Royal Consulting Services, Inc.

MEMORANDUM

To: Clell Ford, Lakes Manager HCPNR

From: Richard Jones, PE

Re: IMWID – Phase II – Fill Assessment

Date: February 15, 2016

C: Brian Roy

General

The preliminary earthwork estimate for a minor impoundment berm to be constructed at the IMWID Phase II Impoundment site is 220,000 cubic yards of Selected fill. NRCS defines Select Backfill as soils that are free of debris, roots, organic matter, and peat of types CL, ML, and SC, according to ASTM D2487. CL corresponds to clays with low plasticity, which are typically sandy or silty clays. ML soils are typically silts, very fine sands, silty fine sands, or clayey fine sands. SC soils are typically clayey sands or clayey fine sands.

Picture 1 – IMWID Phase II site

The cost associated with constructing the impoundment berm is dictated by several site-specific factors, including the availability of suitable soils on site, proximity of the borrow site to the berm, and the depth of unsuitable topsoil to be removed. The typical and most cost effective method to construct an impoundment berm is to excavate a borrow ditch, either on the inside or outside of the impoundment, to supply the necessary earthfill. This construction method has several benefits including:

- Lowers the cost of the earthwork by eliminating or minimizing the loading and transporting of fill dirt
- Requires the least amount of construction equipment and operators compared to other methods
- Provides a ditch for drainage or seepage control, where needed

- Creates internal ditches and borrows that can be used as receiving ponds, settling basins, and conveyance ditches

Despite the benefits of constructing a ditch parallel to the berm, the NRCS recommends the ditch be separated from the berm such that a straight line drawn through the inside peak water stage and the outside toe of the berm does not intersect the adjacent ditch. This is a "rule of thumb" that is abundantly cautious, but it does illustrate the concern about excavation near the impoundment berm. Anderson Andre Consulting Engineers, Inc. (AACE), the geotechnical consultant for the IMWID Phase II project, will provide guidance as to suitable borrow sites locations and recommended separation distance from the berm.

This memo will assume the earthfill used for the construction of the impoundment berm will be from a nearby borrow ditches. The purpose of this memo is to review the field data collected, observations, and conclusions of Royal Consulting Services, Inc. (RCS), the design engineering firm for the project. It does not, however, supersede data, reports, or conclusions by AACE.

NRCS Soils Data

The NRCS soil map for the impoundment site is shown in **Figure 1**. It indicates that there are two predominate soils types on the site: Tequesta Muck and Kaliga Muck. Arents refers to highly sloping land, which, in this case, is the existing C-41A spoil berm. Kaliga occupies approximately 70% of the property and Tequesta 30%. The official U.S. Government description for each is as follows:

- Kaliga Muck – very deep, very poorly drained, slow permeable soils. Moderately thick deposits of sapric material with underlying loamy and clayey materials. The high organic and muck soil layer is normally 0 to 26 inches deep.
- Tequesta Muck – very deep, very poorly drained, slow permeable soils. Formed in stratified marine sandy and loamy sediments. The high organic and muck soil layer is normally 0 to 12 inches deep with steaks down to 25 inches deep.

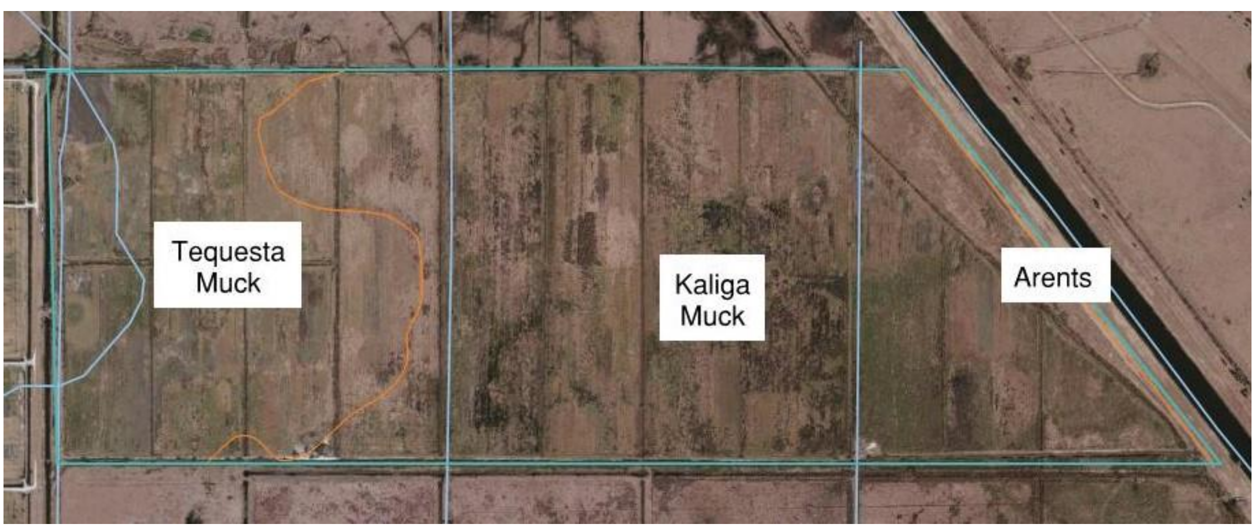

Figure 1 - NRCS Soil Map

Soil Excavations

To complete an initial investigation of the soil conditions on the site, RCS used a tractor mounted backhoe and excavated 34 sites along the perimeter of the property. The excavation sites were along the approximate location of the proposed impoundment berm and evenly spaced 600 feet apart, where possible. The holes were dug to a depth of at least 4 feet, conditions permitting, photographed, and the engineer's observations recorded. The location of each test hole was recorded by GPS and plotted by AutoCAD on an aerial map for future reference. **Table 1** provides a summary of the data collected for each site. The figure in **Appendix A** shows the location of the excavations on the property. **Appendix B** contains the photographs of each test hole.

Table 1

Site #	North			West			Picture IDs	Comments & Observations
	deg	min	sec	deg	min	sec		
1	27	17	2.17	81	14	2.04	Site 1a, 1b	0"-16" Organic Topsoil, 16"-48" Fine Sand w/ Cohesion
2	27	16	56.05	81	14	1.89	none	0"-16" Organic Topsoil, 16"-30" Organic, 30"-84" Marl/Clay
3	27	16	54	81	14	1.87	Site 3a, 3b	0"-16" Organic Topsoil, 16"-24" Light Sand, 24"-40" Fibrous Organic, 40"-60" Dark Sand
4	27	16	53.58	81	13	55.52	Site 4a, 4b	0"-16" Organic Topsoil, 16"-60" Fine Sand w/ Cohesion
5	27	16	53.73	81	13	48.54	Site 5a, 5b	0"-16" Organic Topsoil, 16"-32" Brown Sand, 32"-84", Fine Sand w/ Cohesion
6	27	16	53.79	81	13	41.6	Site 6a, 6b	0"-24" Organic Topsoil, 24"-72" Fine Sand w/ Cohesion
7	27	16	53.8	81	13	40.72	Site 7a, 7b	0"-16" Organic Topsoil, 16"-32" Light Sand, 32"-72" Fine Sand w/ Cohesion
8	27	16	54.05	81	13	39.01	Site 8a, 8b	0"-16" Organic Topsoil, 16"-22" Light Sand, 22"-36" Fine Sand w/ Cohesion
9	27	16	53.94	81	13	34.31	Site 9a, 9b	0"-16" Organic Topsoil, 16"-32" Light Sand, 32"-62" Fine Sand w/ Cohesion
10	27	16	53.86	81	13	27.03	Site 10a, 10b, 10c	0"-16" Organic Topsoil, 16"-28" Light Sand, 28"-48" Fine Sand w/ Cohesion
11	27	16	53.5	81	13	19.46	Site 11a, 11b	0"-21" Organic Topsoil, 21"-32" Dark Sand, 32"-62" Fine Sand w/ Cohesion
12	27	16	53.85	81	13	12.45	Site 12a, 12b	0"-24" Organic Topsoil, 24"-48" Fine Sand w/ Cohesion
13	27	16	53.81	81	13	4.27	Site 13a, 13b, 13c	0"-30" Organic Topsoil, 30"-57" Fine Sand w/ Cohesion
14	27	16	54.25	81	12	57.38	Site 14a, 14b, 14c	0"-27" Organic Topsoil, 27"-36" Dark Sand, 36"-72" Fine Sand w/ Cohesion
15	27	16	54.14	81	12	50.43	Site 15a, 15b	0"-10" Organic Topsoil, 10"-36" Dark Sand
16	27	16	53.79	81	12	44.85	Site 16a	0"-12" Organic Topsoil, 12"-32" Light Sand, 32"-48" Dark Sand
17	27	16	53.85	81	12	41.4	Site 17a, 17b	0"-12" Organic Topsoil, 12"-36" Light Sand, 36"-48" Dark Sand
18	27	16	53.96	81	12	42.17	Site 18a, 18b	0"-20" Organic Topsoil, 20"-28" Light Sand, 28"-48" Dark Sand

Site #	North			West			Picture IDs	Comments & Observations
	deg	min	sec	deg	min	sec		
19	27	16	58.64	81	12	45.62	Site 19a, 19b	0"-20" Organic Topsoil, 20"-28" Light Sand, 28"-48" Dark Sand
20	27	17	3.42	81	12	50.23	Site 20a, 20b	0"-9" Organic Topsoil, 9"-48" Grey Sand
21	27	17	7.92	81	12	53.78	Site 21a, 21b	0"-20" Organic Topsoil, 20"-28" Light Sand, 28"-48" Dark Sand
22	27	17	11.82	81	12	57.48	Site 22a, 22b	0"-6" Organic Topsoil, 6"-22" Light Sand, 22"-48" Grey Sand w/ Some Blue Color
23	27	17	15.69	81	13	0.92	Site 23a, 23b	0"-8" Organic Topsoil, 8"-48" Brown Sand
24	27	17	17.05	81	13	4.59	Site 24a, 24b	0"-6" Organic Topsoil, 6"-26" Brown Sand, 26"-34" Light Sand, 34"-48" Grey Sand w/ Some Blue Color
25	27	17	16.58	81	13	8.59	Site 25a, 25b	0"-6" Organic Topsoil, 6"-40" Brown Sand, 40"-48" Grey Sand w/ Some Blue Color
26	27	17	16.94	81	13	12.52	Site 26a, 26b	0"-8" Organic Topsoil, 8"-58" Brown Sand
27	27	17	16.83	81	13	20	Site 27a, 27b	0"-8" Organic Topsoil, 8"-20" Light Sand, 20"-48"Brown Sand
28	27	17	16.85	81	13	26.28	Site 28a, 28b	0"-12" Organic Topsoil, 12"-24" Light Sand, 24"-48" Brown Sand w/ Cohesion
29	27	17	16.61	81	13	34.67	Site 29a, 29b, 29c	0"-6" Organic Topsoil, 6"-30" Light Sand, 30"-48" Brown Sand w/ Cohesion
30	27	17	17.14	81	13	42.33	Site 30a, 30b	0"-9" Organic Topsoil, 9"-29" Grey Sand w/ Some Blue Color, 29"-42" Coarse Sand w/ Shell, 42"-60" Grey Sand w/ Some Blue Color
31	27	17	16.44	81	13	48.98	Site 31a, 31b	0"-6" Organic Topsoil, 6"-51" Coarse Sand w/ Shell
32	27	17	16.55	81	13	55.91	Site 32a, 32b	0"-26" Organic Topsoil, 26"-56" Brown Sand
33	27	17	8.74	81	14	2.5	Site 33a, 33b	0"-6" Organic Topsoil, 6"-48" Brown Sand
34	27	17	12.53	81	14	2.16	Site 34a, 34b, 34c	Site was obviously filled in the past, 0"-16" Sandy Fill Dirt, 16"-26" Brown Sand w/ Cohesion, 26"-46" Dark Organic Soil, 46"-68" Brown Sand w/ Cohesion

Conclusions

The preliminary soil investigation produced significant and useful data about the existing conditions of the site and will be useful during the design and construction phases of the project. In general, the depth of the high organic and muck layer was found to be less than would be expected from the

NRCS soil map. The west and south sides appeared to have the most significant muck layers, but the depth was inconsistent. The deepest muck layers were found in Sites 11-14, 18, 19, and 21, though none exceeded 30 inches. The east and north sides of the property had a surprisingly thin organic topsoil layer. Only excavation Site 2 had organic soils deeper than 4 feet, where the tractor type backhoe could not find a suitable subsoil layer. This is partially due to the high water table conditions at the location. However, the soil conditions at Site 2 seemed to be an anomaly, limited to a small area; Site 3 was only 200 feet away and had sandy subsoil only 16 inches below ground level.

In general, the soil investigation allows RCS to make the following conclusions concerning the construction of the proposed treatment and reuse impoundment at the IMWID Phase II site:

- Muck top soils exist on the site, but their depths should not cause a significant impairment to the project
- Most of the subsoil found in the excavations appeared to RCS to be suitable for impoundment construction
- Deep muck was located in a few of the sites, but appeared to have a limited extent
- There is sufficient construction material on site that is easily accessed and would require only short hauling distances
- Although there was standing water on the land surface, the subsoil was surprisingly dry to a depth of approximately 4 feet.

Appendix A
Excavation Locations Drawing

JOB NO.	0202-02-ES
SCALE:	AS SHOWN
DATE	1-5-2016
DESIGN	R.A.J.
DRAWN	J.J.D.
CHECKED	
APPROVED	

NO.	DATE	REVISION

HIGHLANDS COUNTY BCC
ISTOKPOGA MARSH WATER
IMPOUNDMENT DISTRICT
IMPOUNDMENT PHASE II
HIGHLANDS COUNTY FLORIDA

CIVIL
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FOR REVIEW PURPOSES ONLY

Richard A. Jones
FL P.E. No. 31118

SHEET
G-3

Appendix B
Excavation Pictures

Picture Location: Site 1a

Picture Location: Site 1b

Picture Location: Site 3a

Picture Location: Site 3b

	
Picture Location: Site 4a	Picture Location: Site 4b
	
Picture Location: Site 5a	Picture Location: Site 5b

Picture Location: Site 6a

Picture Location: Site 6b

Picture Location: Site 7a

Picture Location: Site 7b

Picture Location: Site 8a

Picture Location: Site 8b

Picture Location: Site 9a

Picture Location: Site 9b

	
Picture Location: Site 10a	Picture Location: Site 10b
	
Picture Location: Site 11a	Picture Location: Site 11b

Picture Location: Site 12a

Picture Location: Site 12b

Picture Location: Site 13a

Picture Location: Site 13b

	
Picture Location: Site 13c	Picture Location: Site 14a
	
Picture Location: Site 14b	Picture Location: Site 14c

	
Picture Location: Site 15a	Picture Location: Site 15b
	
Picture Location: Site 16a	Picture Location: Site 17a

	
Picture Location: Site 17b	Picture Location: Site 18a
	
Picture Location: Site 18b	Picture Location: Site 19a

Picture Location: Site 19b

Picture Location: Site 20a

Picture Location: Site 20b

Picture Location: Site 21a

	
Picture Location: Site 21b	Picture Location: Site 22a
	
Picture Location: Site 22b	Picture Location: Site 23a

Picture Location: Site 23b

Picture Location: Site 24a

Picture Location: Site 24b

Picture Location: Site 25a

Picture Location: Site 25b

Picture Location: Site 26a

Picture Location: Site 26b

Picture Location: Site 27a

Picture Location: Site 27b

Picture Location: Site 28a

Picture Location: Site 28b

Picture Location: Site 29a

Picture Location: Site 29b

Picture Location: Site 29c

Picture Location: Site 30a

Picture Location: Site 30b

	
Picture Location: Site 31a	Picture Location: Site 31b
	
Picture Location: Site 32a	Picture Location: Site 32b

	
Picture Location: Site 33a	Picture Location: Site 33b
	
Picture Location: Site 34a	Picture Location: Site 34b

	
Picture Location: Site 34c	