PLANT ROOT STUDY

Prepared for:

STATE OF LOUISIANA
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF CONSERVATION

IN RE: DOCKET NO. ENV-L-2015-01

Martha Zoe Moore, et al. v. Denbury
Onshore, L.L.C.
U.S.D.C.-Western District
Monroe Division
CIVIL ACTION NO. 3:14-CV-913

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1.0 Introduction

On behalf of Denbury Onshore, LLC (Denbury), Holloway Environmental Services (HES) is pleased to submit this root depth study and aspects of Plaintiffs' remediation plan to the Louisiana Departmental Natural Resources (LDNR) for the DFU 125-01 Saltwater Release located in Sections 32 and 33, Township 17N, Range 9E in Richland Parish, Louisiana. Figure 1 in Appendix A shows the general location of the property and the release site while Figure 2 is a topographic map showing section lines, the release location and other topographic data. Figure 3 shows an outline of the approximate area affected by the release.

Details of the release, cleanup activities and remediation aspects have been presented by me in a previous report (Holloway, 2015) and reports by others (Cork, 2014; MP&A, 2015; Arabie, 2015) and will not be addressed herein except for clarification of certain points that have been brought up since the date of my report.

1.1 Scope and Objectives

The scope and objectives of this root depth study and review include the following:

- Root depths and abundance for typical trees/shrubs and herbaceous plants growing on the Moore property
- Discussions of effective root zones (ERZs) for plant growth and reproduction for sites in and around the leak release area
- General comments on aspects of plaintiffs' proposed remediation plans as it relates to potential future uses of the release site

1.2 Author's Background and Areas of Expertise

Dr. Luther F. Holloway is an environmental consultant with forty-plus years

experience in the environmental field. He has a Bachelor of Science Degree in Wildlife Management from Louisiana Tech University in 1966, a Master of Sciences Degree in Fisheries from Louisiana State University in 1969 and a Ph.D. in Plant Pathology from Louisiana State University in 1971. He has worked in the oil and gas industry since 1984 conducting studies on the impacts of oil and gas operations on vegetation and soils in numerous states, especially Louisiana, Oklahoma, Texas and Mississippi. In addition to serving as a consultant for many individuals and numerous oil and gas companies, Dr. Holloway has served as a consultant for the U. S. Army Corps of Engineers, EPA and the states of Louisiana and Florida. He has reviewed and worked on hundreds of oil field sites during his tenure as a consultant. Much of the work has concerned environmental impacts to vegetation and soils, agronomic practices and methodologies for remediation of impacts at oil field sites. He has worked on and provided measures for cleanup of pipeline spills, oil field pits and general sites impacted by both produced water and petroleum hydrocarbons at many locations around the country. He has also conducted investigations of tree and herbaceous plant root growth and depths in both elevated wetlands and uplands in oil fields. Through education and practice Dr. Holloway is recognized as an expert on the impacts of oil field exploration and production (E & P) activities on plants and soils, agricultural and general agronomic practices, wetlands and other fields. Appendix B contains a list of cases in which Dr. Holloway has given testimony in the last five years. His hourly rate for field/preparation work and testimony is $250.00.

2.0 Site Setting

The release site is located in a rural area in the Delhi Gas Field approximately 3.5 miles south of the small hamlet of Dunn, Louisiana. Access to the property is from Ferguson Road. According to the Cork Report (2014), the area west of the pipeline right-of-way (ROW) is currently used for cattle grazing and recreational hunting while the area east of the ROW was formerly used for row crops but has been fallow since the late 1990s. The area to the south of the ROW is utilized for timber production. Arabie Environmental Solutions (2015) produced a lengthy list of future potential uses for the property that included livestock grazing, cropland, aquaculture, Conservation Reserve and Wetland Reserve Programs, and commercial forest to produce lumber, wood pulp, and biomass for fuel or fuel production.

2.1 Site Soils

A detailed review of the soils was presented in my initial report (Holloway, 2015) and will not be repeated here, however, for purposes of efficiency a short summary is given herein for quick reference to the locations and types of soils in the release area. The surface soils on the Moore property have been mapped by the United States Department of Agriculture Soil Conservation Service (USDA-SCS) and are shown in Figure 3. The soils on the Moore property in the release area consist of Calhoun silt loam (Ca) and Grenada-Calhoun silt loam (Gu) and a small area of Calhoun-Calloway silt loam (Cc) that is on the northwest and west side of the release site.

2.2 Vegetation

Vegetation on the site varies substantially across the property and in the release footprint. A flourishing marsh has developed on the west and north sides of the release site with a mixed shrub/wetland community in the central and east areas of the release area which indicates that soil conditions are continuing to improve. The west side of the property consists of a wet marsh-type area that is dominated by cattail (*Typha latifolia*), barnyard grass (*Echinochloa muricata*), beaksedge or beakrush (*Rhynchospora* sp.), marshmallow (*Hibiscus moscheutos*), spikerush (*Eleocharis spp.)*, common rush (*Juncus effusus*) and other wetland species. At the time of the study the area showed a very lush growth of wetland plants all over the site. Higher sites along the tree line area are vegetated by species such as patches of Bermuda grass (*Cynodon dactylon*) and trees along the fence row including post oak (*Quercus similis*), water oak (*Quercus nigra*), winged elm (*Ulmus alata*), persimmon (*Diospyros virginiana*) and other hardwood species along with an occasional loblolly pine (*Pinus taeda*), cedar elm (*Ulmus crassifolia),* honey locust (*Gleditsia triacanthos*) and sugarberry (*Celtis laevigata*).

The far west edge of the release is unimproved pasture vegetated by numerous grasses with a spotty distribution of hardwood trees. Areas on the south-central side of the tract are generally vegetated by a mixture of hardwood and pine trees that have been killed, however, many surviving species occur on the north and south edges of the central area. Species such as silverling (*Baccharis halimifolia),* winged elm, loblolly pine, Chinese tallow (*Triadica sebifera),* herbaceous species as plumegrass (*Saccharum giganteum*), spikerush, flatsedge or nutsedge (*Cyperus* spp.), sumpweed (*Iva annua*), common rush, barnyard grass and beaksedge. On the north side of the area is a slough area that is heavily populated by cattail along the edges. Other species include beaksedge, buttonbush and numerous other wetland species. The east side of the release area is vegetated with wetland communities similar to those found in the south-central area. Plant communities outside the release site in this area generally resemble those of the central area with a dominance of silverling and a mixed stand of pine and hardwoods such as sweetgum, Chinese tallow, green ash (*Fraxinus pennsylvanica*), bitter pecan (*Carya aquatica*) and an occasional red cedar (*Juniper virginiana*).

2.2 Wetlands

A wetland delineation report has been prepared by Messinger and Associates, Inc. (2013). Figure 4 shows the wetland types at the release area. The wetland types consist of herbaceous, scrub and forested wetlands. Of the areas that were affected by the release, 9.2 acres of herbaceous wetlands, 9.82 acres of scrub-shrub wetlands and 1.9 acres of forested wetlands were impacted.

3.0 Plant Root Study

3.1. General Aspects

Over the past few years, greater attention to the potential root depths of plants in alleged impacted areas from oil field E & P activities have been emphasized by attorneys seeking damages for activities that are similar to those that occurred in this case. In many cases the alleged root depths and proposed remediation depths have grossly exceeded the actual root depths found at the sites in which the plants were growing. Since scant literature exists in the area of the effects of oil field E & P activities on plant roots, I have undertaken several site specific investigations to determine root depth and effective root zones of plants growing in and around areas of oil field impacts. During the course of these investigations, I have found that root densities and penetrations in various soil types have varied greatly from site to site. This is particularly important with the changes in soil types, area hydrology and the intended future use for various properties. As such, it is imperative to tailor an investigation that is specific to the plants and soils of the areas of impact and surrounding areas in order to determine the particular depths at which plants grow and for the potential formulation of depths where remediation measures may be required.

Macon Ridge soils at the release site often develop fragipans that impact root penetration and growth. Also, much of the release area is wetlands where shallow soils often exist in a reduced or anoxic condition that greatly reduces root penetration to substantial depths. These soil factors must be considered in the interpretation of root growth and densities and potential effective root zone (ERZ) depths for the release site. These ERZs represent the depths of the roots that are necessary for plants to grow and complete their life cycles. ERZs do not represent the deepest roots but comprise those root areas where the majority of the roots reside to sustain the plants.

3.2. Methods

To determine the root depths and distributions of the woody vegetation, nine trees and shrubs were selected for study. The locations of these plants are shown in Figure 5. The general distribution of the typical plants that grow in the area that were in the release area and the areas nearby represented a general mix of the most abundant species that occur in the area. Trees selected for study were measured at diameter at breast height (dbh) or at lower levels for shrubs, distances were measured from the bole to the deepest depth of the deepest root, depth to the top of the root, depth to the bottom of the root and root diameter or circumference. These data were entered on a root form along with species name and coordinates showing the location of the plant. Extensive reviews were conducted of the dominant roots on the trees by probing with steel rods to determine the general depths of all of the major roots around the tree. After comparing those with the greater depths, a root was selected to follow by either probing all along the length of the root or digging up the soil from the top of

the root to observe the root as it extended away the bole of the tree. Along with the major roots, views of the roots and the growth of feeder roots were also viewed for the trees. Root depths and other important information for the trees and shrubs are shown on the tree root forms in Appendix C.

In order to determine the root depths of the herbaceous species, twelve plants were selected at various areas both inside and outside the footprint for observation of the root depths and the distribution pattern. The names and locations of these plants are shown in Figure 5 and are given in the root forms in Appendix C.

To determine the depth of the penetration of the herbaceous root systems, root abundance was noted from the top of the soil profile using downward gradations for the abundance factors. In those areas where the root mat was heavy and very thick across the soil profile, root densities were considered to be very abundant while those areas where root systems that did not fill the entire width of the observational points were considered to be abundant. Those areas with roots dotted along the entire soil profile face were considered to be common while those areas with few roots were considered to be sparse or very sparse in distribution. In some instances the number of roots were noted where only a very few roots (such as 1, 2 or 3) occurred across a given area. The data were written on plant root sheets and are shown in Appendix C along with photographs that were taken at observation points. At herbaceous sites, observations were made of the soil profile to confirm if the particular soil type generally followed the USDA Soil Survey for Richland Parish (Soil Survey Staff, 1993).

At the same time that the roots were viewed or probed, a review was made of the selected plant(s) and existing plants around the sample point to determine the plant conditions and the notation of any impacts such as leaf scorch and leaf burning from any residual components that existed from the leak. Other factors viewed for were epicormic branching, dieback and other known features of salt contamination. Where applicable, this information is given in the results section below for each observation point.

3.3. Results

The results of the tree root investigation for effective root zones (ERZs) are shown in Table B-1. For purposes of discussion, all of the photographs of the trees and herbaceous vegetation that were observed in the study are included in Appendix C along with the tree and herbaceous plant data sheets.

Tree T01 (6.1 inch dbh Sweetgum, *Liquidambar styraciflua*)

Tree T01 is a healthy sweetgum growing at the edge of the release area on the south central part of the release area. The tree is in excellent condition with no symptoms related to the salt water release.

Probing of areas around the sweetgum (Photo C-1) showed a very shallow root system where most of the roots were encountered at a depth of approximately five inches below land surface (bls). The depth to the top of the deepest root (Photo C-2) at a distance of 1.2 feet from the bole of the tree measured 7.2 inches bls while the bottom of the root was at 7.8 inches bls. During the course of the probing the site, a fragipan or a resistant layer was found at about 5 inches bls and another at about 25 inches bls. The soil type here is shown as Granada-Calhoun silt loam (Gu).

Photo C-3 shows the vegetation facing to the east of the tree. The area on the left is within the area of the release while the area on the right is outside. Vegetation in the release area has come back very quickly and consists of silverling, plumegrass and numerous wetland species that are in excellent condition and showing no signs of impacts from the saltwater release. An effective ERZ for Tree T01 would be 6 inches bls since the overwhelming majority of the roots occur from the surface to 6 inches bls.

Tree T02 (6.1 inch dbh Willow Oak, *Quercus phellos*)

This tree is located on the far east side of the release site (Photo C-4). Even though the tree is right at the edge of the release site, the tree is in excellent condition. The maximum depth to the top of the deepest root is 7.8 inches bls while the depth to the bottom of the root is 8.4 inches bls (Photo C-5). The general probing of the roots in the general area showed other maximum root depths around the tree to be in the range of 5 to 6 inches bls. Photo C-6 shows the vegetation growing in the release site by Tree T02. This community consists of a very robust stand of barnyard grass, sumpweed, beakrush, common rush and marshmallow. Some patches of spikerush are located in the general area. Based on the probing of the roots and following the deepest root, an ERZ root zone for this site would be no more than 7 inches bls.

Tree T03 (7.8 inch dbh Loblolly Pine, *Pinus taeda*)

This tree is located on the east side of the property slightly upslope from the release area. Photo C-7 shows this tree. The tree is healthy with no signs of any kinds of impacts from the release. Two of the deepest roots on the tree were measured at this site. Root 01 at a distance of 4.3 feet from the bole of the tree measured 7.2 inches bls while the depth of the bottom of the root measured 7.8 inches bls (Photo C-8). The smaller root (02) at a distance of 4.7 feet from the bole of the tree measured 9.0 inches bls at the top of the root while the depth at the bottom of the root was 9.36 inches bls (Photo C-9). Extensive probing in the area showed most of the roots ranging from 5 to 6 inches bls. A conservative estimate of ERZ would be 7 inches or a 0 to 7 inch zonal depth where the overwhelming majority of the roots resided bls at this site.

Tree T04 (7.6 inch dbh Chinese Tallow, *Triadaca sebifera*)

Chinese tallow trees are invasive exotics that are rapidly invading and displacing many hardwood stands in the general area and all over Louisiana. As such, this tree is fast becoming an important consideration in timber management. Tree T04 is located near the south central part of the release area in a flat area north of the release line. This tree is a healthy specimen (Photo C-10) that is growing in a mixed stand of pine, sweetgum, winged elm and some silverling. Other species include cedar and persimmon. Most of the vegetation is shrub-sized and slightly larger trees. The depth to the top of the deepest root on the tree was 5.4 inches bls at a distance of 9.5 feet from the bole of the tree (Photo C-11). Photo C-12 shows the vegetation growing beside Tree T04. Extensive probing in the area showed most of the roots to be either above the surface of the ground or only a couple of inches into the soil under the tree. Based on the shallowness of the roots at this site, an effective ERZ of 5 inches would be a generous ERZ depth for this particular tree.

Tree T05 (double-bole persimmon, *Diospyros virginiana*, of 2.52 inch dbh and 2.9 inch dbh)

This tree consists of a double-bole tree coming from a common source. The east side at dbh is 2.52 inches while the west side is 2.9 inches. Photo C-13 shows the top of this tree which is a vigorously growing young tree in a mixed stand of pine, Chinese tallow, sweetgum, winged elm, deciduous holly and some silverling. Ground cover in the area consists mostly of blackberries and a few plumegrass tufts along with trumpet creeper. Extensive probing of the roots in the area of this tree revealed most root depths of 3 to 5 inches bls. Photo C-14 shows the length of the root on the tree while the depth to the top of the deepest root is shown in Photo C-15 with a maximum depth to the top of the root of 6.96 inches bls and 7.1 inches bls to the bottom of the root. Based on all probings of the major roots on the tree the ERZ of this persimmon would be 6 inches bls in depth. Soils at this site were typical Granada-Calhoun silt loams (Gu) and were extremely difficult to dig.

Tree T06 (17.57 inch dbh Honey Locust, *Gleditsia triacanthos*)

This tree was located just outside the limits of the release area on the southwest corner of the release site (Photo C-16). This tree is located in a pasture area where there is a mixture of Bermuda grass, crabgrass, Dallas grass and bahia grass. Surrounding the tree is a stand of switchcane that has been disturbed by cattle. An overwhelming majority of the roots are at or near the surface on this tree. Extensive probing around the area showed roots such as that shown in Photos C-17, C-18 and C-19 either at the surface or slightly beneath the surface of the soil level. General depths of the roots were basically at the land surface level or slightly beneath at 1 to 2 inches all around the tree. These roots would

have made up over 95% of the tree roots. One root was found running east from the tree. While following this root shown in Photo C-20 a distance of 20.5 feet from the bole of tree, the root made a sudden downward turn and stopped at a depth of 19.9 inches bls for the top of the root and 20.6 inches bls at the bottom of the root. This root represented an extreme anomaly for the site and is likely the result of the root encountering a small crevice or soil tongue that extended through the profile. All of the other roots probed around the tree showed this to be an anomaly, therefore the overwhelming majority of the roots and the ERZ for this tree would be 6 inches. This would be a generous depth even at that level for this tree. In digging around the tree, the review of the soils showed this tree to be a typical Calhoun-Calloway silt loam (Cc) suggesting that this soil type extended slightly farther to the south into this location and thus differed slightly from the USDA Surface Soil Types shown in Figure 3.

Tree T07 (1.9 dbh Silverling, *Baccharis halimifolia*)

This is a 1.9 inch dbh silverling located in the south central part of the release area (Photo C-22). As can be seen from Photo C-23, the vegetation in the surrounding area is quite lush consisting of a mixed stand of silverling along with numerous wetland sedges and grasses. Photo C-24 is a profile showing the roots on T07 while C-25 shows shallow roots emanating from the bole of the tree. In general, the overwhelming majority of the roots are found in the first 6 inches bls around the tree with additional roots extending down in a sparse distribution to very sparse to 0.9 foot. Most of these grade down to very fine or sparse roots in this area. An ERZ would be on the order of 6 inches. This distribution is shown in Photo C-24. Photo C-25 shows the shallow roots that are emanating from the tree in a shallow zone of 0 to 5 inches bls.

Tree T08 (Buttonbush, *Cephalanthus occidentalis*)

Tree T08 is a small buttonbush (Photo C-26). This woody plant is typical of plants that grow in wetland areas such as those found on the Moore property. Photo C-27 shows some of the vegetation that grows in the surrounding area. They include trees such as green ash and bitter pecan. Other wetland species include various sedges and grasses typical of wetland environments. Photo C-27 shows a typical root pattern and distribution around Tree T08. Extensive probing around this tree showed almost all of the root system to be within 2 to 4 inches bls. In one instance, a single root hit a tire rut that was close to the tree and then went down through a crack and heavier organic layer as can be seen in Photo-28. This anomalous root is typical of a site where disturbance has occurred and organic matter has filled in an opening in the soil typical of that of an old crack or crawfish burrow that has organic matter. Based on the overwhelming amount of very shallow roots that are typical of numerous similar situations that I have observed in the field, the ERZ for this site would be no more than 6 inches in depth.

Tree T09 (4.4 inch dbh dead Winged Elm, *Ulmus alata*)

This tree is on the southwest side of the release site. Extensive probing in the general area showed all of the roots emanating from the tree to be very shallow with most being at or near the surface. Photo C-30 shows the deepest root at a distance from the bole of 9.1 feet with a depth of 4.2 inches bls to the top of the root and 4.8 inches bls to the bottom of the root. Photo C-31 is a better view of the deepest root without the measuring tape. Photo C-32 shows a section of a very shallow typical root that is basically on the surface of the ground. Photo C-33 shows the view facing east from the tree of the vegetation growing in the area. Most of the vegetation consists of silverling mixed in with species such vervain and various sedges that occupy the site. The photo also shows numerous dead mostly winged elms back to the east at this site. Since almost all of the roots on this tree are very near the surface, an ERZ for this tree would be no more than 4 inches.

Herbaceous Plant Observation No. H01. (Spikerush, *Eleocharis microcarpa*)

Much of the area on the south east side of the release area has been invaded by numerous species of wetland sedges and grasses. The spikerush in Photo C-34 is a very dense stand that is typical of several of the areas on this side of the release area. Vegetation is growing vigorously with no evidence of any impacts and is very typical of a stand of this type. Other plants growing in the vicinity include barnyard grass, beakrush, common rush, sumpweed and several species of nutsedges. The profile of the soil at this site is shown in Photo C-35 and shows an abundant distribution of roots from the surface to 0.1 of a foot bls. From 0.1 to 0.3 of a foot is common to sparse and 0.3 to 0.55 foot is sparse. Farther down from 0.55 to 0.7 feet is very sparse and 0.7 feet to 0.9 feet is very sparse to none and none below that point. The overwhelming majority of the roots are located in the first 0.3 of a foot of the soil and contain an overwhelming majority of the roots for the spikerush. Based on the root penetration and depths at this site, the ERZ for this area would be no more than 5 inches.

Herbaceous Plant Observation H02. (Sumpweed, *Iva annua*)

Sumpweed is one of the dominant plants in this area and is mixed in with the same type of wetland species as described for spikerush (H01). As shown in Figure 5 this observation area is slightly southeast of the spikerush. Photo C-36 shows the stand of vegetation where the observation was made and shows a vigorous young stand of plants with a few wetland species such as nutsedge growing in the stand. Photo C-37 shows a soil profile of the roots at this site and indicates an abundant distribution across the profile from 0 to 0.05 feet. From 0.05 feet down to 0.25 feet, the root distribution is common with a dotted distribution of the roots across the soil profile. From 0.25 to 0.4 feet, the

distribution is sparse while from 0.4 to 0.6 feet is very sparse. Below this level, the root distribution is very sparse showing only a few dotted root hairs down to none at that site. Based on these considerations, the ERZ for this area would be no more than 5 inches.

Herbaceous Plant Observation H03. (Beaksedge, beakrush, *Rhynchospora* sp.)

This stand of beakrush is growing on the northeast side of the release site. Photo C-38 shows the vegetative community here with a dense stand of beakrush in the foreground of the photograph and a cattail marsh in the background. All of the plants in this area are growing very lush and show no signs of any kind of impacts from the release that occurred at the site. There are no indicia such as vegetative dieback and leaf yellowing that occur as possible impacts from a saltwater release. These plants have regenerated and are now a very healthy marsh. Photo C-39 shows a soil profile at the H03 site with a root distribution of 0 to 0.1 foot as abundant across the soil profile in this area. From 0.1 to 0.32 feet is a common distribution across the area while areas below this are none except for a very dotted distribution across the profile of only a few small roots. In general, the lower portion past 0.32 feet is insignificant to the plant population at that site. Based on these considerations, an ERZ for this site would be 4 inches bls.

Herbaceous Plant Observation H04. (Bahia Grass, *Paspalum notatum*)

Photo C-40 shows this stand of bahia grass in the northeast corner of the spill area as a very lush growth of this pasture grass. In viewing this stand, the vegetation shows no evidence of any impacts from saltwater damage and has already headed out indicating that the stand has already reproduced. Again, there is no evidence of dieback or any kind of sign that this stand of grass is encumbered in any way by the saltwater release. Photo C-41 shows a soil profile at this site with an abundant distribution across the root zone from 0 to 0.25 feet. From 0.25 to 0.5 feet farther down is a common distribution and from 0.5 to 1 foot is sparse and 1.1 to 1.3 feet is sparse to none. In essence, the area below 0.5 feet is insignificant to the growth and reproduction of this plant. Therefore, an ERZ for this site would be no more than 6 inches in depth. Photo C-42 shows a fencerow at the site facing to the east and shows a healthy stand of hardwood trees along a fence line in this area. Probing the soil around these trees showed very shallow root systems. Other vegetation in the general area consists of Bermuda grass, Dallas grass, broomsedge, switchcane, goat weed and some vasey grass. Photo C-43 is facing to the south at site H04 and shows the very lush marsh community extending to the south.

Herbaceous Plant Observation H05. (Plumegrass, *Saccharum giganteum*)

This stand of plumegrass is growing just inside the release area on the south-central side of the release site (Photo C-44). This green grass is growing back from the base of last year's stand. This stand shows no evidence of any impacts whatsoever and indicates that the stand is coming back from the roots. Photo C-45 shows some of the vegetation growing in the area and consists of a stand of silverling with plumegrass. Other plants include winged elm and wetland species such as nutsedge. Photo C-44 shows the soil profile at the plumegrass site with an abundant distribution of roots across the profile in the 0 to 0.1 foot depth. Depths from 0.1 to 0.4 feet have a common distribution of roots. 0.4 to 0.85 feet is sparse while 0.85 to 1.2 feet shows one small rootlet coming out from the area within this stretch of the root zone. Based on these considerations and viewing the rest of the area that was dug up across the profile, an ERZ of 6 inches depth is appropriate for this site growing the plumegrass.

Herbaceous Plant Observation H06. (Cattail, *Typha latifolia*)

This cattail stand is located on the north central side of the release site in the slough that runs from the northwest to southeast in this area. This stand is a very lush stand that is just inside the footprint of the release site. These cattails show no evidence of any damage. They are green and growing and have reproduced typical seed heads for this species (Photo C-45). As shown in Photo C-46, the soil profile and the roots at this site are very abundant in the 0 to 0.1 foot range across the face of the profile while from 0.1 to 0.5 feet the distribution is common. In the area from 0.5 to 1.0 foot, the distribution is common to sparse and from 1.0 down to 1.4 is very sparse to none. Based on this root distribution in the profile, the ERZ for this site would be in the order of 8 inches.

Herbaceous Plant Observation H07 (Cattail)

Photo C-47 shows the stand of cattail for H07 facing to the north. The vegetation appears to be distressed as shown in the photograph. Photo C-48 shows the general area with some cattail on the right hand side of the photograph and in the background near the tree line to the north. In general, the vegetation in this area consists of mostly dense cattails with some spikerush that can be seen in the background past the water area on Photo C-48. There are also some spikerush and nutsedge in the area. Photo C-49 shows the soil profile at H07 with the area of 0 to 0.1 of a foot very abundant and from 0.1 to 0.55 foot as common. From there on down to 1.55 feet, the distribution is sparse to very sparse and very sparse to none at this site. At Photo C-50 is a deeper part of the soil profile at H07 that has two tiny rootlets that are in this area between 1.0 foot to 1.55 feet.

Based on these considerations, the very abundant and common distribution of roots in the first 7.0 inch level or zone would mark the ERZ for this site.

At first observation, the cattails appeared to be very ragged and in poor vigor. Further review showed that the plants were being eaten by a marsh moth called Henry's marsh moth (*Simyra insularis*). They had caused a tremendous amount of damage and were basically eating the leaves to where many had actually died or were skeletonized (Photo C-51).

Herbaceous Plant Observation H08. (Cattail)

This observation is of a stand of cattail on the southwest side of the site. Photo C-52 shows the general vegetation in the stand. Cattails here are dominant in the area along with some spikerush, barnyard grass, smartweed, beakrush and nutsedge. This is a healthy marsh at this site and the cattail have produced seeds. There is no evidence of any kind of impact on the vegetation here at this time. Some of the trees that were killed from the release are still in the area. Photo C-53 is a soil profile of H08. The vegetation roots are very abundant in the 0 to 0.15 zone and common in the 0.15 to .4 zone. From 0.4 down to 1.2 feet the roots go from sparse to very sparse to none. There is only one root hair in the zone of 0.7 to 1.2 feet. Based on these conditions, the ERZ for this site would be on the order of 6 inches in depth.

Herbaceous Plant Observation H09. (Bermuda Grass, *Cynodon dactylon*)

The Bermuda grass in this stand is very lush showing no sign of any impacts. The growth is very good since the cattle have been taken off and the grazing has been stopped. The stand is pretty much a monocultural stand with some wetland species located back to the east and south of the area (Photo C-54). Photo C-55 is a root profile at H09 showing a very abundant distribution of roots at 0 to 0.5 feet and a common distribution at 0.5 to 0.35 feet. At depths of 0.5 to 0.85, the root zone is still sparse to common and from 0.85 on down to 1.3 feet the graduation goes from sparse to very sparse to none. The ERZ for this site would be 8 inches. Vegetation in the surrounding area is shown in Photos C-56 to C-57 with very dense stands of wetland species on the east side of C-56 and a totally vegetated stand of mixed wetland species dominated by cattail in C-57 facing to the west at this site. This is all a very healthy marsh in this area.

Herbaceous Plant Observation H10 (Barnyard grass, *Echinocholoa muricata*)

This stand of barnyard grass is located on the west side of the release area just northwest of the release site. As shown in Photo C-58, this is an extremely lush stand of barnyard grass showing no signs of any kinds of impacts from the release. The plant has already headed out and produced a prolific amount of

seed. This is pretty much a monocultural stand with only a few cattail right at this spot. Photo C-59 shows a soil profile at the H10 site with an abundant to very abundant distribution of roots in the top 0 to 0.15 foot interval. Below this zone from 0.15 to 0.55 feet the distribution drops off very quickly from a common distribution to sparse and from 0.55 down to 1.35 feet, a gradation from sparse to very sparse in this zone indicating that root penetration is generally limited to the first half foot or so at this site. Based on these considerations, the ERZ would be 7 inches bls.

Herbaceous Plant Observation H11. Marshmallow, (*Hibiscus moscheutos*)

This stand is located right at the edge of the release footprint on the northeast corner of the release zone. Photo C-60 shows this stand of marshmallow that is growing at the site. This stand is very lush and is blooming or has produced seed pods. Behind these marshmallow to the northeast is a large stand of cattail. Other species included in the area include nutsedge, barnyard grass and some goldenrod on the more elevated areas back to the west toward the pasture. Photo C-61 shows the profile of the root zone at H11. At 0 to 0.2 feet there is a very abundant cross-section of the roots. From 0.2 to 0.6 feet is common and from 0.6 to 1.1 feet is very sparse, 1.1 to 1.6 feet is sparse and 1.6 feet down there are only two rootlets in the zone. These can be seen on the left hand side of the profile. The ERZ would be at a depth 8 inches bls.

Herbaceous Plant Observation H12. (Common rush, *Juncus effuses*)

This observation is located near T08, a buttonbush on the southeast corner just outside the footprint of the release. Photo C-62 shows the stand of common rush that has not been impacted by the release. Photo C-63 shows the soil profile at H12 with a very abundant root zone at 0 to 0.2 feet and common from 0.2 to 0.4 feet. From 0.4 feet down the distribution is sparse to very sparse in nature. Based on these root densities at the site, the ERZ would in the order of 6 inches. Vegetation in the surrounding area consists mostly of wetland species such as buttonbush, plumegrass, beakrush, smartweed, barnyard grass and spikerush. Photo C-65 shows the vegetation facing south with a lush stand of wetland species along with some green ash and silverlings alongside a road at this site.

4.0 General Discussion

The results of the root study indicated that root penetration into the soils by both the woody vegetation and the herbaceous vegetation was very limited on the Moore property. Most of the trees had only a very shallow root system that normally extended no more than six inches below the surface. Generally speaking, the overwhelming majority of the roots occurred within this zone and many at a much shallower depth than six inches. From these data, an ERZ was determined for each tree/shrub or herbaceous plant. Table 1 in Appendix B shows the ERZs for each plant. Based on the abundance of roots at particular depths, none of the plants in the root study exceeded 8 inches in depth for the ERZs.

Of the thousands of roots observed in all the probing, uncovering and viewing of roots in soil profiles, only two atypical roots were found to go deeper than 20 inches. This was a small root on Tree T06 (honey locust) outside the southwest corner of the release area in a pasture that measured 19.2 inches to the root top and 20.6 inches to the bottom of the root. The other root found to go deeper was a small root on Tree T08 (Buttonbush) in an area outside the southeast corner of the release site that hit a rut and followed a crack with organic discoloration to a deeper level. These anomalies are usually found in tongues in the soil profile, crawfish tunnels or cracks in the soil where aerobic conditions prevail in small seams that allow for deeper root penetration in the soil profile.

Considering all of the factors involved in the root study no remediation is warranted at this time. A monitoring program as proposed by MP&A (2015) should be allowed to go forward. If required, a contingency remediation could then be instituted, however, no remediation below one foot would be necessary to be protective of the soils and plant communities in the release area.

As previously stated, the issue of future uses was addressed in the Arabie Environmental Solutions (2015) remediation report. Many of the areas in the release footprint contain vegetated wetlands and open water that would have to be drained before conversion to farmland, pasture or timberland. These activities would require an Army Corps of Engineers wetland permit with concomitant mitigation that would result in a very high cost that would be simply economically infeasible to get the land to a point to where it could be used for those purposes. It is also highly unlikely that the Corps would issue such a permit. Also, to put the land in the Wetland Reserve Program or the Conservation Reserve Program, the United States Department of Agriculture requires the owner to have farmed the property a number of years out of the last five years. Since the land was allowed to go fallow without being farmed and to grow up in trees since the 1990s, it is highly unlikely that the land would ever qualify for these programs.

The issue of water quality for irrigation was also addressed in the Arabie mitigation report. The report stated that 568 mg/L (equals ppm) as too high to use for irrigation. Later in the report it was indicated that one of two monitor wells

installed in the release area at 15-25 feet bls showed chloride levels of 298 mg/L while another one at 19-29 feet bls showed 312 mg/L but the report did not allude to the usefulness of the water for irrigation. Also, yields from such shallow wells would be inadequate for irrigating crops. Wells would have to be drilled and screened in deeper parts of the aquifer to produce ample amounts of water for irrigation. McFarland et al. (2002) has shown that critical chloride levels for corn, grain sorghum and cotton, three crops that are grown in the area around the Moore property, are much higher than those of water sampled from the two wells. Additional data cited in the Arabie report showed a level of 114 mg/L of chlorides from two other wells nearby indicating that other irrigation water is available for the release area even though there is little chance that conversions to other uses are possible other than those uses that were in effect at the time of the release.

In viewing the vegetation in the release site, none of the plants growing in the release area showed any symptoms or indicia of impacts from the saltwater release. In addition, with the exception of plumegrass and Bermuda grass that had not headed out, all of the herbaceous plants were flowering and/or had produced seeds thus completing the life cycle of the plants. All plant communities were healthy and very verdant within the release area. This shows that any remaining salt parameters are not affecting the growth and reproduction of the plant communities and is typical of numerous areas that I have observed in oil fields that have wetland soils that remain saturated for much of the year. These areas can have high SAR and ESP levels and still not affect plant growth and reproduction. Based on these observations and the results of the root study, I believe that the release area will continue to support healthy plant communities and with additional time and monitoring as suggested in the MP&A report will provide for those productive uses that are feasible and allowable for the Moore property.

5.0 Literature Cited/Reviewed

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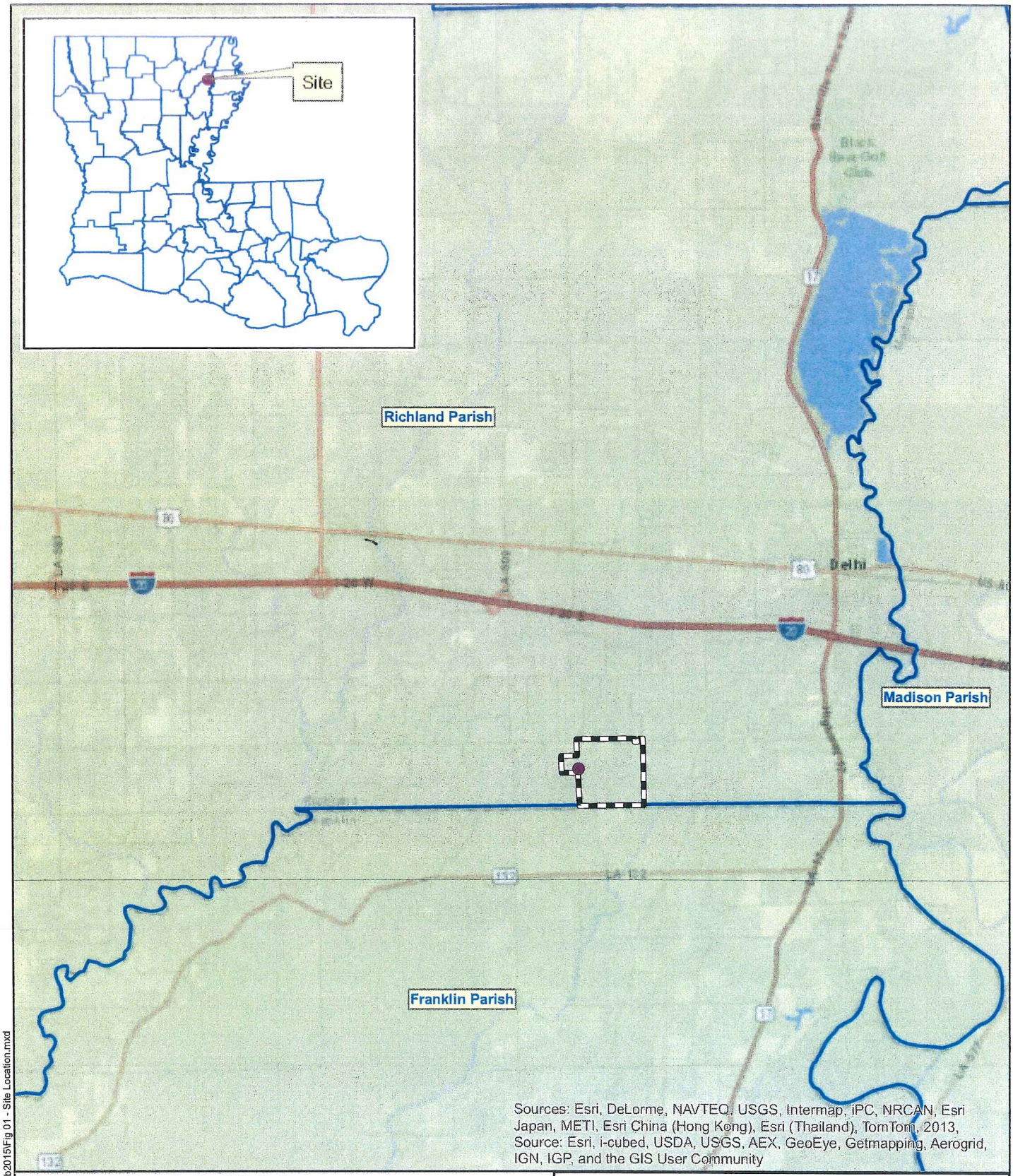
APPENDIX A

Figures



World Street Map via ArcGIS Online.
Property line georeferenced from Messinger et al., 2/19/15 figure

Legend

Release Location
Property Line
Parish Boundary

0 1.25 2.5 5 Miles

N

Figure 1
Site Location
Martha Zoe Moore, et al. vs. Denbury Onshore, LLC
Richland Parish, Louisiana

MICHAEL PISANI & ASSOCIATES, INC.
Environmental Consulting Services
Houston, Texas New Orleans, Louisiana Baton Rouge, Louisiana

Designed: JRB	Drawn: SAW	Checked: DGA	Date: 4/9/2015	Project: 145-02

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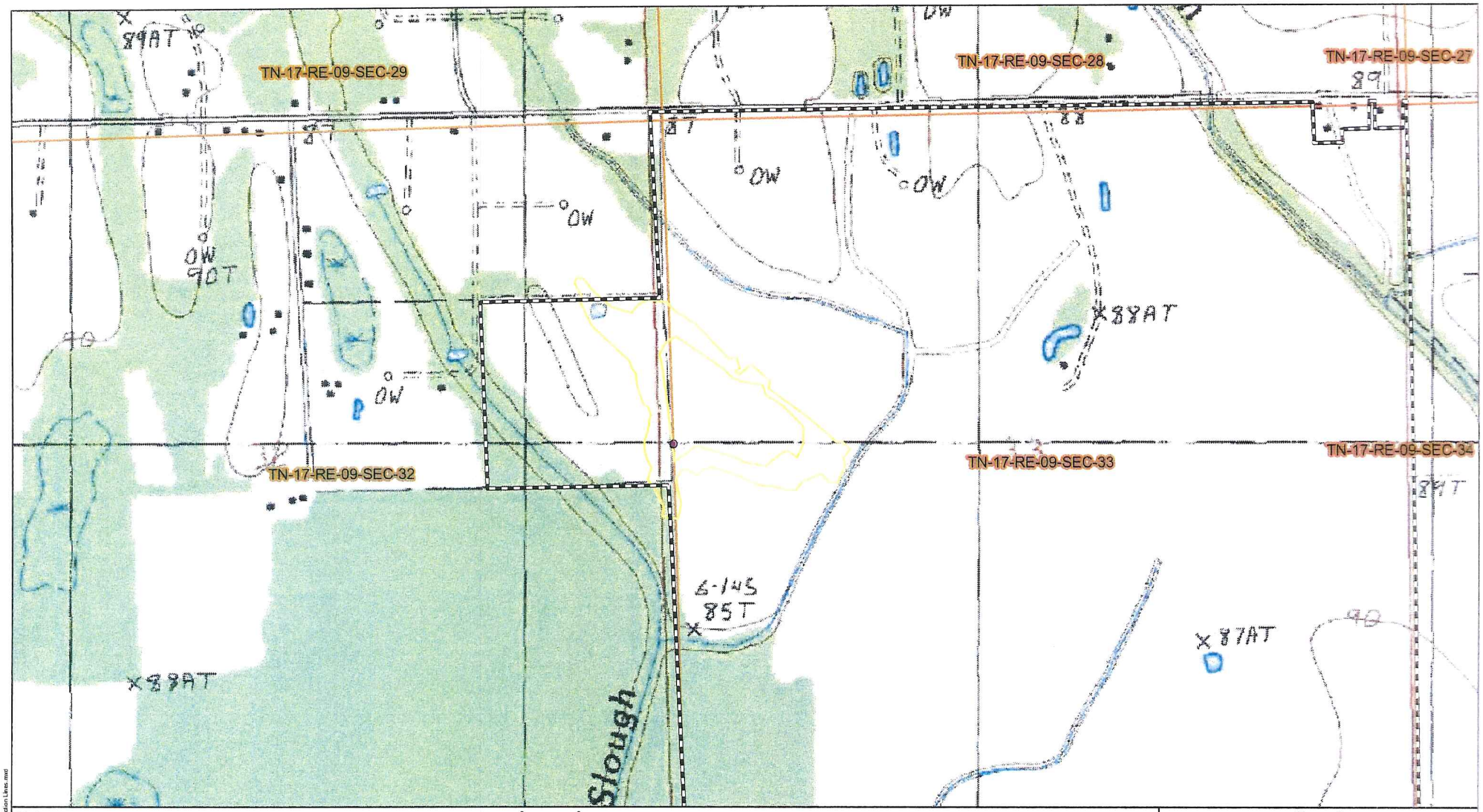

Notes:
Topographic map from USDA (http://datagateway.nrcs.usda.gov)
Quadrangle: Dunn
Approximate area affected by surface release georeferenced from 2014 Cork RECAP Site Investigation Report
Property line georeferenced from Messinger et al. 2/19/15 figure

0 500 1,000 2,000 Feet

Legend

- Release Location
- Property Line
- Approximate Area Affected by Surface Release
- Public Land Survey Sections

N

Figure 2
USGS Topographic Map and Section Lines
Martha Zoe Moore, et al. vs. Denbury Onshore, LLC
Richland Parish, Louisiana

MICHAEL PISANI & ASSOCIATES, INC.
Environmental Consulting Services
Houston, Texas New Orleans, Louisiana Baton Rouge, Louisiana

Designed: SAW	Drawn: SAW	Checked: DGA	Date: 4/10/2015	Project: 145-02

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Soil data from USDA Soil Data Mart (http://soildatamart.nrcs.usda.gov)
Basemap imagery via ArcGIS Online
Approximate area affected by surface release georeferenced from 2014 Cork RECAP Site Investigation Report
Property line georeferenced from Messinger et al. 2/19/15 figure

0 250 500 1,000 Feet

Legend

- Release Location
- Approximate Area Affected by Surface Release
- Property Line

N

Figure 3
USDA Surface Soil Types
Martha Zoe Moore, et al. vs. Denbury Onshore, LLC
Richland Parish, Louisiana

MICHAEL PISANI & ASSOCIATES, INC.
Environmental Consulting Services
Houston, Texas New Orleans, Louisiana Baton Rouge, Louisiana

Designed: SAW	Drawn: SAW	Checked: DGA	Date: 5/21/2015	Project: 145-02

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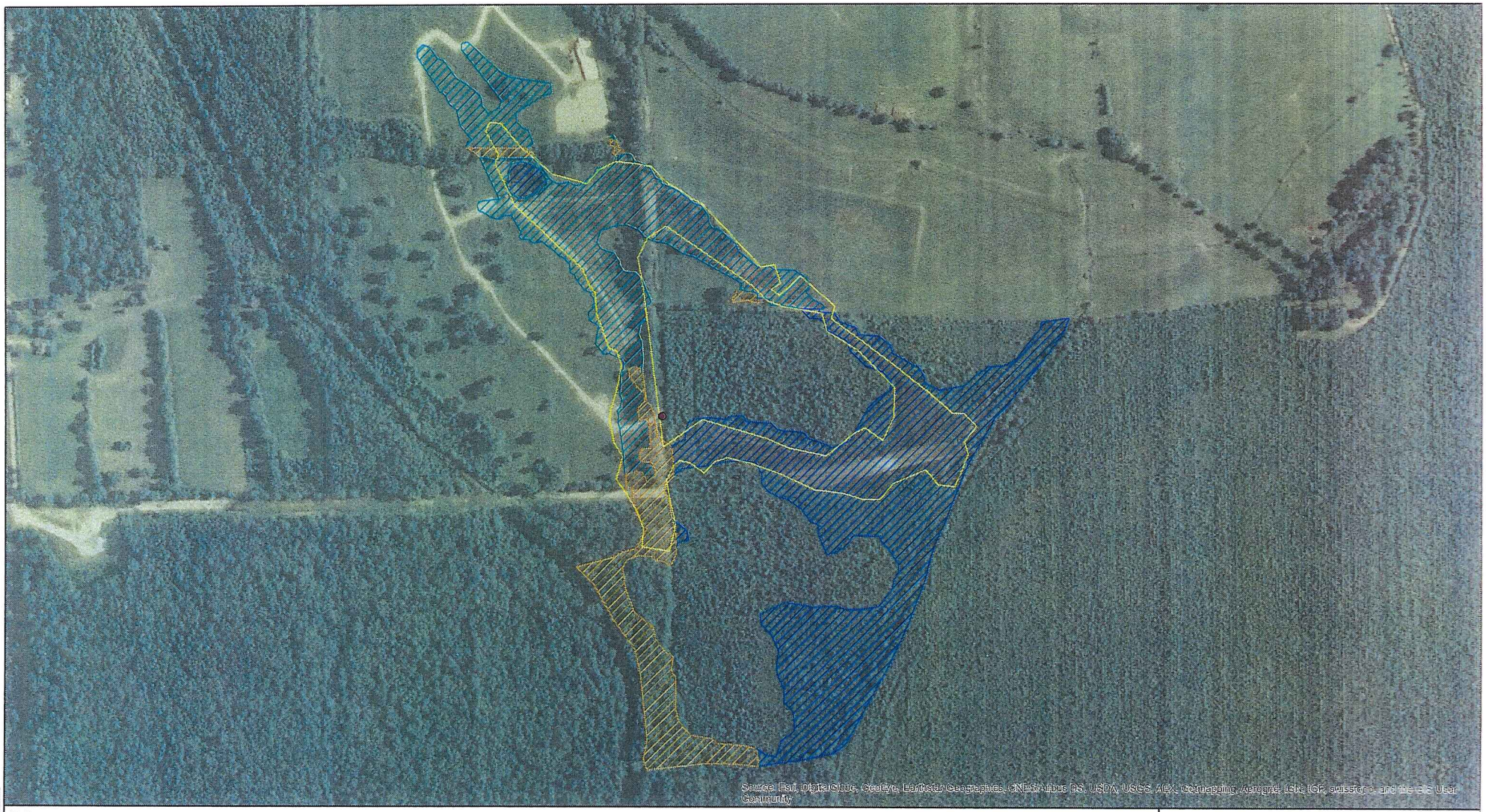

Notes:
Wetlands georeferenced from Messinger & Associates, Inc.
Wetalds Delineation Report, June 2013

0 250 500 1,000 Feet

Legend

- Release Location
- Approximate Area Affected by Surface Release

Wetlands

- Forested Wetland
- Herbaceous Wetland
- Scrub-Shrub Wetland

N

Figure 4
Wetlands Delineation
Martha Zoe Moore, et al. vs. Denbury Onshore, LLC
Richland Parish, Louisiana

MICHAEL PISANI & ASSOCIATES, INC.
Environmental Consulting Services
Houston, Texas New Orleans, Louisiana Baton Rouge, Louisiana

Designed: SAW	Drawn: SAW	Checked: DGA	Date: 5/21/2015	Project: 145-02

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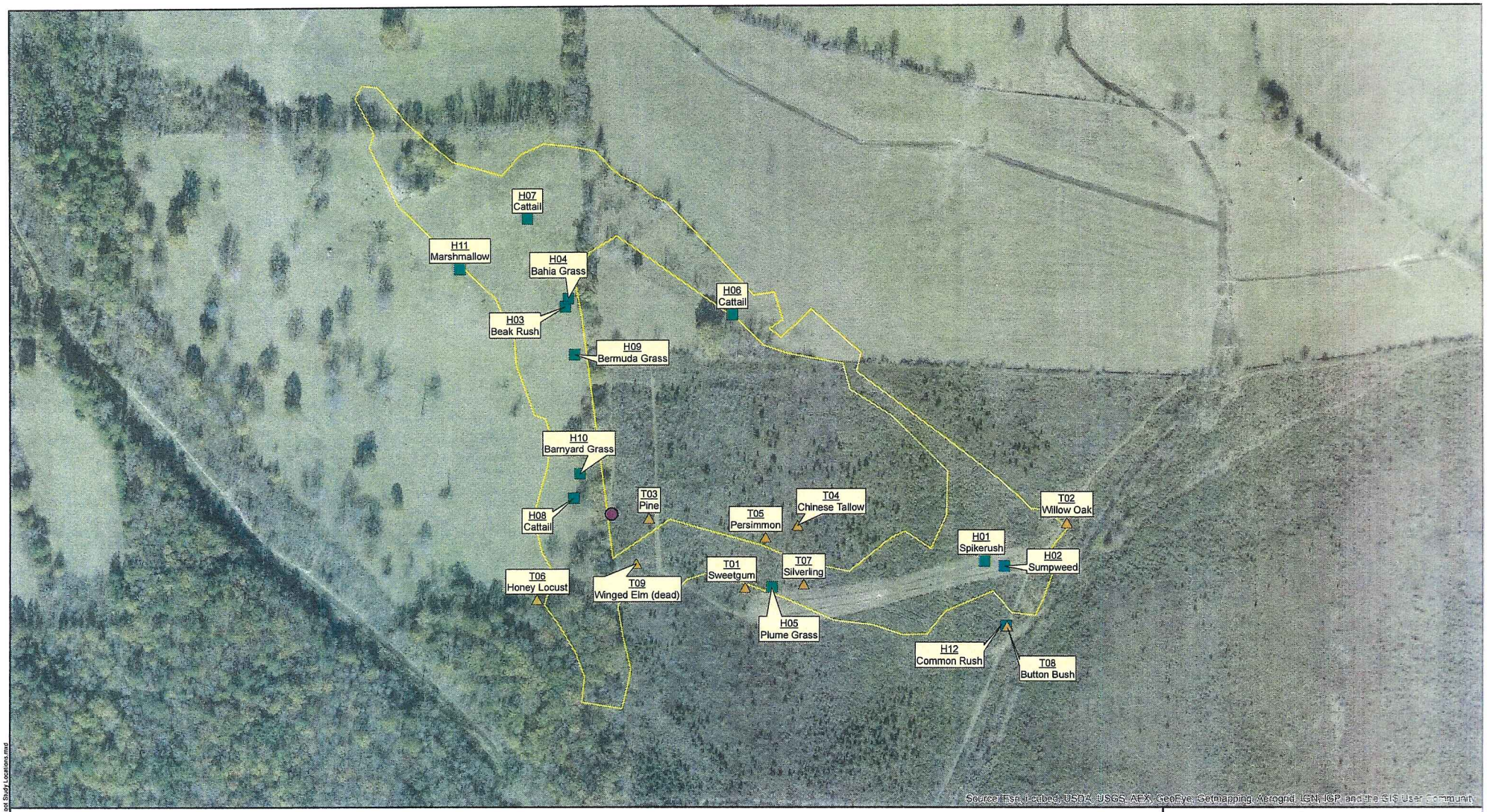

Imagery basemap via ArcGIS Online
Approximate area affected by surface release georeferenced from
2014 Cork RECAP Site Investigation Report

0 250 500 1,000 Feet

Legend

- Root Study Location (Tree/Bush)
- Root Study Location (Grass/Herb)
- Release Location
- Approximate Area Affected by Surface Release

N

Figure 5
Dr. Holloway Root Study Locations
Martha Zoe Moore, et al. vs. Denbury Onshore, LLC
Richland Parish, Louisiana

MICHAEL PISANI & ASSOCIATES, INC.
Environmental Consulting Services
Houston, Texas New Orleans, Louisiana Baton Rouge, Louisiana

Designed: SAW	Drawn: SAW	Checked: DGA	Date: 8/7/2015	Project: 145-02

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APPENDIX B

Table

Table 1. Tree and Herbaceous Species Effective Root Zones (ERZs)

Tree/Herb. No.	Species	ERZ (in.)
T01	Sweetgum	6
T02	Willow oak	7
T03	Loblolly pine	7
T04	Chinese tallow	5
T05	Persimmon	6
T06	Honey locust	6
T07	Silverling	6
T08	Buttonbush	6
T09	Winged elm	4
H01	Spikerush	5
H02	Sumpweed	5
H03	Beaksedge	4
H04	Bahia Grass	6
H05	Plumegrass	6
H06	Cattail	8
H07	Cattail	7
H08	Cattail	6
H09	Bermuda Grass	8
H10	Barnyard Grass	7
H11	Marshmallow	8
H12	Common rush	6

APPENDIX C

PHOTOGRAPHS

ROOT DATA SHEETS

Photo C-1. Tree T01 Sweetgum located on south central edge of release area.

Photo C-2. Depth to deepest root of Tree T01.

Photo C-3. Facing E at edge of release area by T01.

Photo C-4. Willow oak (Tree T02) located on east side of release area.

Photo C-5. Maximum root depth of Tree T02.

Photo C-6. View of vegetation growing in release site by Tree T02.

Photo C-7. Tree T03, Loblolly Pine.

Photo C-8. Depth of root 01 on Tree T03.

Photo C-9. Depth of root 02 on Tree T03.

Photo C-10. Chinese tallow tree (T04) growing beside Loblolly Pine.

Photo C-11. View of maximum depth of root on Tree T04.

Photo C-12. Vegetation growing beside Tree T04, Chinese tallow.

Photo C-13. Tree T05, persimmon growing N of release zone.

Photo C-14. View of exposed root of Tree T05, Persimmon.

Photo C-15. Maximum depth of root on Tree T05.

Photo C-16. Tree T06, honey locust, growing in pasture at edge of release site.

Photo C-17. Typical root at surface on Tree T06.

Photo C-18. Section of root just under ground on Tree T06.

Photo C-19. Section of root 13 ft. from bole of Tree T06.

Photo C-20. Section of smaller root near surface on Tree T06.

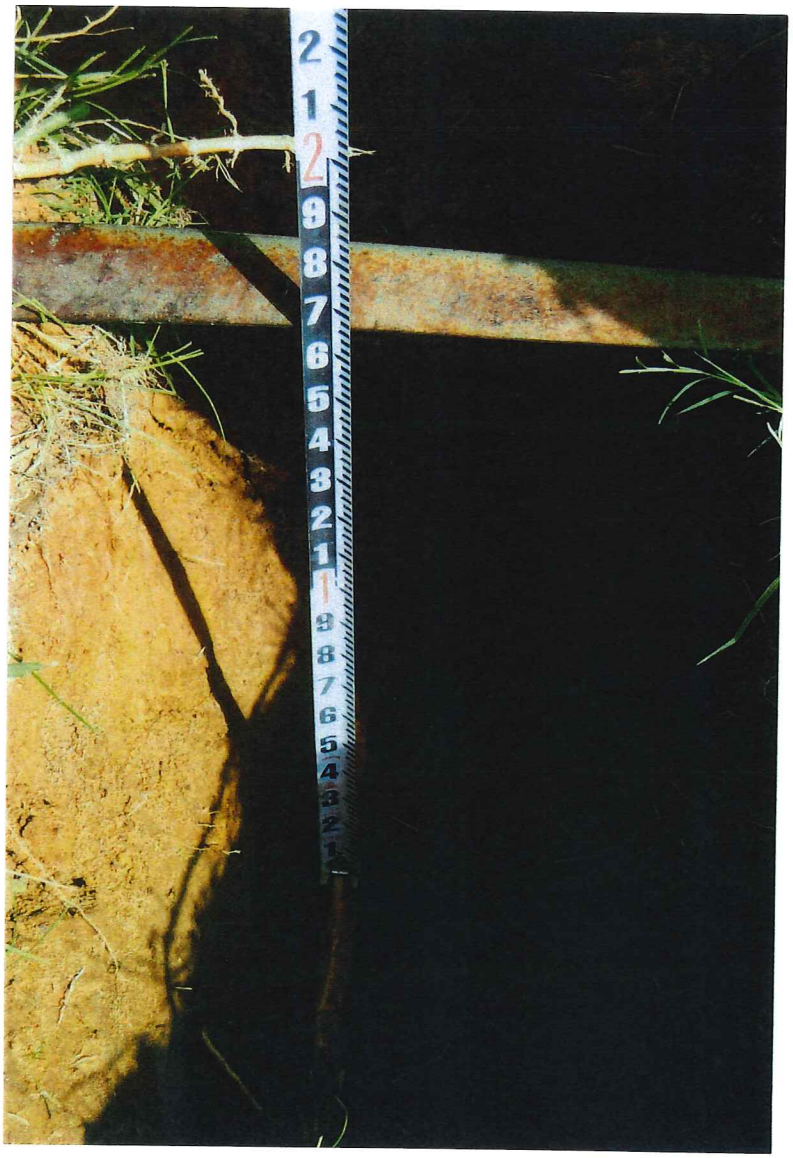

Photo C-21. Section of atypical root at greatest depth on Tree T06.

Photo C-22. Tree T07 (Silverling) located in S central area of release.

Photo C-23. View at T07 in release area facing N.

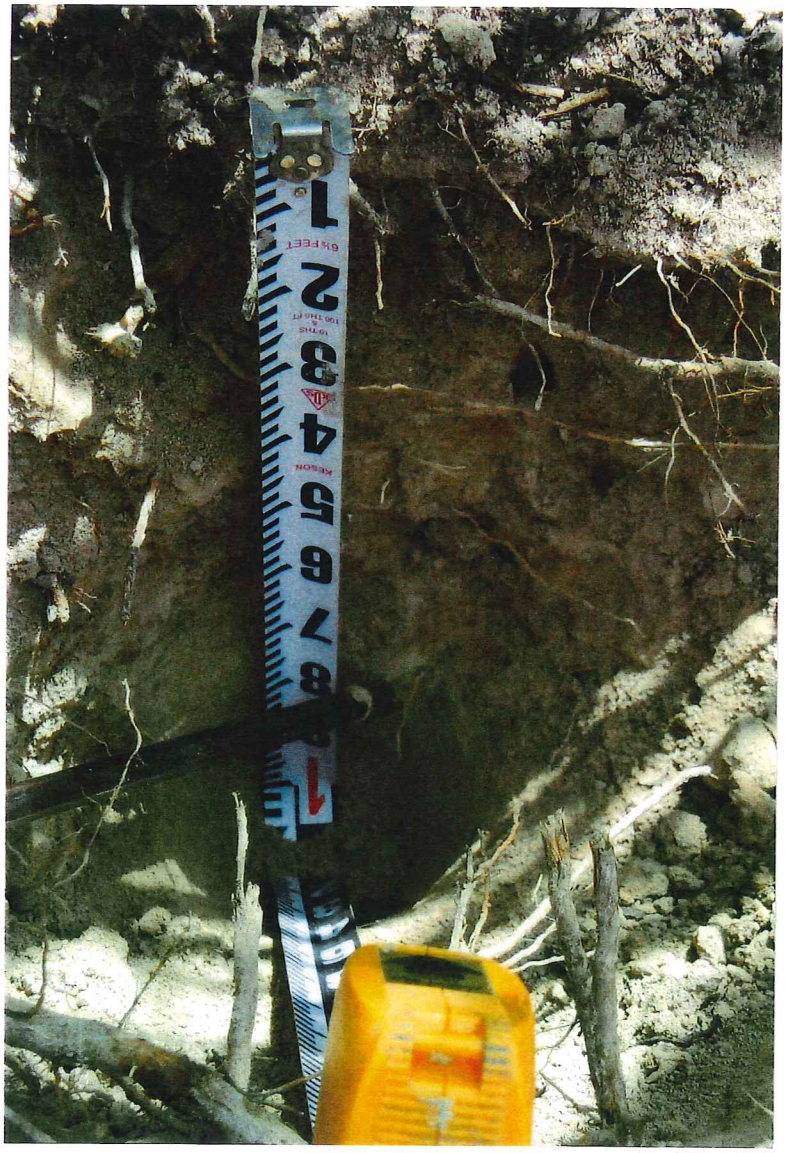

Photo C-24. Profile showing roots on T07.

Photo C-25. Shallow roots growing from Tree T07.

Photo C-26. Buttonbush, Tree T08 growing at SE side of release area.

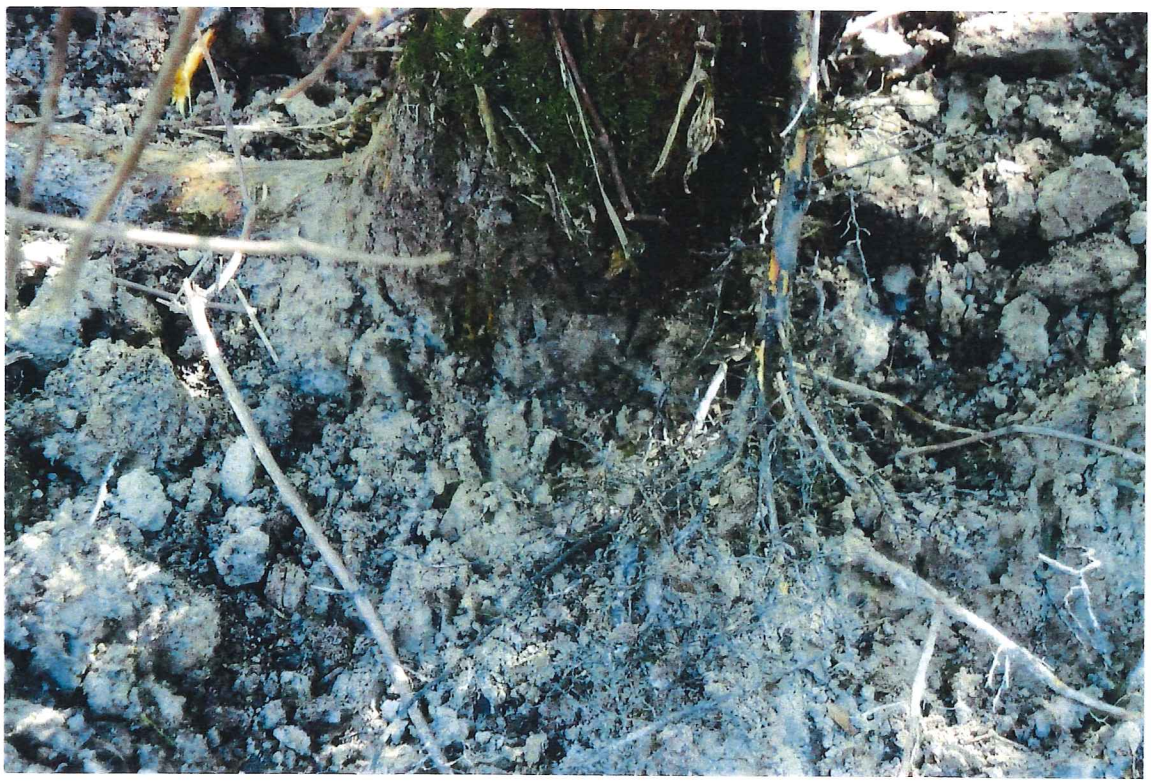

Photo C-27. Typical root pattern and distribution of Tree T08.

Photo C-28. Root in tire rut and filled crack, Buttonbush, T08.

Photo C-29. Tree T09, dead winged elm in release zone.

Photo C-30. Depth of deepest root of Tree T09, Winged Elm.

Photo C-31. View of deepest root of Tree T09.

Photo C-32. Section of very shallow typical root of Tree T09.

Photo C-33. View of vegetation by Tree T09 facing E in release zone.

Photo C-34. Spikerush, H01, growing on SE side of release zone.

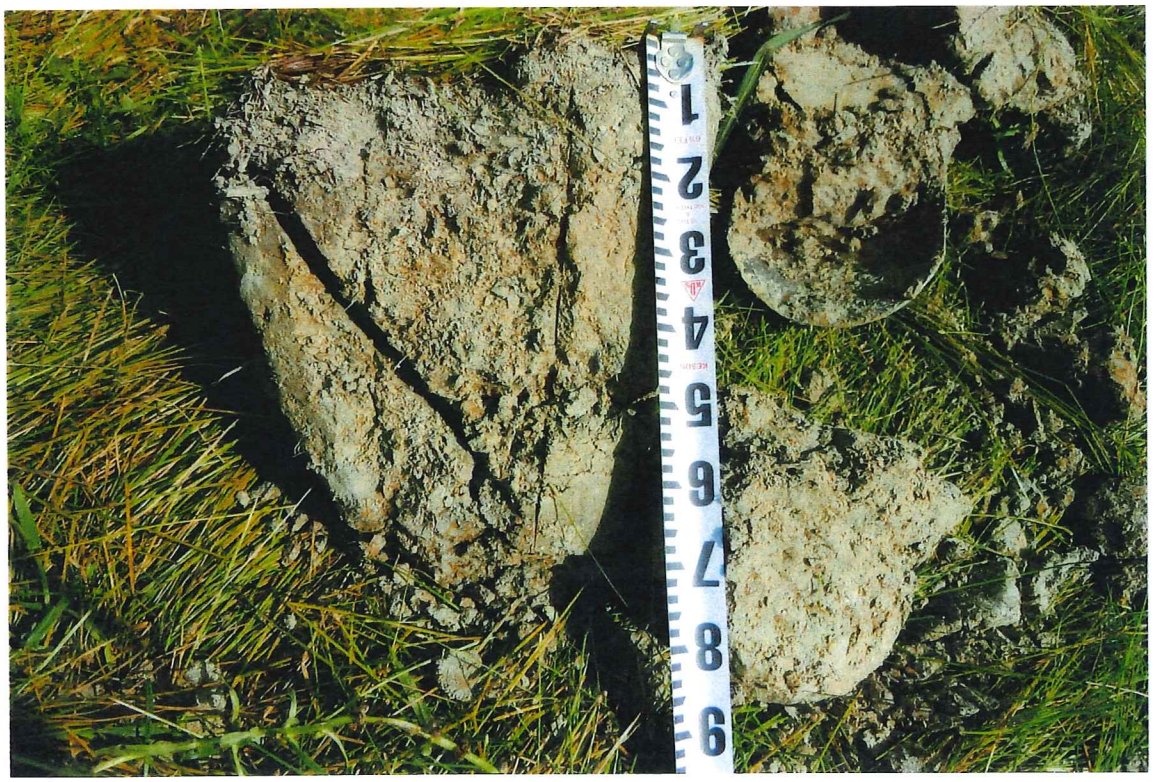

Photo C-35. Profile of soil at H01 site.

Photo C-36. Sumpweed growing in release area.

Photo C-37. Soil profile of Sumpweed.

Photo C-38. Beakrush (H02) growing in NW side of release area.

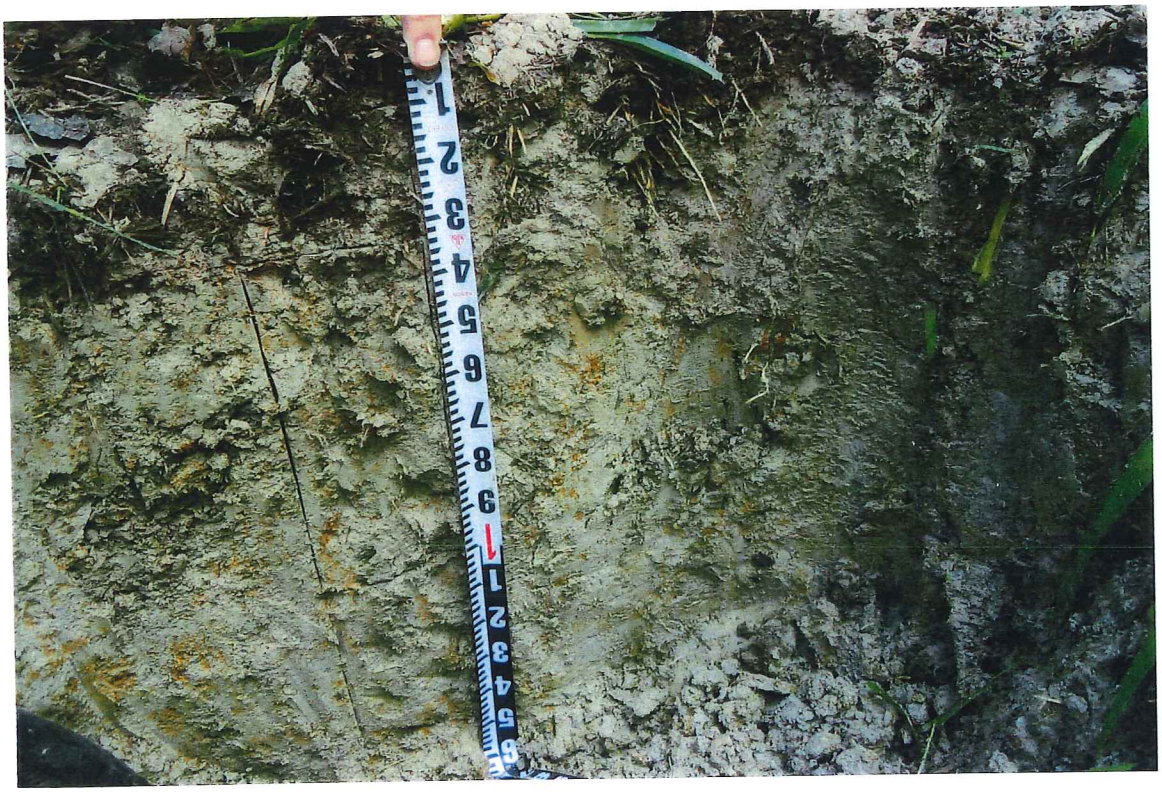

Photo C-39. Soil profile at H03 site.

Photo C-40. Bahiagrass (H04) growing on NW side of release site.

Photo C-41. Profile of bahiagrass shown horizontally.

Photo C-42. Vegetation in fence row E of Site H04.

Photo C-43. Marsh area facing S from Site H04.

Photo C-44. Plumegrass (H05) growing in S. central area of release.

Photo C-45. Vegetation growing in area of H05.

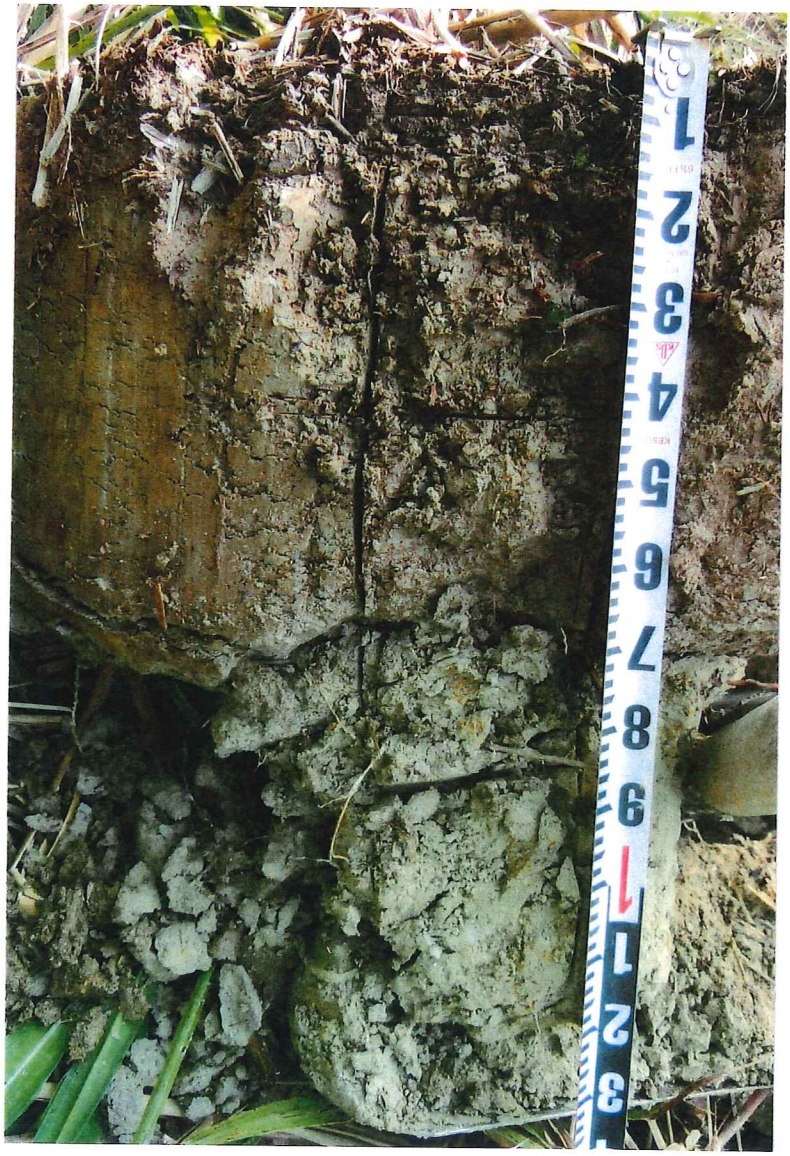

Photo C-44. Soil profile under plumegrass (H05) area.

Photo C-45. Facing N at area of cattail review (H06).

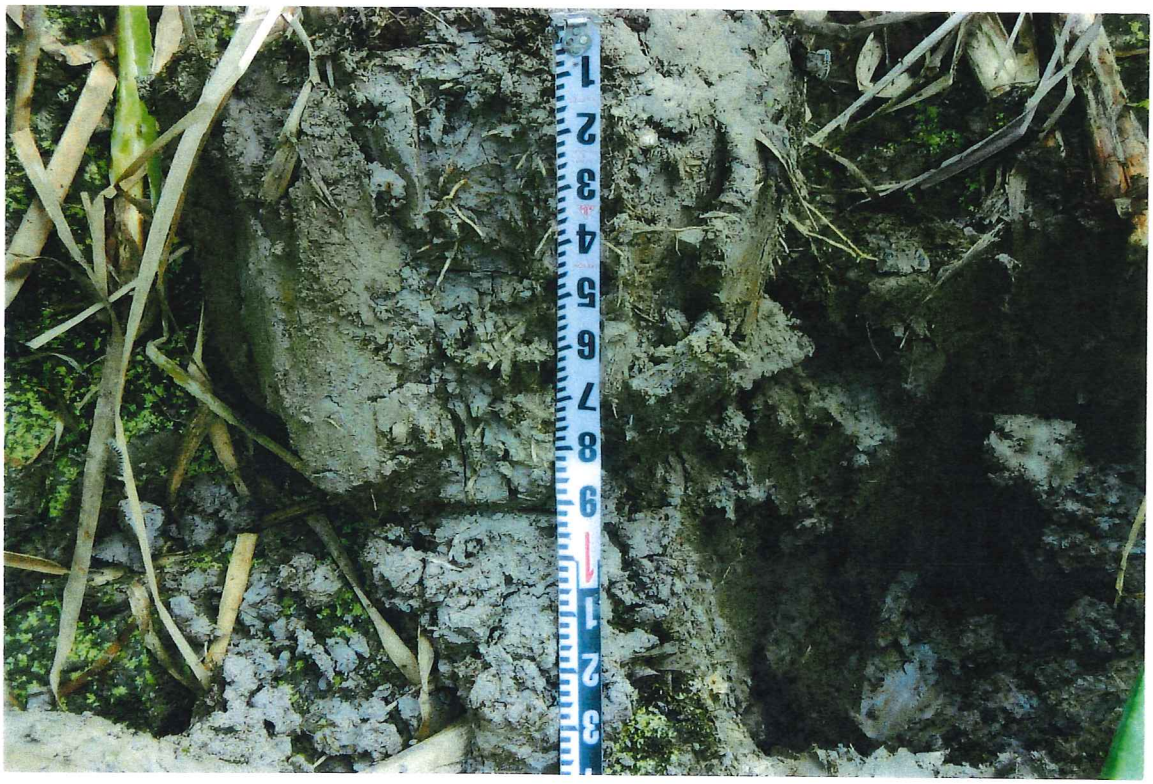

Photo C-46. Soil profile under area H06.

Photo C-47. Stand of cattail for H07 facing N.

Photo C-48. Area N of H07 site.

Photo C-49. Soil profile at H07.

Photo C-50. Additional deeper part of soil profile at H07.

Photo C-51. Larva of Henry's marsh moth feeding on leaves.

Photo C-52. Stand of cattail in area of H08.

Photo C-53. Soil profile of H08.

Photo C-54. Dense stand of Bermuda grass at H09.

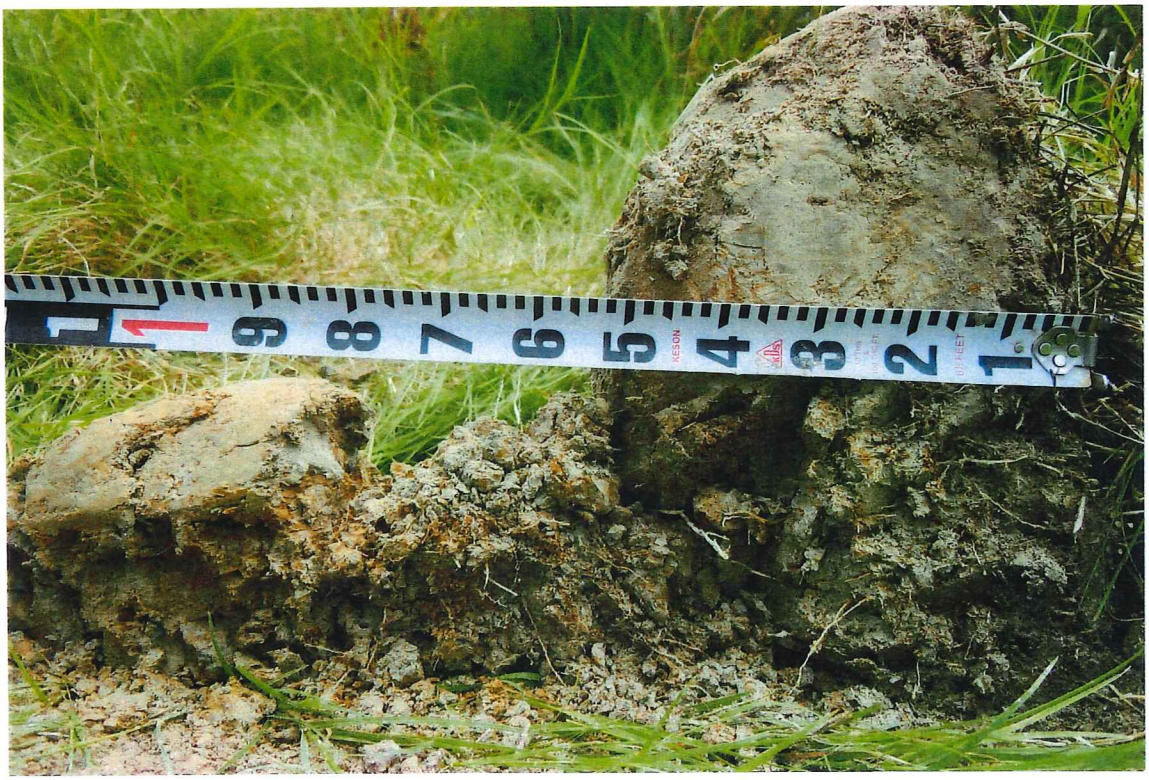

Photo C-55. Root profile at H09.

Photo C-56. View of vegetation looking N from H09.

Photo C-57. View of vegetation looking W from H09.

Photo C-58. Stand of Barnyard grass facing SW (H10).

C-59. Soil profile at H-10

Photo C-60. Stand of Marshmallow (H11) facing NE.

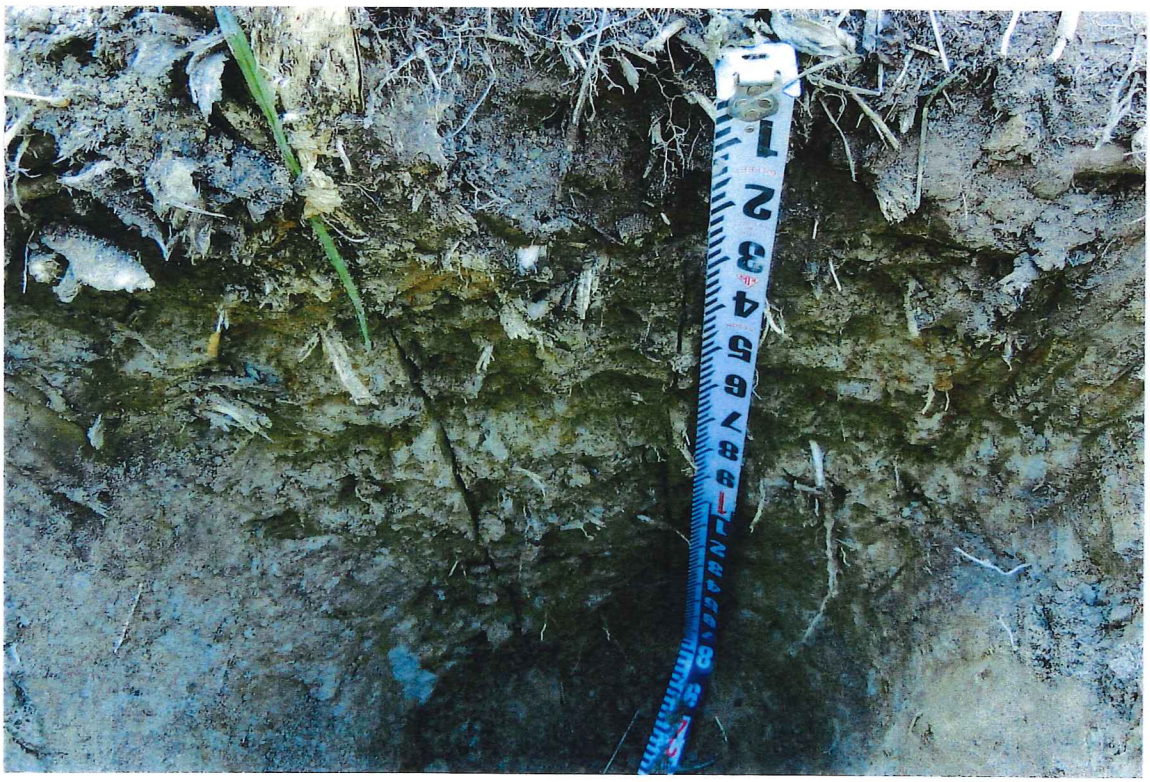

Photo C-61. Profile of root zone at H11.

Photo C-62. Stand of Common Rush (H12).

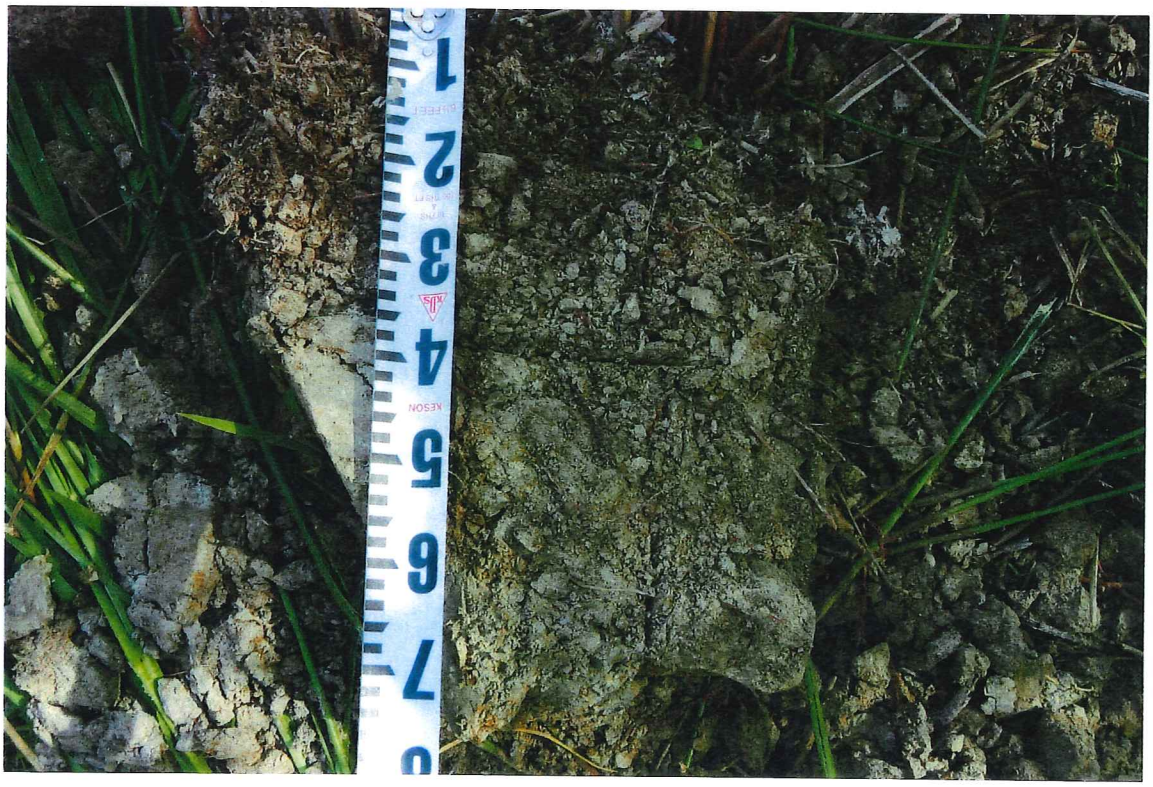

Photo C-63. Soil profile at H-12.

Photo C-64. Vegetation facing N at H12.

Photo C-65. Vegetation facing S at H12.

APPENDIX C

ROOT DATA SHEETS

TREE ROOT FORM

Date 7.6.15 Observ. No. T01 By Holloway

Property Moore Coords. 32.41309 91.55983

Other Info.

Species Sweetgum DBH/Circ. 1.6' (6.1" dbh)

Root No. 01 Distance From Bole 1.2' Depth Top of Root 0.6' (7.2")

Depth Bottom of Root 0.65' (7.8") Root Dia./Circ. 0.35' (4.2")

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

Frag:pan/Resistance 0.45' & 2.1'

TREE ROOT FORM

Date 7.6.05 Observ. No. T02 By Holloway

Property Moore Coords N 32.41356 W 91.75691

Other Info.

Species Willow Oak DBH/Circ. 1.6' (6.1" dbh)

Root No. 01 Distance From Bole 3.3' Depth Top of Root 0.65' (7.8")

Depth Bottom of Root 0.70 (8.4") Root Dia./Circ. 0.15

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

TREE ROOT FORM

Date 7.7.15 Observ. No. T03 By Holloway

Property Moore Coords. 32.41364 91.56069

Other Info.

Species Pine DBH/Circ. 2.05 (7.8" dbh)

Root No. 01 Distance From Bole 4.3' Depth Top of Root 0.6' (7.2")

Depth Bottom of Root 0.65' (7.8") Root Dia./Circ. 0.22'

smaller
Root No. 02 Distance From Bole 4.7 Depth Top of Root 0.75 (9.0")

Depth Bottom of Root 0.78 (9.36") Root Dia./Circ. 0.09'

Notes:

TREE ROOT FORM

Date 7.7.15 Observ. No. T04 By Holloway

Property Moore Coords. 32.41357 91.55935

Other Info.

Species Chinese Tallow DBH/Circ. 2.0' (7.6" dbh)

Root No. 01 Distance From Bole ~~0.45'~~ 9.5' Depth Top of Root 0.45' (5.4")

Depth Bottom of Root 0.55 (6.6") Root Dia./Circ. 0.32

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

TREE ROOT FORM

Date 7.8.15 Observ. No. T05 By Holloway

Property Moore Coords. 32.41348 91.55964

Other Info. _____

Species Persimmon DBH/Circ. E 0.66' (252" dbh) W 0.76' (2.9" dbh)

Root No. 01 Distance From Bole 6.1' Depth Top of Root 0.58' (6.96")

Depth Bottom of Root 0.59 (7.1") Root Dia./Circ. N/A*

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

*Small root - not measured

TREE ROOT FORM

Date 7.8.15 Observ. No. T06 By Holloway

Property Moore Coords. 32.41302 91.56171

Other Info.

Species Honeylocust DBH/Circ. 4.6" (17.57"/66)

Root No. 01 Distance From Bole 20.5' Depth Top of Root 1.66' (19.9")

Depth Bottom of Root 1.72' (20.6") Root Dia./Circ. 0.22

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

TREE ROOT FORM

Date 7.9.15 Observ. No. T07 By Holloway

Property Moore Coords. 32.41311 91.55930

Other Info.

Species Silverling DBH/Circ. N/A 0.5"(1.9" dbh)*

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

* Measured below typical dbh

0-6" Uneven distribution around shrub.
6-12" Sparse to very sparse roots

TREE ROOT FORM

Date 7.10.15 Observ. No. T08 By Holloway

Property Moore Coords. 32.411277 91.557462

Other Info.

Species Buttonbush DBH/Circ. N/A*

Root No. 01 Distance From Bole 2.65 Depth Top of Root ** 2.1' (25.2") End of Root

Depth Bottom of Root N/A Root Dia./Circ.

Root No. _____ Distance From Bole _____ Depth Top of Root 0.35'

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes: * Not measured
** Anomaly Rest of roots .4-.8'

TREE ROOT FORM

Date 7.10.15 Observ. No. T089 By Holloway

Property Moore Coords. 32.41329 91.56081

Other Info. _____

Species Winged Elm DBH/Circ. 1.14' (4.4")

Root No. 01 Distance From Bole 9.1' Depth Top of Root 0.35' (4.2")

Depth Bottom of Root 0.40 (4.8") Root Dia./Circ. 0.14'

Root No. _____ Distance From Bole _____ Depth Top of Root _____

Depth Bottom of Root _____ Root Dia./Circ. _____

Notes:

Dead Tree

PLANT ROOT FORM

Date: 7.7.15 Observation No. #01 By: Holloway

Property: _____ Coords. 32.41327 W91.55766

Other Info. Spikerush

0 - 0.1' Abundant
0.1 - 0.3' Common to Sparse
0.3 - 0.55' Sparse
0.55 - 0.7' Very Sparse
0.7 - 0.9' Very sparse to none

PLANT ROOT FORM

Date: 7.7.15 Observation No. H02 By: Holloway

Property: Moore Coords. 32.41323 91.5[illegible]748

Other Info. Iva annua (Sumpweed)

0 - 0.05' Abundant
0.05 - 0.25' Common
0.25 - 0.4' Sparse
0.4 - 0.6' Very Sparse
0.6 > Very Sparse to None

PLANT ROOT FORM

Date: 7.7.15 Observation No. H03 By: Holloway

Property: Moore Coords. 32.41528 91.56142

Other Info. Beakrush

0 - 0.1' Abundant
0.1 - 0.32' Common
0.32 > None (few across + down profile)

PLANT ROOT FORM

Date: 7.7.15 Observation No. H04 By: Holloway

Property: _____ Coords. 32.41534 91.56139

Other Info. Bahia grass

0-0.25' Abundant
0.25-0.5' Common
0.5 – 1.1' Sparse
1.1 – 1.3' Sparse to None

PLANT ROOT FORM

Date: 7.7.15 Observation No. H05 By: Holloway

Property: Moore Coords. 32.413097 91.55959

Other Info. Plumegrass

0 - 0.1' Abundant
0.1 - 0.4' Common
0.4 - 0.85' Sparse
0.85 - 1.2' One small root hair in zone

PLANT ROOT FORM

Date: 7.8.15 Observation No. H08 By: Holloway

Property: Moore Coords. 32.41520 91.55991

Other Info. Cat-tail

0-0.1' Very Abundant
0.1-0.5' Common
0.5-1.0' Common to sparse
1.0-1.4' Very Sparse to None

PLANT ROOT FORM

Date: 7.8.15 Observation No. H07 By: Holloway

Property: Moore Coords. 32.41596 91.56175

Other Info. Cat-tail

0-0.1' Very Abundant
0.1-0.55' Common
0.55-0.9' Sparse
0.9-1.0 Sparse to Very Sparse
1.0-1.55 Very sparse to None

PLANT ROOT FORM

Date: 7.8.15 Observation No. H08 By: Holloway

Property: Moore Coords. 32.41380 91.56137

Other Info. Cat-tail

0-0.15' Very Abundant
0.15-0.4' Common
0.4-0.7' Sparse
0.7-1.2' Very Sparse to None
(1 Root Hair in Zone)

PLANT ROOT FORM

Date: 7.9.05 Observation No. H09 By: Holloway

Property: Moore Coords. 32.41491 91.56131

Other Info. Bermuda

0-0.05' Very Abundant
0.05-0.35' Common
0.35-0.85' Sparse to Common
0.85-0.95' Sparse
0.95-1.3 Very Sparse to None

PLANT ROOT FORM

Date: 7.9.15 Observation No. H10 By: Holloway

Property: Moore Coords. 32.41399 91.56131

Other Info. Barnyard Grass

0-0.15' Abundant to very Abundant
0.15-0.55' Common to Sparse
0.55-0.8' Sparse
0.8-1.35 Very sparse

PLANT ROOT FORM

Date: 7.9.15 Observation No. H11 By: Holloway

Property: Moore Coords. 32.41558 91.56237

Other Info. Hibiscus (marshmallow)

0-0.2' Very Abundant
0.2-0.6' Common
0.6-1.1' Very Sparse
1.1-1.6' Sparse
1.6> Very Sparse (2 rootlets in zone)

PLANT ROOT FORM

Date: 7.9.15 Observation No. H12 By: Holloway

Property: Moore Coords. 32.41277 91.55747

Other Info. Rush (Common Rush)

0-0.2' Very Abundant
0.2-0.4' Common
0.4-0.8 Sparse to Very Sparse

APENDIX D

TESTIMONY IN LAST FIVE YEARS

TESTIMONY IN LAST FIVE YEARS
(Depositions)

CAROLYN R. BUNCH ET AL.

V.

BRIGHTON ENERGY CO. ET AL.

DOCKET NO. C-43-11
31ST JUDICIAL DISTRICT COURT
PARISH OF JEFFERSON DAVIS
STATE OF LOUISIANA

STERLING SUGARS, INC.

V.

BP AMERICA PRODUCTION
COMPANY ET AL.

DOCKET NO. 113095
16TH JUDICIAL DISTRICT COURT
DIVISION "E"
PARISH OF ST MARY
STATE OF LOUISIANA

CLYDE TUCKER ET AL.

V.

SHELL OIL COMPANY ET AL.

DOCKET NO. 42934 "B"
3RD JUDICIAL DISTRICT COURT
PARISH OF UNION
STATE OF LOUISIANA

JOSEPH DUPONT ET AL.

V.

MOBILE & P SOUTHEAST, INC. ET AL.

DOCKET N0. 52,090
18TH JUDICIAL DISTRICT COURT
PARISH OF IBERVILLE
STATE OF LOUISIANA