creek which carries runoff from the eastern portion of SPE to the Peace River. Apart from these defined stream channels, small diffuse runoff areas without any defined drainage pattern also discharge from the property north to Gum Swamp Branch and south to East Branch.

The drainage network of the property can best be described as consisting of a series of headwater and interconnected wetlands with sporadic stream channels linking them together. The Brushy Creek, Lettis Creek, Doe Branch, Shirttail Branch, Coons Bay Branch, and Troublesome Creek systems all form obvious chains-of-wetlands on the Hardee Phosphate Complex. The historically dominant physiographic consisted of a flatwoods ecoregion interspersed with isolated and flowing wetlands.

Three USGS stream gages exist relatively near the CF mine property with decadal scale daily flow records. They are (1) Horse Creek near Myakka Head (USGS station number 02297155), (2) Payne Creek near Bowling Green (USGS station number 02295420), and (3) Peace River at Zolfo Springs (USGS station number 02295637). **Table IMR-1** lists the recorded average daily flow and average basin yield at the above stations from all the available data recorded at each station. Also included is one stream with a short duration record with two full water years, Brushy Creek (USGS station number 02297220). This is the same Brushy Creek that drains CF property gaged approximately 10 miles downstream of the property boundary.

2.2 Precipitation and Evapotranspiration

For west-central Florida evapotranspiration has been estimated to be about 73 percent of long term average precipitation (Sumner, 2001; Knowles, 1996). However, for dry years the percentage may be higher. Knowles (1996) determined that long term annual average of rainfall for the area is 52 inches/year, with actual evapotranspiration being about 35-38 inches/year. For areas dominated with wetland communities, values in the vicinity of 40 inches/year are common. The rainfall is unevenly distributed throughout the year, with about 60 percent falling during the summer months. Rainfall patterns vary widely among years and typically have pronounced wet and dry seasons within the year. For these reasons, it is important to have a multiple-year record when assessing hydrology in peninsular Florida.

2.3 Hydrogeology

The following hydrogeologic description of the study area (Hardee Phosphate Complex) for this report was derived from a variety of sources (cited as applicable), with particular focus on a study conducted specifically at the Hardee Phosphate Complex: the Consumptive Use Application – Supporting Report compiled by Dames and Moore (Dames and Moore, 1975).

The SP and SPE are located near the boundary between the Central Florida Phosphate District and the Southern Extension District (Scott and Cathcart, 1989). Stratigraphic formations present at the mine, in descending order are the undifferentiated surficial deposits, the Hawthorn Group, and Suwannee Limestone. The Hawthorn Group includes the Bone Valley Member of the Peace River Formation, the Undifferentiated Peace River Formation, and the Arcadia Formation (Scott, 1988). Mining within the SPE will typically extend to the upper portion of the Peace River Formation.

The surficial sediments include the undifferentiated Pliocene-Pleistocene and recent sandy to clayey sediments deposited on top of the Hawthorn Group. In general, surficial sediments consist of fine to medium-grained quartz sand and clayey sand with very minor amounts of phosphate. The characteristics of the phosphate vary widely throughout the unit, ranging from sands cemented by aluminum phosphates (leach zone) to minor white to black fine grained phosphate particles. Surficial sediments within the area range from about 8 to 42 feet in thickness.

The Bone Valley Member of the Peace River Formation occurs erratically as elongated reworked and erosional patches scattered across the property, and comprises the uppermost layer of the mineable phosphate matrix, when present. It is comprised of interbedded quartz sands, clays, and granule to gravel sized phosphate particles (Scott, 1988). The sands are generally fine to coarse-grained with depth, slightly clayey, and variably phosphatic. The Bone Valley Formation is the uppermost stratum of the Hawthorn Group on the property, and varies in thickness from about 0 to 25 feet.

The Undifferentiated Peace River Formation is comprised of interbedded quartz sands, clays, and carbonates (Scott, 1988). Its sands are generally fine to medium-grained, with clays and phosphate each comprising about 15 to 30 percent of the stratum by weight. The phosphate is predominately fine grained. Most of the mineable matrix on the property is within the Peace River Formation, with thicknesses ranging between 5 to 65 feet.

The Arcadia Formation occurs as limestone and dolostone with sporadic lenses of quartz sand and clayey sediments containing fine grained phosphate. The phosphate content of the formation generally ranges between 10 and 25 percent. In general, the middle to lower portions of the Arcadia Formation contains no economically recoverable phosphate rock and unconformably overlies the Suwannee Limestone.

The Suwannee Limestone is a yellowish-white to white, chalky, fossiliferous, non-phosphatic calcarenite.

Three hydrogeologic units underlie the South Pasture Extension: the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS) and the Floridan Aquifer System (FAS). The hydrogeologic unit terminology described above is in accordance with definitions set forth by the Ad Hoch Committee on Florida Hydrostratigraphic Unit Definition (Southeastern Geological Society, 1986).

Surficial Aquifer System

The SAS is the uppermost hydrogeologic unit on the mine site and consists principally of unconsolidated, poorly drained, and inundated sandy deposits. Groundwater in the SAS occurs under unconfined (non-artesian) conditions and extends from the water table to the top of the first laterally extensive bed of much lower hydraulic conductivity (Southeastern Geological Society, 1986). The SAS is termed a system due to the presence of slightly lower permeable layers and lenses, which may restrict or impede movement of groundwater within surficial sands.

The SAS in comprised of undifferentiated Pliocene-Pleistocene and Recent sands (Clark, 1972). The upper sandy materials begin at land surface and are composed primarily of clean, fine-grained quartz sands or sandy loams. Occasionally, hardpan layers of iron-cemented sands and clay lenses occur discontinuously in the soil horizons of the upper sandy unit. The base of the SAS coincides with the top of the upper confining unit of the IAS. Over most of the site, the Hawthorn Group includes the first vertically persistent stratum of lower hydraulic conductivity, which begins the separation and retardation of groundwater exchange to the lower artesian aquifers. In portions of the area where beds of the phosphorite unit of the surficial deposits are very clayey or contain extensive clay lenses, these less permeable strata are considered the base of the SAS (Clark, 1972). At the SPE site, the top of the IAS generally begins at the top of the clayey stratum that underlies the mineable matrix within the Peace River Formation.

Intermediate Aquifer System

The IAS is stratigraphically represented by portions of the Peace River Formation and by the Arcadia Formation and includes all confining beds and water-bearing strata between the SAS and FAS. In the upper portions of the Peace River Formation, a typical confining bed lithology includes interbedded phosphatic clayey sands and sandy clays. The upper portion of the Peace River Formation has a lower hydraulic conductivity than the more sandy Pliocene-Pleistocene and Recent deposits, but generally has a relatively high effective horizontal transmissivity in comparison to the confining strata between the surficial and Intermediate Aquifers

The lower carbonate section of the Arcadia Formation contains permeable strata composed of sandy limestones and dolomites. The lower confining unit corresponds stratigraphically to the “sand and clay” unit of the Arcadia Formation and regionally consists of variable mixtures of sand, clay, and dolomitic limestone. The higher transmissive zones of the IAS are separated from

the SAS (and bottom of the mineable matrix) by a confining unit(s) made up of intermittent layers of clays and limestone with a combined thickness of approximately 200 feet at the South Pasture Extension.

Floridan Aquifer System

The FAS underlies the lower confining unit of the IAS and consists of a thick carbonate sequence of permeable limestones and dolomites. The top of the FAS coincides with the top of the Suwannee Limestone. The Suwannee Limestone is a white, nodular, fossiliferous limestone with a distinct lithologic contact and gamma ray signature that is similar to that of the overlying confining beds of the IAS.

Included in the FAS and located stratigraphically beneath the Suwannee Limestone are limestones of the Ocala Group and the Avon Park Formation. The Ocala Group is composed of chalky, very fossiliferous (foraminiferal) limestone with some dolomite beds in the lower section. The Avon Park Formation, which includes strata that were formerly termed the Lake City Limestone, is lithologically very similar in composition to the Ocala Group. The lower portion of the Avon Park Formation contains a massive dolomite unit, which is a highly permeable water-bearing zone. This dolomite unit is considered to be in a zone of solution activity.

The base of the FAS is termed the Sub-Florida confining unit and coincides with the appearance of a regionally persistent sequence of lower hydraulic conductivity anhydrite beds of Cedar Keys Limestone. These evaporite strata mark a sharp hydraulic conductivity contact with the dolomite beds of the Floridan Aquifer and effectively limit the depth of groundwater circulation in peninsular Florida (Southeastern Geological Society, 1986).

As discussed in the Development of Regional Impact (DRI) for the SPE dated August 2010, site-specific vertical leakance values were determined to estimate groundwater flow between the surficial and intermediate aquifer systems. Referring to Section 14 of the DRI, the vertical leakance for the current, pre-mining conditions ranges from approximately $2.4x10^{-6}$ to $6.6x10^{-5}$ ft/day/ft, with an average of 3.2x10-5 ft/day/ft. As a result of the low vertical hydraulic conductivity exhibited by the bed clay/upper confining unit, changes in the SAS during mining activities will have little influence on the underlying IAS and FAS

Hydrological Characteristics of Aquifers and Confining Beds

The Surficial Aquifer System

The Surficial Aquifer System (SAS) is the uppermost hydrogeologic unit on the Hardee Phosphate Complex mine site and on an average has a thickness of about 40-50 ft. The lithic material comprising the aquifer is dominantly fine sand and clay with some coarse sand, gravel and shell material. The SAS is termed a system due to the presence of slightly lower permeable layers and lenses which may restrict or impede movement of ground water within surficial sands. Analyses of the aquifer tests indicated a representative transmissivity of 3000 gpd/ft (~ 400 ft^2/day).

First Confining Bed

At the base of SAS and overlying the limestone of the Hawthorn Formation is layer of clay material which is about 40 ft thick. This material acts as a confining layer for water in the underlying IAS and also serves to retard downward movement of water from the shallow aquifer.

Intermediate Aquifer System

The IAS consists of about 250 feet of alternating limestone and clays within the Hawthorn Formation at the mine site. The aquifer is overlain by the first confining unit and underlain by relatively impermeable material at the base of the Hawthorn. The potentiometric surface of the IAS is generally 35 feet below the land surface at the Hardee Phosphate Complex.

Second Confining Bed

The water bearing zones in the Hawthorn Formation (SAS and IAS) are separated from the lower Floridan aquifer by about 50 feet of basal hawthorn or upper Tampa clays. The effectiveness of clays as confining material is indicated by significant difference in the water levels measured in the IAS and the lower Floridan aquifers. The clays tend to retard downward movement of water from the Hawthorn Formation into the Tampa Formation.

Floridan Aquifer System

The Floridan Aquifer System (FAS) consists of more than 1,300 feet of alternating beds of limestone and dolomite with the Tampa, Suwannee, Ocala, Avon Park, and Lake City formations at the South Pasture site. The aquifer underlies the entire west-central Florida region and is the principal source of large ground water supplies in the area. The entire FAS aquifer appears to behave as an interconnected hydrologic unit at the study site. The potentiometric surface of the FAS is generally 68 feet below the land surface at the Hardee Phosphate Complex.

The proposed mining will essentially affect the SAS and the lower systems will remain substantially isolated by the existing confining beds. For this reason, the FAS can be set-up as a boundary condition in the model.

3.0 MODEL SELECTION AND DESCRIPTION

MIKE SHE provides an advanced flexible framework for setting up integrated surface and groundwater models. The modularity of the set up process facilitates modifications/additions to the model as needed, making the system useful for planning and evaluating surface mine reclamation sites as they expand or mine plans change. MIKE SHE represents all the components of the hydrologic system with modules, for simulation of evapotranspiration, overland flow, unsaturated flow, groundwater flow, and channel flow. To simulate channel flow MIKE SHE couples to the MIKE11 software code, which can also be used as a standalone program for modeling channel-networks, lakes, and reservoirs.

MIKE SHE solves for overland flow using diffusive wave approximation of the two-dimensional St.Venant's Equation while the channel flow is solved (in MIKE 11) using one-dimensional St.Venant's Equation. Infiltration and water-flow in the vadose zone is calculated using soil hydraulic characteristics, while the saturated ground water flow is simulated using numerical solutions of the differential equations based on conservation of mass and Darcy's law, similar to the popular MODFLOW code.

MIKE SHE offers the capability to describe every model parameter at different levels of spatial and temporal variability. Thus, depending on the availability of data and modeling requirements the specification of a given parameter can be customized. The following paragraphs describe the inputted data and parameters specified for the current study.

3.1 Model Domain, Grid Spacing, and Period of Simulation

The scope of the current study includes development of an integrated surface and ground water model for the SPE. However as described earlier, to assure continuity of the drainage network and basin divides the SP is also included in the area of interest. To generate boundary conditions for the Hardee Phosphate Complex model, a bigger model (covering a larger area) with a domain extending more than 5000 feet outwards from the Complex was set up. The exact extent of the model boundary was determined by surface-water basin divides of all the drainage features present within 5000 feet of the Hardee Phosphate Complex. Setting up the model boundary this far from the areas of direct interest assists in generation of modeling results without undue influence of the boundary conditions. This model boundary determines the extent of the both pre-mining and post-reclamation integrated models.

Figure IMR-2 shows the domain of the integrated model used in this study. A grid size of 250m X 250m was selected to optimize modeling resolution as well as computational burden. A 25 year period from 1/1/1985 to 1/1/2010 was simulated in this investigation. However, the first five years of model run were just used to stabilize and fully-condition the model to provide sufficiently-accurate "hot-start" conditions for the subsequent run. The results from 1/1/1990 to 1/1/2010 were used in the analysis of modeling results.

From an operational standpoint the period of 1990 to 2010 was divided into four five-year sub-periods and set up as four different models. The end results from one run were used as initial conditions for the subsequent run, to maintain continuity. Use of intervals facilitates quality control and provides a means to efficiently explore design alternatives without sacrificing the integrity of the modeling effort.

3.2 Topography

Pre-mining Topography

Light Detection and Ranging (LiDAR) data from the Southwest Florida Water Management District (SWFWMD) in 2005 was used in part to generate pre-mining topography (**Figure IMR-3**). Because the LiDAR dataset was collected subsequent to the initiation of mining in the SP and in some adjacent Mosaic properties, it reflects active mined, disturbed, and reclaimed areas. Accordingly, the Digital Elevation Model (DEM) derived from the LiDAR data was modified to represent pre-mining topography in such previously disturbed areas. To accomplish this, previously disturbed areas in the DEM were selectively replaced with topographic information generated from one-foot pre-mining contours provided by CF Industries within the SP and five-foot contours provided by USGS for all the disturbed areas outside the South Pasture property. The entire SPE is currently unmined and therefore the LiDAR data was used for the DEM on that property.

Although it provides a highly-detailed topography more than sufficient for the purposes of this modeling effort, the LiDAR DEM does not necessarily always provide a "bare earth" contour. In fact, a comparison of cross-sections from the LiDAR DEM to cross-sections derived from previous land surveys indicates that the LiDAR-derived elevations within the forested headwater wetlands of the property tended to reflect the tops of hummocks, not the base of the wetland. The hummock crests are typically 1 to 2 feet above the wetland bed elevation in such systems and this was taken into account when assessing hydroperiod and water level data in the forested wetland systems.

Post-Reclamation Topography

A post-reclamation DEM (**Figure IMR-4**) was developed using GIS. Five basic considerations were utilized in developing the post-reclamation DEM as follows.

- Location and size of the pre-mining sub-basin drainage divides
- Topology of pre-mining headwater depressions and riparian valleys
- Locations and elevations of wetlands and stream channels within preservation boundaries and at property boundaries
- The pre-mining water table and seasonal high wetland levels (onsite and offsite)
- Reclaimed landform types

For preservation areas (**Figure IMR-1**), the topography was clipped from the pre-mining DEM and pasted onto the post-reclamation DEM. Offsite areas were assumed to have the same topography. Stream channel connections and wetland bottomlands intersecting property or preservation boundaries were located and edge-matched in the DEM.

The design team noted the locations and size of the major headwater depressions, drainage features (valleys), and sub-basin divides under the pre-mining conditions. The initial design step involved identification of available areas within the corresponding mine area (SP or SPE) where these features could be positioned similarly to the pre-mining landscape. These major topologic features were then positioned within the post-reclaimed landscape as close to pre-mining conditions as practicable. In areas where some shifting of position was necessary, the topography was established to approximate the general sequence and size of wetland-stream connections in the drainage network. This design protocol helped to maintain an appropriate balance of conveyance and storage functions of the connected wetlands of the property.

Previous design experience with the SP has demonstrated that areas reclaimed close to original grade achieve seasonal high groundwater elevations similar to pre-mining conditions. Therefore, an approximate pre-mining phreatic surface was developed based on the observations of seasonal high water table from numerous wetlands located at and adjacent to the SP and SPE. The elevation of the phreatic surface was subtracted from the land elevation, using the pre-mining DEM, to get an estimate of depth to the seasonal high water table across the whole property.

An initial approximation of the post-reclamation land-use map was then superimposed over the seasonal high water table distribution for areas to be reclaimed using sand tailings and overburden. The desired wetland depressions and upland areas were then incorporated into the DEM at elevations to appropriately intersect or avoid the phreatic surface based on desired land use. The topography within clay settling and sand clay mix areas was derived from modeled consolidation estimates based on generalized clay characteristics and mining depths provided by CF.

Meteorological Dataset

Precipitation and evapotranspiration are the two biggest components of the water budget. Both serve as climate "boundary" conditions in the model and some care must be taken to assure that these climate variables are input to the level of specificity based on the model purpose and available data. Time series for both precipitation and evapotranspiration covering the 25 years of simulation period were developed from multiple sources because no single source covering the entire period was available.

Precipitation

It is important to note that neither long-term (e.g. 25-year) rainfall nor discharge records exist for the SPE. Therefore, BCI sought to acquire a rainfall record that would cover the normal, natural, and full range of variability occurring in the region. In BCI's experience, MIKE SHE provides the most-realistic results when attributed with rainfall data reported in 15 minute intervals or, if such data is unavailable, data reported in one hour intervals that is parsed into 15-minute intervals. No single local gage provides a record during the entire period of interest for this simulation, so data from two different sources were used to develop the rainfall time series. For years 1998 onwards 15 minute rainfall data from Florida Automated Weather Network (FAWN) weather station located at Ona, FL (Station ID 380) was used. For years prior to 1998 the availability of long term continuous data set is limited to a small number of rainfall stations. The two rainfall stations closest to the project site with long term hourly data are Lakeland Regional Airport and Tampa International Airport. Comparison of rainfall data from both the sites with the Ona weather station revealed that Lakeland Airport on the average has more similar rainfall pattern then Tampa Airport, which is more influenced by coastal effects. Hence the rainfall observed at Lakeland was considered adequate for use in the model simulations. Since the weather data was not derived from observations within the project area, the simulated water levels and flow may not represent exact values for the corresponding period, but in general they provide a very reasonable and realistic rainfall record for use in comparing potential hydrologic changes between pre-mining and post-reclamation conditions at the SP and SPE in Hardee County, Florida.

The rainfall records from the Lakeland Regional Airport were hourly and for the purpose of developing input time series for the model they were disaggregated into 4 equal rainfall records on 15 minutes intervals. **Figure IMR-5** shows the cumulative rainfall values with time for the entire 25 year period of record.

Evapotranspiration

Estimation of actual evapotranspiration in MIKE SHE requires specification of a reference evapotranspiration time series. Reference evapotranspiration (ET_0) is defined as the rate at which readily available soil water is vaporized from a hypothetical crop surface with specific characteristics such as height, surface resistance etc. (Allen et al. 2005). For the state of Florida, satellite-based estimates of daily reference ET on a 2 km X 2 km grid from year 1995 onwards are available (Jacobs et al. 2008). The estimated ET_0 grid for the model domain was downloaded from a USGS website (USGS, 2009) and spatially averaged to generate a daily ET_0 time series for years 1995 to 2009. For years prior to 1995 daily values of USGS Class A pan evaporation from the weather station located at the Ona Research Center, maintained by Southwest Florida Water Management District (SWFWMD, Site ID 24548) were downloaded from the SWFWMD website (SWFWMD, 2009) . The pan evaporation (E_{pan}) values were then converted to reference ET values before being used in the model. Unlike rainfall, MIKE SHE functions well with 24 hour ET_0 input values. Therefore, the Ona station record is useful and represents the best and most-local available point data for the model period where the spatially distributed data was unavailable.

Equation 1 was used to convert the daily pan evaporation to daily reference ET.

$$ET_0 = E_{pan} \times K_{pan} \quad (1)$$

where K_{pan} was determined by dividing average annual reference ET with average annual pan evaporation, such that the long term reference ET obtained from pan data matches the observed values of satellite based reference ET. The value of K_{pan} was calculated to be 0.80 for the current study.

ET_0 obtained from both these methods were combined to generate a single spatially uniform time series for years 1985 to 2010. **Figure IMR-6** shows the temporal distribution of ET_0 for the period of record of model simulations.

3.3 Land Use

Model input requires certain land use groups, necessary to provide some spatial representation of factors such as Manning's n values for overland flow and root depths for ET calculations that are typically lumped into broader (less-specific) categories than those provided by the 1999 Florida Land Use, Cover and Forms Classification System (FLUCCS) at Level II. Therefore, Level II FLUCCS provides a useful threshold of mapping detail more than sufficient for the mode requirements. **Tables IMR-2 through IMR-5** provides specific information regarding how the model input corresponds to various land use categories. FLUCCS maps outside of the Hardee Phosphate Complex were obtained from the Florida Department of Environmental Protection's March 1994, Land Boundary Information System (LABINS, www.labins.org). Land-use information for pre-mining conditions within the SP was provided by CF, while for the SPE

ENTRIX, Inc. provided the land-use delineations. **Figure IMR-7** shows the land-use map for pre-mining conditions.

For the post-reclamation conditions, the land use outside of the SP, SPE, and within the preservation areas was assumed unchanged with respect to the pre-mining conditions. For other areas within the mine property, BCI staff developed a post-reclamation land use map in accordance with reclamation and wetland mitigation requirements. **Figure IMR-8** shows the resulting post-reclamation land use map.

For specification of land use in MIKE SHE, land cover was classified into eleven groups depending on characteristics such as leaf area index and rooting depths. **Table IMR-2** lists the eleven landforms that were derived from the FLUCCS code. For each landform, leaf area index and rooting depth were specified as described below

Leaf Area Index

The Leaf Area Index (LAI) is the total surface area of the leaves (both sides) divided by two, per unit area of the horizontal land below the canopy. MIKE SHE has the option of specifying either a constant or time varying value of LAI. For the current study LAI values were defined to be varying on a monthly basis however the monthly values do not change from one year to another.

The seasonal variations in LAI were taken from different sources depending on the landform. The LAI variation for citrus, pasture, marsh, industrial, shrub were adapted from a previous model investigation conducted in South Florida (DHI, 2004). LAI for urban low density, urban medium density and urban high density landforms were derived from the LAI variation for pasture with an assumption that the landforms have respectively 25%, 30%, and 38% of the area as impervious (i.e. the LAI for pasture was reduced by the percent of impervious area associated with each landform). The percent of imperviousness for each land form was taken from Table 2-2a of Technical Release 55 (USDA, 1986). Seasonal LAI for Hardwood forests were based on reports for the Southern Forests in Sampson et al. (1997). Seasonal LAI for coniferous forests were based on reports for Loblolly Pine (Sampson et al. 2003, Martin and Jokela 2001).

Root Depth

Root density and depth is used to calculate the rate of plant uptake from the saturated and unsaturated soils below the land surface. Rooting depth and distribution are controlled by a combination of factors including the genetic limitations of the plant, the interactive development of the plant and available soil moisture, soil texture, soil compaction, soil nutrient availability, plant health, insect damage, and nematode damage. For many annual plant species there are dynamic changes in root depth and root density with depth during the growing season. However, these changes are not as dramatic for mature perennials, trees, and shrubs.

Each land cover was assigned a constant value of maximum root depth. The maximum root depths were taken from Table 22 of Allen et al. (1998). **Table IMR-3** lists all the assigned root depths for each of the eleven land cover classes (landforms).

3.4 Overland Flow

During any precipitation event, when net rainfall (rainfall minus the interception storage) exceeds the infiltration capacity of the soil, water gets ponded on the surface and depending on the detention storage (storage in the micro depressions in the landscape); some of that ponded water may be available as surface runoff. The flow-path and flow-dynamics of surface runoff depends on topography of the landscape, flow resistance, and losses due to evapotranspiration as well as re-infiltration of surface water.

MIKE SHE uses the diffusive wave approximation of the two-dimensional form of the St.Venant's Equations to simulate overland flow. Solution of overland flow on the ground surface requires a-priori specification of parameters including Manning's number, detention storage, initial water depth, and separated flow areas. These are described in more detail below.

Manning's Number

Flow resistance is specified in MIKE SHE in terms of Manning's overland flow roughness coefficient. The user's manual for the two-dimensional overland flow modeling software FLO-2D (FLO-2D, 2001) provides a table of estimated roughness coefficients for overland flow, which are listed in **Table IMR-4**. The values of overland roughness coefficients are descriptive and provide a broad range. To make this table useful to MIKE SHE, the Manning's roughness coefficients were extrapolated to a range of landforms (based on FLUCCS codes). In making the extrapolation it was assumed that the impervious areas have a roughness of 0.02. Hence for low residential area (FLUCSS 110) 20 percent of its area has roughness of 0.02 and 80% has a roughness of 0.2 (for an average grass cover), resulting in a combined roughness of 0.16. Similar calculations were done for all landforms having some impervious area to derive a representative Manning's n value All water bodies were assigned a Manning's n equivalent to an impervious area i.e. 0.02. **Table IMR-5** lists the values of the aggregated values of Manning's overland roughness coefficients based on the FLUCCS codes along with the percent impervious areas associated with each FLUCCS code.

Detention Storage

Detention storage (sometimes also referred to as depression storage) is defined as the storage present in micro-depressions such as potholes that are much smaller than the model grid cell. The depth of the ponded water in a particular grid cell must exceed the detention storage value of that particular cell for any overland flow to occur.

Detention storage depends on the quality of field drainage. If the field drainage quality is good, the expected depressional storage is 2 to 5 mm. If the field drainage is fair, then expected depressional storage is 10 to 15mm. If the field drainage is poor, then the expected depressional storage is greater than 20mm.

Table IMR-5 lists the values of detention storage by FLUCCS code. The values of depressional storage listed in **Table IMR-5** are generally within the limits described by the U.S. Department of Agriculture (Workman et al. 1994). Areas listed as water bodies and wetlands (FLUCCS 500 through 650) were treated as poorly drained, but could arguably have higher values of detention storage. However, many of these depressional areas, such as lakes and large wetlands, are represented as separate hydraulics features with storages above those listed in **Table IMR-5**. Based on a detailed study conducted by BCI under a grant sponsored by Florida Institute of Phosphate Research (FIPR) (BCI, 2001) the detention storage of the fully-reclaimed clay settling areas, irrespective of the proposed land use, was set as 50 mm (~2 inch).

Initial Water Depth

The initial water depth for the overland flow module in MIKE SHE was set to zero for the first run. The purpose of the first run was to stabilize the model and develop initial conditions for the subsequent model runs. On sequenced model runs, the modeling results from the end of the latest time series solution was used to provide the initial value of overland flow for each cell for subsequent runs.

Separated Flow Areas

Due to averaging of surface elevations within a grid cell, information about hydrologic divides such as embankment, dikes, roads, or other natural features may be lost. This loss of information may cause overland flow to occur erroneously across hydrologic basin divides. To overcome this problem MIKE SHE allows specification of separated flow areas in its overland flow module.

For the current study, topographic information (for both post and pre conditions) was available at a much finer resolution than the specified grid size. Thus, the available topography in conjunction with hydraulic structures and aerial images were used to delineate sub-basins within the Hardee Complex property. The sub-basins were aggregated for each of the main drainage features and specified as separated flow areas in the MIKE SHE model set up. **Figure IMR-9** and **Figure IMR-10** show the separated flow areas specified for the SP and SPE for pre-mining and post-reclamation conditions respectively.

3.4 Unsaturated Flow

MIKE SHE allows simulation of one dimensional flow through the vadose (unsaturated) zone. The 1D flow can be used to represent infiltration and ultimate recharge to the water table or transpiration which occurs via root water uptake.

The computationally faster gravity flow infiltration method was selected in MIKE SHE versus the highly non-linear Richard's Equation method. This is prudent because of the generally shallow water table conditions on the property and the computation burden given the scale of the model domain. For shallow water tables, the water content distribution in the vadose zone is at or very close to equilibrium, consistent with the applicable assumptions of MIKE SHE's gravity flow method (Shah and Ross 2009). Hence using MIKE SHE's gravity flow method significantly improves computational speed without sacrificing the desired level of accuracy for unsaturated zone processes.

Soils Description

The soils description specified in MIKE SHE outside of the South Pasture was obtained from the Florida Geographic Data Library (www.fgdl.org). Within the South Pasture, pre-mining soils information was obtained from previous studies. BCI determined post-reclamation soils in accordance with the materials balance and reclamation land form design conducted in association with this South Pasture Extension permit application. **Figure IMR-11** and **Figure IMR-12** show the soil distribution for the pre-mining and post-reclamation conditions respectively.

Vertical soil zonation information was taken from the soil characterization data compiled by the University of Florida's Institute of Food and Agriculture Sciences (Carlisle et al., 1985). Vertical soil data in the soil characterization study exist for the top two meters of the soil profile. The soil profile deeper than 2 m was assumed to be uniform with characteristics similar to the last defined soil zone. This does not mean that the lowest defined soil layer represents the surficial aquifer though. To understand the effect of this assumption, an important characteristic of MIKE SHE is that the soil layers only apply to the unsaturated zone. The model input settings for the perennially-saturated portion of the surficial aquifer will supersede the unsaturated zone soil input characteristics where the two zones overlap.

The dominant soil types that exist in the model domain were defined using details specific to their soil layers as described in Carlisle et al. (1985). These seven dominant soil types covered 71% of the model domain while numerous other soils exhibiting small, localized distributions were able to be more efficiently lumped and classified either as a uniform column of sand, loamy sand, or muck. This distinction was important because MIKE SHE can encounter a significant numerical burden, potential instabilities, and unacceptably large run times if numerous small soil inclusions are allocated. The grid-scale of the model is appropriately-matched to soils resolutions used in the manner described. **Table IMR-6** lists the prominent soils types along with the percentage of the pre-mining model domain they cover.

For the post-reclamation conditions, four additional mine soil types, namely overburden, sand tailings, sand-clay mix and clay are generated. The overburden, clay, and sand-clay mix reclaimed soil types were attributed with a vertically uniform soil profile to the mined pit-bottom depth for each model cell. Each proposed clay and sand-clay mix area on the CF property will be surrounded by a dam wall, which is primarily built from overburden and compacted overburden soil. The dam walls for all the sand-clay mix and clay settling areas were defined in the model as two-layer vertical soil profile with compacted overburden overlying the overburden soil. Information about the dam height and characteristics of overburden and compacted overburden soil used for each of the sand-clay mix areas and clay settling areas was derived from the engineering design analysis done by the Ardaman and Associates, Inc. (Ardaman and Associates 2003).

The sand-tailings backfill areas were attributed with a three foot thick sandy layer at the soil surface and with a vertically uniform subsurface layer to the pit bottom that represents the variable mixture of sand and overburden with an effective hydraulic conductivity for each model cell based on the proportion of overburden and sand tails in each cell. The proportion of sand and overburden was based on the mine prospect data profiles and the backfill plan materials balance. The modeled configuration represents a condition consistent with CF's typical practice of mining in fairly irregular patterns without long uniformly trending spoil rows of overburden and sand tailings.

Soil set up in MIKE SHE requires specification of variability in soil water content and unsaturated hydraulic conductivity with changes in suction head. For the dominant soil types defined in the model, tabulated values of soil moisture content versus suction head were taken directly from the soil characterization data (Carlisle et al., 1985). For the generalized soils and post-reclamation soils (e.g. sand, clay, loamy sand etc.) it was assumed that the soils follow the van Genuchten model (van Genuchten, 1980), (**Equation 3**), which describes the relationship between suction head and soil water content.

$$\theta(h) = \begin{cases} \theta_r + \dfrac{\theta_s - \theta_r}{\left[1 + (\alpha |h|)^n\right]^m} & h < 0 \\ \theta_s & h \geq 0 \end{cases} \qquad (3)$$

where h (cm) is the pressure head (negative values mean suction),m = 1 – 1/n for n > 1, θ_r and θ_s denote the residual and saturated water contents respectively, $\alpha[cm^{-1}]$, *n* and *m* are the van Genuchten empirical parameters.

The values of van Genuchten parameters for sand, clay, loamy sand, and muck were taken from a soil database developed by Carsel and Parrish (1988). For compacted overburden and overburden, value of bulk density and an approximate soil composition (percentage of sand, silt, and clay) were used in a neural network predictive tool, Rosetta Lite (Schaap et al. 2001), to generate values of van Genuchten parameters for these soils.

Hydraulic conductivity variation for all the soils were assumed to follow the van Genuchten model for hydraulic conductivity **Equation 4**

$$K(h) = \begin{cases} K_S S_e^l [1-(S_e^{1/m})^m]^2 & h < 0 \\ K_S & h \geq 0 \end{cases} \quad (4.1)$$

$$S_e = \frac{\theta(h) - \theta_r}{\theta_s - \theta_r} \quad (4.2)$$

where S_e is the effective water content, K_S (m/s) is the saturated hydraulic conductivity of the soil column, and l is the pore connectivity parameter assumed to be 0.5 as an average for most soils. Other parameters are same as defined previously in **Equation 3**. The values of saturated hydraulic conductivity for the dominant soil types were taken from the soil characterization data (Carlisle et al., 1985) while the database of Carsel and Parish (1988) was used to get saturated hydraulic conductivity values for the generalized soil types. For the mined soils present in the post-reclamation conditions saturated hydraulic conductivity values were taken from the study done by Ardaman and Associates, Inc. (Ardaman and Associates 2003). **Table IMR-7** lists the soil properties used for the generalized and mined soil types.

3.6 Saturated Zone

Based on the geological characteristics of the area, the saturated zone module for the MIKE SHE model was set up as a three-layer aquifer system with two confining units. The aquifers were named surficial aquifer system (SAS), intermediate aquifer system (IAS), and Floridan aquifer system (FAS), while the confining units were called confining unit 1 (CU1) and confining unit 2 (CU2). The heads values in all the layers were allowed to fluctuate, except in the FAS which were specified as a time-varying fixed-head boundary. This means that the potentiometric surface of the Lower Floridan Aquifer forms the lower vertical boundary condition of the model. By allowing the hydrology in the lithological layers above the Floridan to dynamically fluctuate, the model represents potential interactive effects between the mining depths and reclamation materials on the hydrology in the surficial and intermediate aquifers and their potential interactions as well.

Geological Layers

Five geological layers (three aquifer units and two confining units) were set up in the saturated zone module. Values of thickness of each layer, horizontal and vertical hydraulic conductivity, specific yield, and specific storage were specified for each layer, for both pre-mining and post-reclamation conditions. **Table IMR-8** lists all the aquifer properties that were defined for the pre-mining and post-reclamation conditions. **Figure IMR-13 (a-e)** shows the aquifer properties for the pre-mining and post-reclamation conditions.

Layer Thickness

For the pre-mining simulation, findings of the geological investigation completed by Dames and Moore (1975) were used to define the thickness of all geological layers for the entire model domain excluding SPE. For SPE soil boring data collected by CF to determine prospect mining depths were used to determine the thickness of SAS and CU1. Thickness of IAS, CU2, and FAS were taken from the summary table provided in the Dames and Moore study (Figure 3-5, of Dames and Moore, 1975) and used as a constant value across the model domain.

For the post-reclamation conditions, the prospect mining depths data on a 330 feet grid provided by CF Industries were used to adjust the thickness of the reclaimed SAS and CU1. If the mining depth was found to be greater than the pre-mining SAS thickness, the thickness of SAS for that particular cell was set as the mining depth while the thickness of the CU1 was reduced accordingly. This approach assures that the effects of potential thinning of the uppermost confining unit are accounted for in the water balance. The IAS, CU2, and FAS thicknesses were attributed exactly as in the pre-mining simulations because mine depths are not proposed that would penetrate to their lithological elevations.

Hydraulic Conductivities

For the pre-mining simulation, values of vertical and horizontal hydraulic conductivities of aquifers and confining layers were taken from a previous hydrologic investigation completed for the SP property (BCI, 2004).

For the post-reclamation conditions equivalent hydraulic conductivities values for the SAS were estimated based on the soil characteristics of the mining soils. Owing to the field scale variability and soil stratification it is generally observed that vertical hydraulic conductivity is about an order of magnitude smaller than the horizontal hydraulic conductivity (Carlson, 2007; DHI, 2009). Considering this, the vertical hydraulic conductivity for the SAS was set at an order of magnitude less than the estimated equivalent horizontal hydraulic conductivities.

Specific Yield and Specific Storage

MIKE SHE uses specific yield values to calculate water table fluctuations for the SAS and uses specific storage values for the confined aquifer. Specific yield value is a soil property and is defined as the difference between saturated water content and water content at field capacity (Freeze and Cherry, 1979). Under both pre-mining and post-reclamation conditions, specific yield values were determined from the soil characteristics for the SAS. Specific storage values were adapted from the 2004 study for the IAS and FAS (BCI, 2004).

Geological Lenses

MIKE SHE allows specification of geological lenses which can be used to represent localized features such as clay lenses. During the process of mining the overburden produced from excavation is placed in piles along the mining direction while the waste material such as sand tailings is pumped in later in the mining pit between the overburden piles. This process can potentially create sectional deposits of overburden piles and sand tailings in the mining pits. To represent the effects of this layered deposition on the subsurface hydrology geological lenses were set up in MIKE SHE model.

From the prospect-depths data provided by CF, the total volume of overburden (including inner burden) was calculated. It was assumed that the overburden piles are placed along the center of each prospect depth cell at a slope of 1:2 (V: H) and extend across the length of the cell. The top 3 feet of the soil profile was assumed to be sand tailing (except CSA and preservation area, see **Figure IMR-12**) and below this, if there was any available volume left in the cell it was assumed to be filled with sand tailing. The geological lens extends from 3 feet below the land surface to the bottom of the mining pit. **Figure IMR-14** shows a conceptual diagram of the geological lens used in MIKE SHE and its relationship with geological layer.

Depending on the relative volume of sand tailings and overburden in each cell equivalent vertical and horizontal hydraulic conductivities were calculated. As the soil layering in the lens is parallel to the vertical flow the equivalent hydraulic conductivity was computed as the volume weighted arithmetic mean of the saturated hydraulic conductivity values of overburden and sand tailings (**Table IMR-7**). Similarly the equivalent horizontal hydraulic conductivity was computed as the volume weighted harmonic mean of the individual hydraulic conductivities. **Figure IMR-15** and **Figure IMR-16** show the spatial extent of the geologic lens along with the computed equivalent vertical and horizontal hydraulic conductivities.

Computational Layers

In MIKE SHE the computational layers (over which values of head, flow, etc. are calculated) can differ from the geological layers. For this particular study that would be an unnecessary complication so the computational layers were set up to directly coincide with the geological layers. Initial and boundary conditions were defined for all the computational layers.

As the model domain extends outside the SP and SPE property (more than 5000 feet) and its periphery is defined by the surface water divides, a no-flow boundary condition can be reasonably assumed for both surface water and groundwater components of the model. Thus, for all aquifers and confining units, the outer boundary condition for the integrated model (both pre-mining and post-reclamation) was defined as a no-flow boundary.

For the FAS, observed values of potentiometric head for Floridan wells in and around the model domain were downloaded from the SWFWMD website (http://www.swfwmd.state.fl.us/data/gis/layer_library/category/potmaps) and an average time series of FAS head was developed for the model domain. This time series was applied as a time-varying fixed head inner-boundary condition for the FAS.

For the initial conditions, observed values of the Floridan aquifer's potentiometric head for September 1984 were used as initial values for FAS as well as CU2. Also the study done by Dames and Moore (1975) found a head gradient of 0.9 ft/ft between the FAS and IAS. Hence, the observed potentiometric surface for FAS was multiplied by 0.9 to generate initial conditions for IAS and CU1. For the SAS an initial water table depth of 1 m below the land surface was used as input.

As the first five-year model run was used to generate initial conditions for the subsequent runs, assumed initial conditions for the first run are not expected to have any controlling effect on the modeling results. However, to make the model converge quickly to the actual values it is always advisable to start with reasonable initial values.

3.7 MIKE 11 (Rivers and Lakes Set up)

River Network

Pre-mining topography, 2006 aerial images, and the USGS stream network map were used to develop the drainage network for the pre-mining conditions on the SP and ENTRIX's GPS stream delineations were used for the SPE (**Figure IMR-17**). For post-reclamation, the drainage network (**Figure IMR-18**) was developed using the post-reclamation land-use map in conjunction with the post-reclamation topography. The alignment of the post-reclamation drainage network was set such that the exit and entry points of all creeks at the boundary as well as within the preservation areas are consistent with the pre-mining condition. The drainage networks depicted on **Figures IMR-17** and **18** are the MIKE 11 flow paths of the model. They do not wholly equate to the stream channels and simply reflect the routing pattern used by the MIKE 11 component in the model. Some parts of that pattern necessarily include other waterbodies in addition to streams such as lakes and wetlands.

Structures

Hydraulic control structures include culverts, bridges, drop structures and other manufactured features intended to pass or regulate flow. CF provided some updated geometric and spatial information for hydraulic structures within the SP and SPE, building upon previous work conducted by BCI within the SP, SPE, and surrounding areas.

For the pre-mining simulation, it was assumed that all the current internal (within the CF Property) and external structures (outside of the CF property) were present. For the post-reclamation case, no structures were assumed to be within the SP and SPE with the exception of those located within the preservation areas. **Figure IMR-19 (a** and **b)** shows the location and type of structures modeled for the pre-mining and post-reclamation models. **Table IMR-9** and **Table IMR-10** show the hydraulic specifications for the structures modeled in pre-mining and post-reclamation conditions respectively.

Initial and Boundary Conditions

Initial Conditions

As the first five-year model simulation is used to generate initial (or "hot-start") conditions for the subsequent model run, water depths in all the streams defined in the MIKE 11 pre-mining model were set to zero. For the post-reclamation conditions however, all the lakes were assumed to be brim full, while the stream beds were set up to be dry initially.

Boundary Conditions

Except for Horse Creek, all the drainage features in the model originate within the pre-mining model domain itself. Hence all the upstream most sub-basin boundaries except Horse Creek were set up as a no-flow boundary, while Horse Creek had a specified inflow boundary condition.

Flow data from a USGS gage (# 2297155) present on Horse Creek at Myakka Head were used to generate the upstream boundary condition. The total drainage area upstream of the gaging station at Myakka Head is about 42.8 sq. miles out of which about 12.9 square miles is upstream of the pre-mining model domain. If it is assumed that the entire watershed contributing to the gaging station at Myakka Head is similar in hydrological characteristics and different areas within the watershed generate similar amount of runoff, the inflow to the model domain can be computed. While this may be an imperfect assumption, it does provide a basis for representing a highly variable and reasonably natural inflow condition for Horse Creek along CF's property boundary in the absence of a long-term daily discharge record at that location. The discharge values observed at the Myakka Head station were multiplied by 0.3024 (= 12.93/42.75) to estimate an inflow time-series for Horse Creek at CF's property boundary.

Different approaches were used to define downstream boundary conditions for streams based on their geomorphology and the presence or absence of a useful discharge monitoring record. For the tributaries of Payne Creek (Doe Branch, Gum Swamp, Shirttail Branch, Plunder Branch, and Coons Bay), as the topography is very flat and no excessive flow constriction is present, a normal flow boundary condition was defined. From past field experience absence of any back-flow occurring across SR-62 which runs along the north side of South Pasture supports the fact that the water levels in Payne Creek do not have significant impact on the outflow values of the streams within the SP property.

Specified rating curves relating stage (head) versus discharge values were used as downstream boundary conditions for Horse Creek, Brushy Creek, and Troublesome Creek. To develop the rating curves for Horse Creek, Brushy Creek, and Troublesome Creek, separate HEC-RAS models were set-up. The HEC-RAS model for Brushy Creek and Horse Creek extend from the downstream end of the pre-mining model domain to State Road 64. The Troublesome Creek model extended from the downstream end of the pre-mining model domain to Vandolah Road near its intersection with Maurice Sonny Clavel Road. The rating curves simulated in HEC-RAS were then used as the downstream boundary conditions for Horse Creek, Brushy Creek, and Troublesome Creek.

3.8 MIKE SHE and MIKE 11 Interaction

MIKE SHE and MIKE 11 interaction takes place along the edges of the MIKE SHE grid cell. MIKE SHE approximates the MIKE11 network by re-routing a particular section of MIKE11 network to the closest cell edge. As MIKE SHE allows representation of only one MIKE11 branch at a cell's edge, care must be taken when the drainage network is dense and the cell size is large to make sure that all the important reaches are interacting with MIKE SHE as required.

At every time step, MIKE SHE computes overland flow from one cell to another, however if a MIKE 11 reach is encountered along the edge of two cells, instead of routing the flow from one cell to another, the flow is transferred from MIKE SHE to MIKE11. The water thus moves from MIKE SHE domain to MIKE 11 domain.

4.0 RESULTS

Table IMR-11 shows the water balance for the Hardee Phosphate Complex for pre-mining conditions, while **Table IMR-12** shows the water balance for post-reclamation conditions. Both water balances show low cumulative errors (less than 0.02 inch/yr overall for the 20-year simulation). Unit discharge rates from the property averaged around 9.5 inch/yr, which is generally very close to the overall unit flows reported from long-term USGS records for Horse Creek and the Peace River watersheds (compare **Tables IMR-1 and IMR-13**).

Overall stream discharge from the reclaimed SPE as proposed in this design was calculated in the model to be 8.42 inches, while the calculated pre-mining discharge was 10.14 inches (**Table IMR-13**). Groundwater outflow from the property was calculated to be 2.92 inches post-reclamation and 2.33 inches pre-mining. ET values were calculated to be 41.15 inches post-reclamation versus 39.84 pre-mining. Deep recharge to the Floridan aquifer was calculated to average 1.53 inches post-reclamation and 1.29 inches pre-mining. The total outflow of water from the property to offsite surface-water bodies and aquifers sums to 12.9 inches for post-reclamation conditions and 13.8 inches for pre-mining mining conditions (**Table IMR-13**).

In essence these simulations have quantified the effects of the reclamation plan's elimination of drainage ditches and associated restoration and reclamation of on site wetlands. The improved water detention was simulated to result in increased ET, with slight increases in deep groundwater recharge and lateral groundwater outflow from the property. The result is that surface water flow reductions were predicted to occur at annual average volumes approximately equivalent to the increased ET and groundwater outflow volumes. Because ET is greatest during the wettest time periods, surface flow volumes are reduced mainly during times when water is highly abundant and when stream flow is typically high in the region. These conditions typically occur for less than 10% of the time. Despite the fact that some large uncommon flows will be decreased, during most of the year, flow from the property was simulated to be higher post-reclamation versus pre-mining. This is also related to enhanced detention and baseflow characteristics associated with improved wetland conditions and elimination of artificial drainage ditches. More details concerning the temporal distribution of stream flow exiting the property are provided later in this section of the report. This water budget summary suggests two main conclusions, 1) the simulation provides results within the bounds expected for this part of the state for the pre-mining conditions, and 2) the design provides for a post-reclamation water balance that is consistent with the hydrologic improvements desired for the onsite restoration and reclamation wetlands and streams.

Daily phreatic surface elevation records were developed from MIKE SHE for 20 existing sites representing a wide array of wetland types across the project area (**Table IMR-14**). These sites were selected to provide good geographic coverage of the SPE and three offsite locations (**Figure IMR-20**). Five of the sites were within onsite preserves. Similar post-reclamation records were developed for the same five preserve sites and three offsite locations as in the pre-mining model. This allowed for the effects of the reclamation design on the preserves and offsite locations to be evaluated. Additionally, 12 representative mitigation wetlands across the property with examples of hardwood swamps (617), hydric pine savanna (626), mixed swamps (630), freshwater marshes (641), and wet prairies (643) were assessed (**Table IMR-15**, **Figure IMR-21**).

The data from each daily stage record was queried to determine the 15^{th} exceedance percentile (S_{15}). This was used to determine Seasonal High Water depths relative to the wetland bottom (**Table IMR-14 and Table IMR-15**). The S_{15} represents the stage that is, on average, less than 8 weeks out of a year. Therefore, the S_{15} serves as a good indicator of the elevation beyond which wetland conditions requiring a nominal minimum 2-month hydroperiod (e.g. Meyers and Ewel 1991) are unlikely. It serves as a good statistical threshold for making sense of variable, long-term stage records for establishing the wetland-upland interface. Wetland hydroperiods were calculated from phreatic surface data extracted from MIKE SHE groundwater cells at each wetland of interest. The percentage of days the phreatic surface was at or above the wetland bed elevation was used to calculate the hydroperiod (expressed as average total number of months inundated per year) (**Table IMR-14 and Table IMR-15**).

The following observations can be made from the data in **Tables IMR-14** and **IMR-15**. First of all, not all of the existing wetlands have suitable hydrology due to the effects of ditching. Notable examples include 06W-20P (also referred to as the Hub Wetland). The Hub Wetland forms the main headwater wetland of Lettis Creek and it is heavily ditched and drained, as are some of the large wetlands that drain into it from the east. 06W-20P was simulated as having essentially an existing upland inundation hydrology (**Table IMR-14**). Some saturation still occurs at the root zone and this system has a mixture of dog fennels and wetland plants as a result. The system clearly is less than optimal from a hydrologic standpoint. The Lettis Creek reclamation plan was designed, in part, to restore the preserved Hub and allow it to drain once again from its original natural stream channel. This restoration should succeed in returning the system to a hydropattern consistent with freshwater marsh (**Table IMR-15**).

Another example of a large dewatered headwater wetland (R-03E-02) occurs in the eastern Troublesome Creek basin. In this case, the system will be mined and replaced very close to original grade, but without the existing network of artificial drainage ditches. The existing hydrology varies with the varying depth of the historic wetland depression. For example, much of this historic headwater marsh has been converted to upland pasture via drainage. One such area exists at model location 63-17 (**Table IMR-14**). This exact same spot will be part of a large level-pool wetland after reclamation and will support a hydrologic regime consistent with that of a wet prairie (see results for site R-03E-02-643b in **Table IMR-15**). Most of R-03E-02 will be reclaimed as a freshwater marsh, consistent with the results of R-03E-02-641b.

Existing wetland 04E-18 is of particular interest because it is ditched and contiguous with an offsite wetland that is also drained by the same ditch network. The system has wetland hydrology, but it not sustainable for the freshwater marsh that likely occurred there prior to ditching (**Table IMR-14**). Proposed wetland R-04E-06-641 will be reclaimed in the same position as existing wetland 04E-18, but the existing topography cannot be mimicked. Instead, the system's existing seasonal high water level will be essentially retained to prevent offsite flooding and the onsite wetland will be reclaimed with a lower bed elevation to achieve the desired seasonal high water depth and hydroperiod (**Table IMR-15**).

Two seepage wetlands, 03W-24 and 11W-02A appear to be well supported by the existing landscape and proposed reclamation plan. Preservation wetland 02W-56A is close to a clay settling area and has a reduced watershed as a result. This wetland however will still have seasonal high water depth and hydroperiod within the range of acceptable conditions for its hardwood swamp community. Preservation wetland 12W-06 and offsite wetland 55-13 are typical examples for the SPE and nearby areas, with hydrology that will be virtually unaltered by the reclamation plan. Site 60-14 is an offsite, drained wetland with extensive frontage along CF's property boundary. As a result of groundwater flow, the system's hydroperiod will be improved by about 11 weeks per year, but seasonal high water levels will rise only by 0.2 foot. This wetland is already well within the mean annual floodplain.

All of the reclaimed wetlands examined will have hydropatterns within the desired ranges of hydroperiod and water depth (**Table IMR-15**). Furthermore, all are compatible with adjacent systems as applicable. The main reason this plan works this way is because it was designed to provide an upper infiltration layer of sand tailings averaging about three feet thick. This layer approximates the natural soil profile, which typically has an upper sandy layer one to eight feet thick with typical thicknesses generally between two and four feet. This layer allows for a balance of rainfall capture and lateral movement through the soil profile that mimics conditions found in most flatwoods. Also, CF generally mines in an irregular cut pattern rather than with long rectilinear spoil piles. This pattern does not allow the tailings to create preferential flow paths in the landscape and results in sustained high wet-season groundwater tables akin to a natural flatwoods. Figure **IMR-22** shows the maximum phreatic surface elevation for the SPE from the entire 20-year period-of-record for pre-mining conditions. **Figure IMR-23** shows the elevation of the phreatic surface for the simulated 20-year dataset under post-reclamation conditions. Note that the areas reclaimed with overburden and sandtailings, and their adjacent preserves have very similar maximum water tables under existing versus proposed conditions.

Daily flows were projected for the main streams exiting the SPE (Brushy Creek, Lettis Creek, and Troublesome Creek) to develop flow-duration curves for both pre-mining and post-reclamation conditions. The 20-year simulated flow data was broken down into the same three seasonal flow blocks (Low, Medium, and High) used by the SWFWMD for their riverine Minimum Flows and Levels (MFL). No MFL's have been adopted for SPE waterbodies, but the seasonal flow blocks provide a good way to gain some understanding of seasonal flow patterns of the streams of the SPE and compare their discharges to similar blocks of time for the much larger waters (e.g. the Middle and Lower Peace Rivers) for which MFL's have been adopted by rule.. **Figure IMR-24(a-d**) shows the comparison between pre-mining and post-reclamation discharge duration curves for the SPE streams. Due to numerical convergence issues MIKE 11 artificially prevents any cross-section from going completely dry by adding a very small amount of water. For certain cross-sections (which are primarily flat) this may result in a very small amount of flow (~ < 0.01 cms, depending on the cross-sectional characteristics). A manual correction has to be made to remove this artificial flow by making any flow below a certain threshold zero. **Figure IMR-24** indicates the MIKE 11 corrections that were used for the current analysis.

Figure IMR-24 shows for all the three MFL blocks as well as for the entire period of record the post-reclamation conditions results in flows that are truncated on the very high end but are more frequent and sustained on the normal and low end of the flow spectrum. This is typical of what has been observed in the past on extensively mined watersheds such as the Alafia River and Payne Creek (Shreuder Inc., 2006). It is a result of greater detention on-site from decreased ditches, increased wetland acreage and hydroperiod restoration, increased lake acreage, and clay-settling area soil cracks. These changes are not threshold changing as they still result in streams that are seasonally intermittent and that have bankfull flow frequencies and durations well within norms for peninsular Florida's un-ditched flatwoods. Furthermore, the SPE's drainage basins occupy a small portion of the Peace River's watershed (<1%) and was designed to provide a flow regime in keeping with its position in the drainage network. The system was predicted to

function much like an unditched chain-of-wetlands complex in the flatwoods. The predicted SPE post-reclamation flow regime will not violate Middle and Lower Peace River MFLs because flow will actually increase for most of the period of record versus pre-mining, with reductions only occurring during the wettest 10% of the time when Peace River flows are at their highest. SPE outflow is normally much less than 1% of the Peace River's flows downstream of the SPE and the net changes in flow from the property are expected to be as small as to be difficult, if not impossible, to even accurately measure.

Stage-duration calculations were also made from data extracted from MIKE 11 cross-sections in the one proposed lake on the SPE. For the proposed lake, an annual zone of fluctuation was defined by examining the normal range of annual fluctuation that accords to a "seasonal low water" level. This range of fluctuation between the annual high and low stages was used to set the design contours for the littoral shelf in a manner that will provide a surface area that is at least 25% of the lake at seasonal high water. Seasonal low water was used to set the upper elevation below which at least 20% of the lake area must be no deeper than 6 feet.

To conclude, this long-term simulation helps provide reasonable assurance that the design as proposed will restore onsite wetland functions where they have been most significantly damaged by artificial drainage, promote the maturation of reclaimed wetlands, and will not cause adverse effects on offsite wetlands. The plan also provides an overall water balance consistent with the region that is compatible with the Peace River watershed's surface and sub-surface hydrology, given that the combined groundwater and surface water outflow volumes from the property are reasonably similar to pre-mining conditions.

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TABLES

Table IMR-1
Average Streamflow and Basin Yield at Selected USGS Stream Gages

Station No.	Description	Drainage Area (square miles)	Average Stream Flow (cfs)	Basin Yield (inches)	Basin Yield (cfsm)
02297155	Horse Creek Near Myakka Head,FL	42	29.7	9.6	0.71
02297220	Brushy Creek Near Lilly, FL*	48	27.1	7.9	0.57
02295420	Payne Creek Near Bowling Green,FL	121	116.3	13.0	0.96
02295637	Peace River at Zolfo Springs, FL	826	620.1	10.2	0.75

cfs- cubic feet per second

cfsm- cubic feet per second per square mile

inches - average annual discharge from watershed per unit area

***represents water years 1993-94 with average rainfall of 60 in/yr (10 inches above normal)**

Table IMR-2
Landform Descriptions Based on Second Level FLUCCS

Land Use Group	FLUCCS	FLUCCS Description
Citrus	220	Tree Crops
	440	Tree Plantations
Pasture	160	Extractive
	180	Recreational
	190	Open Lands
	210	Cropland and Pastureland
	230	Feeding Operations
	240	Nurseries and Vineyards
	250	Specialty Farms
	260	Other Open Lands
	310	Herbaceous (Dry Prairie)
	740	Disturbed Lands
Urban Low Density	110	Residential Low Density
Urban Medium Density	120	Residential Medium Density
Urban High Density	130	Residential High Density
	170	Institutional
Industrial	140	Commercial and Services
	150	Industrial
	810	Transportation
	820	Communications
	830	Utilities
Coniferous Forests	410	Upland Coniferous Forests
	620	Wetland Coniferous Forests
Hardwood Forests	420	Upland Hardwood Forests
	430	Upland Hardwood Forests
	610	Wetland Hardwood Forests
	630	Wetland Forests Mixed
Marsh	640	Veg. Non-Forested Wetlands
	650	Non-Vegetated Wetlands
Shrub	320	Shrub and Brushland
	330	Mixed Rangeland
Water	510	Streams and Waterways
	520	Lakes
	530	Reservoirs

Table IMR-3
Assigned Rooting Depths for Different Land Use Groups

Land Use Group	Assigned Rooting Depths (mm)
Citrus	1400
Pasture	1000
Urban Low Density	500
Urban Medium Density	500
Urban High Density	500
Industrial	500
Coniferous Forests	1300
Hardwood Forests	2100
Marsh	1000
Shrub	1000
Water	0

Table IMR-4
Overland Flow Manning's Roughness Coefficients

Surface	Manning's Roughness Coefficient
Dense Turf	0.17 to 0.8
Bermuda and dens grass. Dense vegetation	0.17 to 0.48
Shrubs and forest litter, pasture	0.30 to 0.40
Average grass cover	0.20 to 0.40
Poor grass cover and rough surface	0.20 to 0.30
Short prairie grass	0.10 to 0.20
Sparse vegetation	0.05 to 0.13
Sparse rangeland with debris	
0-percent cover	0.09 to 0.34
20-percent cover	0.05 to 0.25
Plowed or tilled Fields	
Fallow-no residuals	0.008 to 0.012
Conventional tillage	0.06 to 0.22
Chisel plow	0.06 to 0.16
Fall disking	0.30 to 0.50
No till-no residue	0.04 to 0.01
No till (20 to 40 percent residual)	0.07 to 0.17
No till (40 to 100 percent residual)	0.17 to 0.47
Open ground with debris	0.10 to 0.20
Shallow flow on asphalt or concrete	0.10 to 0.15
Fallow fields	0.08 to 0.12
Open Ground, no debris	0.04 to 0.10
Asphalt or concrete (deeper flows)	0.02 to 0.05

Table IMR-5
Assigned Manning's Coefficients and Depression Storage Based on FLUCCS Code

FLUCCS Codes	Description	Depression Storage (mm)	Depression Storage (inches)	Manning's Roughness	Percent Impervious
110	Low Residential	9	0.35	0.16	20
120	Residential Medium	6	0.24	0.13	25
130	Residential High	3	0.12	0.08	65
140	Commercial & Services	3	0.12	0.05	85
150	Industrial	3	0.12	0.07	72
160	Extractive	3	0.12	0.30	0
170	Institutional	3	0.12	0.13	85
180	Recreation	3	0.12	0.13	10
190	Openland	3	0.12	0.30	0
210	Cropland & Pasture	4	0.16	0.15	0
220	Tree Crops	10	0.39	0.30	0
230	Feeding Operations	9	0.35	0.20	0
240	Nurseries & Vineyards	10	0.39	0.20	0
250	Specialty Farms	9	0.35	0.20	0
260	Other Open Rural Land	4	0.16	0.15	0
310	Herbaceous Range Land	3	0.12	0.30	0
320	Shrub & Brushland	3	0.12	0.30	0
330	Mixed Rangeland	3	0.12	0.30	0
410	Upland Conifer Forest	14	0.55	0.45	0
420	Upland Hardwood Forest	14	0.55	0.45	0
430	Upland Hardwood Forest	14	0.55	0.45	0
440	Tree Plantation	10	0.39	0.45	0
510	Streams & Waterways	20	0.79	0.02	100
520	Lakes	20	0.79	0.02	100
530	Reservoirs	20	0.79	0.02	100
610	Wetland Hardwood Forest	20	0.79	0.45	100
620	Wetland Coniferous Forest	20	0.79	0.45	100
630	Wetland Forested Mix	20	0.79	0.45	100
640	Vegetated Non-forested Wetland	20	0.79	0.06	100
650	Non-Vegetated Wetland	20	0.79	0.06	100
740	Disturbed lands	3	0.12	0.30	0
810	Transportation	11	0.43	0.20	72
820	Utilities	11	0.43	0.20	72
830	Communications	3	0.12	0.20	72

Note:- For Clay Settling Areas under Post-Reclamation Scenario based on the study done by BCI (BCI 2004) a detention value of 50 mm (~2 inch) irrespective of land use was used

Table IMR-6
Soils Composition for the Pre-Mining Model Domain

Soil Name	Acres	Percentage
Chobee Fine Sandy Loam	2449	4%
Felda Fine Sand	3293	6%
Floridana Fine Sand	3412	6%
Myakka Fine Sand	2695	5%
Pomona Fine Sand	21875	37%
Symrna Sand	5824	10%
Zolfo Fine Sand	2794	5%
Sand	13014	22%
Loamy Sand	2566	4%
Muck	1409	2%

Table IMR-7
Hydraulic Soil Properties for Generalized and Mined-Soil Types

Soil	Van Genuchten Parameters						
	Sat. WC (θ_s)	Res WC (θ_r)	pF_W	Ks (m/s)	alpha (1/cm)	n	l
Sand Tailings	0.5	0.02	4.18	1.00E-04	0.05	1.4	0.5
Sand-Clay Mix	0.55	0.15	4.18	5.00E-07	0.04	1.35	0.5
Overburden	0.5	0.02	4.18	5.00E-06	0.05	1.4	0.5
Comp Overburden	0.25	0.04	4.18	1.00E-07	0.038	1.62	0.5
Clay	0.6	0.5	4.18	2.78E-08	0.008	1.09	0.5
Sand	0.43	0.045	4.18	8.25E-05	0.145	2.68	0.5
Loamy Sand	0.41	0.057	4.18	4.05E-05	0.124	2.28	0.5

Table IMR-8
Aquifer Properties Defined for Pre-Mining and Post-Reclamation Simulations

Geological Unit	Lower Level (m BLS[1])		K_h (m/s)		K_v (m/s)		S_Y		Specific Storage	
	Pre[2]	Post[2]	Pre	Post	Pre	Post	Pre	Post	Pre	Post
SAS	12.7	15.61	Figure 13A	Figure 13B	5.00E-07	Figure 13C	Figure 13D	Figure 13E	0.0001	0.0001
CU1	21.5	24.25	1.00E-08	1.00E-08	2.00E-09	2.00E-09	0.1	0.1	1.00E-05	1.00E-05
IAS	97.54	97.54	0.00141	0.00141	0.00141	0.00141	0.1	0.1	0.0001	0.0001
CU2	112.8	112.8	3.50E-08	3.50E-08	3.50E-09	3.50E-09	0.1	0.1	1.00E-05	1.00E-05

[1] **Below Land Surface**

[2]**average value over Hardee Phosphate Complex**

FAS is represented as a time-varying fixed-head boundary

Table IMR-9
Hydraulic Specification for the Structures Modeled under Pre-Mining Conditions

Branch Name	Structure ID	Upstream Invert (feet NGVD)	Downstream Invert (feet NGVD)	Length (feet)	Number of Culverts	Shape	Size (inch)	Material
Horse Creek	203323-083	110.81	110.41	57.1	4	Rectangular	132 X 72	concrete
Horse Creek	053423-143	100.40	100.29	183.2	5	Circular	36	CMP
Horse Creek	093423-023	94.37	94.01	16.0	2	Circular	72	metal pipe
B1	Pipe 45	113.60	113.50	32.0	1	Circular	36	mine pipe
B1	Pipe 44	116.96	116.38	33.0	1	Circular	16	mine pipe
Brushy Creek	Pipe 3	113.08	113.03	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 4	113.25	113.07	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 5	112.64	112.34	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 6	113.17	112.98	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 8	95.79	95.45	30.0	1	Circular	96	fiberglass
B3	023423-055	106.38	106.05	22.0	1	Circular	36	metal pipe
Brushy Creek	Pipe 9	83.80	83.20	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 10	83.59	82.92	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 11	83.38	83.06	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 12	83.54	83.03	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 13	87.13	86.77	20.0	1	Circular	18	CMP
Brushy Creek	Pipe 14	87.12	86.76	20.0	1	Circular	18	CMP
Brushy Creek	Pipe 15	87.38	86.85	20.0	1	Circular	18	CMP
Brushy Creek	Pipe 16	87.42	87.08	20.0	1	Circular	18	CMP
L1	123423-052	91.36	90.79	37.0	1	Circular	12	metal pipe
Lettis Creek	123423-045	87.70	86.78	20.1	1	Circular	18	metal pipe
L5	073424-015	95.86	95.80	27.0	1	Circular	12	metal pipe
L5	073424-012	98.24	97.91	19.0	1	Circular	12	metal pipe
L5	073424-013	96.16	96.00	25.0	1	Circular	12	metal pipe
Lettis Creek	063424-010	96.88	95.88	50.0	1	Circular	36	metal pipe
S2	163424-061	98.40	97.95	50.0	1	Rectangular	60X39	concrete
L9_T1	053424-008	101.95	101.62	84.0	4	Circular	48	concrete
L9_T1	053424-009	100.62	100.45	10.0	1	Irregular	N/A	RR Trestle
L9_T1	FINR_Pipe2	100.35	100.02	33.0	1	Circular	36	CMP
Troublesome Creek	Pipe3_KM	93.06	92.87	50.0	1	Circular	48	concrete
Troublesome Creek	S-6	105.87	105.54	60.0	2	Circular	36	concrete
Troublesome Creek	Pipe 22	99.72	99.27	30.7	1	Circular	40	mine pipe
Troublesome Creek	Pipe 23	98.06	97.72	30.7	1	Rectangular	54 X 42	CMP
Troublesome Creek	Pipe 25	98.30	97.99	20.0	1	Circular	42	CMP
T2	Pipe 24	99.09	98.79	30.3	1	Circular	20	mine pipe
T3	Pipe 31	100.47	100.15	25.0	1	Circular	24	mine pipe
T3	Pipe 29	99.10	98.77	19.7	1	Circular	16	mine pipe
T3	Pipe 28	98.83	98.51	27.6	1	Circular	18	mine pipe
T3	Pipe 27	99.16	98.83	29.0	1	Circular	18	mine pipe
Troublesome Creek	Pipe 26	97.69	97.60	32.0	1	Rectangular	48 X 33	CMP
T1	093424-029	101.49	101.16	45.0	1	Circular	18	metal pipe
Shirttail Branch	S-1	94.35	94.02	60.0	3	Rectangular	108 X 65	concrete
D1	S-5	103.78	103.45	60.0	1	Circular	36	concrete
Doe Branch	S-2	85.81	85.48	60.0	4	Rectangular	125 X 84	concrete

Table IMR-9 (continued)
Hydraulic Specification for the Structures Modeled under Pre-Mining Conditions

Branch Name	Structure ID	Upstream Invert (feet NGVD)	Downstream Invert (feet NGVD)	Length (feet)	Number of Culverts	Shape	Size (inch)	Material
D2	S-3	112.40	112.07	60.0	1	Circular	36	concrete
P2	Pipe 40	98.49	98.19	40.0	1	Rectangular	24 X 36	metal pipe
Plunder Branch	S-4	87.85	87.52	60.0	1	Rectangular	120 X 64	concrete
Plunder Branch	Pipe 41	112.65	112.20	23.0	1	Circular	24	mine pipe
Coons Bay	Pipe 34	110.45	110.02	58.3	1	Rectangular	96 X 48	concrete
HB1	S-7	113.67	113.37	79.6	2	Circular	36	CMP
Hog Branch	S-8	109.83	109.50	82.5	1	Circular	36	concrete
Hog Branch	S-9	113.26	112.88	43.0	2	Circular	24	concrete
East Branch	GB_Gause	90.52	90.19	32.0	2	Circular	72	CMP
East Branch	S-11	99.75	99.42	27.0	2	Circular	36	concrete

Table IMR-10
Hydraulic Specification for the Structures Modeled under Post-Reclamation Conditions

Branch Name	Structure ID	Upstream Invert (feet NGVD)	Downstream Invert (feet NGVD)	Length (feet)	Number of Culverts	Shape	Size (inch)	Material
Shirttail Branch	S-1	94.35	94.02	60.0	3	Rectangular	108 X 65	concrete
D1	S-5	103.78	103.45	60.0	1	Circular	36	concrete
Doe Branch	S-2	85.81	85.48	60.0	4	Rectangular	125 X 84	concrete
D2	S-3	112.40	112.07	60.0	1	Circular	36	concrete
P2	Pipe 40	98.49	98.19	40.0	1	Rectangular	24 X 36	metal pipe
Plunder Branch	S-4	87.85	87.52	60.0	1	Rectangular	120 X 64	concrete
Coons Bay	Pipe 34	110.45	110.02	58.3	1	Rectangular	96 X 48	concrete
Brushy Creek	Pipe 3	113.08	113.03	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 4	113.25	113.07	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 5	112.64	112.34	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 6	113.17	112.98	25.4	1	Circular	16	mine pipe
Brushy Creek	Pipe 8	95.79	95.45	30.0	1	Circular	96	fiberglass
Brushy Creek	Pipe 9	83.80	83.20	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 10	83.59	82.92	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 11	83.38	83.06	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 12	83.54	83.03	43.0	1	Circular	36	CMP
Brushy Creek	Pipe 13	87.13	86.77	20.0	1	Circular	18	CMP
Brushy Creek	Pipe 14	87.12	86.76	20.0	1	Circular	18	CMP
Brushy Creek	Pipe 15	87.38	86.85	20.0	1	Circular	18	CMP
Brushy Creek	Pipe 16	87.42	87.08	20.0	1	Circular	18	CMP
L1	123423-052	91.36	90.79	37.0	1	Circular	12	metal pipe
L4	073424-015	95.86	95.80	27.0	1	Circular	12	metal pipe
L4	073424-012	98.24	97.91	19.0	1	Circular	12	metal pipe
L4	073424-013	96.16	96.00	25.0	1	Circular	12	metal pipe
T2	S-6	105.87	105.54	60.0	2	Circular	36	concrete
L13_T1	053424-008	101.95	101.62	84.0	4	Circular	48	concrete
L13_T1	053424-009	100.62	100.45	10.0	1	Irregular	N/A	RR Trestle
L13_T1	093424-029	101.49	101.16	45.0	1	Circular	18	metal pipe
L13_T1	FINR_Pipe2	100.35	100.02	33.0	1	Circular	36	CMP
HB1	S-7	113.67	113.37	79.6	2	Circular	36	CMP
Hog Branch	S-8	109.83	109.50	82.5	1	Circular	36	concrete
Hog Branch	S-9	113.26	112.88	43.0	2	Circular	24	concrete
East Branch	GB_Gause	90.52	90.19	32.0	2	Circular	72	CMP
East Branch	S-11	99.75	99.42	27.0	2	Circular	36	concrete
Horse Creek	203323-083	110.81	110.41	57.1	4	Rectangular	132 X 72	concrete
Horse Creek	053423-143	100.40	100.29	183.2	5	Circular	36	CMP
Horse Creek	093423-023	94.37	94.01	16.0	2	Circular	72	metal pipe

Table IMR-11
Pre-Mining Total Water Budget and Aquifer Recharge Summary for Hardee Phosphate Complex 1/1/1990-1/1/2010

Water Budget	1990-1995		1995-2000		2000-2005		2005-2010	
	mm	inch/yr	mm	inch/yr	mm	inch/yr	mm	inch/yr
Rainfall	6350	50.00	7060	55.59	6818	53.69	5420	42.68
ET	4807	37.85	5022	39.54	4616	36.35	4784	37.67
Overland flow	934	7.35	1651	13.00	1835	14.45	388	3.06
Baseflow	28	0.22	46	0.36	35	0.28	17	0.13
Surface Boundary outflow	21	0.17	41	0.32	47	0.37	6	0.05
Groundwater Boundary outflow	177	1.39	372	2.93	198	1.56	379	2.98
OL Storage Change	39	0.31	0	0.00	-11	-0.09	-21	-0.17
SZ Storage Change	425	3.35	-57	-0.45	27	0.21	-184	-1.45
UZ Storage Change	-78	-0.61	-11	-0.09	72	0.57	51	0.40
Error	2	0.02	2	0.02	1	0.01	1	0.01

Groundwater recharge summary	1990-1995		1995-2000		2000-2005		2005-2010	
	mm	inch/yr	mm	inch/yr	mm	inch/yr	mm	inch/yr
Cumulative Recharge from surface	630	4.96	360	2.83	260	2.05	212	1.67
Deep Recharge to IAS	290	2.28	298	2.35	331	2.61	289	2.28
Deep Recharge to FAS	264	2.08	338	2.66	339	2.67	333	2.62

Table IMR-12
Post- Reclamation Total Water Budget and Aquifer Recharge Summary for Hardee Phosphate Complex 1/1/1990-1/1/2010

Water Budget	1990-1995		1995-2000		2000-2005		2005-2010	
	mm	inch/yr	mm	inch/yr	mm	inch/yr	mm	inch/yr
Rainfall	6350	50.00	7060	55.59	6818	53.69	5420	42.68
ET	4936	38.87	5226	41.15	4782	37.65	4913	38.69
Overland flow	768	6.05	1414	11.13	1624	12.79	426	3.35
Baseflow	16	0.13	22	0.17	-2	-0.02	-32	-0.25
Surface Boundary outflow	-23	-0.18	-19	-0.15	-3	-0.02	-11	-0.09
Groundwater Boundary outflow	239	1.88	448	3.53	279	2.20	442	3.48
OL Storage Change	107	0.84	34	0.27	8	0.06	-99	-0.78
SZ Storage Change	343	2.70	-39	-0.31	112	0.88	-241	-1.90
UZ Storage Change	-38	-0.30	-24	-0.19	17	0.13	21	0.17
Error	-2	-0.02	2	0.02	1	0.01	0	0.00

Groundwater recharge summary	1990-1995		1995-2000		2000-2005		2005-2010	
	mm	inch/yr	mm	inch/yr	mm	inch/yr	mm	inch/yr
Cumulative Recharge from surface	597	4.70	430	3.39	389	3.06	170	1.34
Deep Recharge to IAS	317	2.50	320	2.52	360	2.83	318	2.50
Deep Recharge to FAS	280	2.20	343	2.70	347	2.73	342	2.69

Table IMR-13
Water Budget Comparison for Pre-Mining and Post-Reclamation Discharge

Water Budget (19-Year Annual Averages)	Pre Mining		Post Reclamation		Difference
	mm/yr	inch/yr	mm/yr	inch/yr	(Post-Pre)
Rainfall	6412	50.49	6412	50.49	0.00
ET	1012	39.84	1045	41.15	1.30
Stream Discharge*	258	10.14	214	8.42	-1.72
Groundwater Outflow**	59	2.33	74	2.92	0.58
Deep Recharge***	33	1.29	39	1.53	0.24

***sum of MIKE SHE Overland Flow, Baseflow, and Surface Boundary Outflow**

****Lateral flow through the aquifer systems of the property to adjacent land**

*****Vertical flow from the property to the Floridan aquifer**

Table IMR-14
Wetland Hydropattern Summary for Pre-Mining Conditions

Wetland Name	FLUCCS	Bed Elevation (NGVD)	Hummock Elevation (NGVD)	SHW Elevation (NGVD)	SHW Depth at Baselevel (feet)	Hydroperiod (months/year)
No-Mine						
03W-24	611*	108.0	NA	108.0	0.0	9.4
11W-02A	611*	93.0	NA	93.0	0.0	12.0
02W-56A	617	105.0	105.5	106.6	1.6	8.0
12W-06	617	93.5	95.5	96.1	2.6	8.2
06W-20-P**	640	99.0	NA	98.9	-0.1	0.5
Mine						
10W-52B	630	106.0	NA	106.7	0.7	4.1
03W-06E	641	113.1	NA	113.9	0.8	4.2
03W-06E	617	113.6	NA	113.9	0.3	2.6
01W-18	641	105.3	NA	106.7	1.4	6.8
01W-20	643	106.3	NA	106.7	0.4	6.0
01W-56	641	103.5	NA	104.4	0.9	5.7
01W-56	643	104.5	NA	104.4	-0.1	1.7
05E-02	617	102.2	103.5	103.4	1.2	3.8
08E-12	617	99.0	99.8	101.4	2.4	8.3
08E-12	641	99.0	NA	101.4	2.4	8.3
08E-50B-I	641	99.5	NA	101.6	2.1	7.2
04E-18	641	101.1	NA	101.6	0.5	2.4
63-17	210	102.0	NA	101.7	-0.3	0.0
03E-58A	641	100.8	NA	100.9	0.1	2.2
10E-40	641	102.4	NA	103.5	1.1	6.1
Offsite						
55-13	610	101.2	NA	102.0	0.8	7.4
60-14	640	101.1	NA	101.6	0.5	2.6
59-11	170	103.5	NA	102.7	-0.8	0.0

***ON SEEPAGE FACE**
****TO BE RESTORED, IN-SITU**

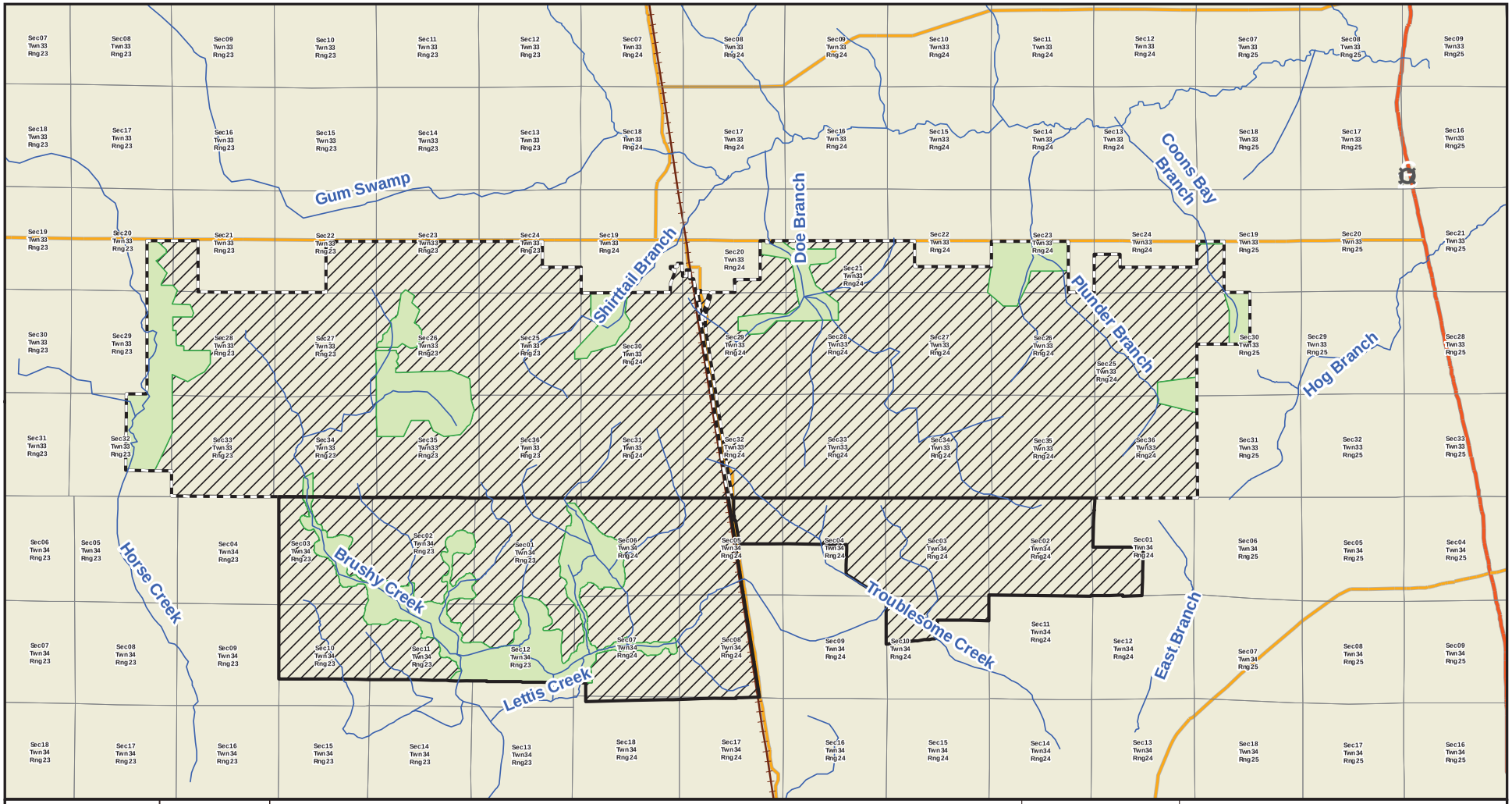
Table IMR-15
Wetland Hydropattern Summary for Post-Reclamation Conditions

Wetland Name	FLUCCS	Bed Elevation (NGVD)	Hummock Elevation (NGVD)	SHW Elevation (NGVD)	SHW Depth at Baselevel (feet)	Hydroperiod (months/year)
No-Mine						
03W-24	611*	108.0	NA	108.0	0.0	9.1
11W-02A	611*	93.0	NA	93.0	0.0	12.0
02W-56A	617	105.0	105.5	105.9	0.9	6.1
12W-06	617	93.5	95.5	96.1	2.6	8.2
06W-20P**	640	99.0	NA	100.1	1.1	8.3
Mine						
R-03W-04-641	641	113.8	NA	114.6	0.8	6.9
R-11W-06-641	641	95.0	NA	96.4	1.4	6.8
R-01W-02-641	641	105.5	NA	106.8	1.3	9.2
R-01W-02-643	643	106.5	NA	106.8	0.3	6.7
R-01W-20-641	641	103.0	NA	104.5	1.5	4.7
R-01W-20-643	643	104.2	NA	104.5	0.3	3.4
R-06W-22-630	630	104.0	NA	104.5	0.5	6.8
R-06W-22-626	626	104.4	NA	104.5	0.1	3.5
R-06W-26-617	617	103.0	104	104.1	1.1	6.1
R-07W-06-617	617	99.0	100.5	100.6	1.6	7.3
R-07W-24-641	641	96.1	NA	97.1	1.0	6.6
R-08E-08-641	641	100.0	NA	101.7	1.7	5.6
R-05-10-641	641	101.0	NA	102.4	1.4	8.3
R-04E-06-641	641	100.5	NA	101.9	1.4	4.9
R-03E-02-643B	643	102.0	NA	102.4	0.4	6.5
R-03E-02-641B	641	100.8	NA	102.4	1.6	8.9
Offsite						
55-13	610	101.2	NA	102.0	0.8	7.6
60-14	640	101.1	NA	101.8	0.7	5.3
59-11	170	103.5	NA	102.7	-0.8	0.0

***ON SEEPAGE FACE**

****TO BE RESTORED, IN-SITU**

FIGURES



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

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FLA. REG. NO. 51991

DATE:

Date: 01/28/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

- Pre-Mining Drainage Network
- South Pasture
- South Pasture Extension
- No-Mine Area/Preservation Area
- Mine Area



CF

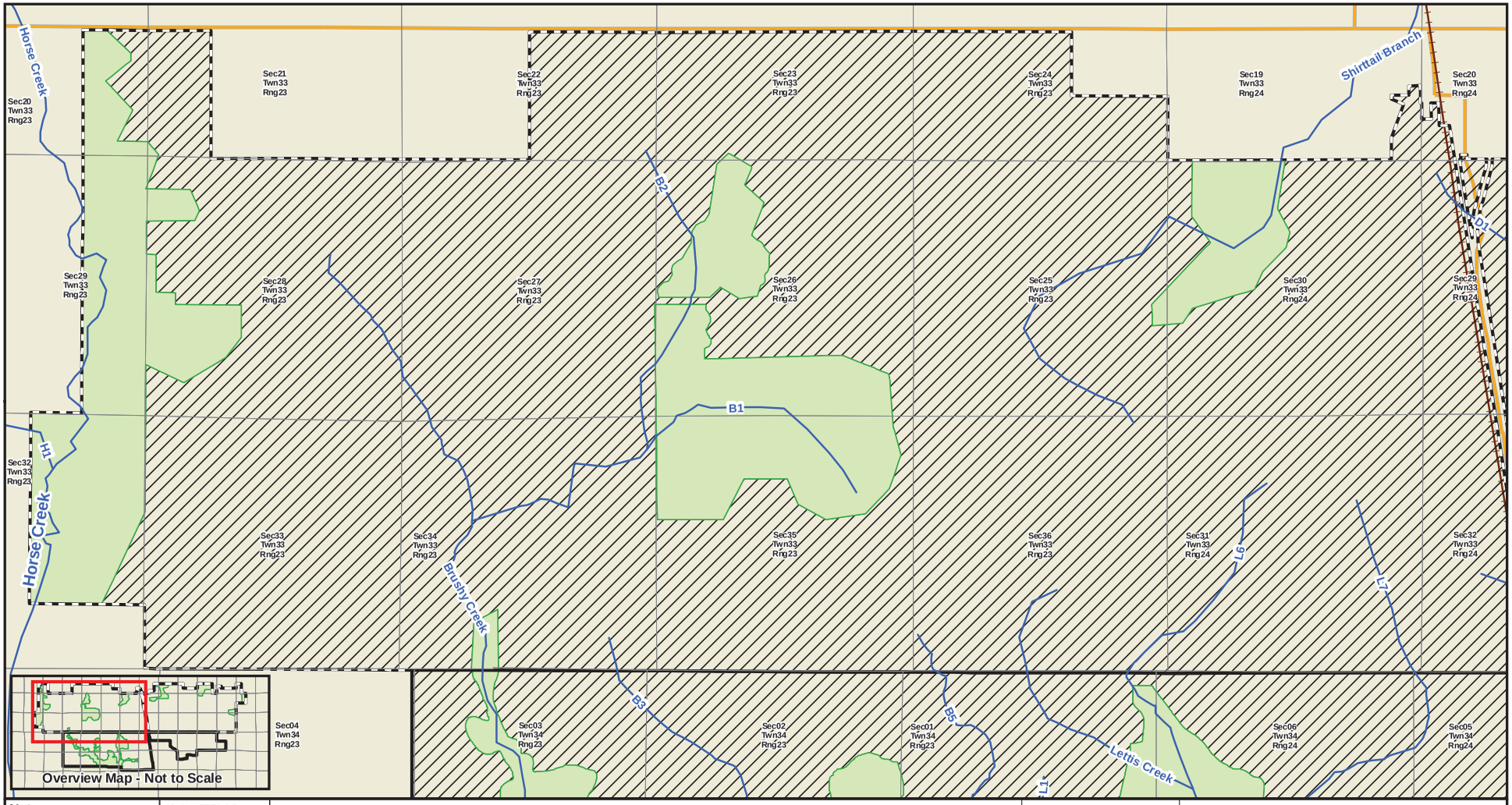
BCI engineers & scientists

0 2,500 5,000

1" = 5,000 Feet

FIGURE IMR-1
Overview Map
Map 1 of 5
South Pasture and Extension Integrated Model
Location Map
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR1_SPX_11x17_1.mxd



Notes:

1- Project No.: 03-16268

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DATE:

Date: 02/01/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

- Pre-Mining Drainage Network
- South Pasture
- South Pasture Extension
- No-Mine Area/Preservation Area
- Mine Area

CF

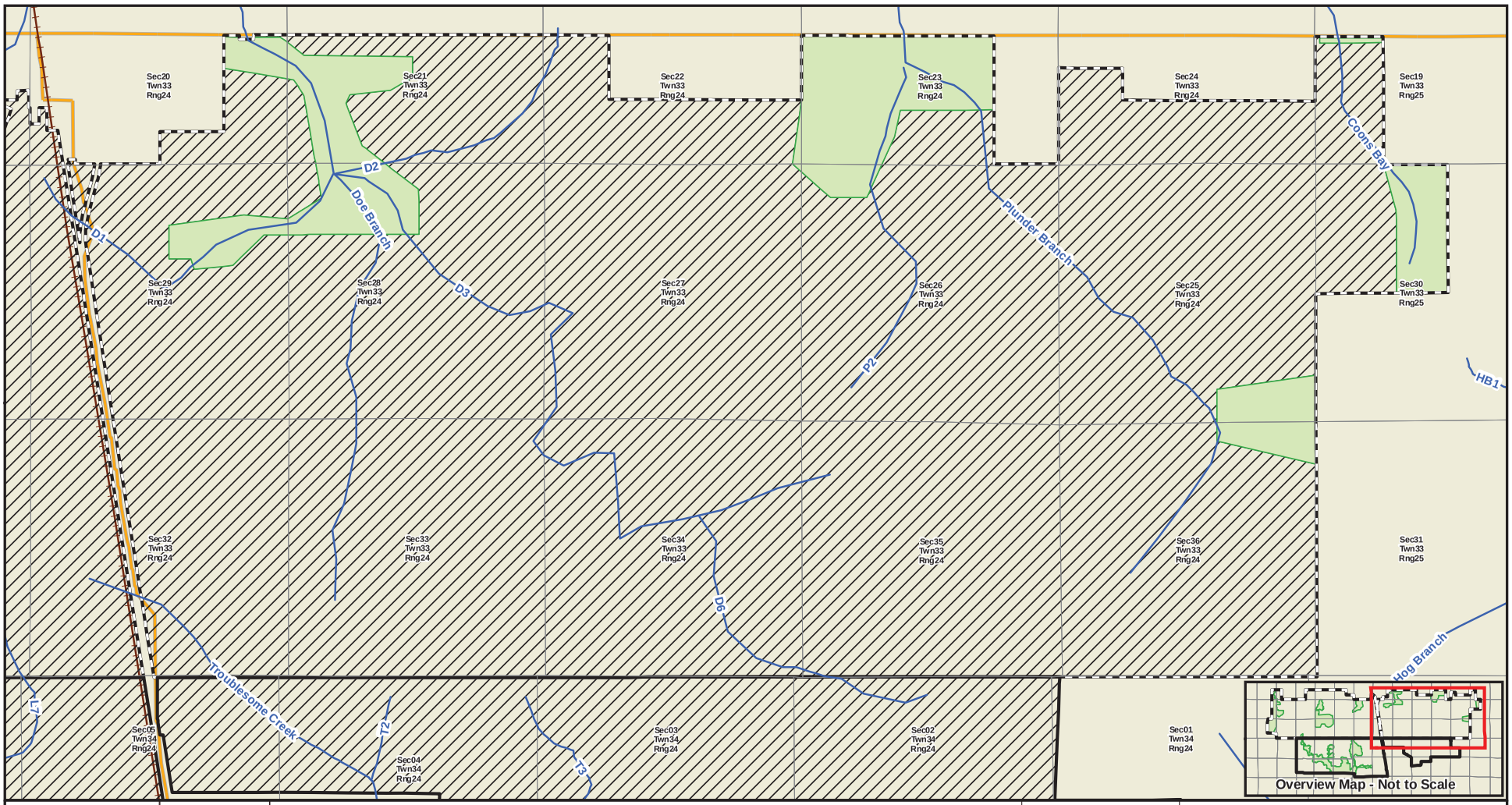
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0 1,000 2,000

1" = 2,000 Feet

FIGURE IMR-1
Map 2 of 5
South Pasture and Extension Integrated Model Location Map
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR1_SPX_11x17_2.mxd



Notes:

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Date: 02/01/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

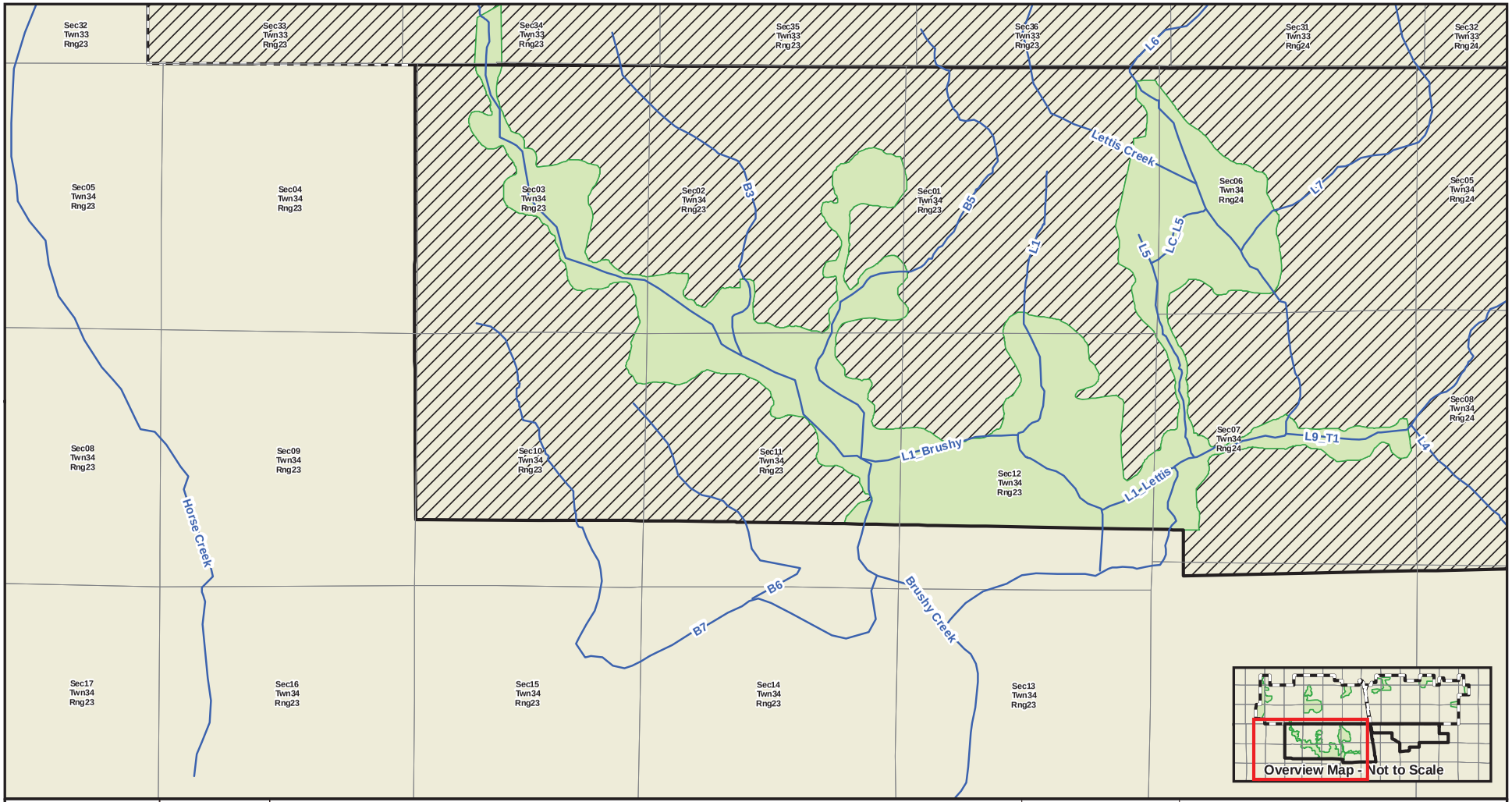
- Pre-Mining Drainage Network
- South Pasture
- South Pasture Extension
- No-Mine Area/Preservation Area
- Mine Area

0 1,000 2,000

1" = 2,000 Feet

FIGURE IMR-1
Map 3 of 5
South Pasture and Extension Integrated Model Location Map
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR1_SPX_11x17_3.mxd



Notes:

1- Project No.: 03-16268

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DATE:

Date: 02/01/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

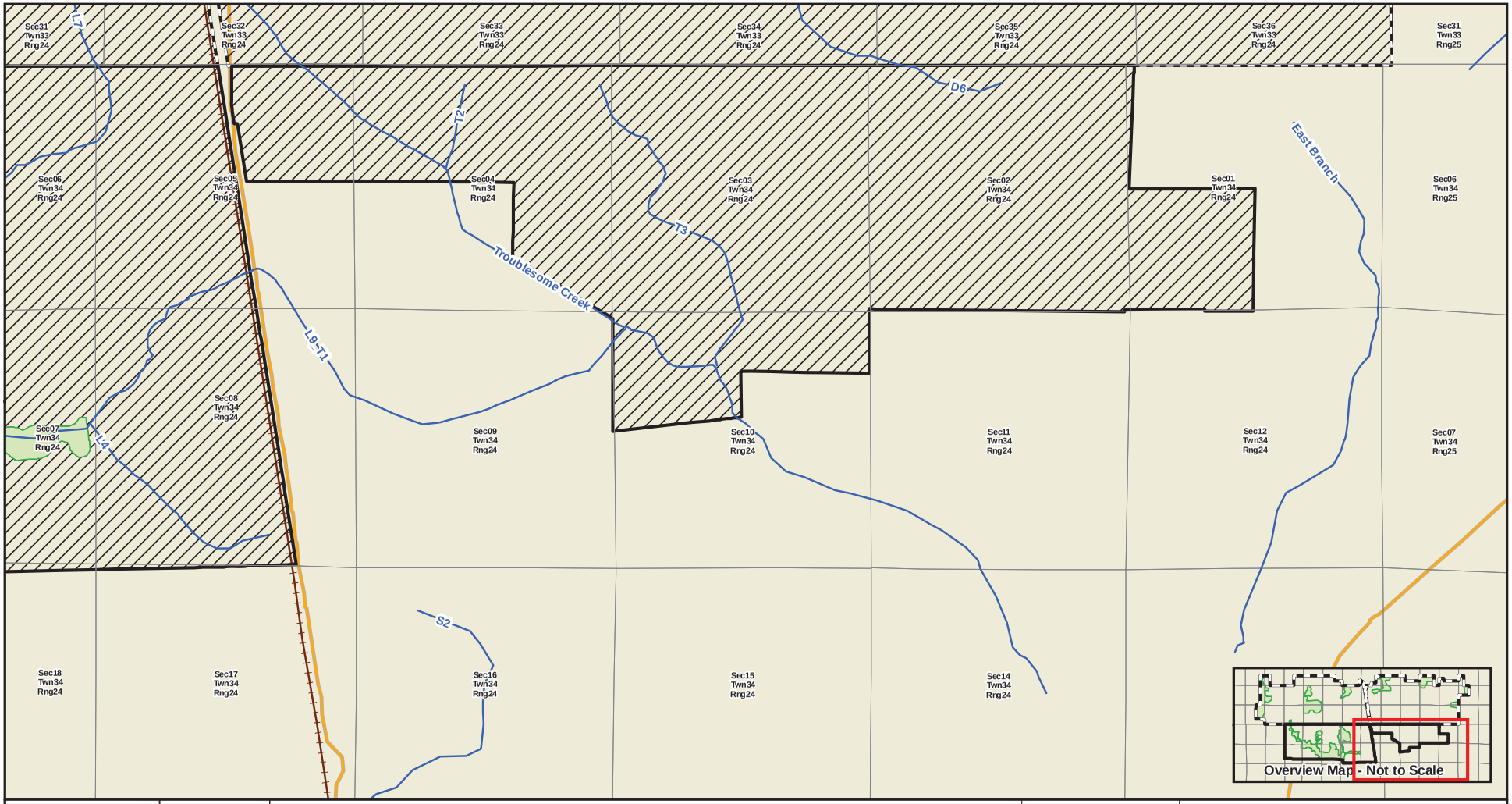
- Pre-Mining Drainage Network
- South Pasture
- South Pasture Extension
- No-Mine Area/Preservation Area
- Mine Area

0 1,000 2,000

1" = 2,000 Feet

FIGURE IMR-1
Map 4 of 5
South Pasture and Extension Integrated Model Location Map
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR1_SPX_11x17_4.mxd



Notes:

1- Project No.: 03-16268

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DATE:

Date: 02/01/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

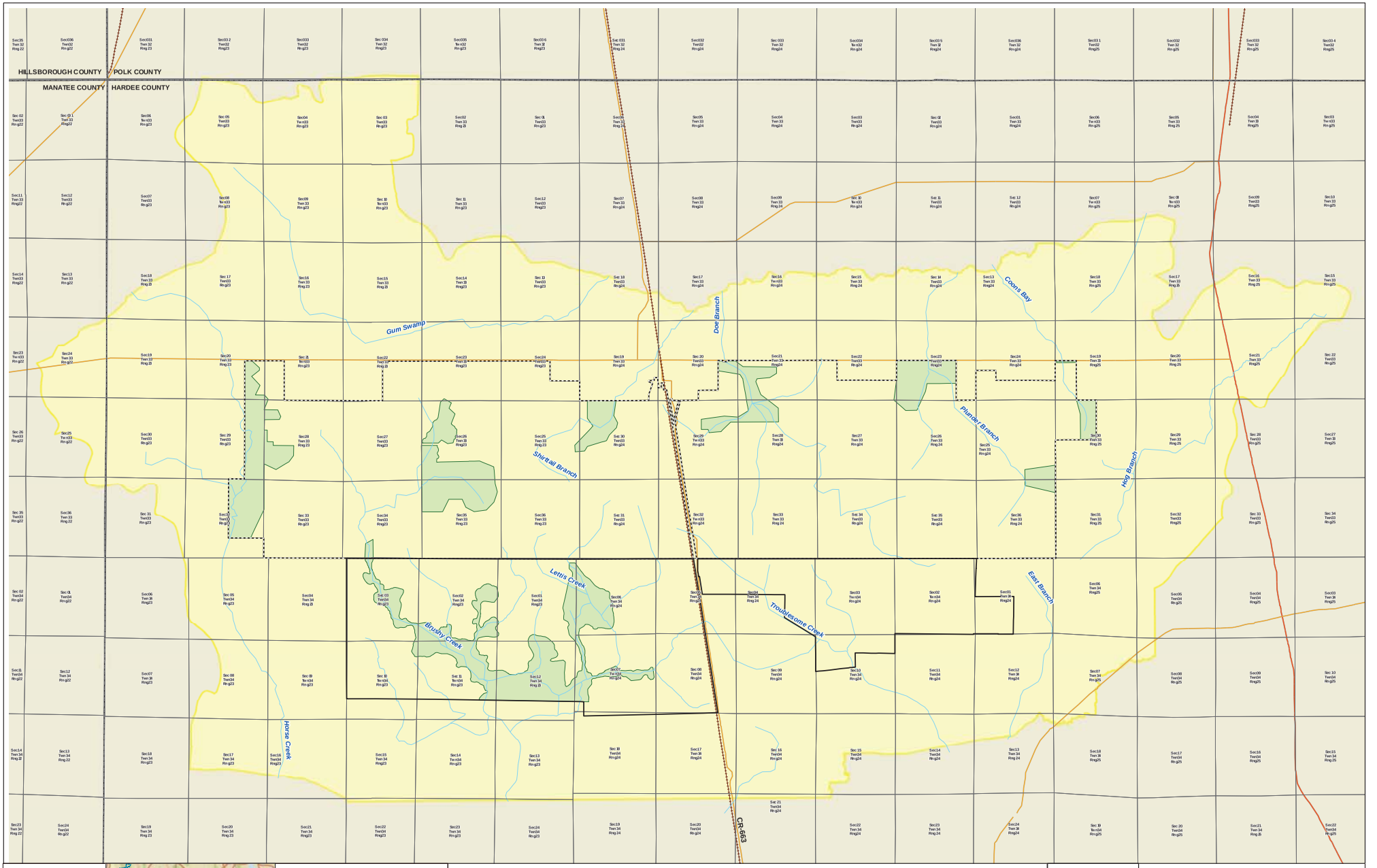
- Pre-Mining Drainage Network
- South Pasture
- South Pasture Extension
- No-Mine Area/Preservation Area
- Mine Area

0 1,000 2,000

1" = 2,000 Feet

FIGURE IMR-1
Map 5 of 5
South Pasture and Extension Integrated Model Location Map
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR1_SPX_11x17_5.mxd





Notes:

1- **Project No.: 03-16268**

2- **This map is intended to be used for planning purposes only. It is not a survey.**

Explanation of Features

- County Boundaries
- South Pasture
- South Pasture Extension
- Pre-Mining Drainage Network
- No-Mine Area/Preservation Area
- Integrated Model Domain
- County Boundaries

0 2,000 4,000

1" = 2,000 Feet

3

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Date:

Date Drawn: 02/09/2011

Checked By: JHK

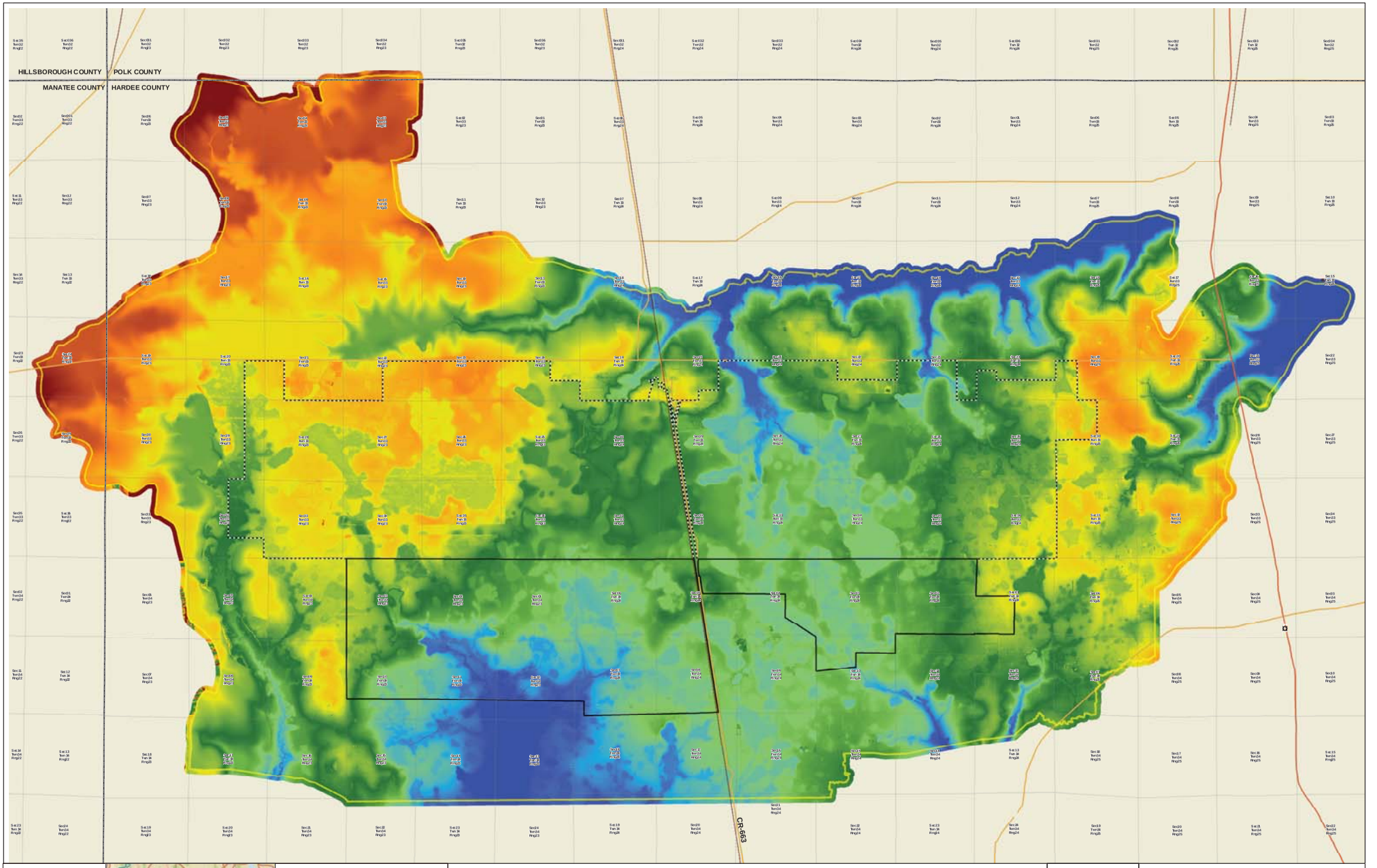
Drawn By: ARB

Revised:

FIGURE IMR-2
South Pasture Extension Integrated Model Domain Hardee County, Florida

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File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR2_SPX_36x48.mxd





Notes:

1- **Project No.: 03-16268**

2- **Digital Elevation Model (DEM) derived from LiDAR, BCI and CF Industries data. (NGVD 1929 Feet)**

3- **This map is intended to be used for planning purposes only. It is not a survey.**

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

DEM (NGVD Feet)

High : 295.71

Low : 46.7012

0 2,000 4,000

1" = 2,000 Feet

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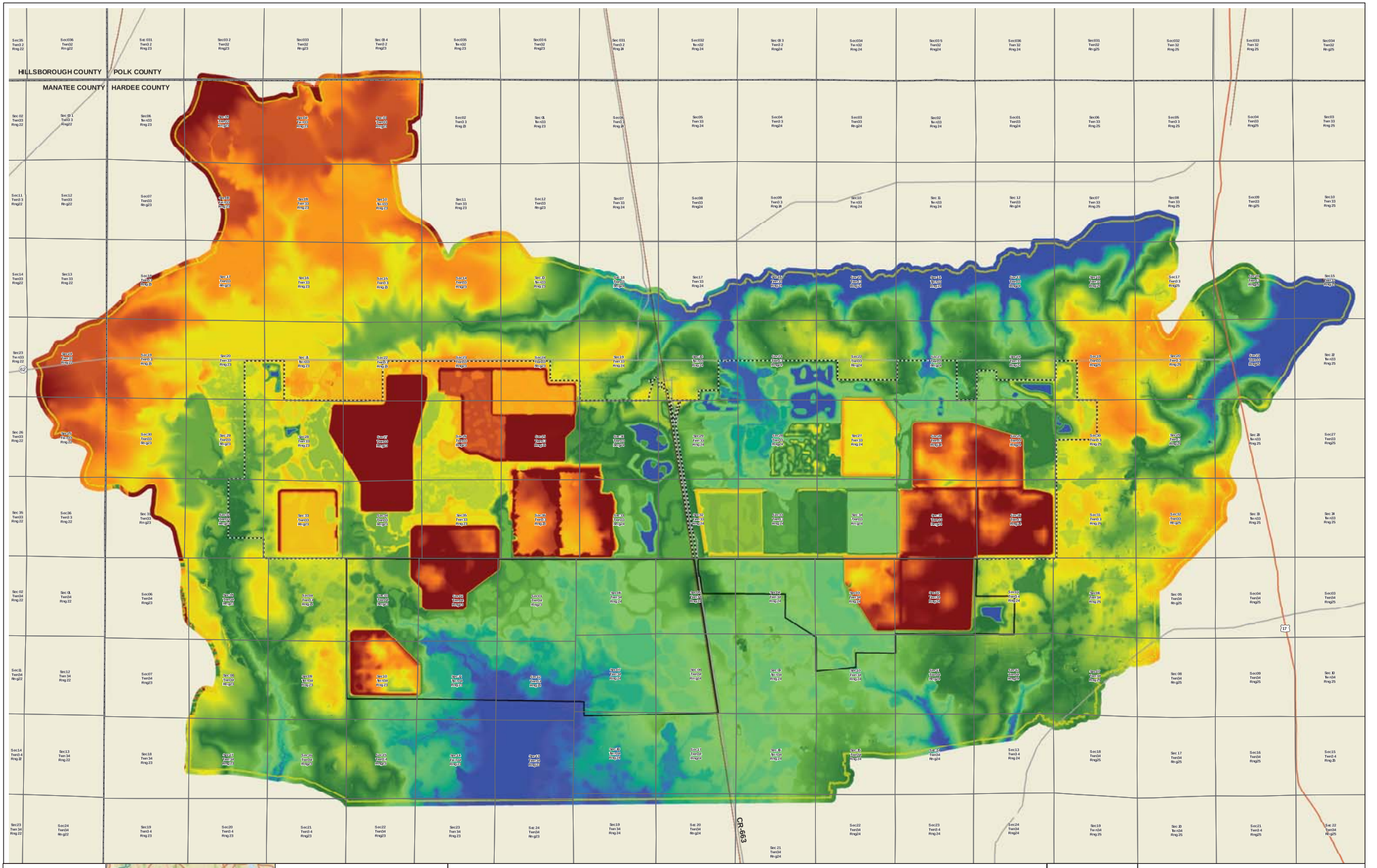
Checked By: JHK

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Revised:

Figure IMR-3
South Pasture Extension Integrated Model Domain Pre-Mining Topography Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR3_SPX_36x48.mxd



Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CF Industries data. (NGVD 1929 Feet)

3- This map is intended to be used for planning purposes only. It is not a survey.

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

DEM (NGVD Feet)

High : 295.713

Low : 46.7017

N

0 2,000 4,000

1" = 2,000 Feet

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Date:

Date Drawn: 02/09/2011

Checked By: JHK

Drawn By: ARB

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Figure IMR-4
South Pasture Extension Integrated Model Domain Post-Reclamation Topography Hardee County, Florida

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File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR4_SPX_36x48.mxd

Figure IMR-5
Rainfall Time-Series used in the model simulation 1985-2009

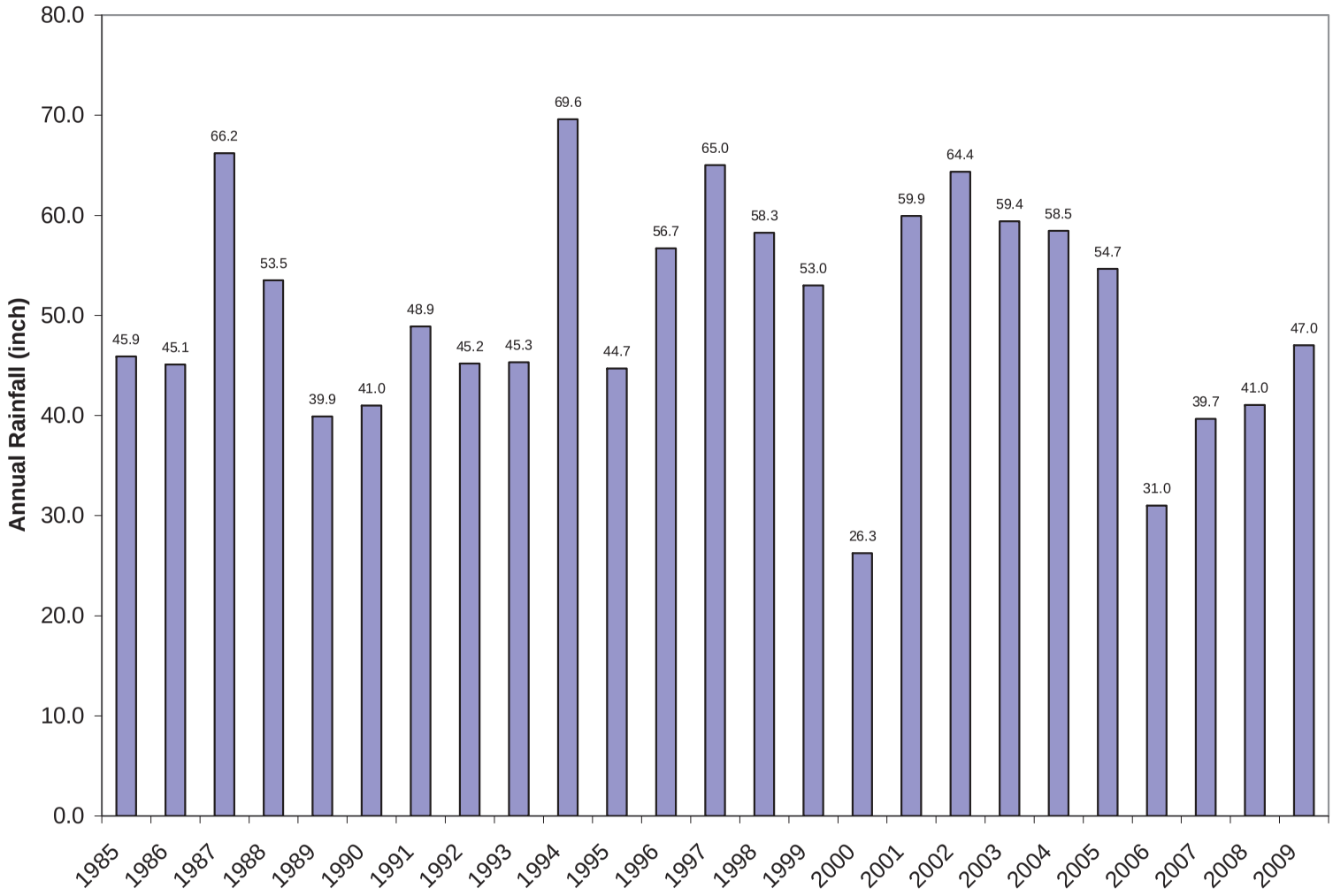
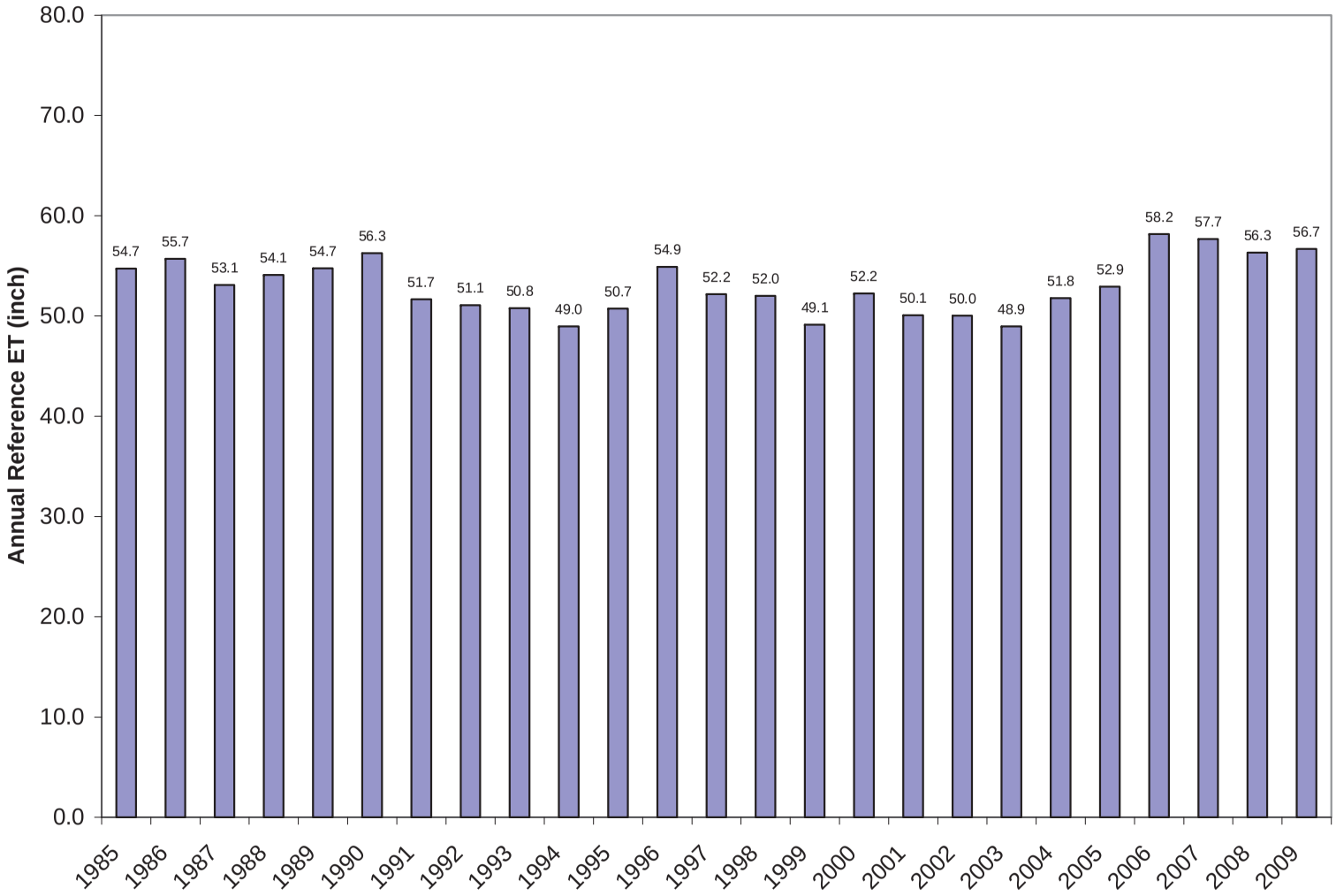
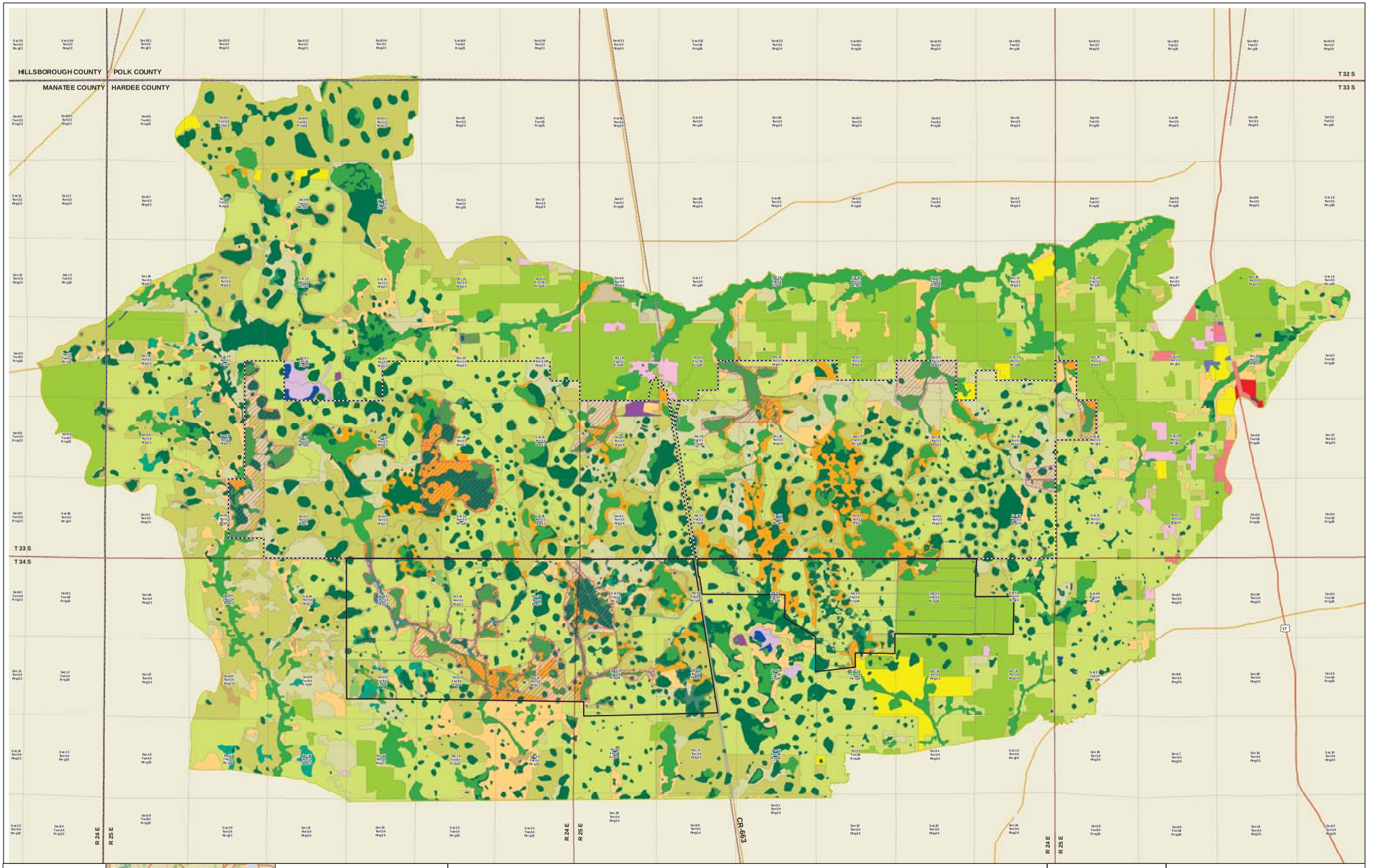


Figure IMR-6
Reference ET time-series used in model simulation 1985-2009





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Notes:

1- **Project No.: 03-16268**

2- **This map is intended to be used for planning purposes only. It is not a survey.**

Explanation of Features

- South Pasture
- South Pasture Extension
- Integrated Model Domain
- No-Mine Area

Pre-Mining Land Use (FLUCCS 1999)

- 110, Residential, Low Density
- 120, Residential, Medium Density
- 130, Residential, High Density
- 140, Commercial and Services
- 150, Industrial
- 170, Institutional
- 180, Recreational
- 190, Open Land
- 210, Cropland and Pastureland
- 220, Tree Crops
- 230, Feeding Operations
- 240, Nurseries and Vineyards
- 260, Other Open Lands <Rural>
- 310, Herbaceous (Dry Prairie)
- 320, Shrub and Brushland
- 330, Mixed Rangeland
- 410, Upland Coniferous Forests
- 420, Upland Hardwood Forests
- 430, Upland Mixed Forests
- 510, Streams and Waterways
- 520, Lakes
- 530, Reservoirs
- 610, Wetland Hardwood Forests
- 620, Wetland Coniferous Forests
- 630, Wetland Forested Mixed
- 640, Vegetated Non-Forested Wetlands
- 740, Disturbed Lands
- 810, Transportation

N

0 2,000 4,000
1" = 2,000 Feet

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Date:

Date Drawn: 02/09/2011

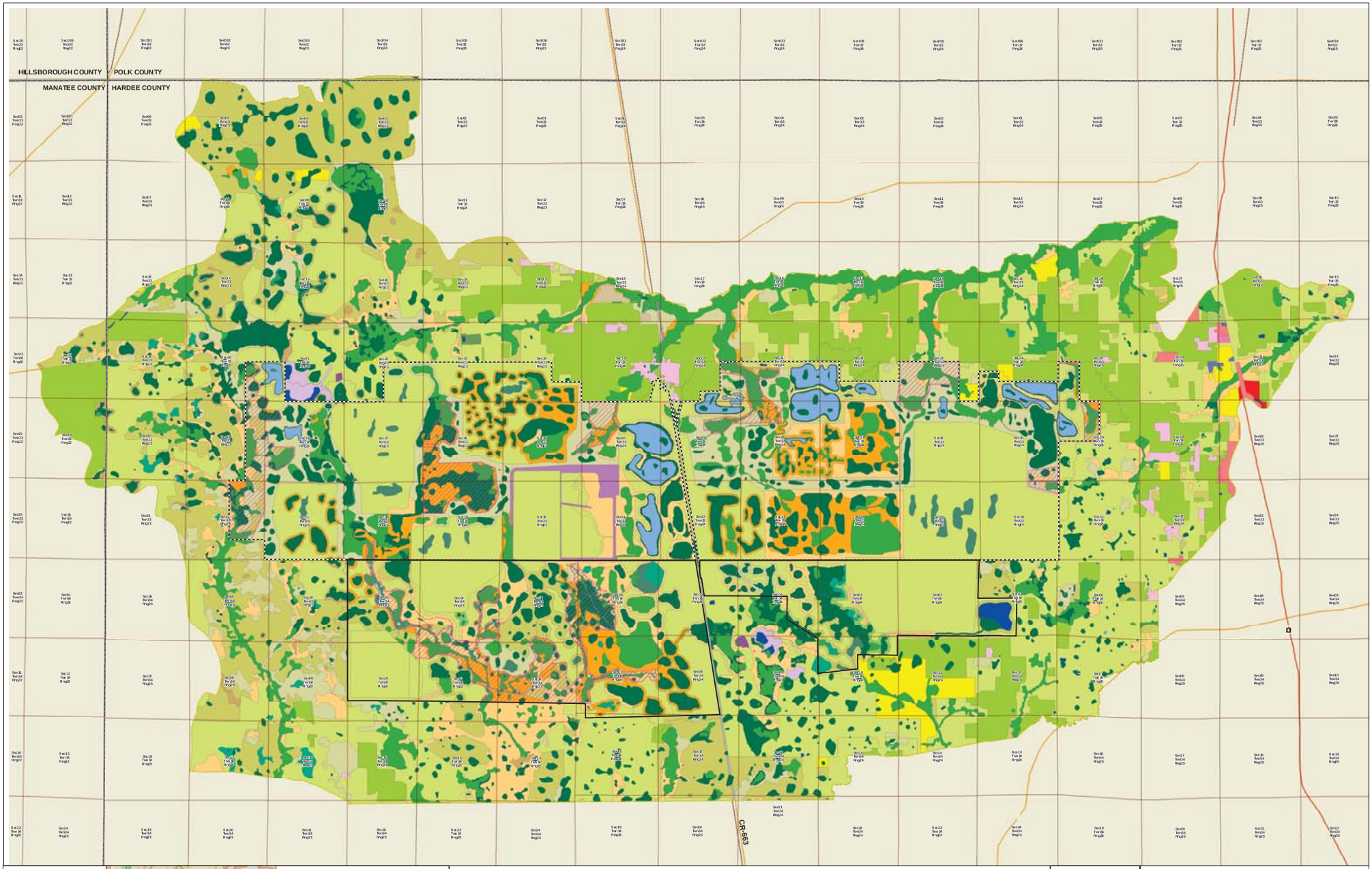
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Figure IMR-7
South Pasture Extension Integrated Model Domain Pre-Mining Land Use Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR7_SPX_36x48.mxd



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Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

Explanation of Features

- South Pasture
- South Pasture Extension
- Integrated Model Domain
- No-Mine Area

Post-Reclamation Land Use (FLUCCS 1999)

- 110, Residential, Low Density
- 120, Residential, Medium Density
- 130, Residential, High Density
- 140, Commercial and Services
- 150, Industrial
- 170, Institutional
- 180, Recreational
- 190, Open Land
- 210, Cropland and Pastureland
- 220, Tree Crops
- 230, Feeding Operations
- 240, Nurseries and Vineyards
- 260, Other Open Lands <Rural>
- 310, Herbaceous (Dry Prairie)
- 320, Shrub and Brushland
- 330, Mixed Rangeland
- 410, Upland Coniferous Forests
- 420, Upland Hardwood Forests
- 430, Upland Mixed Forests
- 510, Streams and Waterways
- 520, Lakes
- 526, Man-Made Lakes
- 530, Reservoirs
- 610, Wetland Hardwood Forests
- 620, Wetland Coniferous Forests
- 630, Wetland Forested Mixed
- 640, Vegetated Non-Forested Wetlands
- 740, Disturbed Lands
- 810, Transportation

N

0 2,000 4,000

1" = 2,000 Feet

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Date:

Date Drawn: 02/09/2011

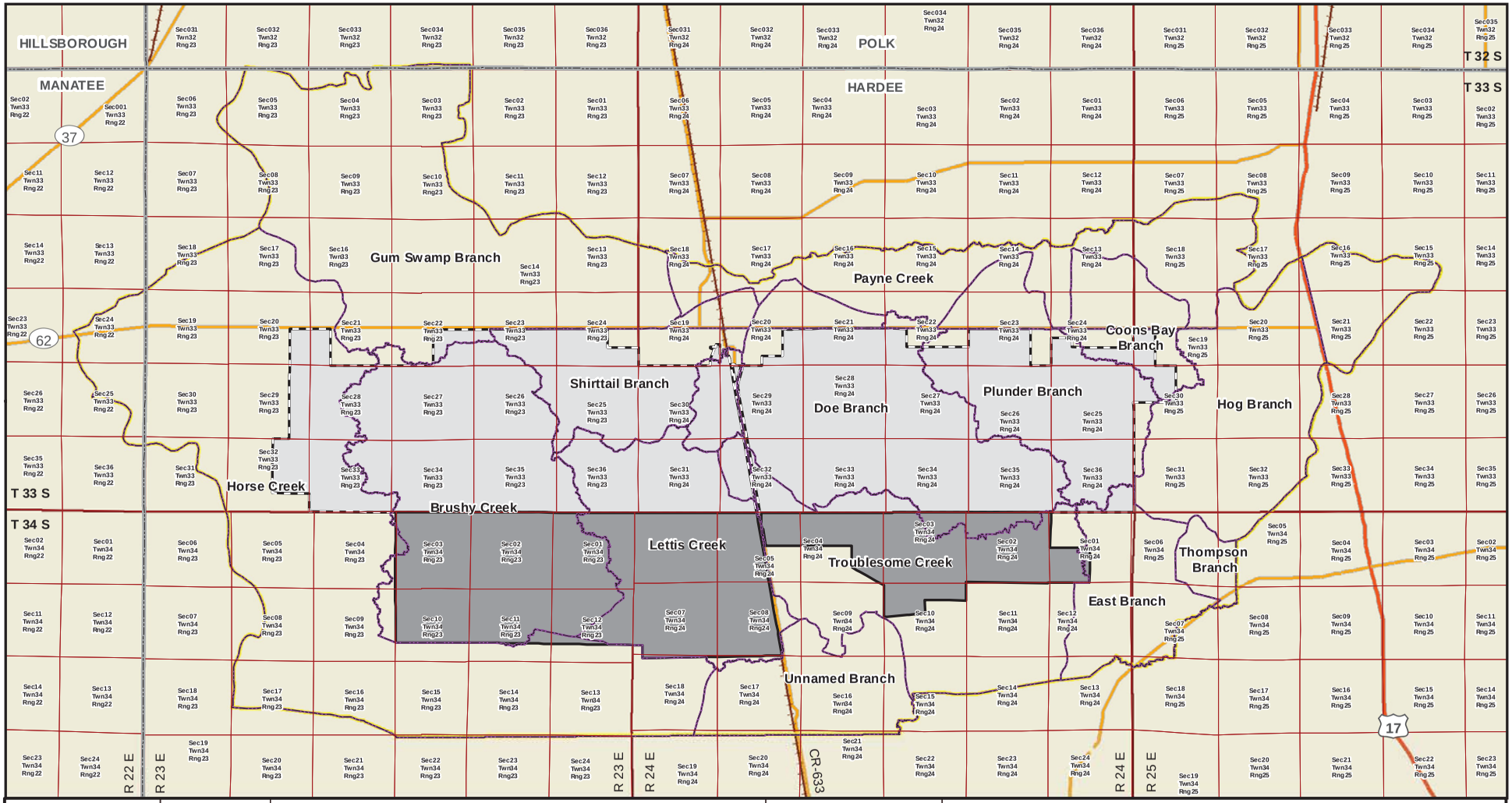
Checked By: JHK

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Figure IMR-8
South Pasture Extension Integrated Model Domain Post-Reclamation Land Use Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Mode\MXD\SPX_Integrated\Figure_IMR8_SPX_36x48.mxd



Notes:

1- Project No.: 03-16268

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FLA. REG. NO. 51991

DATE:

Date: 02/01/2010

Checked By: JHK

Map Prepared By: ARK

N

Explanation of Features

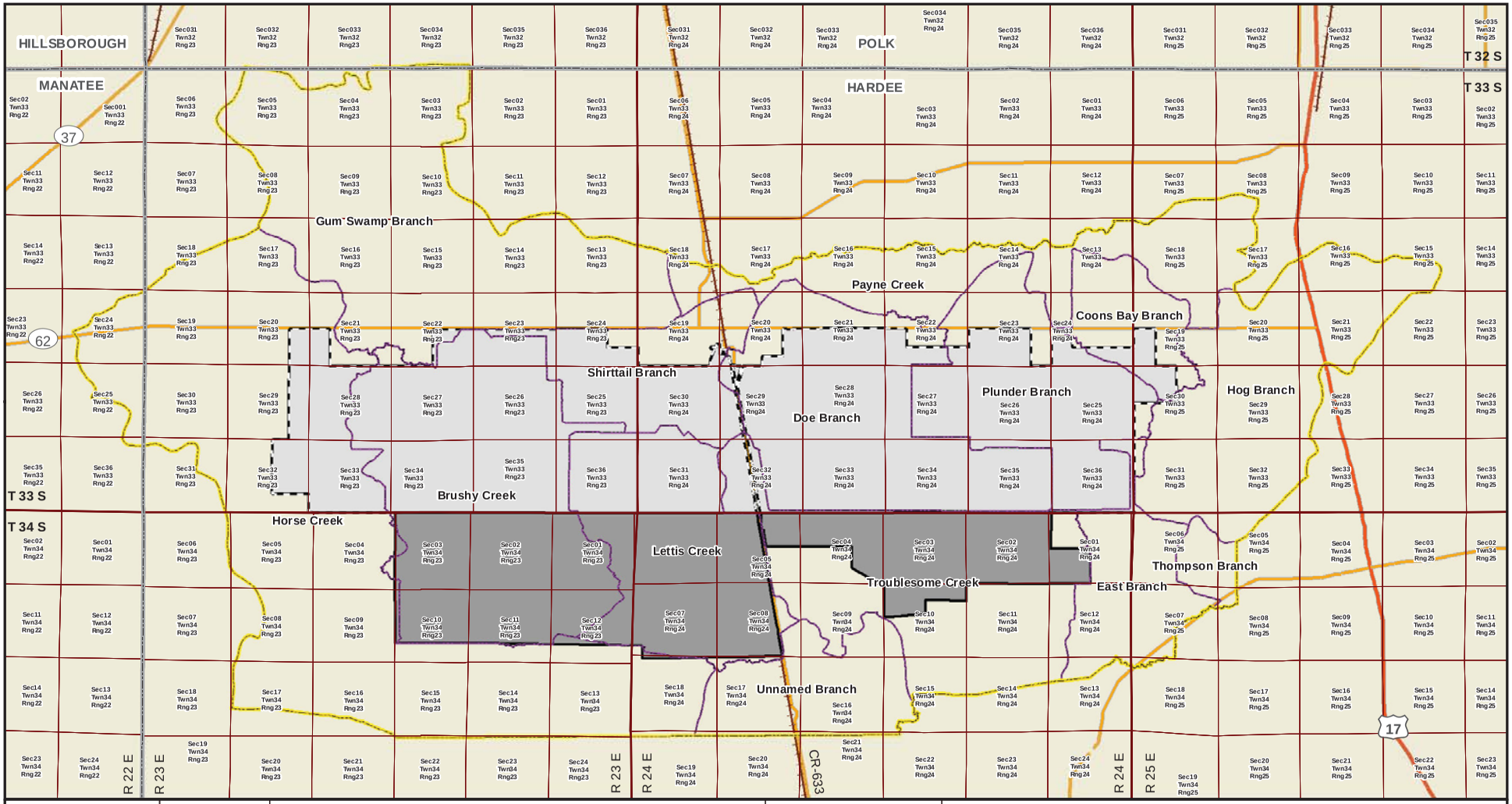
- County Boundaries
- Pre-Mining Separated Flow Areas
- South Pasture
- South Pasture Extension
- Integrated Model Domain

0 3,500 7,000

1" = 7000 Feet

Figure IMR-9
South Pasture Extension Integrated Model
Pre-Mining Separated Flow Areas
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\2009_IntegratedModel\MXD\SPX_Integrated\Figure_9_SPX.mxd



Notes:

1- Project No.: 03-16268

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DATE:

Date: 02/01/2010

Checked By: JHK

Map Prepared By: ARK

N

Explanation of Features

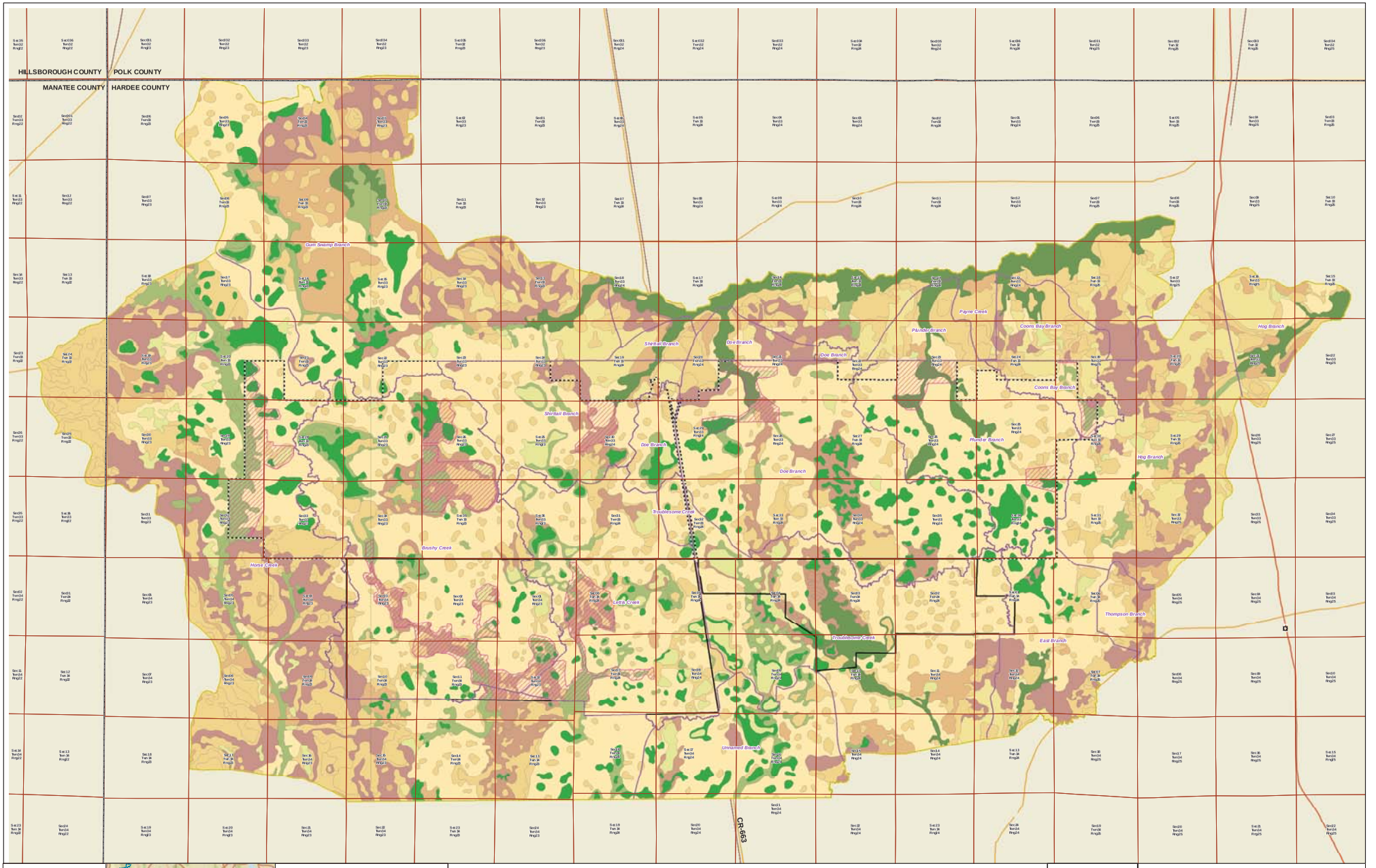
- County Boundaries
- Post-Reclamation Separated Flow Areas
- South Pasture
- South Pasture Extension
- Integrated Model Domain

0 3,500 7,000

1" = 7000 Feet

Figure IMR-10
South Pasture Extension Integrated Model
Post-Reclamation Separated Flow Areas
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\2009_IntegratedModel\MXD\Figure_IMR10_SPX_11x17.mxd





Notes:

1- **Project No.: 03-16268**

2- **This map is intended to be used for planning purposes only. It is not a survey.**

Explanation of Features

- County Boundaries
- Integrated Model Domain
- Pre-Mining Separated Flow Areas
- South Pasture
- South Pasture Extension
- No-Mine Area

SOIL GROUP DESCRIPTIONS

- SAND
- LOAMY SAND
- MUCK
- BRADENTON-FELDA-CHOBEE ASSOCIATION/FREQUENTLY FLOODED
- FELDA FINE SAND
- FLORIDANA MUCKY FINE SAND/DEPRESSIONAL
- MYAKKA FINE SAND
- POMONA FINE SAND
- SMYRNA SAND
- ZOLFO FINE SAND

N

0 2,000 4,000

1" = 2,000 Feet

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FLA. REG. NO. 51991

Date:

Date Drawn: 02/09/2011

Checked By: JHK

Drawn By: ARB

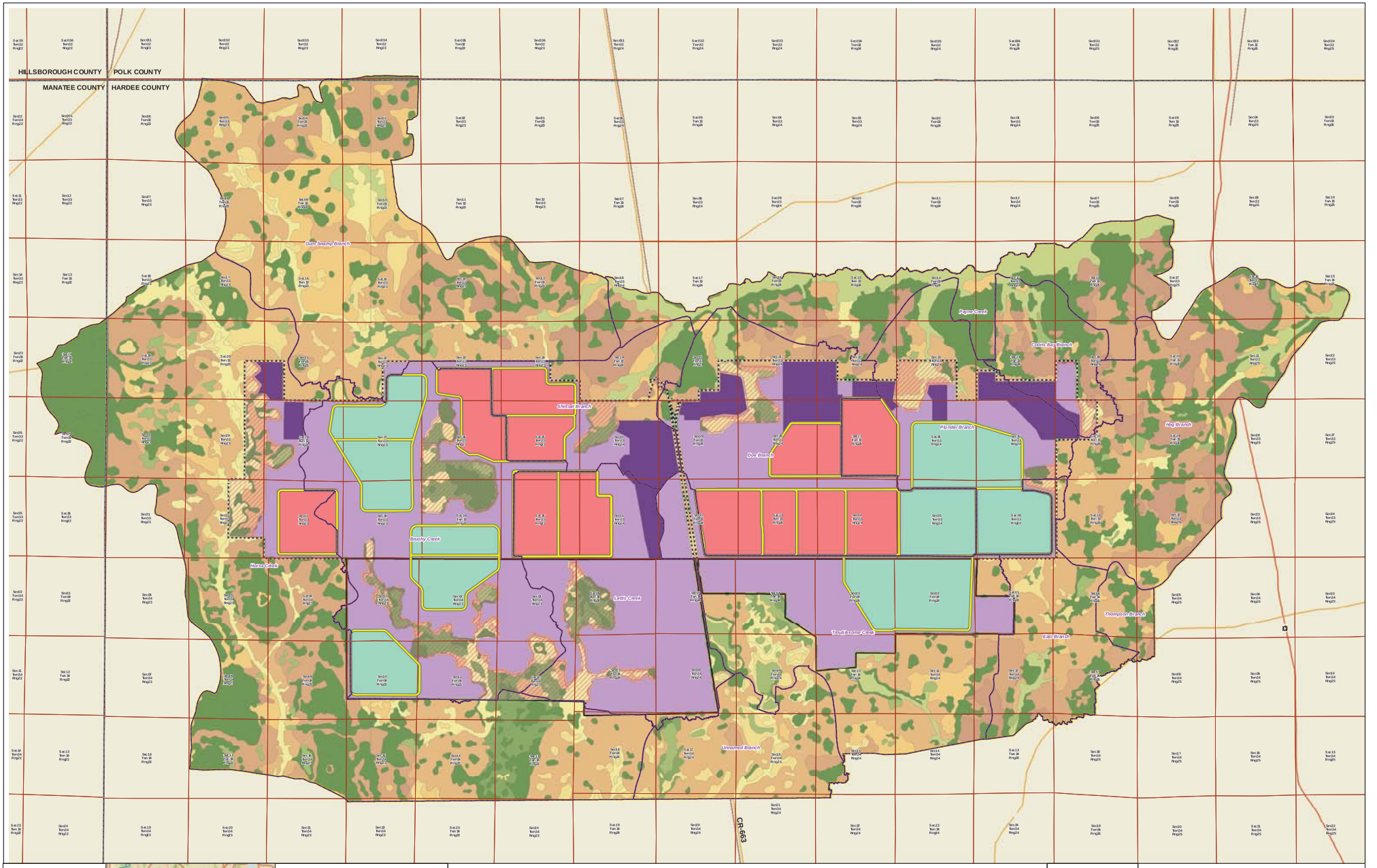
Revised:

Figure IMR-11
South Pasture Extension Integrated Model Domain Pre-Mining Soil Distribution Hardee County, Florida

CF

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Lakeland, FL. 33803
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Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

Explanation of Features

- Post Reclamation Separated Flow Areas
- Dam Walls
- Integrated Model Domain
- South Pasture
- South Pasture Extension
- No-Mine Area

SOIL GROUP DESCRIPTIONS

- SAND
- LOAMY SAND
- MUCK
- BRADENTON-FELDA-CHOBEE ASSOC./FREQ. FLOODED
- CHOBEE FINE SAND LOAM
- FELDA FINE SAND
- FLORIDANA FINE SAND
- FLORIDANA MUCKY FINE SAND/DEPRESSIONAL
- MYAKKA FINE SAND
- MYAKKA FINE SAND
- POMONA FINE SAND
- SMYRNA SAND
- ZOLFO FINE SAND
- OVERBURDEN
- TAILS
- SAND-CLAY MIX
- CLAY

N

0 2,000 4,000

1" = 2,000 Feet

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FLA. REG. NO. 51991

Date:

Date Drawn: 02/09/2011

Checked By: JHK

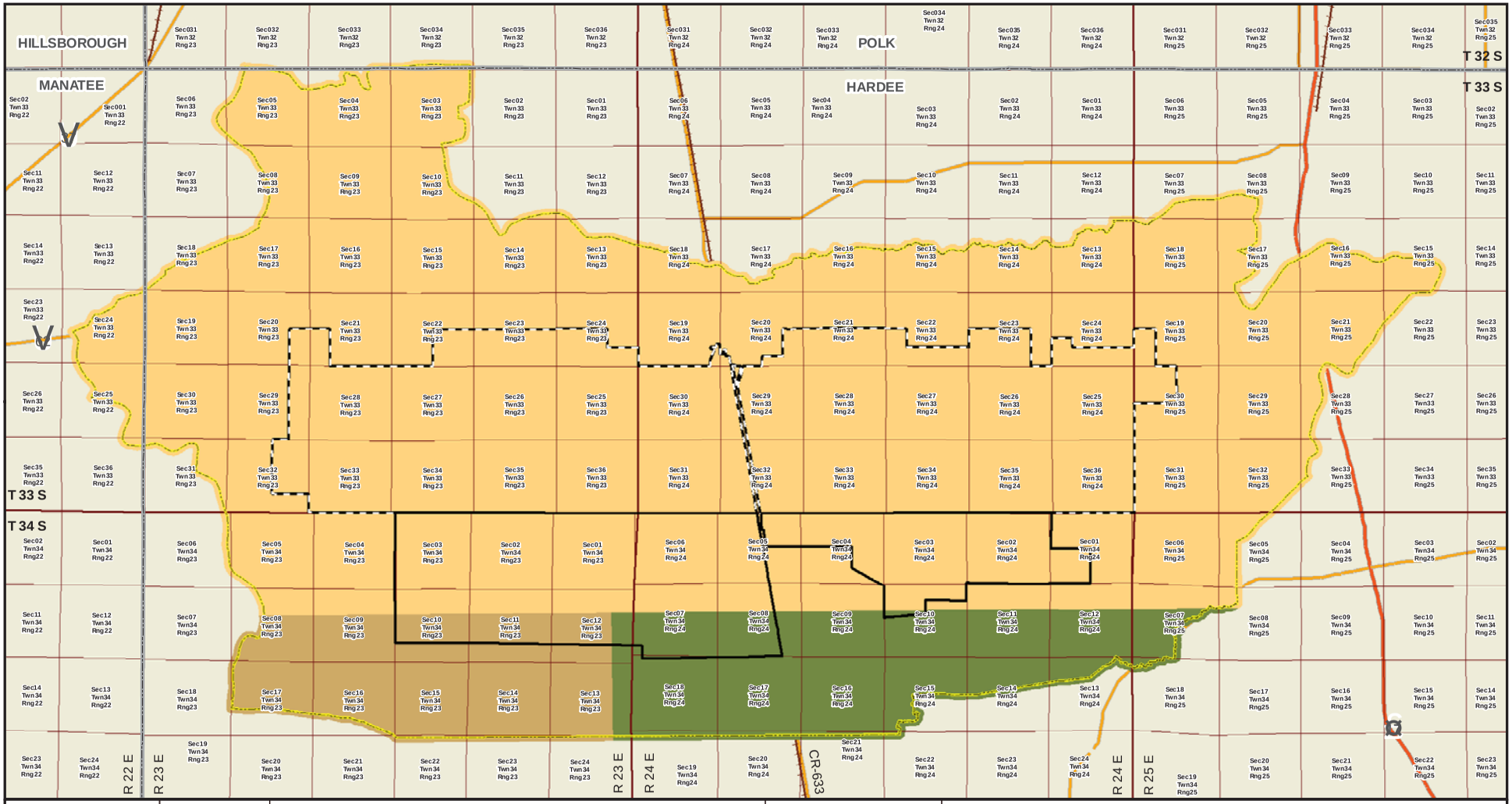
Drawn By: ARB

Revised:

Figure IMR-12
South Pasture Extension
Integrated Model Domain
Post Reclamation
Soil Distribution
Hardee County, Florida

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Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010

Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Kh (feet per day)

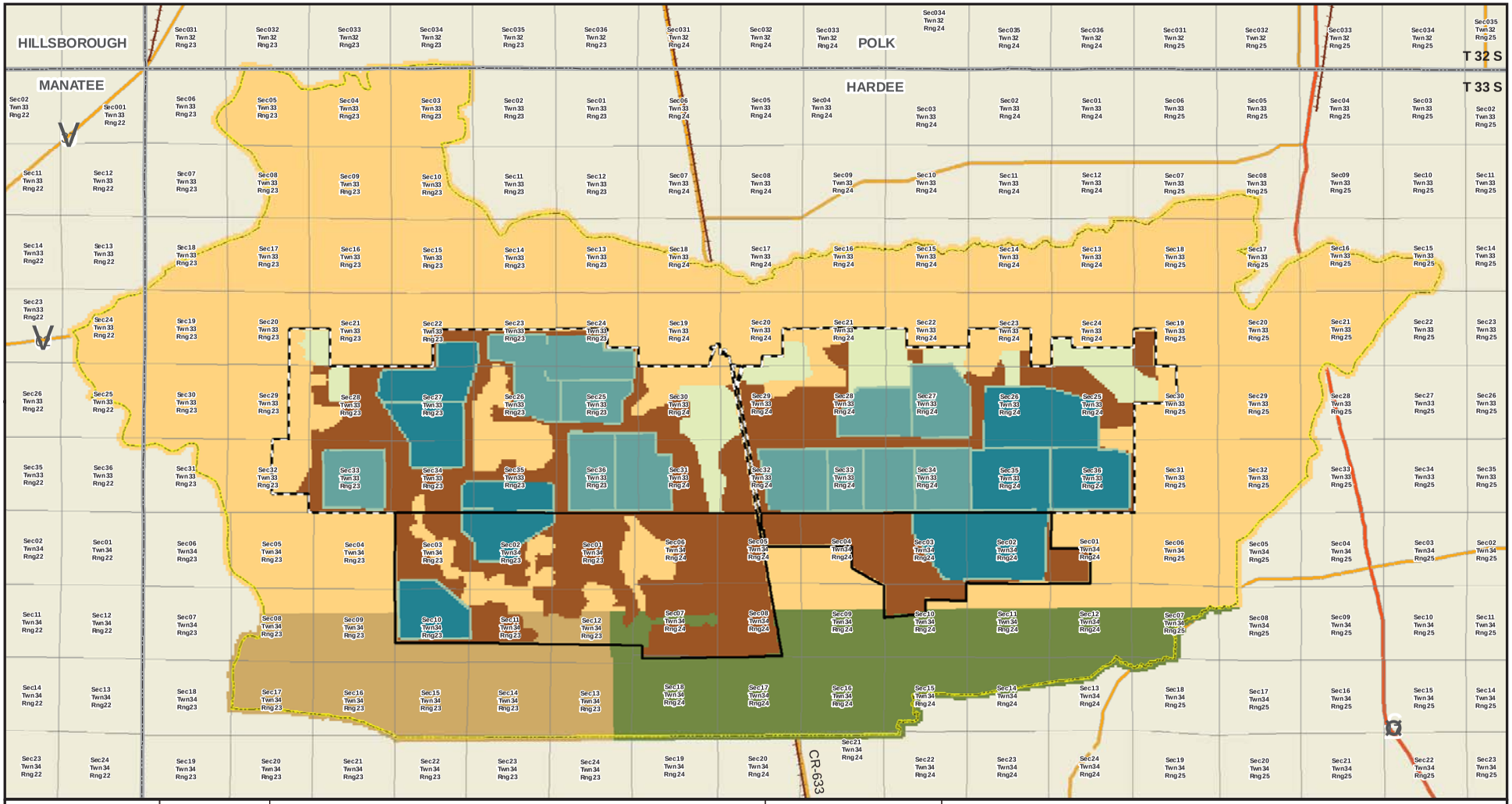
- 7
- 14
- 20

0 3,500 7,000

1" = 7000 Feet

Figure IMR-13a
South Pasture Extension Integrated Model
Pre-Mining
Horizontal Hydraulic Conductivity
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_13a_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised_02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Kh (feet per day)

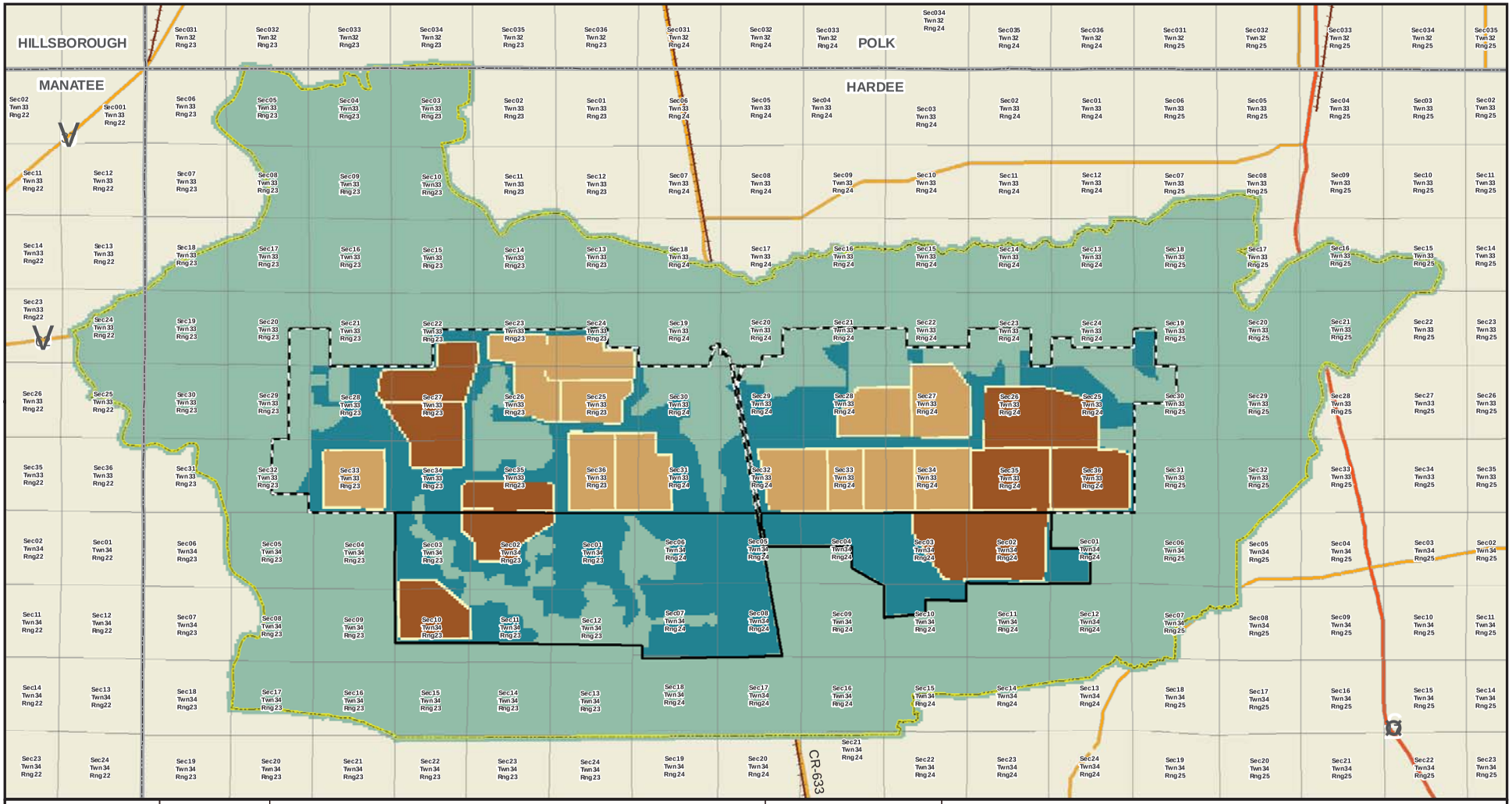
0.0079	7
0.1	14
0.4	20
1.4	28

0 3,500 7,000

1" = 7000 Feet

Figure IMR-13b
South Pasture Extension Integrated Model
Post-Reclamation
Horizontal Hydraulic Conductivity
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_13b_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Kv (feet per day)

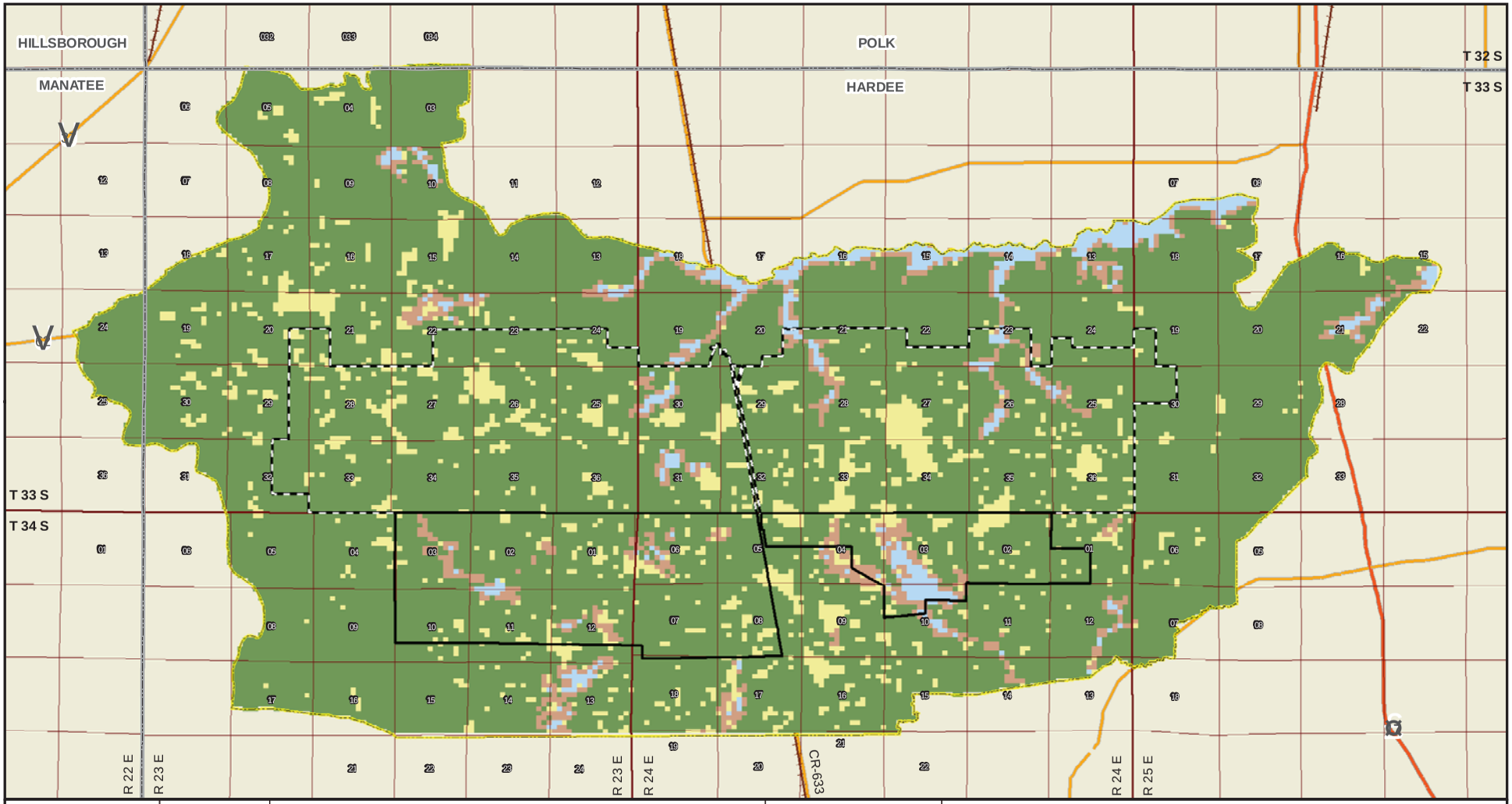
- 0.0008
- 0.01
- 0.03
- 0.14
- 2.8

0 3,500 7,000

1" = 7000 Feet

Figure IMR-13c
South Pasture Extension Integrated Model
Post-Reclamation
Vertical Hydraulic Conductivity
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_13c_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010

Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Specific Yield

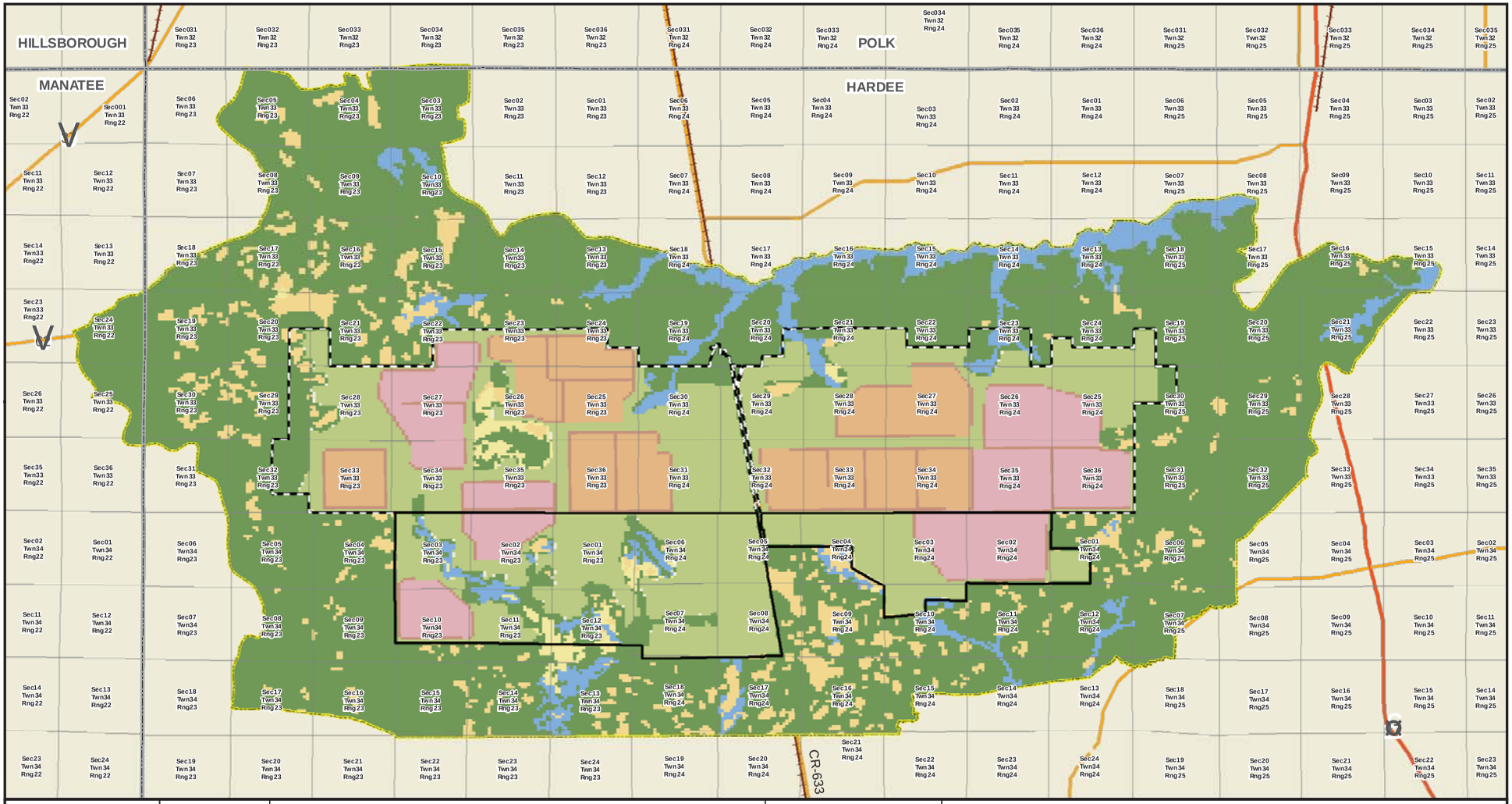
- 0.04
- 0.254
- 0.274
- 0.357

0 3,500 7,000

1" = 7000 Feet

Figure IMR-13d
South Pasture Extension Integrated Model
Pre-Mining
Specific Yield
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_13d_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised 02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Specific Yield

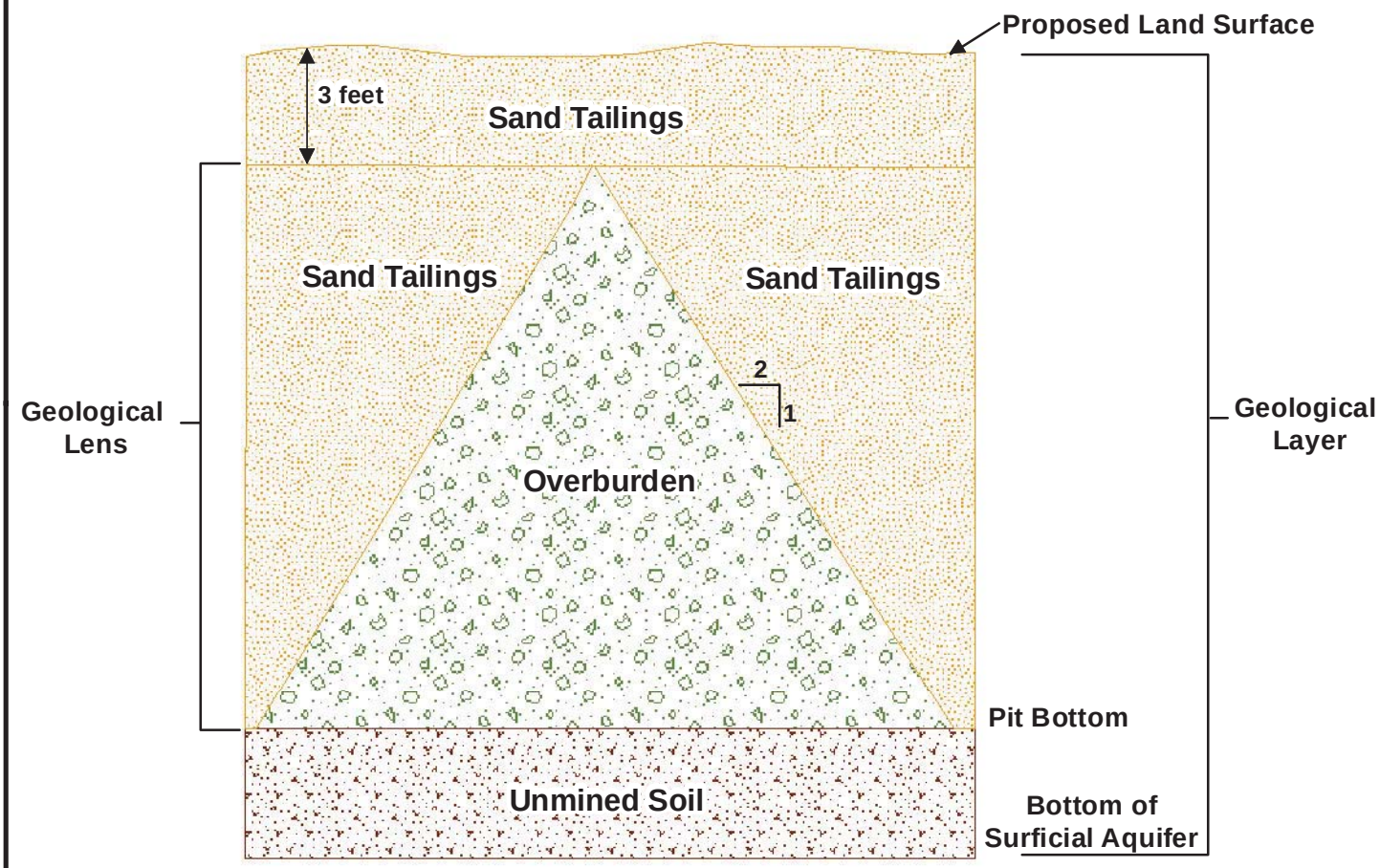
0.04	0.254
0.07	0.273
0.166	0.324
0.239	0.356

0 3,500 7,000

1" = 7000 Feet

Figure IMR-13e
South Pasture Extension Integrated Model
Post-Reclamation
Specific Yield
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_13e_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- Drawing Not to Scale

3- This map is intended to be used for planning purposes only. It is not a survey.

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FLA. REG. NO. 51991

DATE:
Date: 02/21/2011
Checked By: JHK
Map Prepared By: ARB
Revised :

N

Explanation of Features

- Overburden
- Sand Tailings
- Unmined Soils

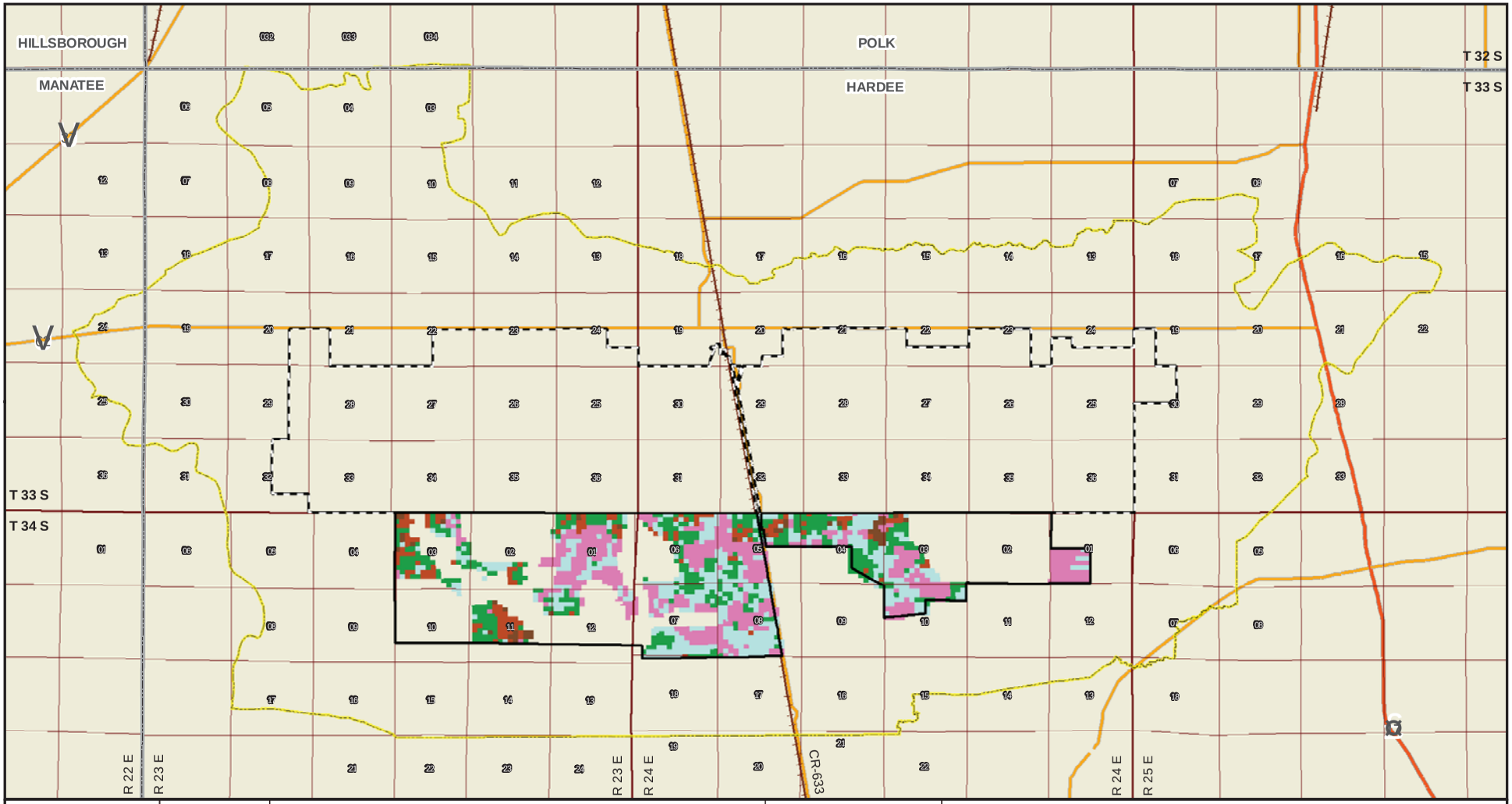
BCI engineers & scientists

0 1,500

1" = 1,500 Feet

Figure IMR-14
South Pasture Extension
Integrated Model
Typical Geological Lens
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_14_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010

Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Kh (feet per day)

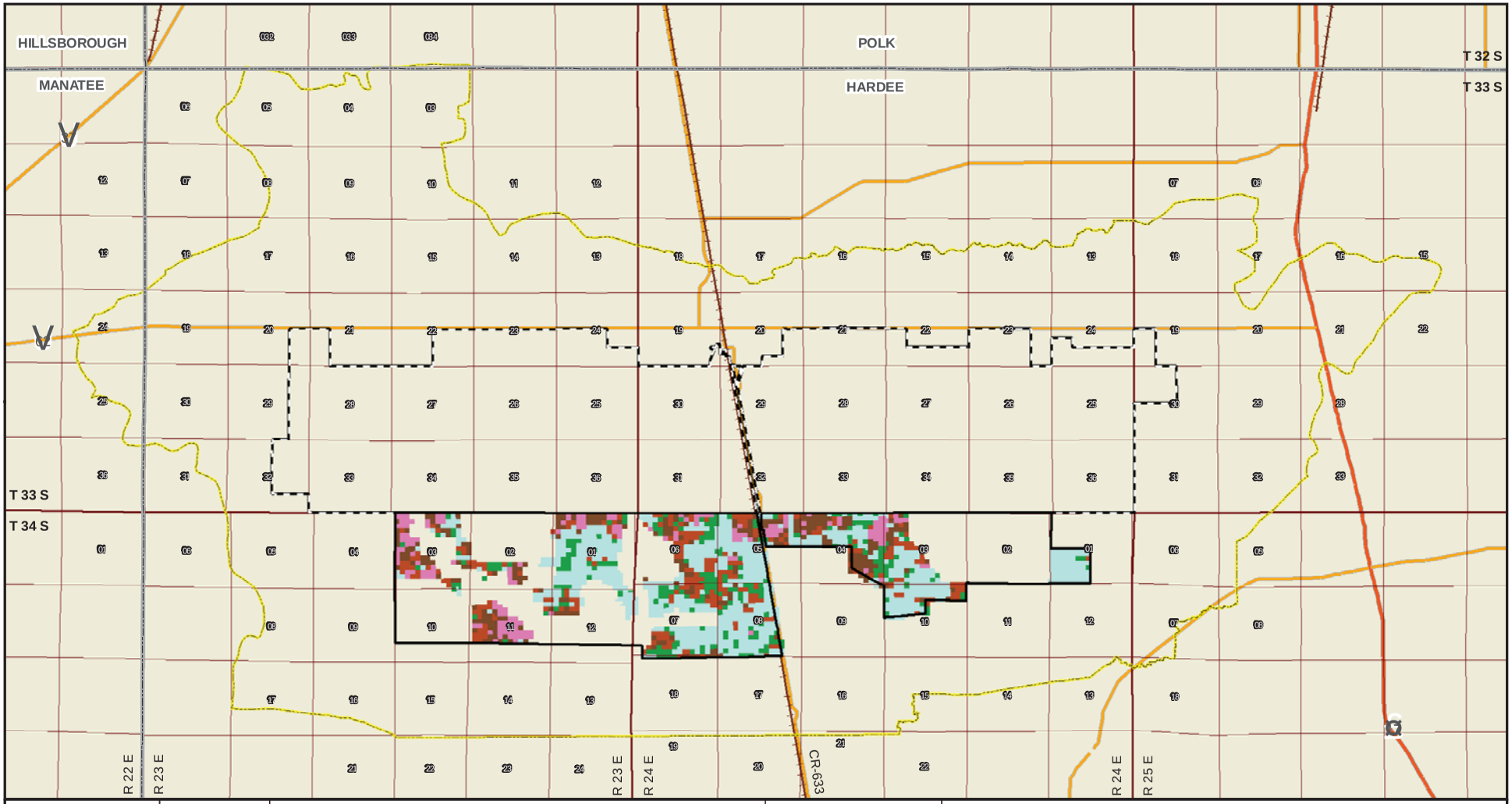
- 1.39 - 2.13
- 2.14 - 3.4
- 3.41 - 5.3
- 5.31 - 10.37
- 10.38 - 28.35

0 3,500 7,000

1" = 7000 Feet

Figure IMR-15
South Pasture Extension Integrated Model
Post-Reclamation
Horizontal Hydraulic Conductivity of Geological Lens
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_15_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

3- DEM Surface (NGVD 1929)

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/21/2010

Checked By: JHK

Map Prepared By: ARB

Explanation of Features

- County Boundaries
- Integrated Model Domain
- South Pasture
- South Pasture Extension

Kv (feet per day)

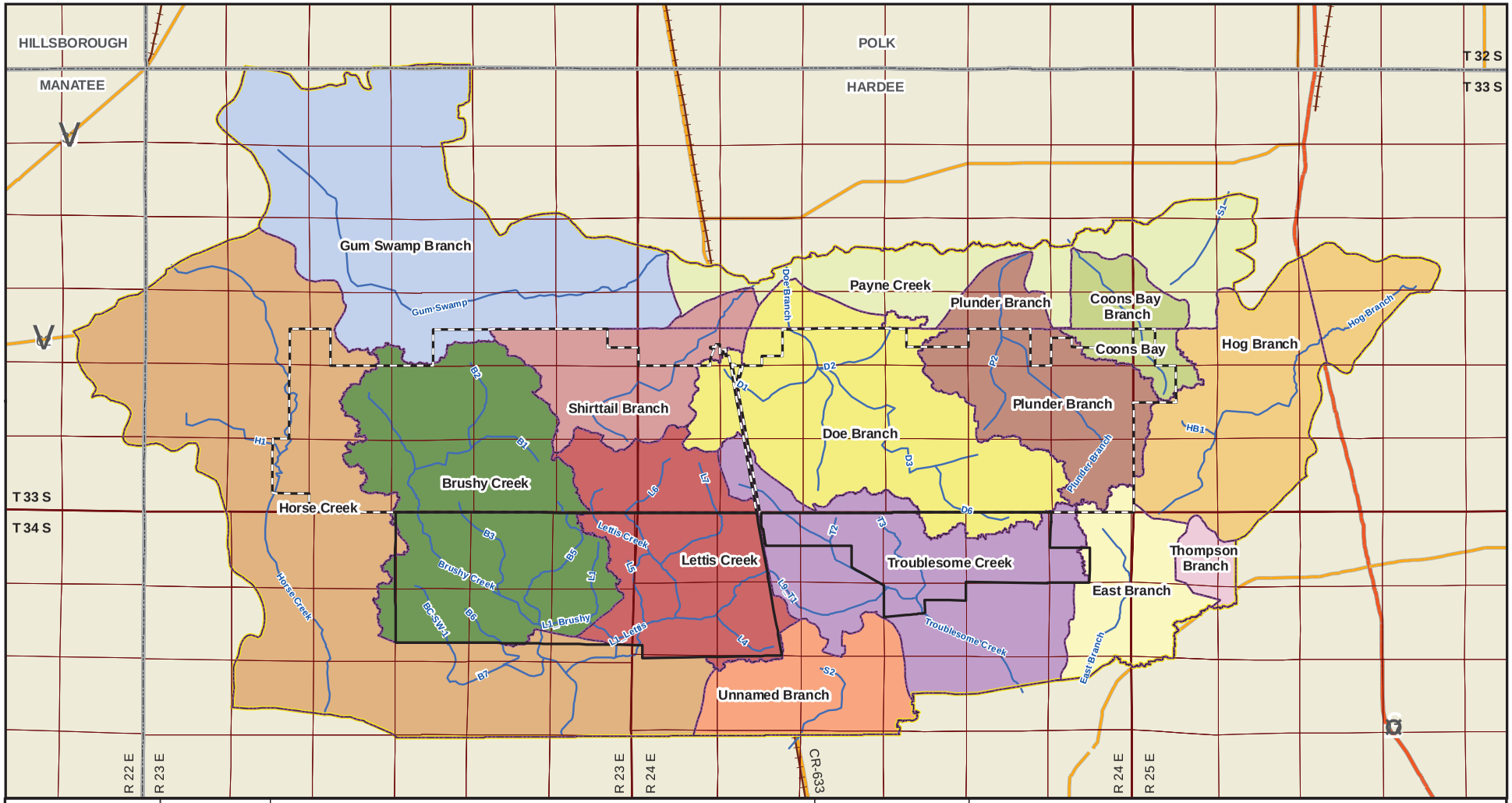
- 0.84 - 5.16
- 5.17 - 9.78
- 9.79 - 14.21
- 14.22 - 18.73
- 18.74 - 25.9

0 3,500 7,000

1" = 7000 Feet

Figure IMR-16
South Pasture Extension Integrated Model
Post-Reclamation
Vertical Hydraulic Conductivity of Geological Lens
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_16_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

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JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- South Pasture
- South Pasture Extension
- Pre-Mining Separated Flow Areas
- Integrated Model Domain
- Pre-Mining Drainage Network

Separated Flow Areas

- Brushy Creek
- Coons Bay Branch
- Doe Branch
- East Branch
- Gum Swamp Branch
- Hog Branch
- Horse Creek
- Lettis Creek
- Payne Creek
- Plunder Branch
- Shirttail Branch
- Thompson Branch
- Troublesome Creek
- Unnamed Branch

CF

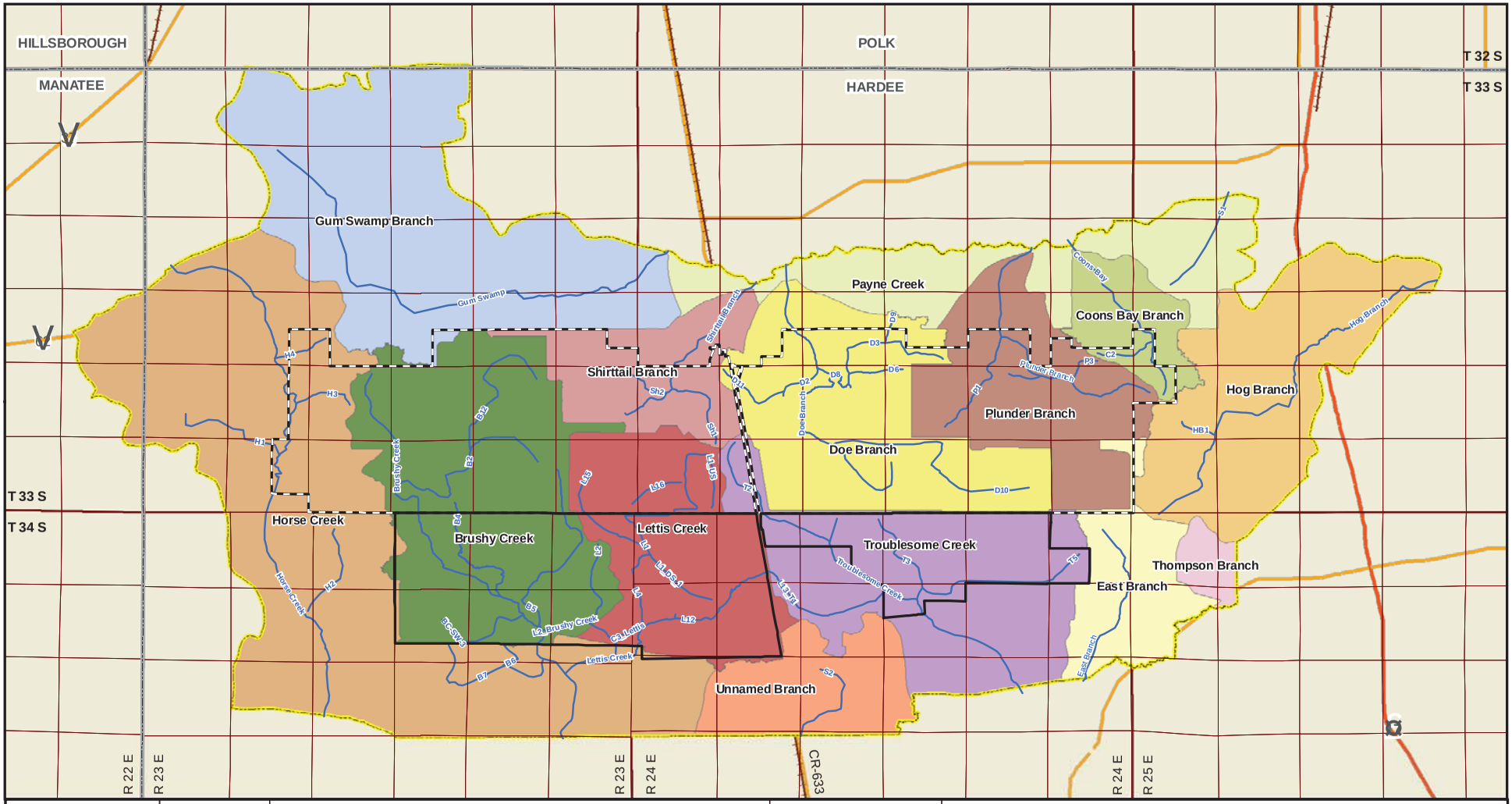
BCI engineers & scientists

0 3,500 7,000

1" = 7000 Feet

Figure IMR-17
South Pasture Extension Integrated Model
Pre-Mining Drainage Network
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_17_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- South Pasture
- South Pasture Extension
- Post Drainage Network
- Integrated Model Domain

Separated Flow Areas

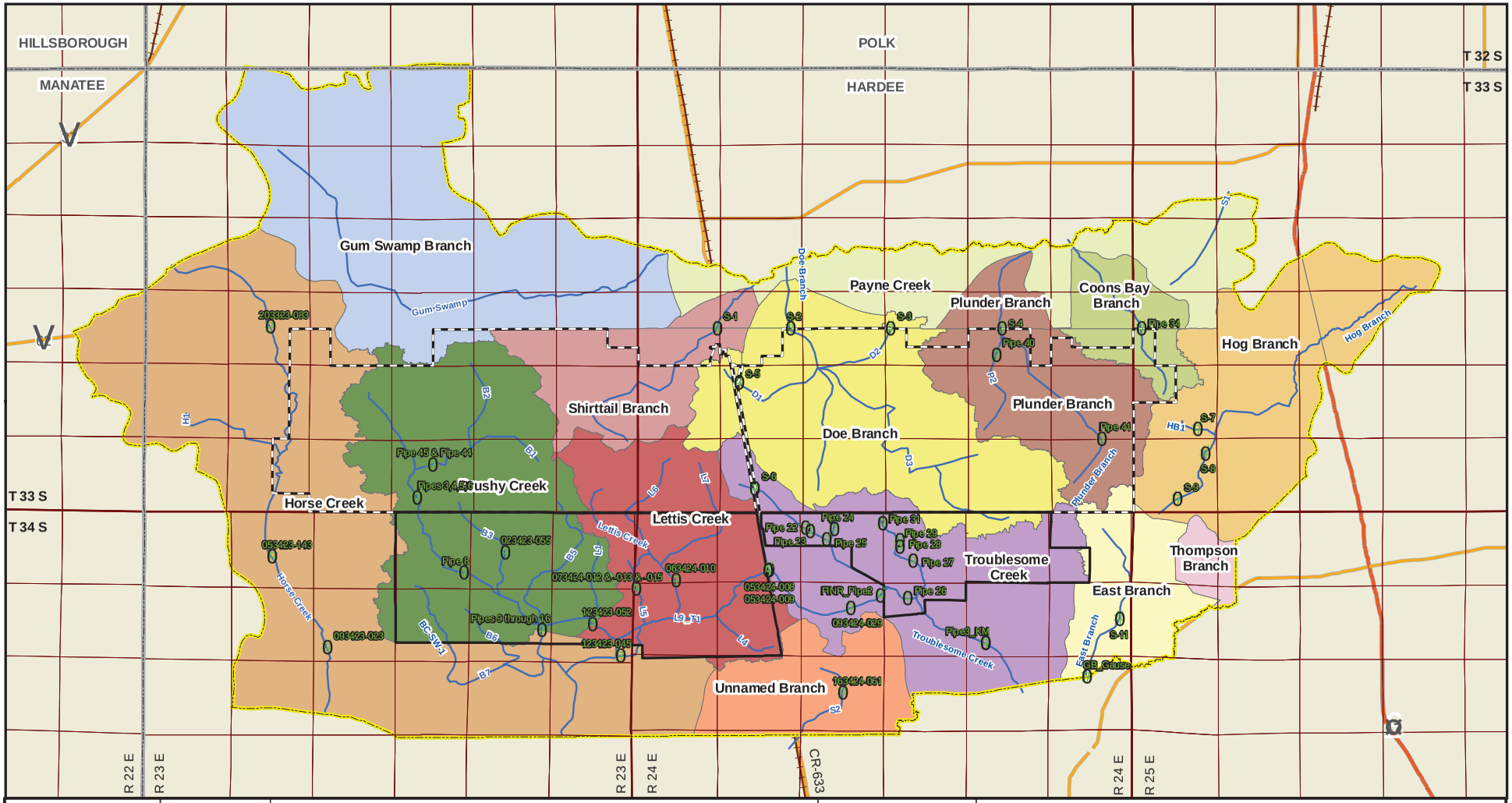
- Brushy Creek
- Coons Bay Branch
- Doe Branch
- East Branch
- Gum Swamp Branch
- Hog Branch
- Horse Creek
- Lettis Creek
- Payne Creek
- Plunder Branch
- Shirttail Branch
- Thompson Branch
- Troublesome Creek
- Unnamed Branch

0 3,500 7,000

1" = 7000 Feet

Figure IMR-18
South Pasture Extension Integrated Model
Post-Reclamation Drainage Network
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR_18_SPX_02212011.mxd



Notes:

1- Project No.: 03-16268

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JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Hydraulic Structures
- South Pasture
- South Pasture Extension
- Integrated Model Domain
- Pre-Mining Drainage Network

Separated Flow Areas

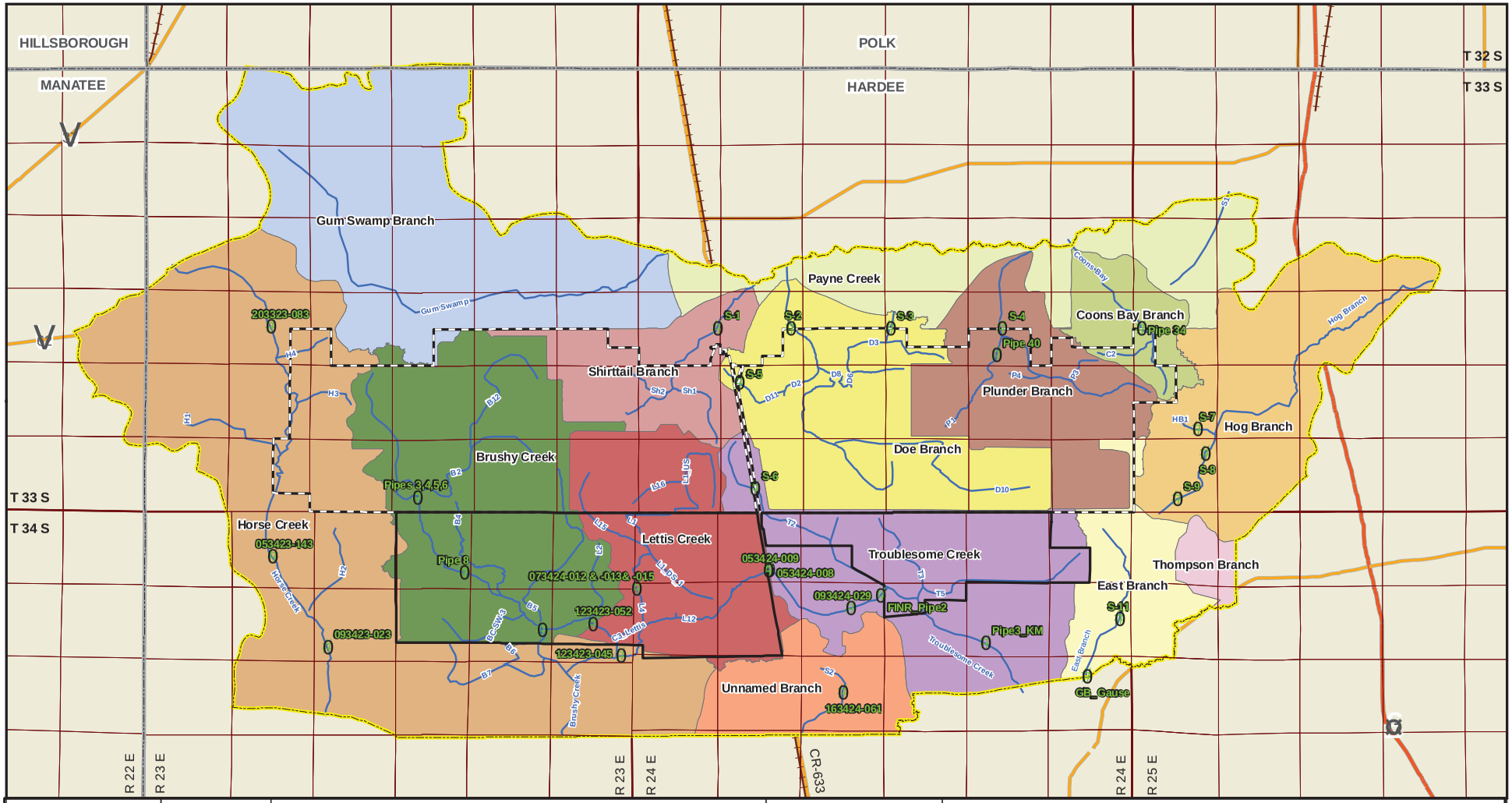
- Brushy Creek
- Coons Bay Branch
- Doe Branch
- East Branch
- Gum Swamp Branch
- Hog Branch
- Horse Creek
- Lettis Creek
- Payne Creek
- Plunder Branch
- Shirttail Branch
- Thompson Branch
- Troublesome Creek
- Unnamed Branch

0 3,500 7,000

1" = 7000 Feet

Figure IMR-19a
South Pasture Extension Integrated Model
Pre-Mining Hydraulic Structures
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_19A_SPX_02142011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/14/2011
Checked By: JHK

Map Prepared By: ARK

Explanation of Features

- County Boundaries
- Hydraulic Structures
- South Pasture
- South Pasture Extension
- Integrated Model Domain
- Post Reclamation Drainage Network

Separated Flow Areas

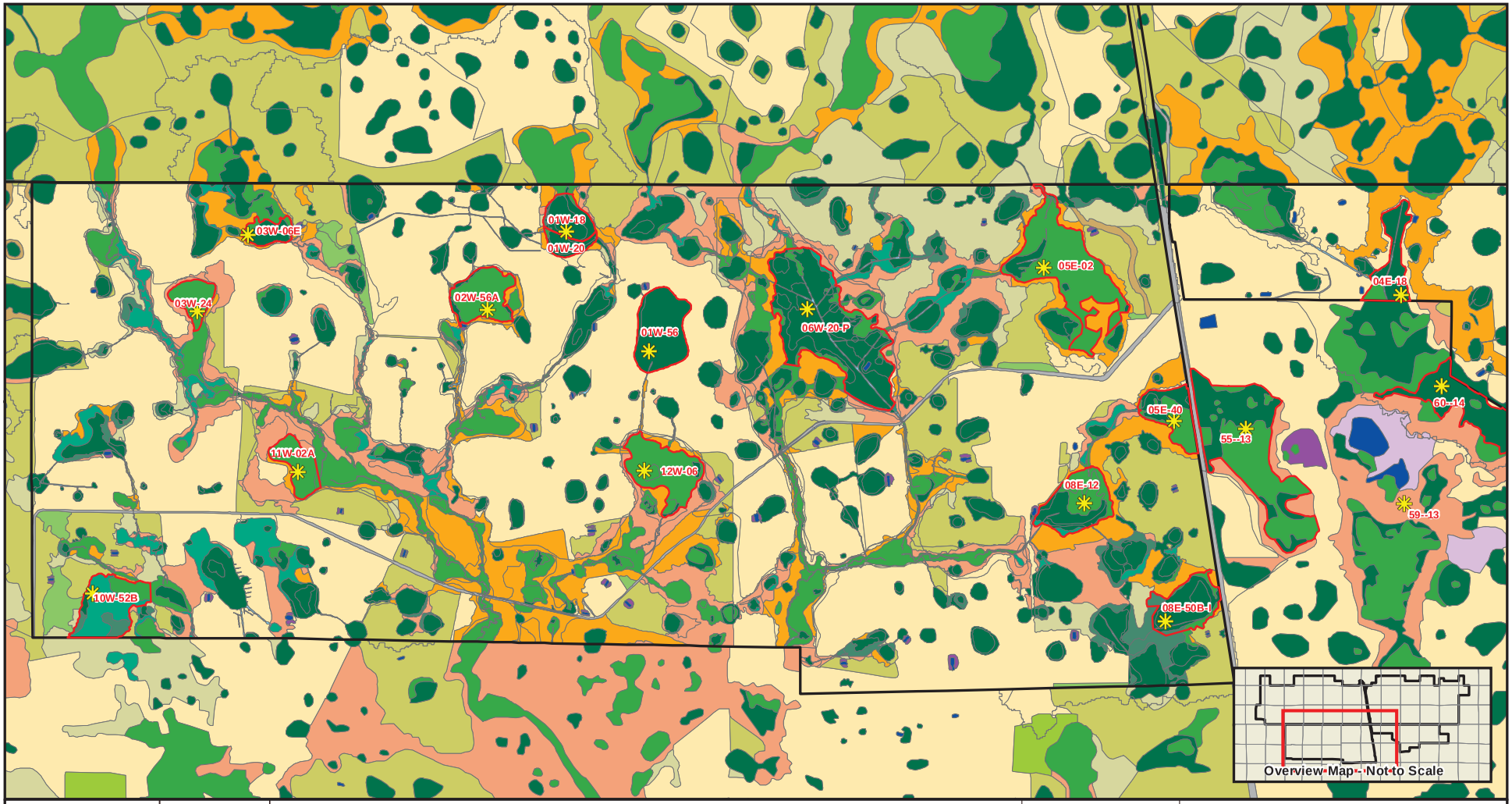
- Brushy Creek
- Coons Bay Branch
- Doe Branch
- East Branch
- Gum Swamp Branch
- Hog Branch
- Horse Creek
- Lettis Creek
- Payne Creek
- Plunder Branch
- Shirttail Branch
- Thompson Branch
- Troublesome Creek
- Unnamed Branch

0 3,500 7,000

1" = 7000 Feet

Figure IMR-19b
South Pasture Extension Integrated Model
Post-Reclamation Hydraulic Structures
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_19B_SPX_02142011.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

N

Explanation of Features

- Cross Section Locations
- Selected Wetlands for Cross Sections
- South Pasture and Extension Boundary

Pre-Mining Land Use (FLUCCS 1999)

- 110, Residential, Low Density
- 120, Residential, Medium Density
- 130, Residential, High Density
- 140, Commercial and Services
- 150, Industrial
- 170, Institutional
- 180, Recreational
- 190, Open Land
- 210, Cropland and Pastureland
- 220, Tree Crops
- 230, Feeding Operations
- 240, Nurseries and Vineyards
- 260, Other Open Lands <Rural>
- 310, Herbaceous (Dry Prairie)
- 320, Shrub and Brushland
- 330, Mixed Rangeland
- 410, Upland Coniferous Forests
- 420, Upland Hardwood Forests
- 430, Upland Mixed Forests
- 510, Streams and Waterways
- 520, Lakes
- 530, Reservoirs
- 610, Wetland Hardwood Forests
- 620, Wetland Coniferous Forests
- 630, Wetland Forested Mixed
- 640, Vegetated Non-Forested Wetlands
- 740, Disturbed Lands
- 810, Transportation

CF

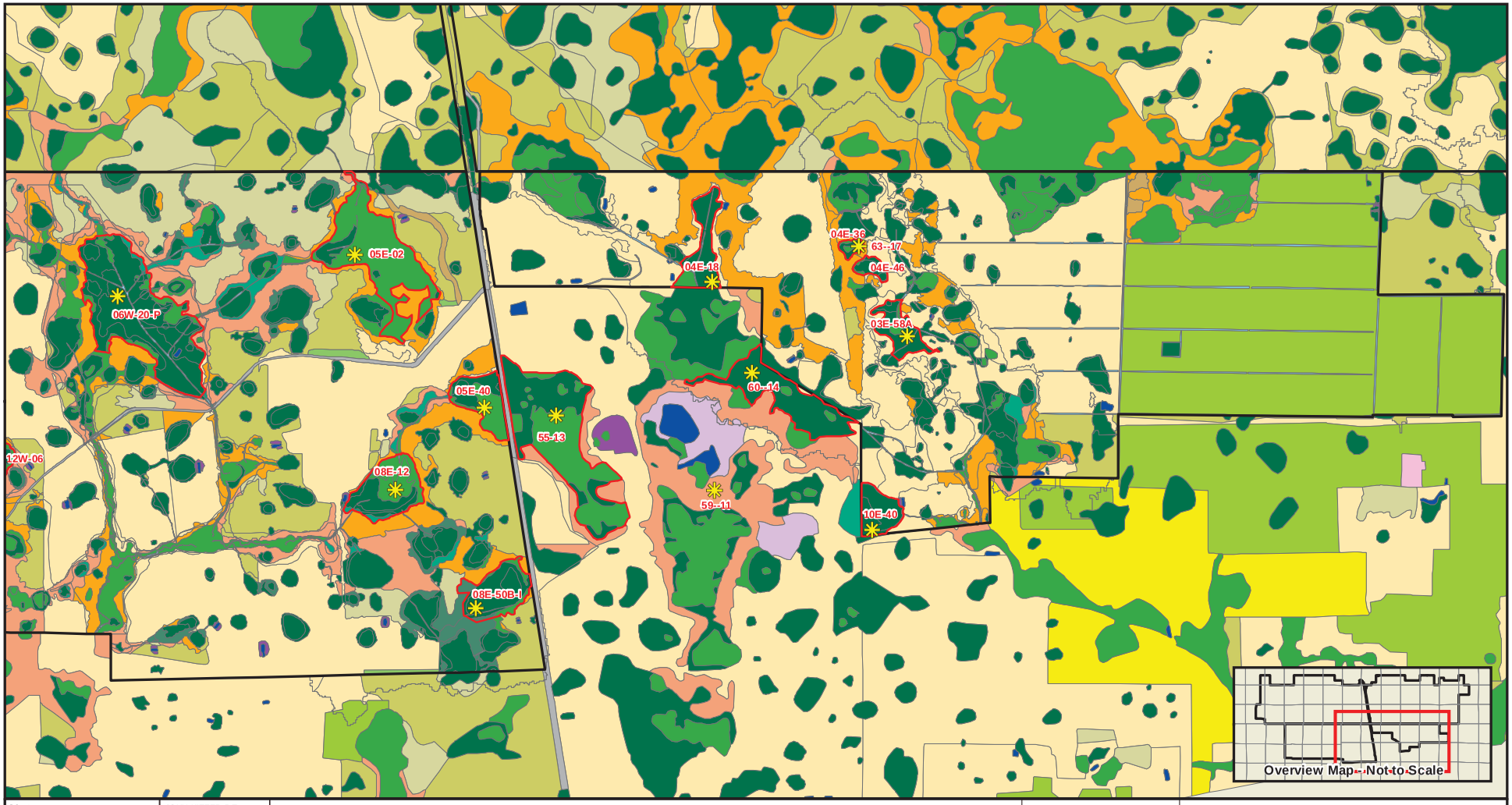
BCI engineers & scientists

0 1,000 2,000

1" = 2,000 Feet

Figure IMR-20a
Wetland Cross Section Location Map
South Pasture Extension
Pre-Mining
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR20a_SPX_11x17_1.mxd



Notes:

1- Project No.: 03-16268

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JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

N

Explanation of Features

- Cross Section Locations
- Selected Wetlands for Cross Sections
- South Pasture and Extension Boundary

Pre-Mining Land Use (FLUCCS 1999)

- 110, Residential, Low Density
- 120, Residential, Medium Density
- 130, Residential, High Density
- 140, Commercial and Services
- 150, Industrial
- 170, Institutional
- 180, Recreational
- 190, Open Land
- 210, Cropland and Pastureland
- 220, Tree Crops
- 230, Feeding Operations
- 240, Nurseries and Vineyards
- 260, Other Open Lands <Rural>
- 310, Herbaceous (Dry Prairie)
- 320, Shrub and Brushland
- 330, Mixed Rangeland
- 410, Upland Coniferous Forests
- 420, Upland Hardwood Forests
- 430, Upland Mixed Forests
- 510, Streams and Waterways
- 520, Lakes
- 530, Reservoirs
- 610, Wetland Hardwood Forests
- 620, Wetland Coniferous Forests
- 630, Wetland Forested Mixed
- 640, Vegetated Non-Forested Wetlands
- 740, Disturbed Lands
- 810, Transportation

CF

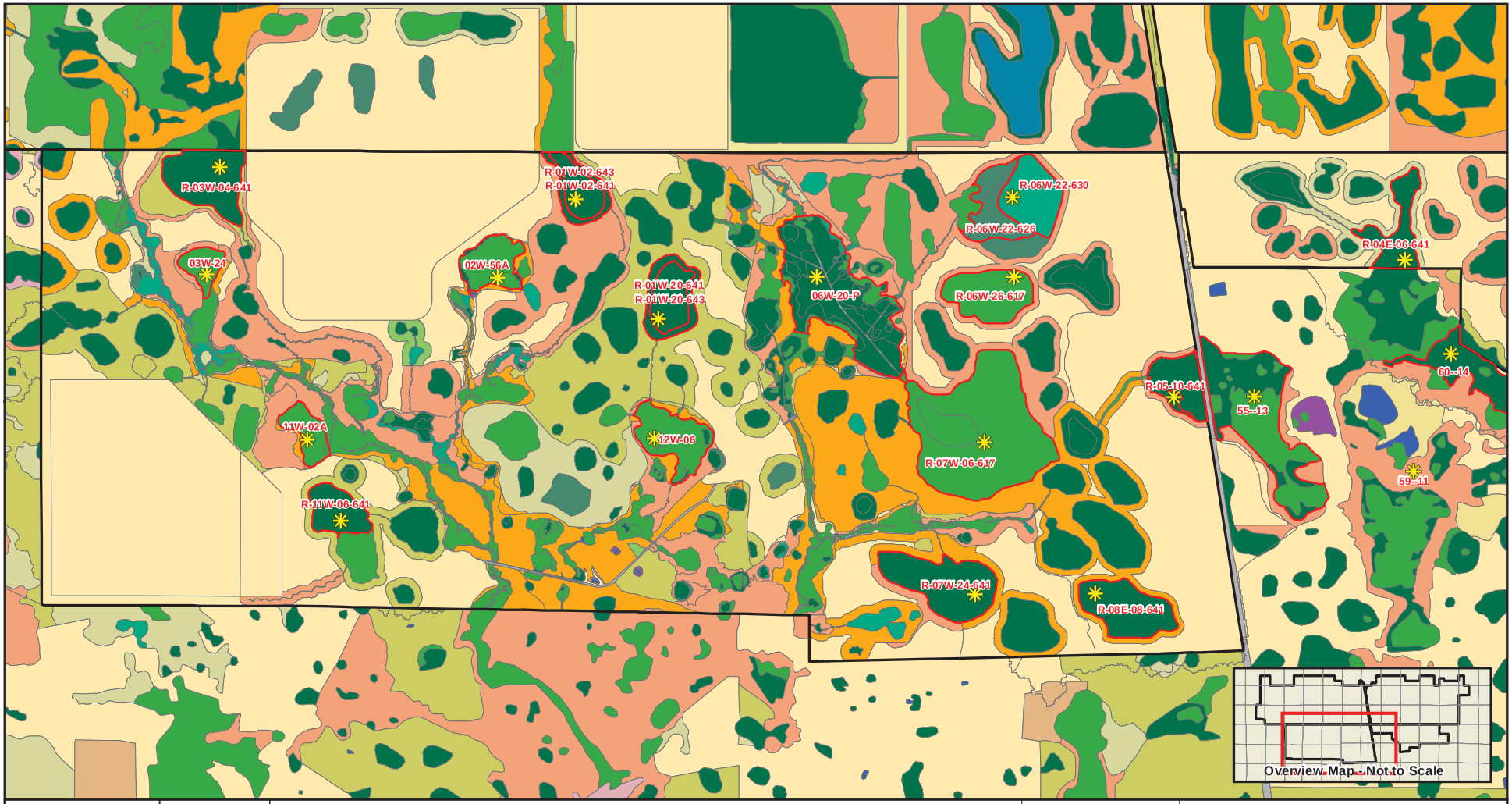
BCI engineers & scientists

0 1,000 2,000

1" = 2,000 Feet

Figure IMR-20b
Wetland Cross Section Location Map
South Pasture Extension
Pre-Mining
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR20b_SPX_11x17_2.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 08/01/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

N

Cross Section Locations

Selected Wetlands for Cross Sections

Post-Reclamation Land-Use (FLUCCS 1999)

- 110, Residential, Low Density
- 120, Residential, Medium Density
- 130, Residential, High Density
- 140, Commercial and Services
- 150, Industrial
- 170, Institutional
- 180, Recreational
- 190, Open Land
- 210, Cropland and Pastureland
- 220, Tree Crops
- 230, Feeding Operations
- 240, Nurseries and Vineyards
- 260, Other Open Lands <Rural>
- 310, Herbaceous (Dry Prairie)
- 320, Shrub and Brushland
- 330, Mixed Rangeland
- 410, Upland Coniferous Forests
- 420, Upland Hardwood Forests
- 430, Upland Mixed Forests
- 510, Streams and Waterways
- 520, Lakes
- 526, Man-Made Lakes
- 530, Reservoirs
- 610, Wetland Hardwood Forests
- 620, Wetland Coniferous Forests
- 630, Wetland Forested Mixed
- 640, Vegetated Non-Forested Wetlands
- 740, Disturbed Lands
- 810, Transportation

0 1,000 2,000

1" = 2,000 Feet

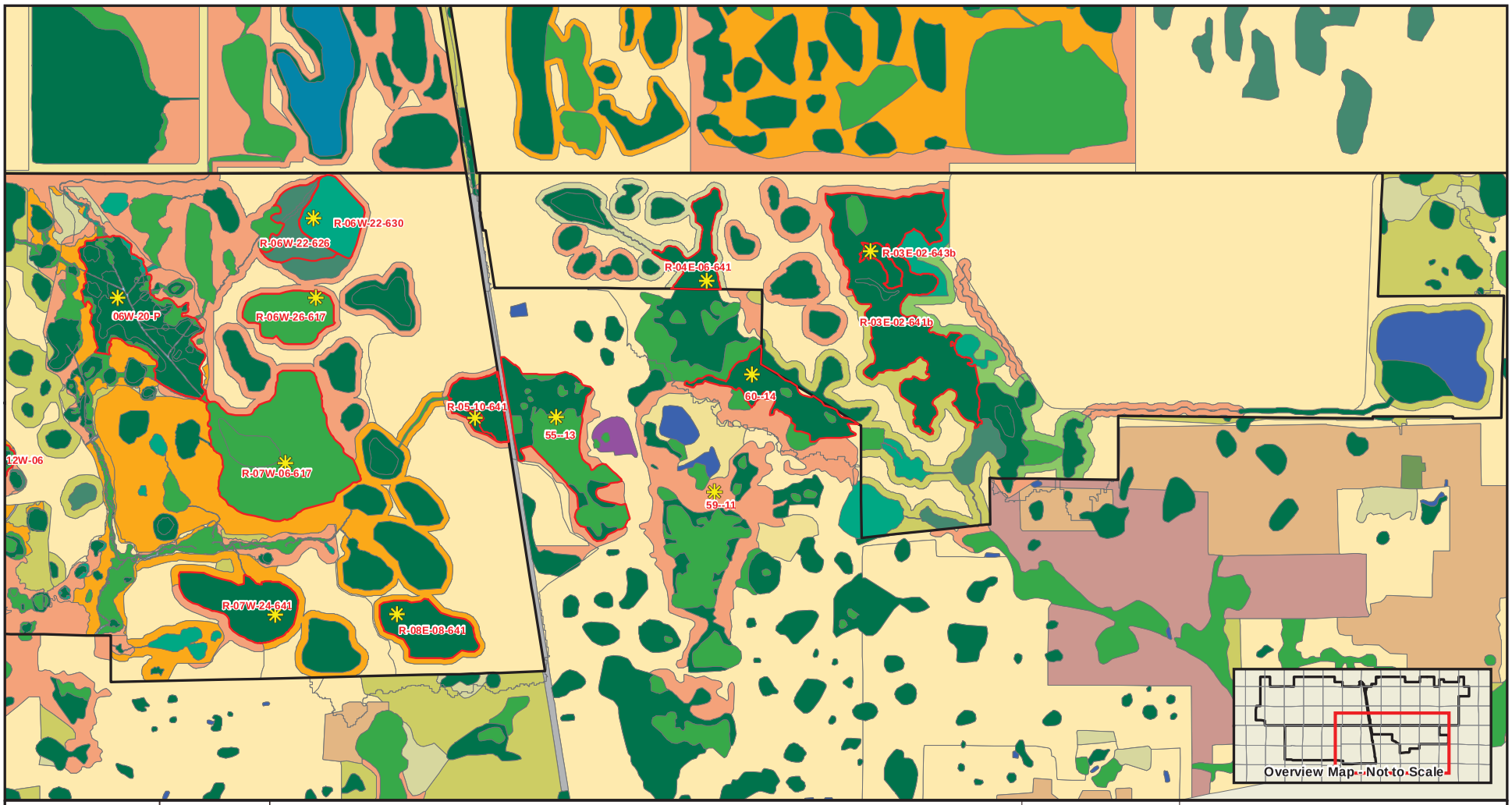
CF

BCI engineers & scientists

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Figure IMR-21a
Wetland Cross Section Location Map
South Pasture Extension
Post-Reclamation
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR21a_SPX_11x17_1.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 02/01/2010
Revised: 08/01/2011
Checked By: JHK

Map Prepared By: ARB

Explanation of Features

N

Cross Section Locations

Selected Wetlands for Cross Sections

Post-Reclamation Land-Use (FLUCCS 1999)

- 110, Residential, Low Density
- 120, Residential, Medium Density
- 130, Residential, High Density
- 140, Commercial and Services
- 150, Industrial
- 170, Institutional
- 180, Recreational
- 190, Open Land
- 210, Cropland and Pastureland
- 220, Tree Crops
- 230, Feeding Operations
- 240, Nurseries and Vineyards
- 260, Other Open Lands <Rural>
- 310, Herbaceous (Dry Prairie)
- 320, Shrub and Brushland
- 330, Mixed Rangeland
- 410, Upland Coniferous Forests
- 420, Upland Hardwood Forests
- 430, Upland Mixed Forests
- 510, Streams and Waterways
- 520, Lakes
- 526, Man-Made Lakes
- 530, Reservoirs
- 610, Wetland Hardwood Forests
- 620, Wetland Coniferous Forests
- 630, Wetland Forested Mixed
- 640, Vegetated Non-Forested Wetlands
- 740, Disturbed Lands
- 810, Transportation

0 1,000 2,000

1" = 2,000 Feet

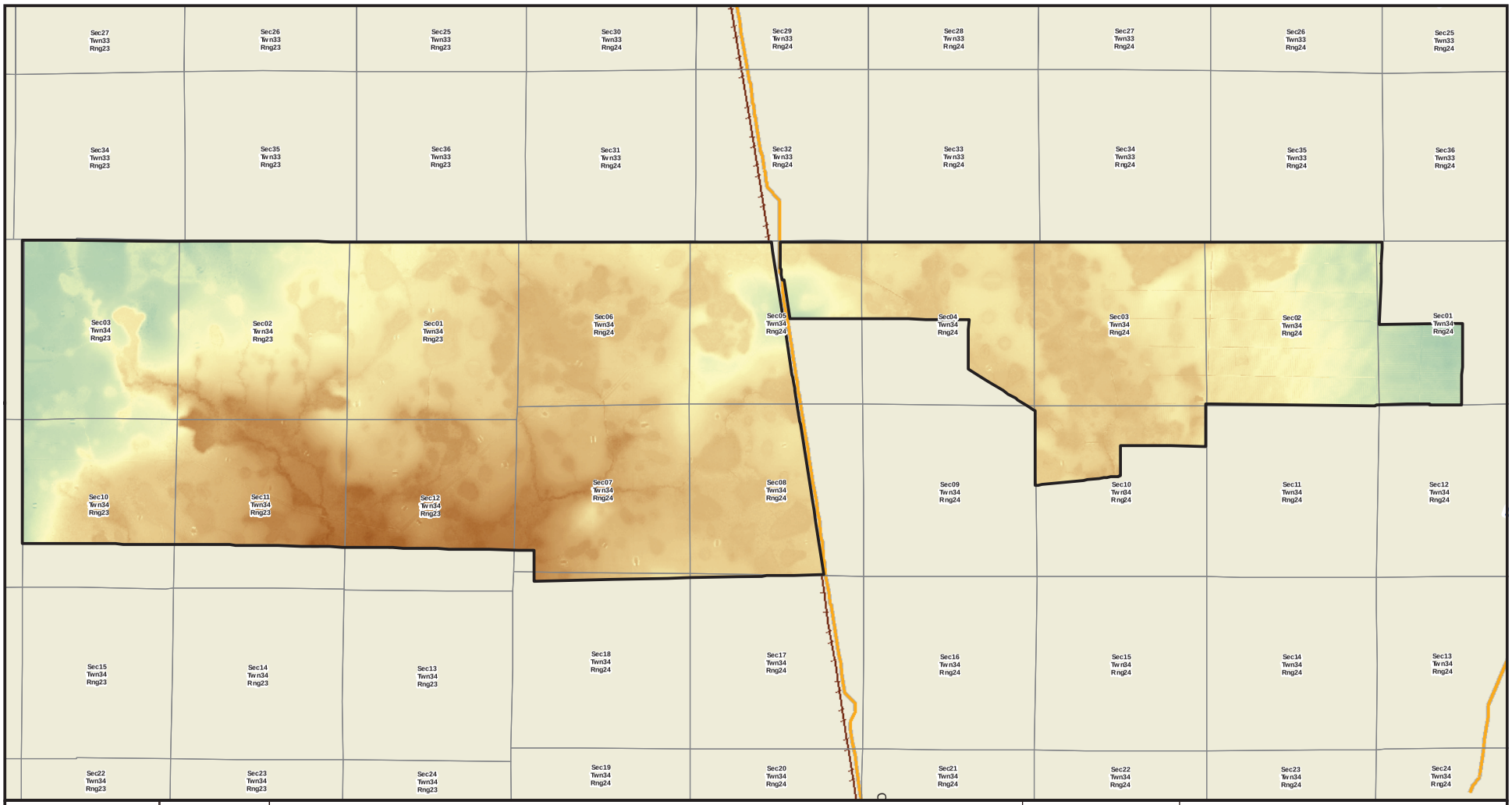
CF

BCI engineers & scientists

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Figure IMR-21b
Wetland Cross Section Location Map
South Pasture Extension
Post-Reclamation
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR21b_SPX_11x17_1.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 01/28/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

N

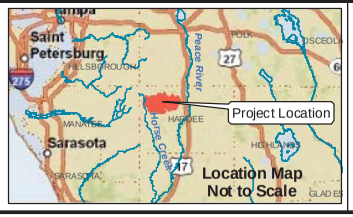
Explanation of Features

South Pasture Extension

Value

High : 145.344

Low : 84.2169

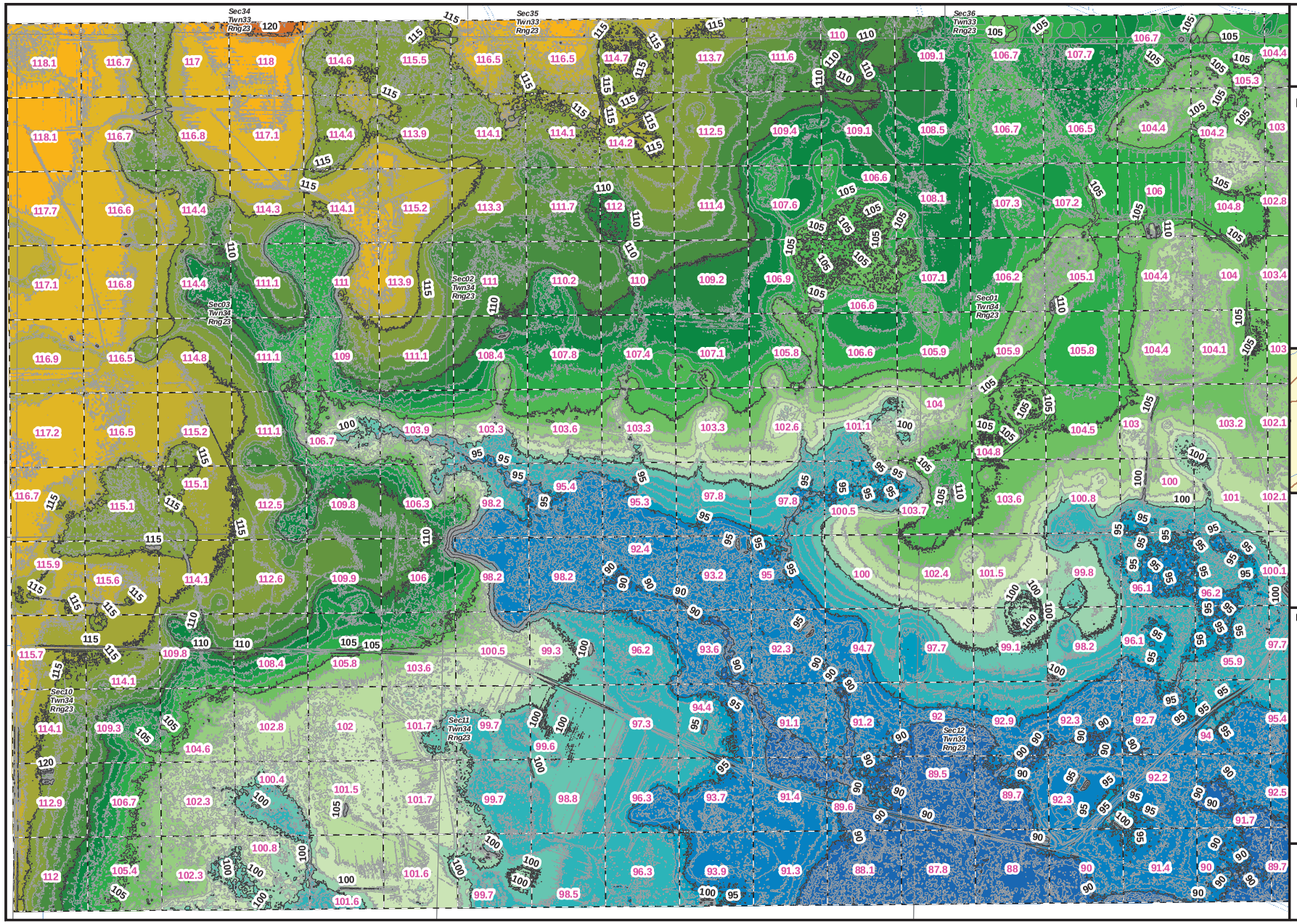


0 1,500 3,000

1" = 3,000 Feet

FIGURE IMR-22
Pre-Mining
Maximum Phreatic Surface Elevation
South Pasture Extension
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR22_SPX_11x17.mxd



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Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

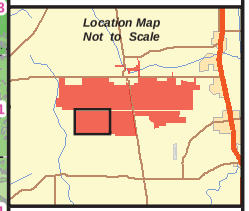


Figure IMR-22a
South Pasture Extension
Pre-Mining
Seasonal High Water
Table Elevation
Superimposed Over
Pre-Mining Topography
Hardee County, Florida

Explanation of Features

5 ft Contours
1 ft Contours

P85 WT Elev (ft NGVD)

MIKE SHE Grid

DEM (NGVD feet)

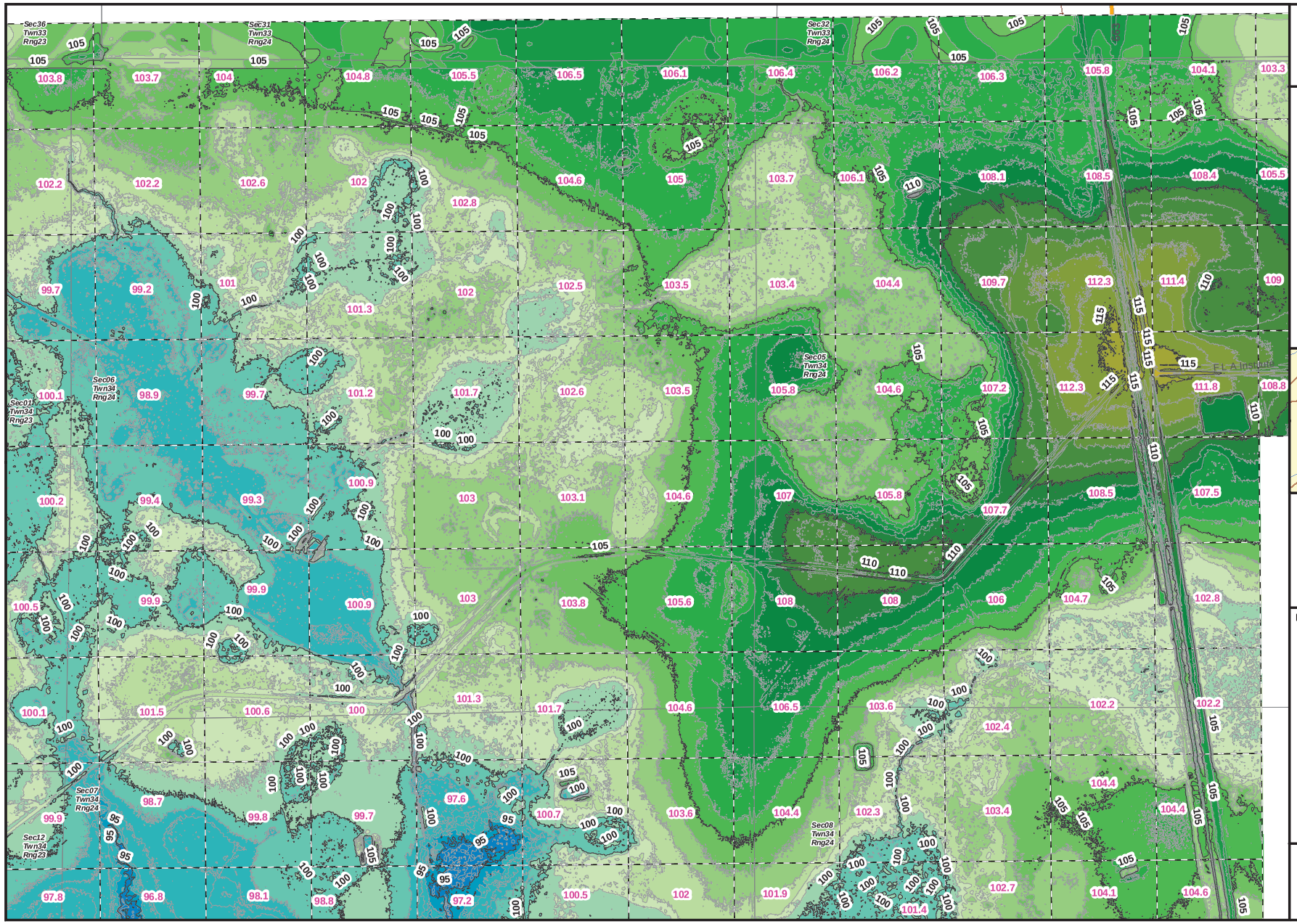
High 124.4
Low 84.4

N

0 500 1,000
1" = 1000 Feet

CF™

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Pre_P85_July2011_11x17_1.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

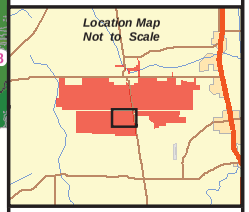


Figure IMR-22b
South Pasture Extension
Pre-Mining
Seasonal High Water Table Elevation
Superimposed Over
Pre-Mining Topography
Hardee County, Florida

Explanation of Features

5 ft Contours

1 ft Contours

P85 WT Elev (ft NGVD)

MIKE SHE Grid

DEM (NGVD feet)

High 124.4

Low 84.4

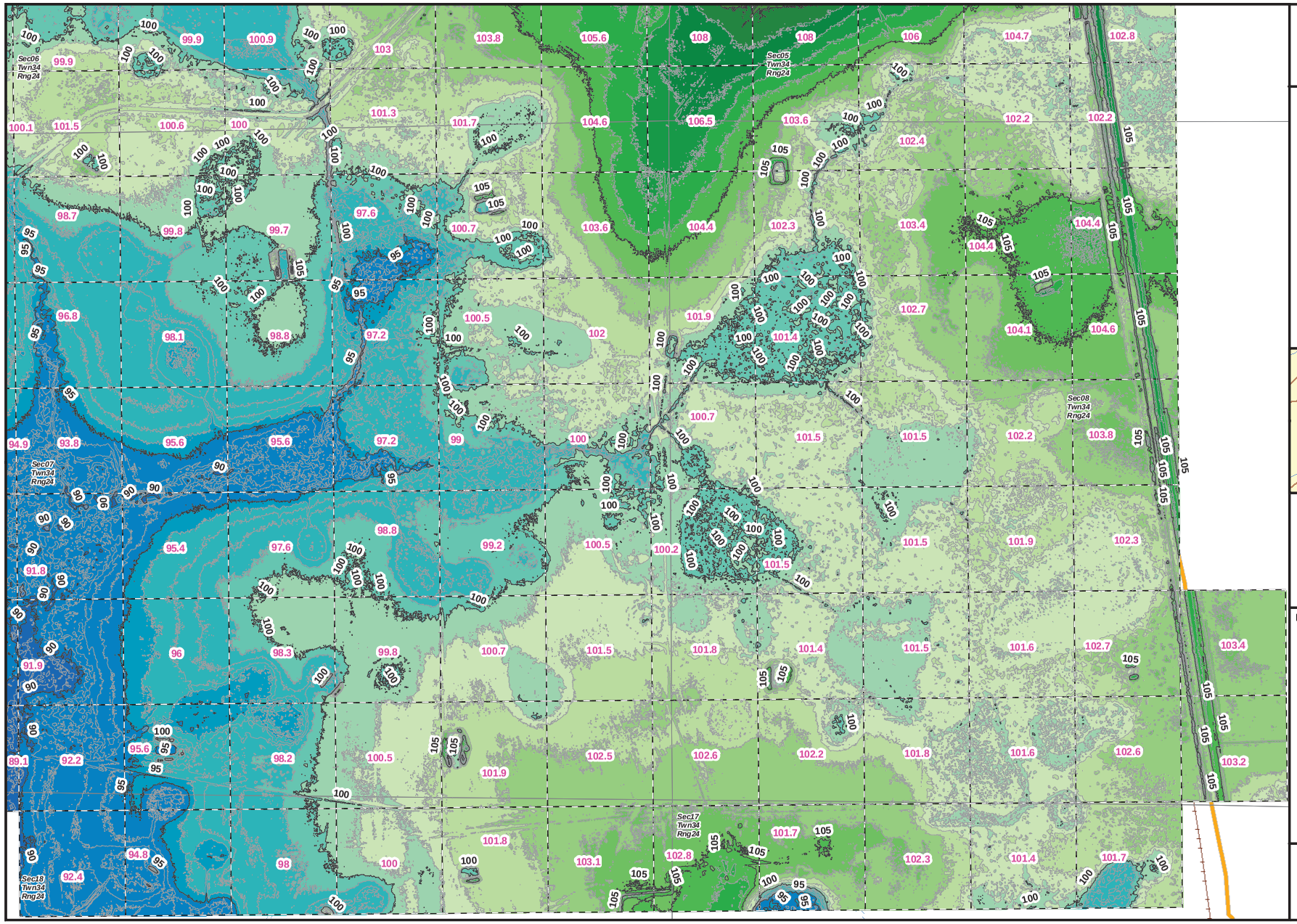
N

0 350 700

1" = 700 Feet

CF

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Pre_P85_July2011_11x17_4.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

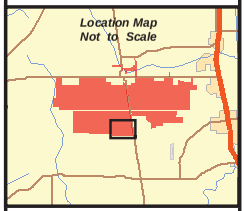


Figure IMR-22c
South Pasture Extension
Pre-Mining
Seasonal High Water Table Elevation
Superimposed Over
Pre-Mining Topography
Hardee County, Florida

Explanation of Features

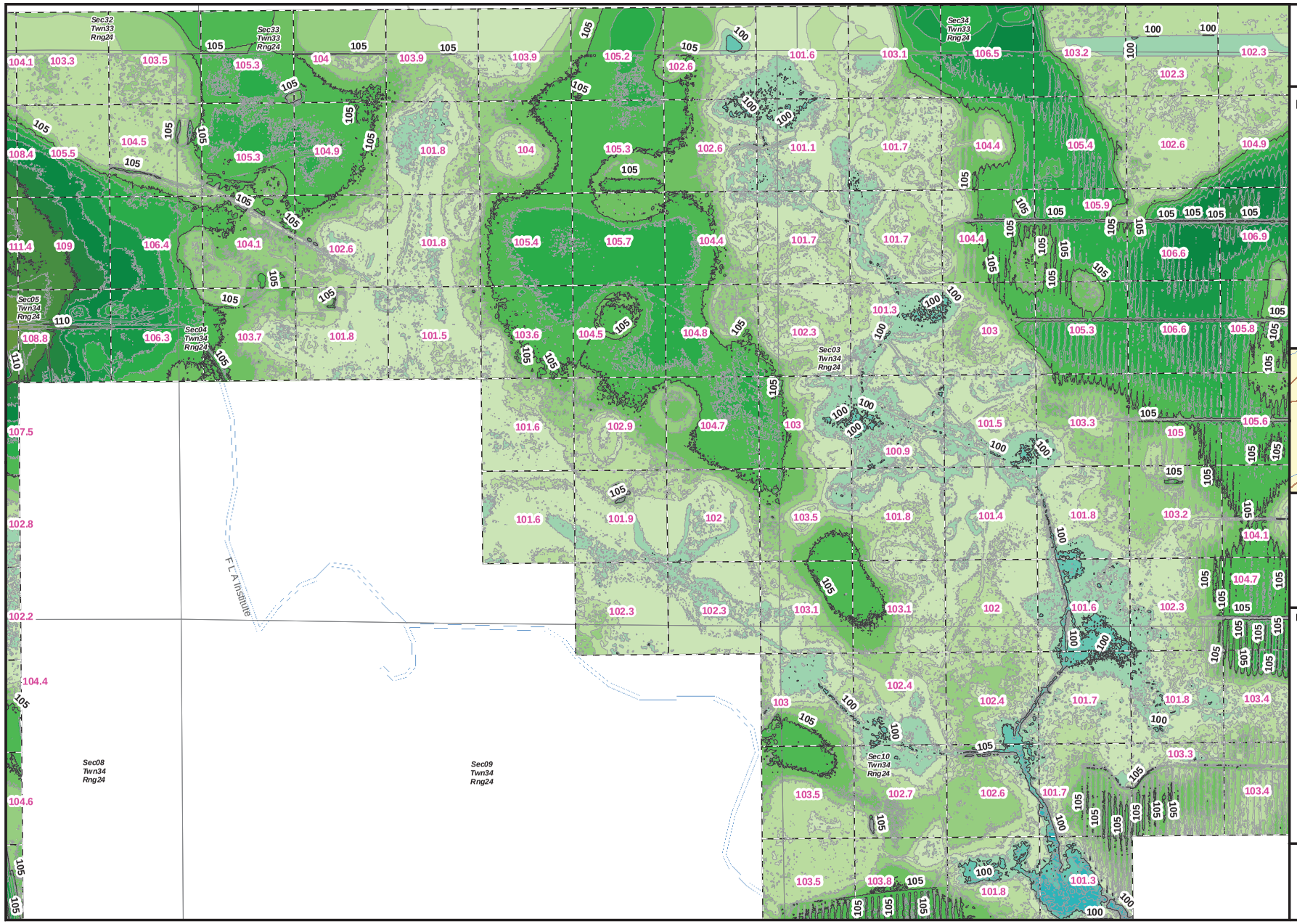
5 ft Contours
1 ft Contours
P85 WT Elev (ft NGVD)
MIKE SHE Grid
DEM (NGVD feet)
High 124.4
Low 84.4

N

0 350 700
1" = 700 Feet

CF™

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Pre_P85_July2011_11x17_5.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

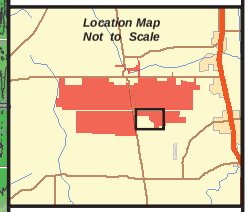


Figure IMR-22d
South Pasture Extension
Pre-Mining
Seasonal High Water
Table Elevation
Superimposed Over
Pre-Mining Topography
Hardee County, Florida

Explanation of Features

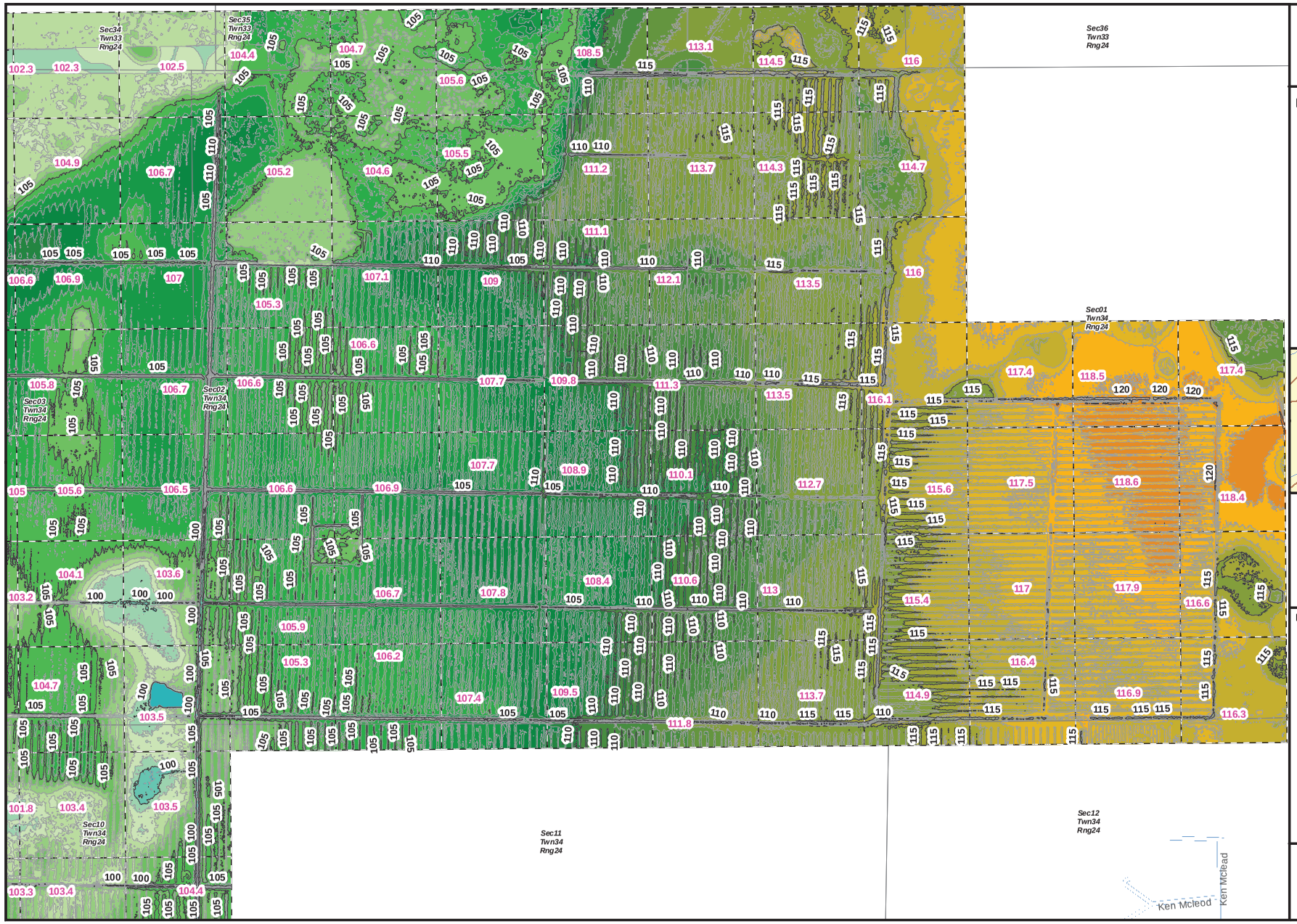
5 ft Contours
1 ft Contours
P85 WT Elev (ft NGVD)
MIKE SHE Grid
DEM (NGVD feet)
High 124.4
Low 84.4

N

0 400 800
1" = 800 Feet

CF™

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Pre_P85_July2011_11x17_1.mxd



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Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

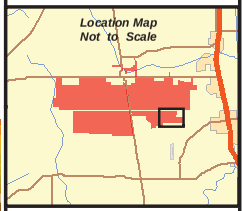


Figure IMR-22e
South Pasture Extension
Pre-Mining
Seasonal High Water Table Elevation
Superimposed Over
Pre-Mining Topography
Hardee County, Florida

Explanation of Features

5 ft Contours

1 ft Contours

P85 WT Elev (ft NGVD)

MIKE SHE Grid

DEM (NGVD feet)

High 124.4

Low 84.4

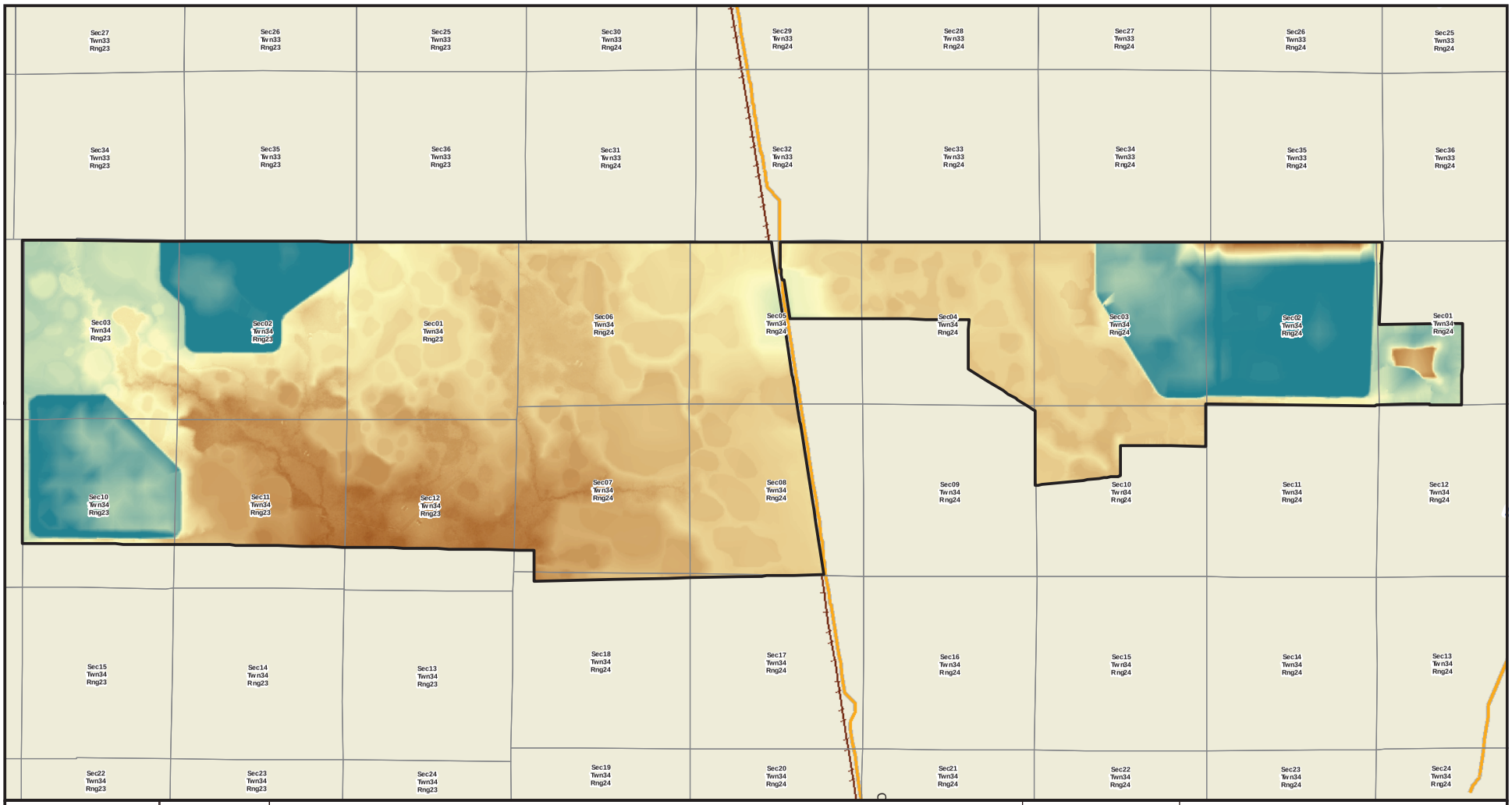
N

0 350 700

1" = 700 Feet

CF

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Pre_P85_July2011_11x17_2.mxd



Notes:

1- Project No.: 03-16268

2- This map is intended to be used for planning purposes only. It is not a survey.

JOHN KIEFER P.E.
FLA. REG. NO. 51991

DATE:

Date: 01/28/2010
Revised: 02/11/2011
Checked By: JHK

Map Prepared By: ARB

N

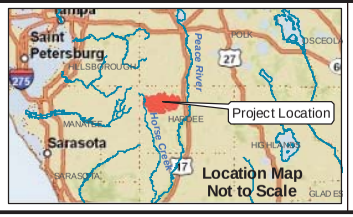
Explanation of Features

South Pasture Extension

Value

High : 145.344

Low : 84.2169

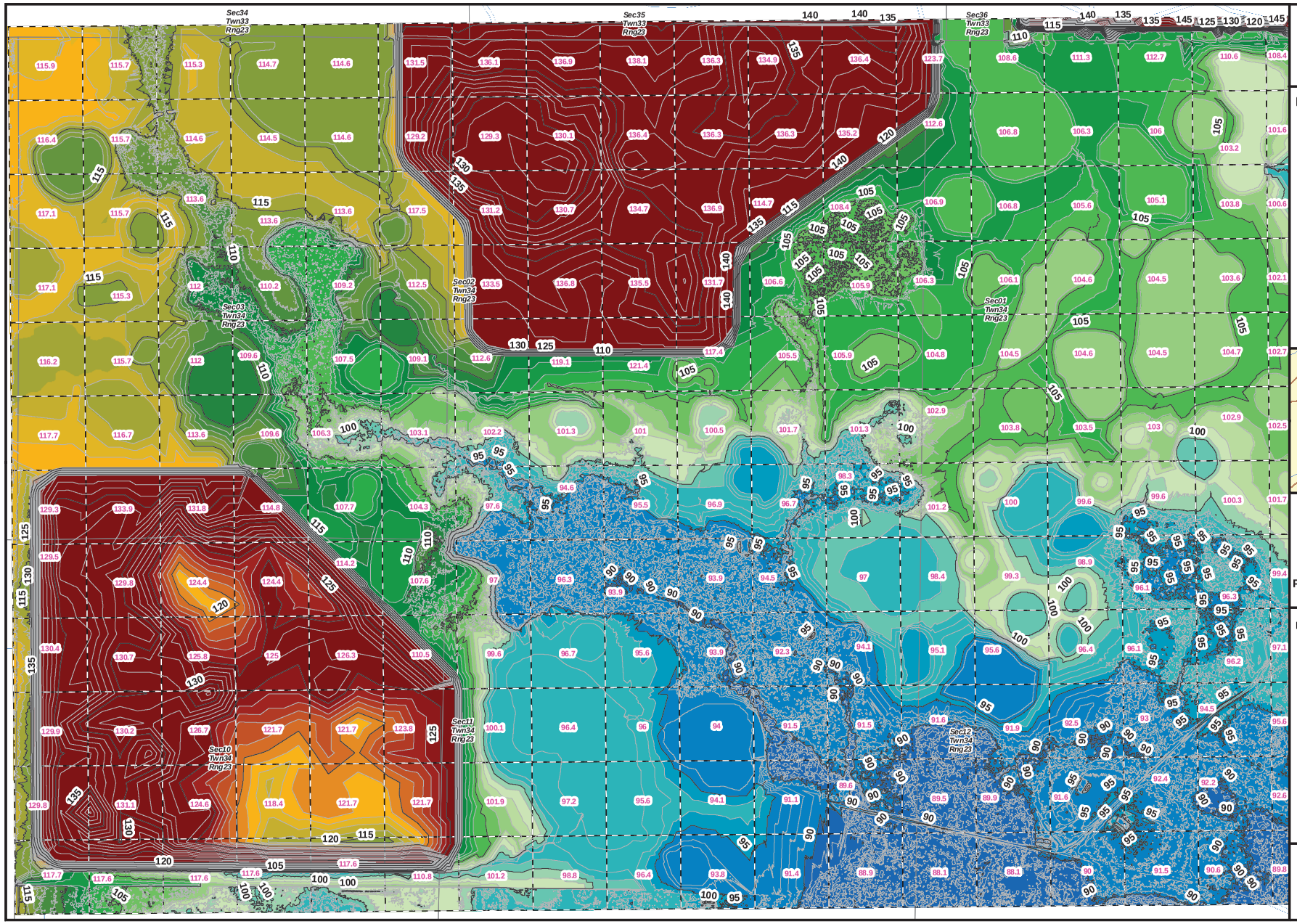


0 1,500 3,000

1" = 3,000 Feet

FIGURE IMR-23
Post-Reclamation
Maximum Phreatic Surface Elevation
South Pasture Extension
Hardee County, Florida

File Pathway: V:\03-16268_CF_SP_SPX_Permit\SP_SPX_Integrated_Model\MXD\SPX_Integrated\Figure_IMR23_SPX_11x17.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

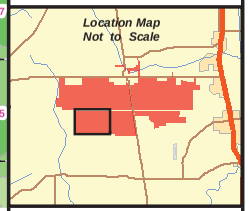


Figure IMR-23a
South Pasture Extension
Post-Reclamation
Seasonal High Water
Table Elevation
Superimposed Over
Post-Reclamation Topography
Hardee County, Florida

Explanation of Features

- 5 ft contours
- 1 ft contours

P85 WT Elev (ft NGVD)

- MIKE SHE Grid

DEM (NGVD feet)

High : 146

Low : 84

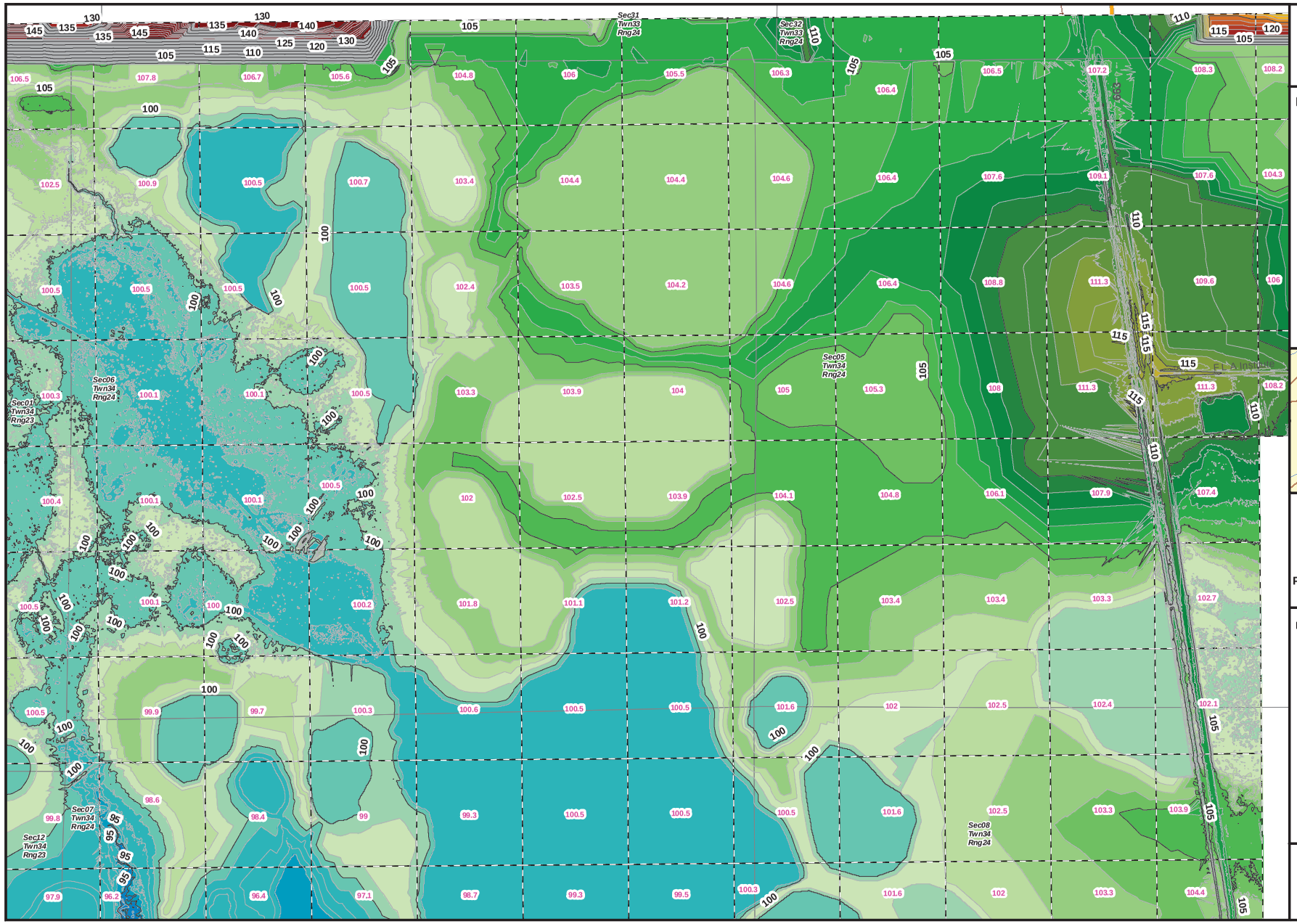
N

0 500 1,000

1" = 1000 Feet

CF™

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Post_P85_July2011_11x17_1.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

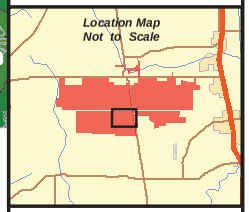


Figure IMR-23b
South Pasture Extension
Post-Reclamation
Seasonal High Water
Table Elevation
Superimposed Over
Post-Reclamation Topography
Hardee County, Florida

Explanation of Features

5 ft contours

1 ft contours

P85 WT Elev (ft NGVD)

MIKE SHE Grid

DEM (NGVD feet)

High : 146

Low : 84

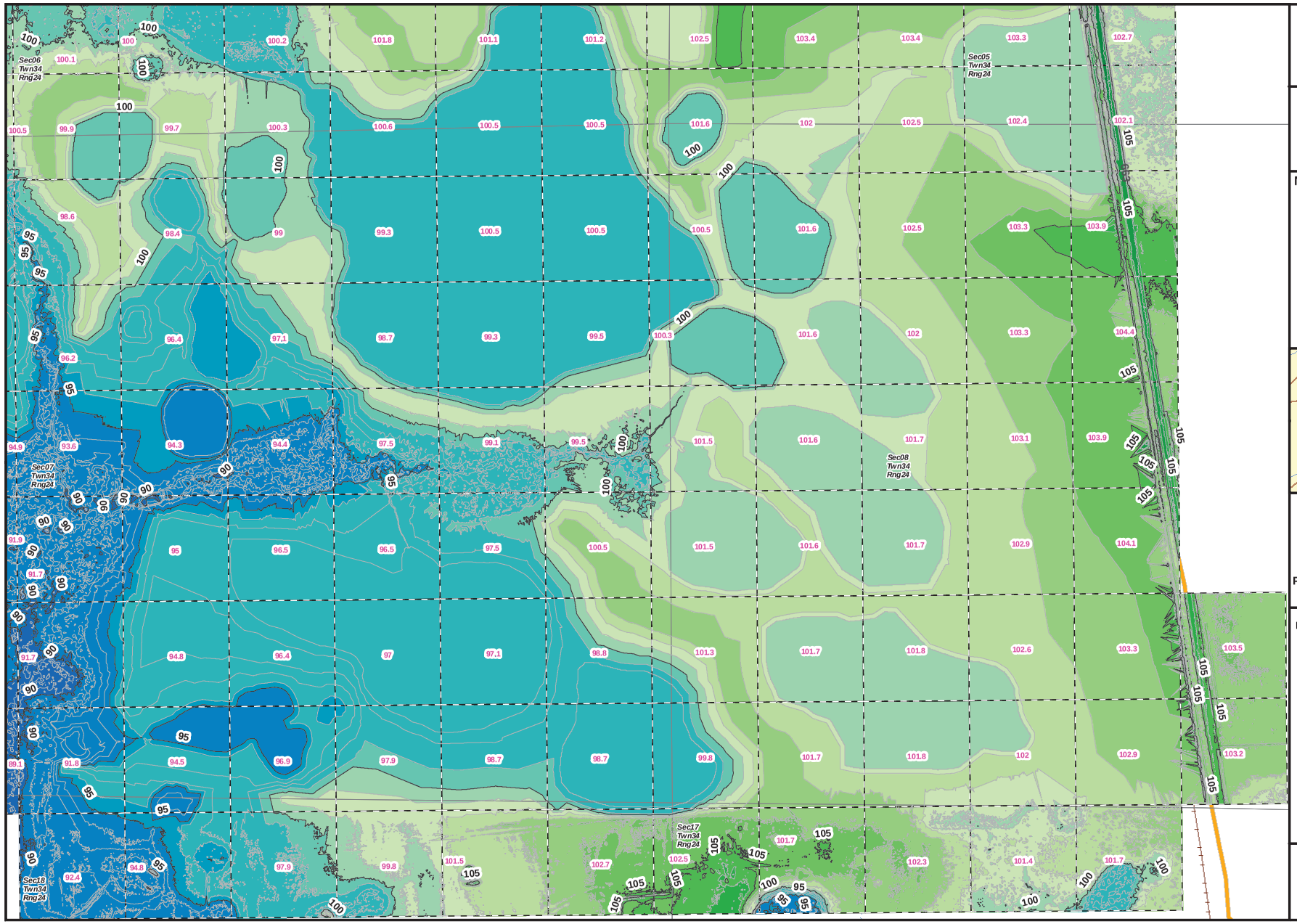
N

0 350 700

1" = 700 Feet

CF

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Post_P85_July2011_11x17_4.mxd



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BCI engineers & scientists

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

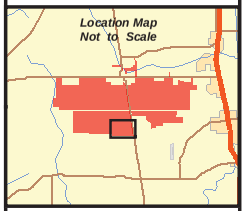


Figure IMR-23c
South Pasture Extension
Post-Reclamation
Seasonal High Water
Table Elevation
Superimposed Over
Post-Reclamation Topography
Hardee County, Florida

Explanation of Features

5 ft contours

1 ft contours

P85 WT Elev (ft NGVD)

MIKE SHE Grid

DEM (NGVD feet)

High : 146

Low : 84

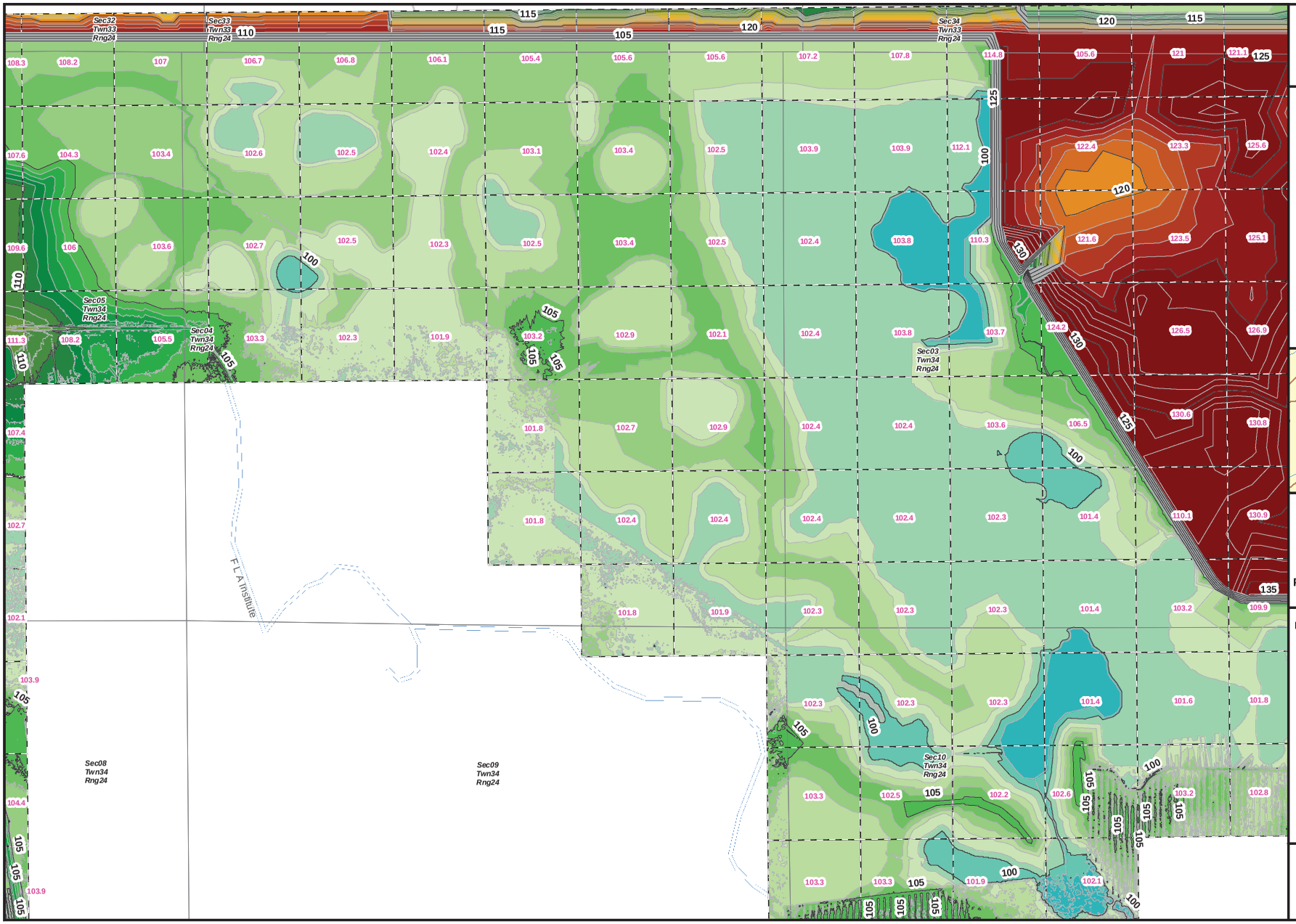
N

0 350 700

1" = 700 Feet

CF™

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Post_P85_July2011_11x17_5.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

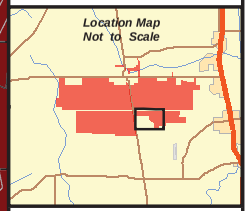


Figure IMR-23d
South Pasture Extension
Post-Reclamation
Seasonal High Water
Table Elevation
Superimposed Over
Post-Reclamation Topography
Hardee County, Florida

Explanation of Features

5 ft contours

1 ft contours

P85 WT Elev (ft NGVD)

MIKE SHE Grid

DEM (NGVD feet)

High : 146

Low : 84

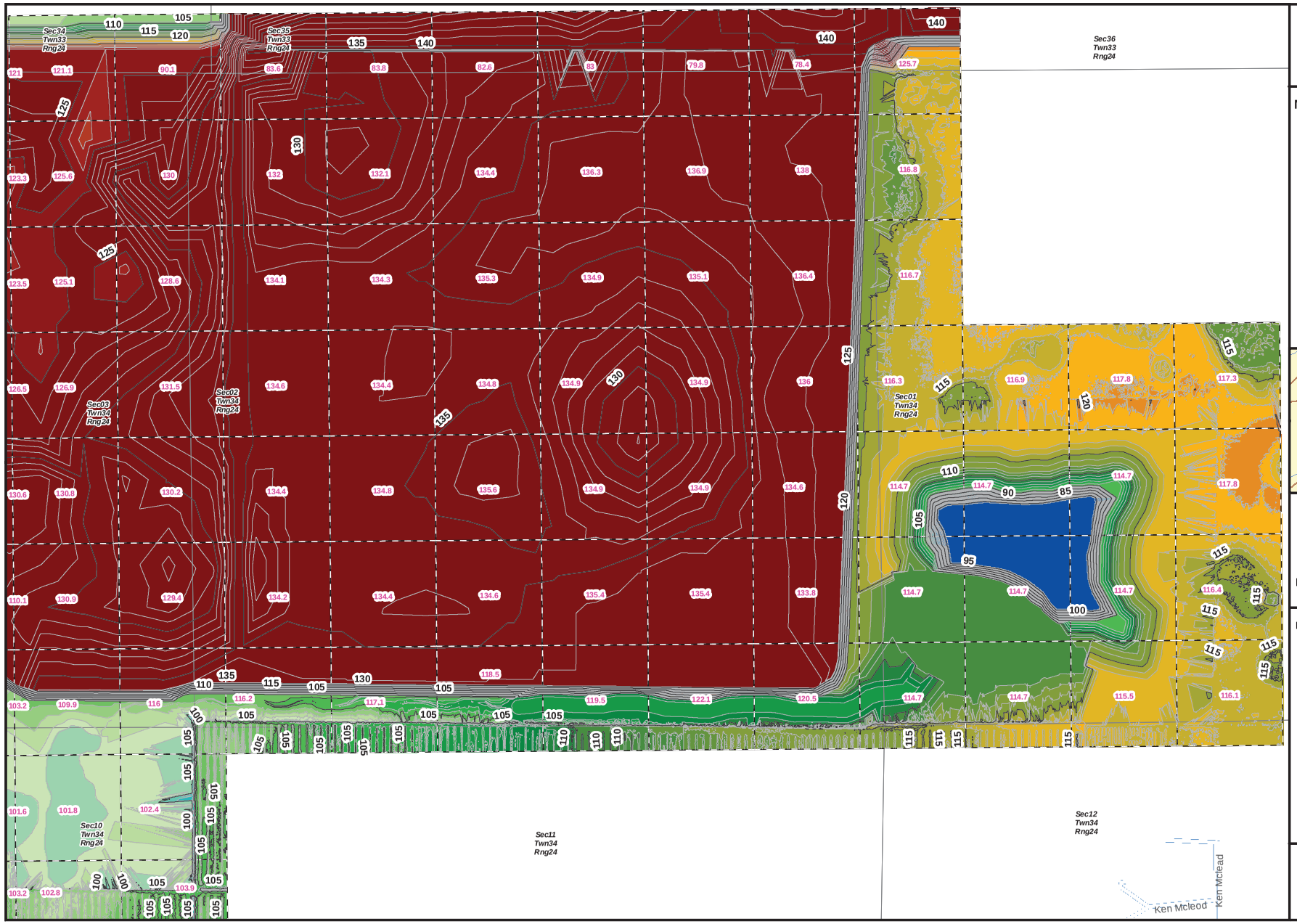
N

0 400 800

1" = 800 Feet

CF™

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Post_P85_July2011_11x17_3.mxd



amec

Notes:

1- Project No.: 03-16268

2- Digital Elevation Model (DEM) derived from LiDAR, BCI and CFIndustries data. Extends 100 feet from project Area.

3 - Benchmark Points in NGVD 1929 (ft.)

4- This map is intended to be used for planning purposes only. It is not a survey.

Date: 07/22/2011
Checked By:SW Map Prepared By:WH

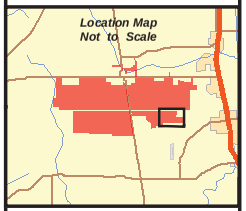


Figure IMR-23e
South Pasture Extension
Post-Reclamation
Seasonal High Water
Table Elevation
Superimposed Over
Post-Reclamation Topography
Hardee County, Florida

Explanation of Features

- 5 ft contours
- 1 ft contours
- **P85 WT Elev (ft NGVD)**
- MIKE SHE Grid
- **DEM (NGVD feet)**
  - High : 146
  - Low : 84

N

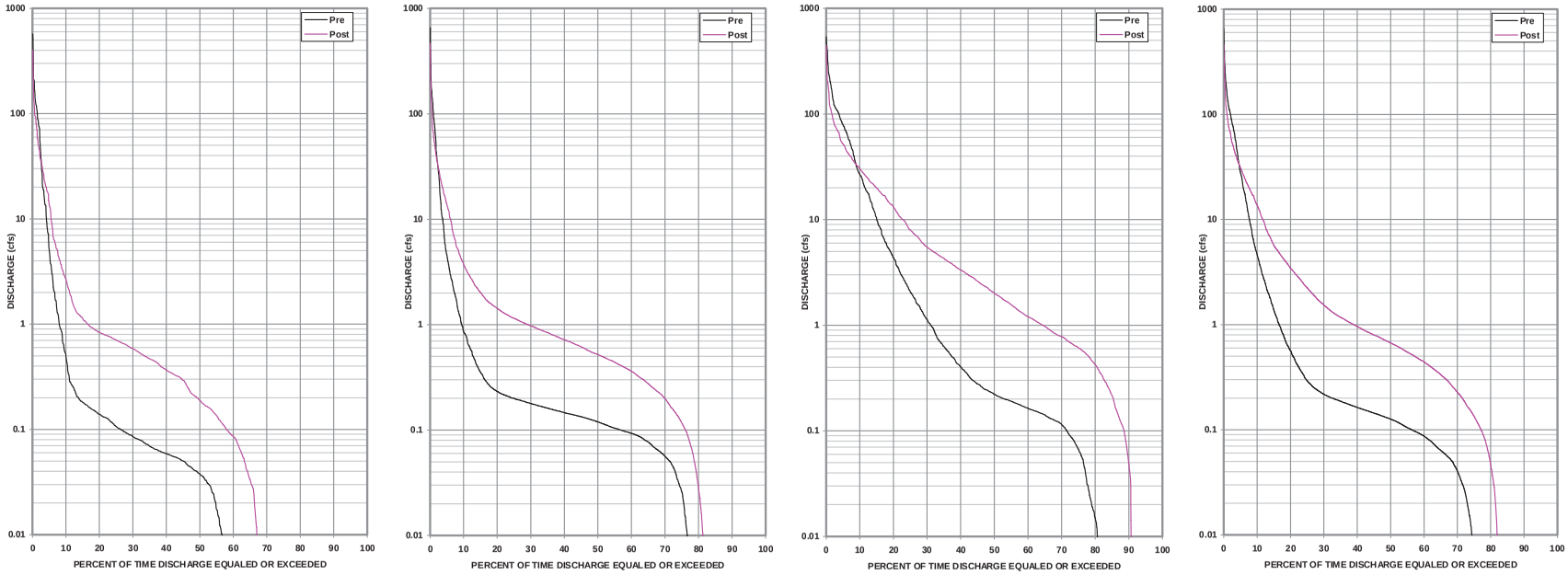
0 350 700
1" = 700 Feet

CF

File Pathway: H:\CF_FebRes\Feb11_Integrated Modeling Report\Models\Analysis_MXD\SPX_Post_P85_July2011_11x17_2.mxd

Figure IMR-24a. Frequency-Discharge Curves for Brushy Creek

SPX INTEGRATED MODEL - BRUSHY CREEK DAILY MEAN DISCHARGE DURATION CURVES (DATA CORRECTED FOR MIKE 11 FLOWS)



MFL BLOCK 1 (LOW): APRIL 20 - JUNE 24

MFL BLOCK 2 (MED): OCTOBER 28 - APRIL 19

MFL BLOCK 3 (HIGH): JUNE 25 - OCTOBER 27

TOTAL

Adjustments:
Pre = 0.002 cms / 0.07 cfs
Post = 0.011 cms / 0.39 cfs

Figure IMR-24b. Frequency-Discharge Curves for Lettis Creek

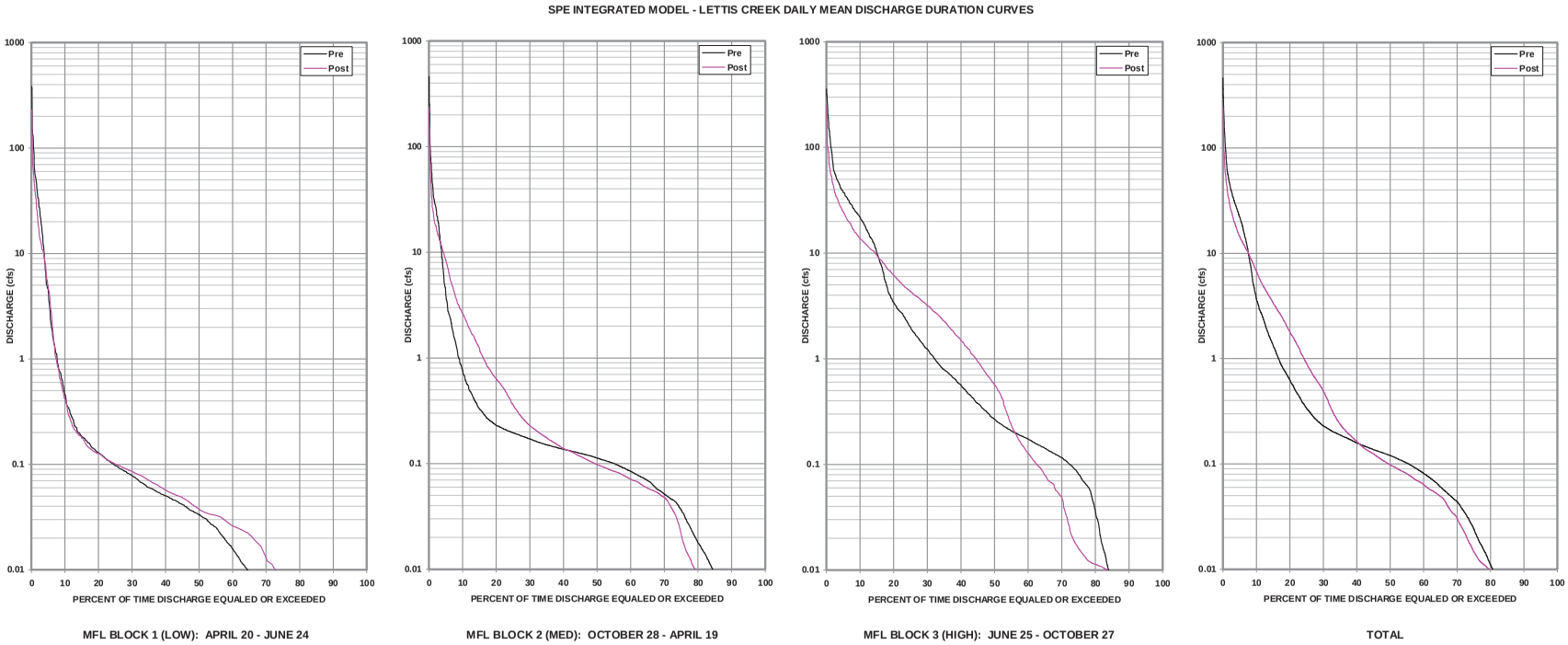
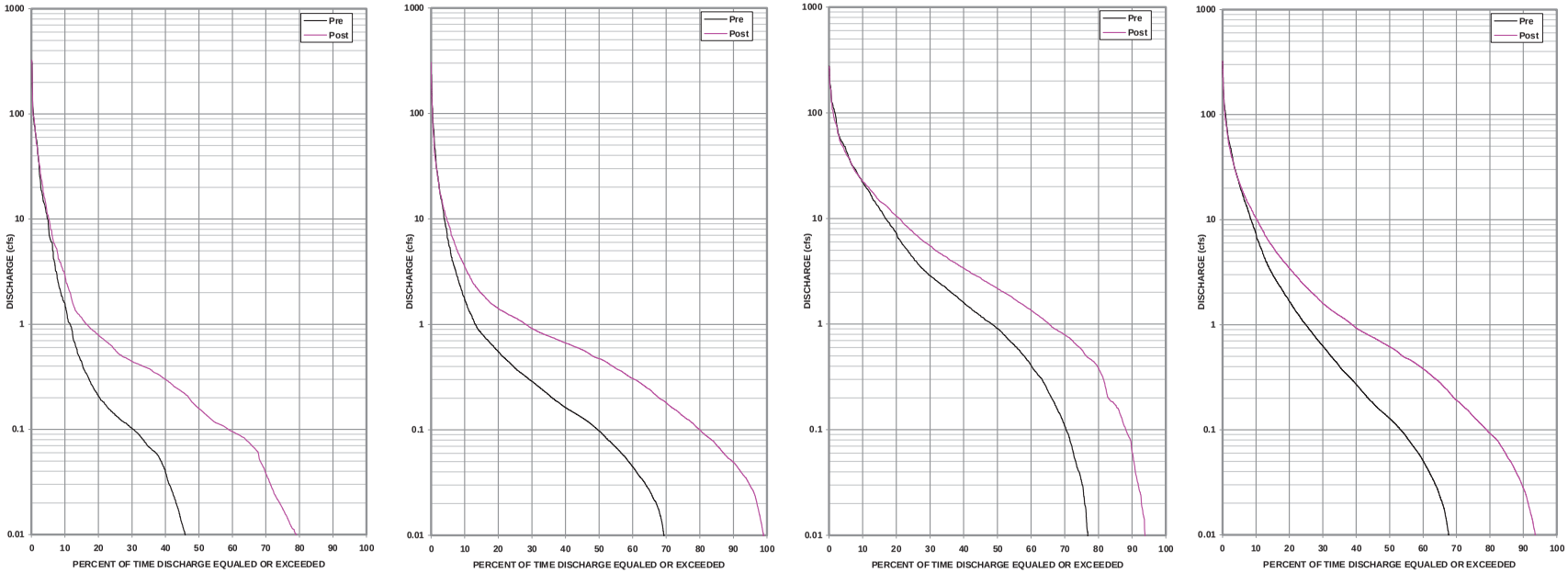


Figure IMR-24c. Frequency-Discharge Curves for Troublesome Creek

SPE INTEGRATED MODEL - TROUBLESOME CREEK DAILY MEAN DISCHARGE DURATION CURVES (DATA CORRECTED FOR MIKE 11 FLOWS)



MFL BLOCK 1 (LOW): APRIL 20 - JUNE 24

MFL BLOCK 2 (MED): OCTOBER 28 - APRIL 19

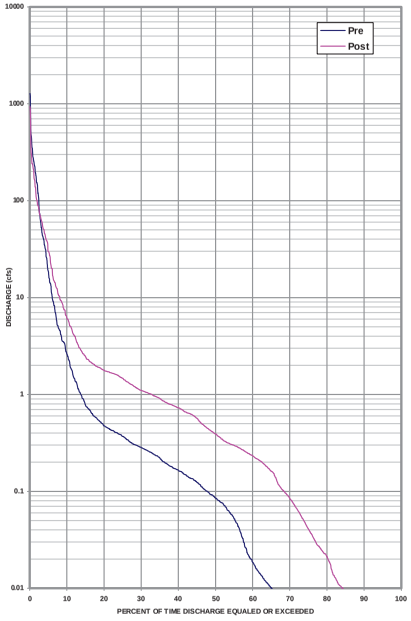
MFL BLOCK 3 (HIGH): JUNE 25 - OCTOBER 27

TOTAL

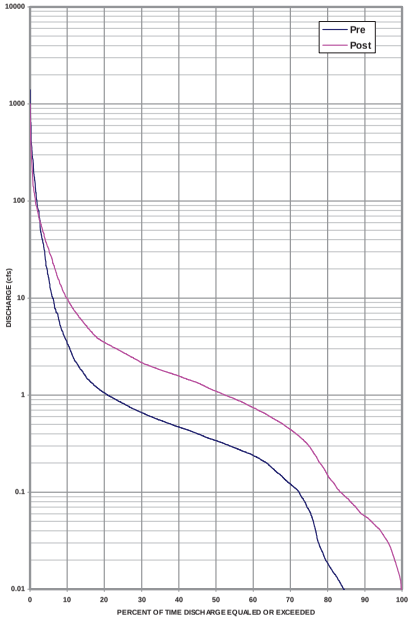
Adjustments:
Pre = 0.001 cms / 0.035 cfs
Post = 0.0013 cms / 0.046 cfs

Figure IMR-24d. Frequency-Discharge Curves for Total Combined Flow Leaving SPE

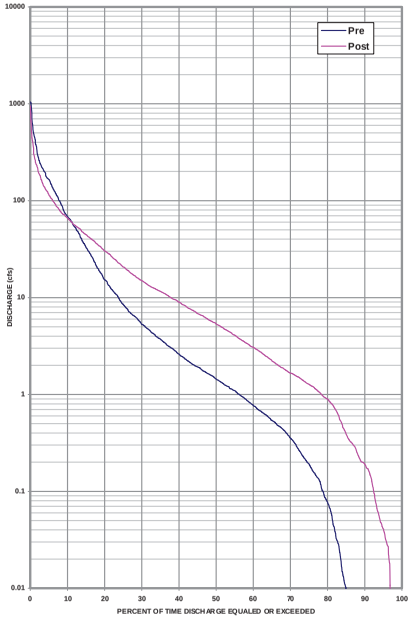
SPE INTEGRATED MODEL - TOTAL DAILY MEAN DISCHARGE DURATION CURVES (DATA CORRECTED FOR MIKE 11 FLOWS)



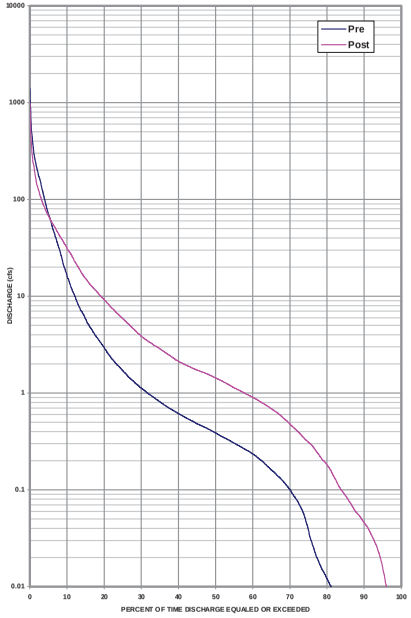
MFL BLOCK 1 (LOW): APRIL 20 - JUNE 24



MFL BLOCK 2 (MED): OCTOBER 28 - APRIL 19



MFL BLOCK 3 (HIGH): JUNE 25 - OCTOBER 27



TOTAL