MORSE BOULEVARD LAKE SUMTER SLOPE STABILITY ANALYSIS

Sumter Landing Community Development District

Prepared for:

Sumter Landing Community Development District

Prepared by:

Kimley-Horn and Associates, Inc.

142202018
July 2016

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THIS IS TO CERTIFY THAT THE ENCLOSED ENGINEERING CALCULATIONS WERE PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION

CHARLES TEMPLE FONTAINE III, P.E.
Florida Registration Number #73042
CA No. 00000696

DATE: 7/11/16

EXECUTIVE SUMMARY

Kimley-Horn was retained through IPO #22 to prepare a slope stability analysis of the Morse Boulevard embankment within Lake Sumter (the "Morse Island"). Our work included meetings with District staff, data collection, obtaining updated field survey (through a subconsultant) and obtaining geotechnical information (through a subconsultant). This report summarizes our findings and recommends alternatives to manage the erosion along the perimeter of Morse Island (Morse Boulevard) over Lake Sumter within The Villages, Sumter County, Florida.

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ANALYSIS

Goals and Objectives

The goal and objective of the project is to halt and prevent further erosion along the perimeter of Morse Island experienced during average high frequency high recurrence interval storm events (i.e. average conditions). The project is to be an aesthetically appealing, natural looking engineered solution to prevent erosion along the perimeter of Morse Island. The project is to require minimal maintenance. The project is not intended for nor designed to provide protection for a 100 year return interval storm event.

Project Site

The project site is located towards the center of the state within The Villages development in Sumter County, Florida. Prior to the development of The Villages, the project site was an active peat mine operated as the Cherry Lake Peat Mine. In permitting of the closure of the peat mine, as identified in the FDEP Permit No. 0168327-004, the operator of the mine completed a post-reclamation topographic and drainage design which included the grading of Morse Island and surrounding body of water known as Cherry Lake (also now known as Lake Sumter). The surrounding body of water was graded to provide a submerged zone, emergent zone, and forested wetland area. As shown in the aerial below, the approximate location of the zones can be determined by the type of vegetation cover as visible in the aerial.

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Figure 1: Project Location Map

The Cherry Lake Post-Reclamation Topography & Drainage Map included in the FDEP Permit identifies that each zone contains the following bottom elevations (Villages Datum):

- Emergent Zone West Lake Elevation +45.2 ft to +49.0 ft
- Emergent Zone East Lake Elevation +45.2 ft to +47.5 ft
- Submerged Zone +45.2 ft to +47.5 ft
- Remaining portion of Cherry Lake +34.5 ft to +45.2 ft

At this time, only small recreational boats which produce a wake of less than half a foot access and utilize the western portion of Lake Sumter. The two bridge structures which divide the lake do not allow recreational boat access in the eastern portion of Lake Sumter.

The stormwater runoff produced from the impervious area on Morse Island collects and sheet flows to curb and gutters, flows to stormwater inlets, and ultimately to outfall pipes located on the sloped planted portion of Morse Island. Some pervious areas of Morse Island contain yard drains which route stormwater runoff to outfall pipes located on the sloped planted portion of Morse Island. This stormwater runoff should be accounted for in the final design of the project. The drainage system should be modified to include outfall structures which will not cause erosion of sediment.

A site visit was performed by Kimley-Horn staff on March 23rd, 2016 which identified escarpments along the majority of Morse Island. The escarpments along the western side of Morse Island appear to be somewhat larger than the escarpments along the eastern side of Morse Island. A fill project was constructed on the northeast corner of Morse Island. Small escarpments were present in this relatively newly placed fill as well. The results of the field visit indicate that the perimeter of Morse Island is eroding near the shoreline. Refer to **Appendix A and B** for detailed assessments and photographs from the site visit.

Geotechnical Investigation

Professional Service Industries, Inc. (PSI) was engaged through a subconsultant agreement to perform a subsurface exploration and slope stability analysis to evaluate the potential that the erosion experienced at Morse Island is attributable to slope failure. The scope of the geotechnical investigation included an analysis to determine:

- the suitability of the existing soils for support of the existing slope geometry
- stability analysis of the failed slope to determine recommendations to rehabilitate the slope
- general location and description of potentially deleterious materials encountered in the borings that may affect the existing slope stability
- identification of near surface soil conditions that may contribute to the reported slope instability

The field exploration performed by PSI included 6 Standard Penetration Tests (SPT) borings to a depth of 30 ft as well as 19 muck probes around the site. In general, PSI determined that existing slopes are regarded as having a low potential for a global stability failure. As identified in the PSI report, "the failure that occurred at the northeast slope of the island can be categorized as a translational failure or surface erosion failure and not a global failure."

PSI performed a slope stability analysis for Morse Island embankment slopes that took into account the current survey data and the soil properties obtained from the geotechnical field exploration. The analysis showed that the calculated factor of safety for the existing slopes exceeded the FDOT minimum factor of safety for permanent slopes. Refer to the PSI report dated June 6, 2016 for further details (**Appendix C**).

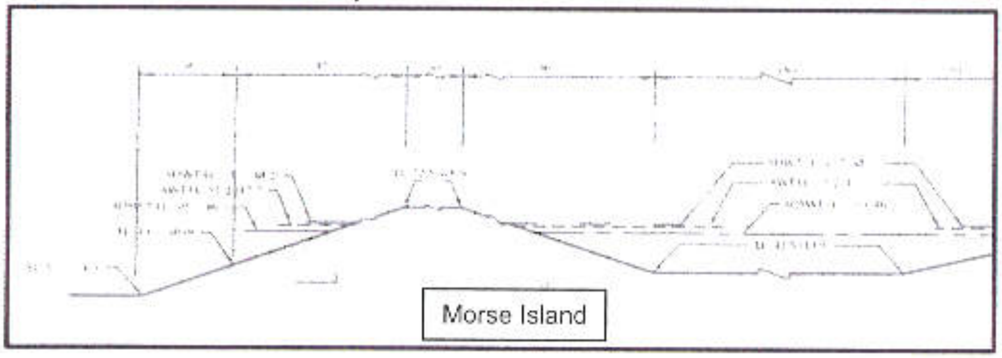
Water Depth Surrounding Project Site

As shown in the Figure below, the Cherry Lake Post-Reclamation Cross-Section included in the FDEP Permit identifies the following water level elevations (Villages Datum):

- Season High Water Table Elevation +48.2 ft
- Average Normal Water Table Elevation +47.7 ft
- Average Dry Season Water Table Elevation +46.5 ft

The lake water elevation at the time of the site visit performed by Kimley-Horn was +48.6 ft Villages Datum. The lake water elevation corresponding to the FEMA 100 year return interval storm event is +55.42 ft Villages Datum.

Figure 2: Profile 9 From Cherry Lake Post-Reclamation Cross-Sections Exhibit 7a



During Seasonal High Water Table conditions, the following water depths are assumed to exist at the project site:

- Emergent Zone West Lake Elevation 48.2 – 45.2 = 3 ft water depth
- Emergent Zone East Lake Elevation 48.2 – 45.2 = 3 ft water depth
- Submerged Zone 48.2 – 45.2 ft = 3 ft water depth
- Remaining portion of Cherry Lake 48.2 – 34.5 = 13.7 ft water depth

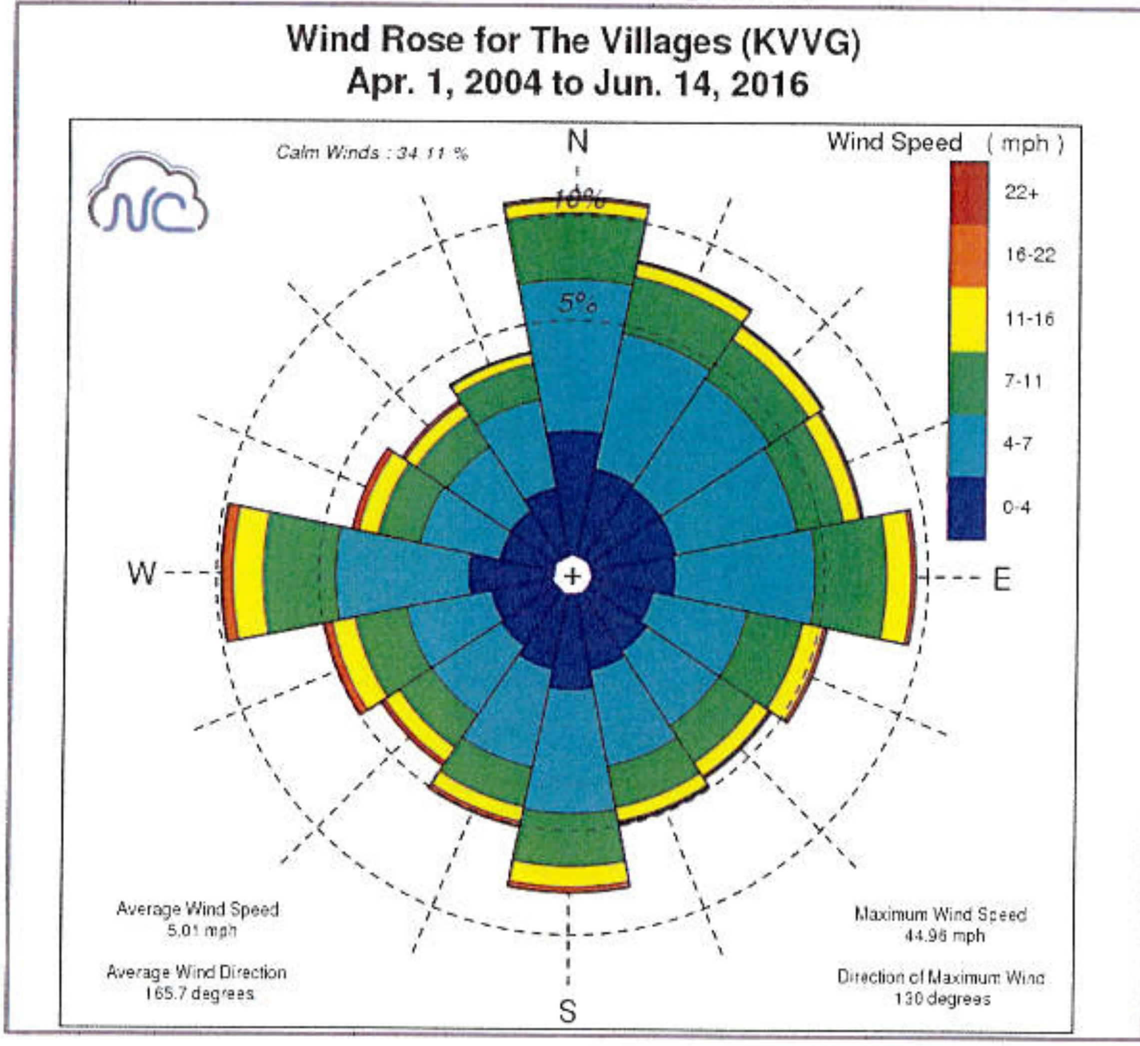
Assuming the FEMA 100 year return interval storm water level, the following water depths are expected to exist at the project site:

- Emergent Zone West Lake Elevation 55.42 – 45.2 = 10.2 ft water depth
- Emergent Zone East Lake Elevation 55.42 – 45.2 = 10.2 ft water depth
- Submerged Zone 55.42 – 45.2 ft = 10.2 ft water depth
- Remaining portion of Cherry Lake 55.42 – 34.5 = 20.9 ft water depth

Wind Data

Due to the small size and low operating speeds of vessels utilizing Lake Sumter, the waves impacting Morse Island are expected to primarily be generated by wind. Therefore, the direction and velocity of wind impacting the project site is important in understanding the wave height and direction which are expected to impact Morse Island. The State Climate Office of North Carolina produces wind roses for multiple weather stations along the southeast including station KVVG located within The Villages, north of the project site. The wind rose depicts the percent occurrence of different wind speeds along different directions from April 1, 2004 to June 14, 2016. April 2004 is the earliest date that the data is available. As can be seen in the wind rose below, generally, the wind does not have a predominant direction for the higher speed wind events (above 16 mph) and the lower wind speed events appear to slightly favor the easterly direction. The maximum wind speed was recorded at about 45 mph from the southeast, and the average wind speed is 5 mph from the south.

Figure 3: Wind Rose for Weather Station KVVG – The Villages Florida



Expected Wave Height

The wind data identified above was utilized to forecast the corresponding wave height expected to impact Morse Island during different wind events. The wave height is used as a design parameter for the shoreline stabilization. Wave heights are either limited by (1) the depth of water the wave is traveling over or (2) the fetch or distance over which the wind is blowing to generate waves. Due to the relatively deep water depths and limited fetch conditions at the site, the waves expected at the site are assumed to be fetch limited.

Fetch Limited Wave

Equations 3-39 and 3-40 from the US Army Corps of Engineers (USACE) Shore Protection Manual shown below can be used to forecast the wave heights expected to impact the project site for different water levels and wind speeds. These equations utilize deepwater forecasting relationships to determine the energy added due to wind stress and wave energy lost due to bottom friction and percolation (SPM 1984).

Figure 4: Equations 3-39 and 3-40 from the USACE Shore Protection Manual

$$\frac{gH}{U_A^2} = 0.283 \tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]\tanh\left\{\frac{0.00565\left(\frac{gF}{U_A^2}\right)^{1/2}}{\tanh\left[0.530\left(\frac{gd}{U_A^2}\right)^{3/4}\right]}\right\} \qquad (3\text{-}39)$$

$$\frac{gT}{U_A} = 7.54 \tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]\tanh\left\{\frac{0.0379\left(\frac{gF}{U_A^2}\right)^{1/3}}{\tanh\left[0.833\left(\frac{gd}{U_A^2}\right)^{3/8}\right]}\right\} \qquad (3\text{-}40)$$

The table below summarizes the different wave heights forecasted for the depths corresponding to the SHWL elevation and FEMA 100 Year water elevation for 10, 20, 40, and 60 mph wind speeds along 4 different vectors from the shoreline across Lake Sumter to the shoreline of Morse Island. The maximum wind speed of 60 mph was chosen consistent with the FEMA Guidance for Coastal Flood Hazard Analyses and Mapping in Sheltered Waters, dated February 2008 which recommends a wind speed of 60 mph for inland fetch corresponding to a FEMA 100 year storm event. As shown in the table below, Morse Island is expected to relatively frequently be impacted by 1ft high waves. The maximum wave height expected during a FEMA 100 Year return interval storm event is expected to be over 2 ft.

Figure 5: Transect Location Map

Table 1: Calculated Wave Height Summary									
		SHWL (13.7 ft depth)				FEMA 100 YEAR (20.9 ft depth)			
		Wind Speed (MPH)				Wind Speed (MPH)			
		10	20	40	60	10	20	40	60
Transect	**Fetch**	Wave Height (ft)				Wave Height (ft)			
Northwest	2,160	0.2	0.5	1.1	1.7	0.2	0.5	1.1	1.7
Southwest	4,500	0.3	0.7	1.5	2.3	0.3	0.7	1.5	2.4
Northeast	600	0.1	0.3	0.6	0.9	0.1	0.3	0.6	0.9
Southwest	600	0.1	0.3	0.6	0.9	0.1	0.3	0.6	0.9
Average	**2,000**	**0.2**	**0.4**	**0.9**	**1.5**	**0.2**	**0.4**	**0.9**	**1.5**

Profile Comparison

As shown in Figure 2 above, the side slopes of Morse Island were designed and constructed to be equivalent to approximately 1 vertical to 3 horizontal both above and below the water line. The survey data and field visit photographs indicate that sediment has eroded from above the water line and settled to below the water line, developing a shallower side slope below the water line. This movement of the sediment is known as profile equilibration. Sediment will continue to move from the higher portion of the profile to the lower portion of the profile until the profile reaches an equilibrated state. There is a great deal of research focused on open coasts with depth limited wave conditions. Much less research is available for fetch limited coastlines. For open coasts with depth limited waves, the equilibrated profile can be predicted based upon the median grain size of the sediment present at a given site. For fetch limited project sites, the equilibrated profile will likely over predict the amount of sediment which will move offshore. This will predict a flatter profile than is expected and is not appropriate for this site. An equilibrated profile with a slope closer 1 vertical to 10 horizontal than the existing 1 vertical to 3 horizontal is what is expected for this site.

Erosion Discussion

Based upon the site visit performed on March 23, 2016 and comparison of the survey data and historical aerial photography, both the western and eastern shorelines of Morse Island appear to be eroding at similar rates. The escarpments present at the site are likely due to the amount of clay material present in the existing sediment as well as the root system of the existing vegetation holding the sediment in place, resulting in the vertical faced escarpment present at the shoreline. The wind data indicates that the wind direction and velocity at the site is expected to produce waves from all directions, without a predominate direction. The fetch conditions at the site indicate that relatively larger waves should be impacting the western shoreline of Morse Island compared to the waves impacting the eastern shoreline of Morse Island. This would increase the erosion expected on the western shoreline as compared to the eastern shoreline of Morse Island. Two general approaches appear to be appropriate to manage the erosion experienced at Morse Island. The first general approach is to install a hard structure to protect the existing sediment from waves impacting the shoreline and hold the existing sediment in place. The second general approach is to modify the shoreline using coarse sediment installed at a shallower slope with native plantings.

ALTERNATIVES

The following three alternatives are proposed to meet the goals and objectives identified above. Note that none of these alternatives are designed for the FEMA 100 year return interval storm event, although each of the alternatives would increase the level of protection during a FEMA 100 year return interval storm event as compared to the existing condition of Morse Island. Each alternative will have associated costs and benefits which are further discussed below. These alternatives are presented in order of the most aggressive response to manage the erosion to the least aggressive response to manage the erosion. The three alternatives include:

- a rock revetment structure with fill and plantings
- a living shoreline with a toe protection breakwater structure
- the placement of additional coarse sediment fill with native plantings.

Alternative 1 – Rock Revetment

The first alternative consists of a rock revetment structure with additional fill and native plantings. The rock revetment structure consists of installing coarse sands to repair the existing erosion, placing filter fabric to keep the soil from eroding and rock on top of the layer of filter fabric to hold the filter fabric in place. The required median rock was sized using the Hudson formula shown below. The Hudson formula confirmed that the rock specified in the FDOT Standard Specification 530-2.1.3.1 Rubble (Bank and Shore Protection) is adequately sized for the shoreline stabilization of Morse Island. The Hudson Formula assumes 5% damage during the design wave condition. Therefore, the revetment structure could require maintenance after significant storm events. The maintenance will consist of rocks being moved back into place or replaced with the placement of new rocks. The seaward terminal point and landward terminal point of the revetment was determined consistent with the USACE Shore Protection Manual. The landward extent of the revetment was determined as the landward extent of expected wave run-up. The seaward extent of the revetment was determined as the expected scour depth assuming a low risk of scour.

Figure 6: Hudson Formula

$$W_{50} = \frac{w_r H^3}{K_{RR} (S_r - 1)^3 \cot \theta}$$

The revetment can be constructed using native limestone to improve the aesthetic quality of the revetment. Additionally, fill and native plantings can be placed over the limestone above the Seasonal High Water Elevation which may eventually erode but may improve the aesthetic quality of the revetment. A benefit of the revetment is that it can provide a level of protection during different water levels and will function as a wave breakwater structure when the water elevation is higher than the design water elevation. Additionally, the revetment will protect against erosion due to wave runup. To improve the appearance of the revetment, the revetment can be designed around the existing trees. The revetment will provide the most protection of the upland due to the added protection during higher water elevation events and protection against wave runup. Figure 7a below depicts a conceptual level cross-section view of the revetment. Figure 7b below is a photograph of a typical revetment structure taken on the eastern shoreline of the Indian River Lagoon in Vero Beach, Florida.

Figure 7a: Alternative 1 – Revetment with Fill and Plantings

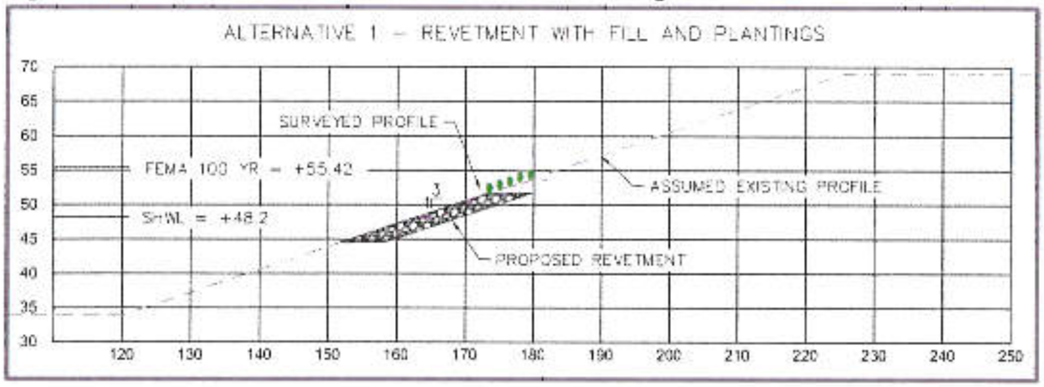
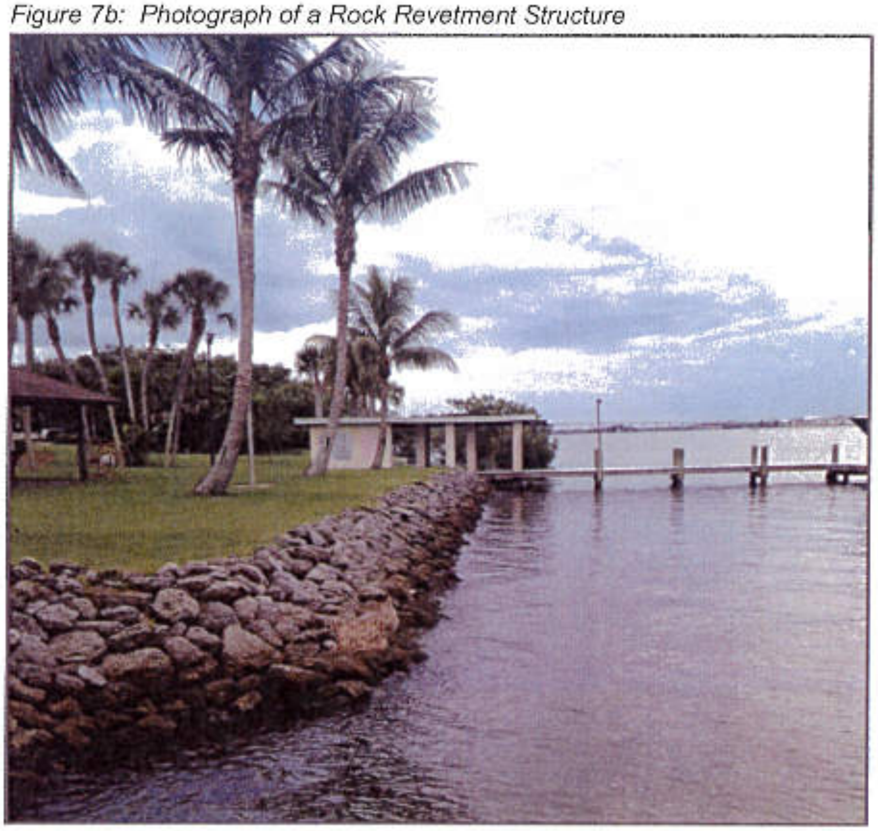


Figure 7b: Photograph of a Rock Revetment Structure



Alternative 2 - Living Shoreline with Toe Breakwater Structure

The second alternative consists of a living shoreline with a toe protection breakwater structure. The purpose of the toe protection structure is to function as a wave breakwater and as a sill. A breakwater functions by causing larger waves to break on the structure before they can reach the shoreline and erode the shoreline. A sill is used to create a perched shoreline by holding the sediment material landward of the sill keeping sediment from moving seaward. The area landward of the toe structure can be sloped at a relatively flat slope to reduce the erosion potential from wave runup. The toe structure is constructed similar to the revetment structure where rock is placed over filter fabric, a coarse sediment fill is placed between the rock and the existing shoreline at a 1 vertical to 10 horizontal slope. Native plantings are placed over the coarse fill. The required median rock for the breakwater is sized consistent to the revetment option. The seaward terminal point and landward terminal point and crest elevation of the breakwater is designed to be consistent with the USACE Shore Protection Manual.

The breakwater structure can be constructed using native limestone to improve the aesthetic quality of the breakwater. Additionally, the breakwater is designed such that the crest of the structure is at the seasonal high water elevation, therefore, the structure will not be apparently visible for a majority of a given year. Similar to the revetment structure, the breakwater structure can be designed to avoid impacting existing trees. Figure 8a below depicts a conceptual level cross-section view of the living shoreline with toe structure. Figure 8b below is a photograph of a living shoreline with a toe breakwater structure.

Figure 8: Alternative 2 – Living Shoreline with Toe Breakwater Structure

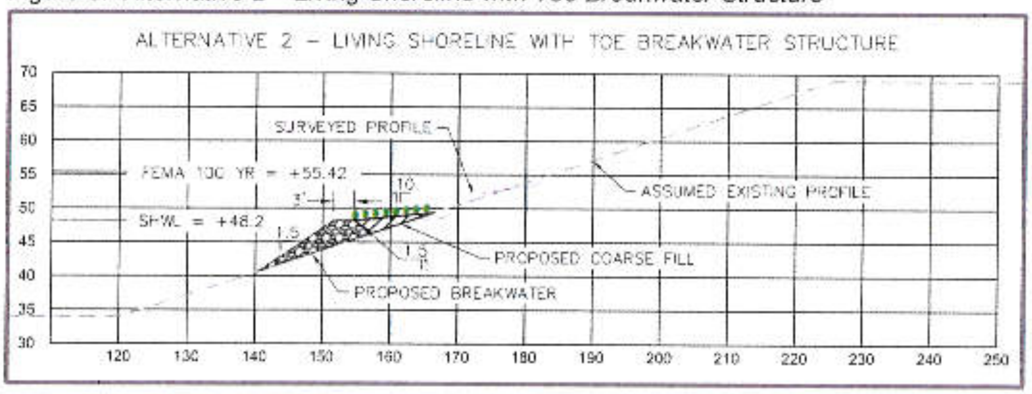


Figure 8a: Photograph of a Living Shoreline with a Toe Breakwater Structure. Photograph from the North Carolina Coastal Federation.

Alternative 3 - Living Shoreline

The third alternative consists of the placement of coarse fill with the installation of native plantings. A small rock with a diameter of about 1 ft would be placed seaward of the plantings to reduce the wave activity to allow the plantings to establish. This alternative will likely be the most natural looking and attractive alternative but could require the most maintenance. This alternative is designed by assuming an equilibrium profile and placing the volume of coarse sediment fill to complete equilibrium profile. This alternative assumes an equilibrium profile equivalent to a 1 vertical to 10 horizontal slope to a depth of a couple of feet below the season high water line. After initial placement of the coarse sand fill, the seaward-most portion of the newly placed fill will move in the cross-shore direction. After this initial adjustment, the shoreline is expected to be relatively stable. Assuming the site experiences 1 foot of shoreline loss per year, the Living Shoreline alternative would have a life span of approximately 8 years. **Figure 9a** below depicts a conceptual level cross-section view of the living shoreline. **Figure 9b** below is a photograph of a living shoreline.

Figure 9a: Alternative 3 – Living Shoreline

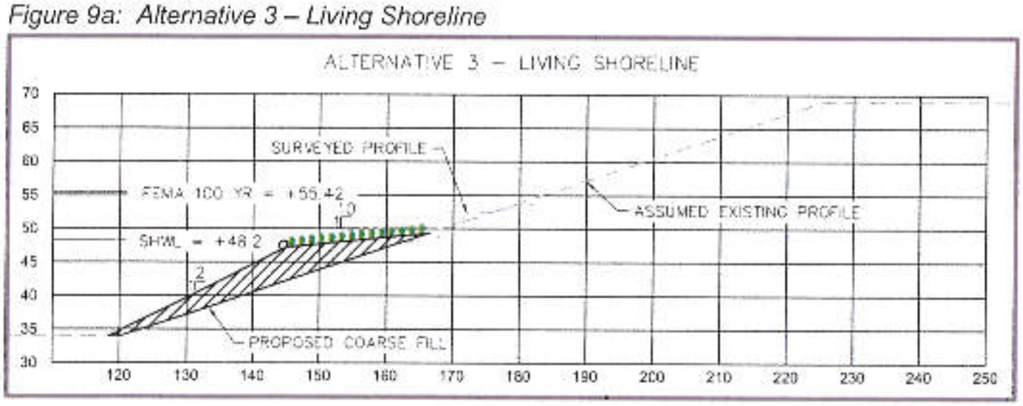


Figure 9b: Photograph of a Living Shoreline

Opinion of Probable Construction Costs

A Conceptual level Opinion of Probable Construction Cost (OPC) was developed for each alternative. The unit costs within the OPC are based upon experience and judgment. The quantity of units is expected to vary during the next phase of design. The length of shoreline was assumed to be 1,500 ft. This length is expected to vary in response to the meandering shape of the selected alternative to account for the existing trees on Morse Island. A detailed breakdown of the OPCs can be found in **Appendix D**. The following summarizes the OPC for each alternative:

- Alternative 1 – Revetment = $1,472,900
- Alternative 2 – Living Shoreline with Toe Structure = $1,000,000
- Alternative 3 – Living Shoreline = $520,000

The above OPC's are general planning level estimates only. They are not based on final design plans and will require updating when those plans are prepared.

Permitting

We expect that each of the recommended alternatives should be permittable by the State and USACE. We expect that each of the alternatives will not require a State Submerged Lands Lease from FDEP, which must be confirmed during the next phase of design and permitting. The project site may be within the jurisdiction of the USACE. The selected alternative may require a permit from the USACE. The next phase of design and permitting should include a request for jurisdictional determination from the USACE. The selected alternative will require an Environmental Resource Permit from the State. We expect the selected alternative will not impact wetlands and therefore wetland mitigation should not be required.

Future Action

Upon selecting an alternative to pursue, we recommend that a tree survey be performed to determine the location of the existing trees so that they may be appropriately incorporated into the design. We recommend that a jurisdictional determination request be sent to USACE. A pre-application meeting should be held with the FDEP staff and potentially USACE staff. Submerged lands ownership should be determined with FDEP.

Summary and Conclusions

Our field analysis documented that erosion is occurring at Morse Island shoreline. Based upon the survey data, field observations, expected wave climate, and geotechnical investigation and analysis, the erosion experienced at Morse Island warrants an engineered response to protect the upland improvements including the mature trees, landscaping, irrigation system and roadway improvements. The erosion appears to be caused by cross-shore sediment transport in response to repetitive wave impact on the shoreline during average weather conditions. Portions of the existing soil contain finer sediments including clay which exacerbate the development of escarpments. The existing vegetation may also be encouraging the formation of escarpments. PSI's field work and analysis concluded that the erosion experienced on Morse Island is not due to a global failure of the soil, and that slope and construction of the island embankments exceed the FDOT level of safety for permanent embankments.

Three alternatives were evaluated at a conceptual design level to determine the approximate construction costs, likelihood of obtaining the required permits for construction, and likelihood of meeting the goal and objective of the project.

Alternative 1 – Rock Revetment is the most aggressive response to the erosion and therefore is expected to have the greatest likelihood of addressing the erosion experienced on Morse Island. This alternative has the highest initial construction cost and the least natural appearance. This alternative is expected to have the lowest associated maintenance costs. Though structural in nature, this alternative may be implemented in such a way that the aesthetics of the shoreline are not negatively impacted.

Alternative 2 – Living Shoreline with Toe Breakwater Structure is an aggressive response to the erosion and is expected to have a high likelihood of addressing the erosion experienced on Morse Island. This alternative has a relatively high initial construction cost and is expected to have a relatively low future maintenance cost. Though structural in nature, this alternative may be implemented in such a way that the aesthetics of the shoreline are not negatively impacted.

Alternative 3 – Living Shoreline is the softest response to the erosion and therefore is expected to have less likelihood of addressing the erosion experienced on Morse Island than the other alternatives. This alternative has the most natural appearance. This alternative has the lowest initial construction cost but may require the greatest amount of future maintenance.

REFERENCES

Florida Department of Environmental Protection Minor Modification Permit No. 0168327-004 Cherry Lake Peat Mine. July 29, 2003.

Geotechnical report. Morse Island Slope Stability Analysis The Village, Sumter County, Florida PSI Project No. 07571518 dated June 6, 2016 by PSI.

(SPM 1984). U.S. Army Corps of Engineers. 1984. Shore Protection Manual. Coastal Engineering Research Center Department of the Army Waterways Experiment Station, Corps of Engineering 3909 Halls Ferry Road, Vicksburg, Mississippi 39180.

(CEM 2002). U.S. Army Corps of Engineers. 2002. Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington, D.C. (in 6 volumes).

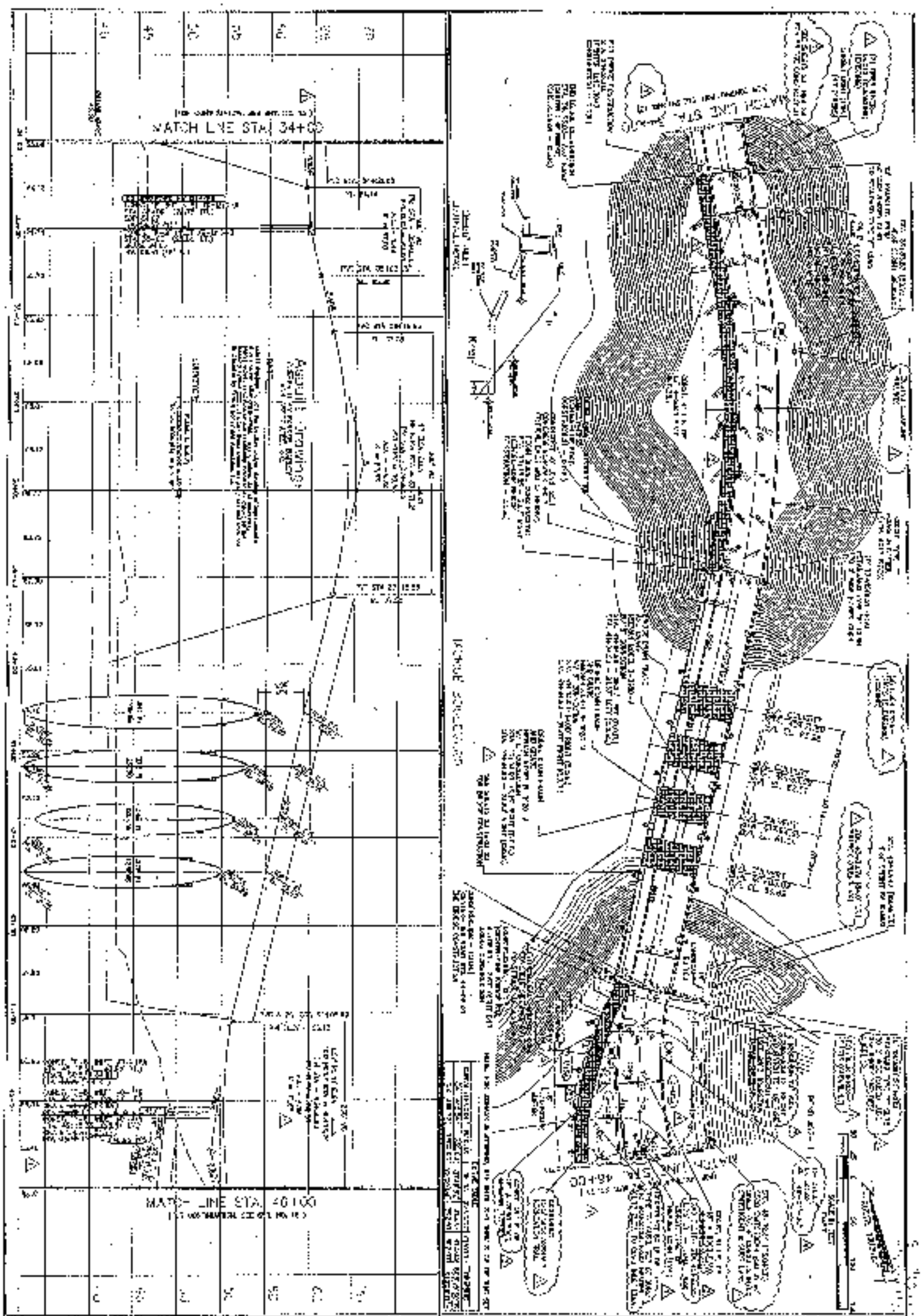
(FEMA 2015). Federal Emergency Management Agency. 2015. Guidance for Flood Risk Analysis and Mapping Coastal Erosion.

(FEMA 2008) Federal Emergency Management Agency. 2008. Guidance for Coastal Flood Hazard Analyses and Mapping in Sheltered Waters.

(FEMA 2007) Federal Emergency Management Agency. 2007. Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update.

APPENDICES

APPENDIX A: Plan and Profile Morse Boulevard, 2003

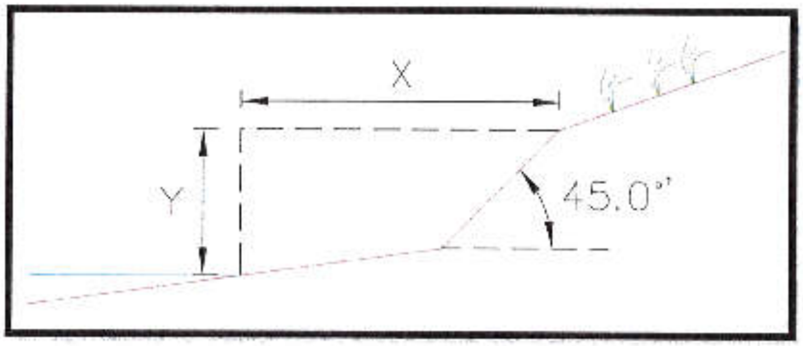


PLAN & PROFILE
MORSE BOULEVARD

FARNER BARLEY

APPENDIX B:
Field Observation Log

FIELD OBSERVATIONS
March 23, 2016



Escarpment Typical Section

WEST SIDE OF ISLAND			
Station	Escarpment		Observation
	X (ft)	Y (ft)	
6+22	5	3.5	Soil surface 4" below an existing tree (shrub) - indicative of wave slap erosion at water edge. Escarpment continues to approx. STA. 5+95 (cabbage palm).
6+07	5.5	4.5	Bank escarpment stable due to clayey soils (cohesive). Stiff soils.
6+00	2.5	4	
5+85			Clayey soils continue. Rigid escarpment.
5+50			Surface erosion (gully or foot path). 6" HDPE drain pipe. Rod probe indicated soft soils (possible backfill to HDPE pipe).
5+00	8	4	Escarpment stable, high clay content. Rod probe indicates stiff soils.
4+75			(2) 8" HDPE pipes to approx. STA. 4+50 laid parallel to shore (for erosion?). Irrigation to cypress trees in water.
4+50			6" HDPE pipe into water. Clayey soil present but backfill soft (probe). Cypress tree in soil.
4+30			Sandy soils but stiff.
4+10			Concrete slab with 4" PVC stand pipe with 90° fitting and 2" reducer at top. Possible old well pump location.
4+00	8	2.5	Bank material seems consistent to this point (6+22 - 4+00). Upper bank seems rigid (point of focus from VCCDD staff).
3+60	10	4.5	
3+30			Freshly collapsed area. Escarpment stiff but collapsed area soft.

Station	Escarpment X (ft)	Escarpment Y (ft)	Observation	
3+20			Freshly collapsed area and bank actively eroding. Probe shows very soft soils (probe not stopped).	
3+00			Stabilized erosion and hole. Moss growing on inside of hole.	
3+00 UP			Upper bank: 8" PVC pipe daylights from ground 100' from water edge. 18" erosion depth. Pipe comes from yard drain in golf cart parking lot.	
2+60	4.5	3	Escarpment present. Stiff soils.	
2+20	6	2.5	Escarpment ends. Stiff soils.	2+20 to 1+00 sandy soils
2+00			Little to no escarpment	
1+00	7	3.5	Escarpment begins.	
0+90			Cypress tree exposed roots on lake side in shallow water	
0+80	6	5.5	Escarpment present. Stiff soils.	0+00 to 0+80 Worst erosion area on island
0+40	7	5	Escarpment present. Stiff soils.	
0+00	15	2.5	Escarpment present. Stiff soils.	

EAST SIDE OF ISLAND

Station	Escarpment X (ft)	Escarpment Y (ft)	Observation
7+00			Landscape/erosion control netting present. Vegetation to waterline (in water also). Rod probe shows soft soils. No escarpment.
6+80			Sandy soils. Escarpment present. Water is 3.5' deep 5.0' off water edge.
6+70			Recent movement noted. Slopes sandy. Landscape/erosion control netting present. Plants of same species at different contours. Tree in water (approx. 3.0' deep).
6+40	4	2	Escarpment present from 15' to north to 40' to south
6+00			Cypress tree at waterline. 6" of water up tree trunk on waterside. No escarpment. Landscape/erosion control netting present.
5+40			(2) 20' palm trees sloughed down slope. Appears trees may have also leaned into bank and soil eroded around trees. Landscape/erosion netting at each tree base.
			North tree covered in soil up to beginning of old leaf sheaths. South tree at water edge.
5+00			Rod probe indicates sandy soils present.

Station	Escarpment X (ft)	Escarpment Y (ft)	Observation
4+80			Escarpment present. Rod probe shows stiffer soils than 5+00. Root mass into water (more vegetation present).
4+60			Steep slope but not an escarpment. Sandy soil on top but stiffer underneath. (38 deg. Angle, 40 deg. Angle 5' to the north).
4+25	5	3	Escarpment present. Soft soils at surface but stiffer underneath. Tree present. Slope after tree gentle. Plants present.
4+00	6	2.5	Escarpment present. Clayey soils.
3+60			Stiffer, clayey soils present.
3+30			Hard sands present with clayey pockets. Escarpment present at dying cypress tree.
3+00			Muddy sands in water (not mucky). Loose top soil with stiffer soils underneath.
2+70			Escarpment present. Approximately 3 yr. old cabbage palm in slope of escarpment (not a fresh failure).
2+00			Mucky soils. Bank erosion (verify with survey cross section). Stiff soils present.
1+70			Vegetation ends. Water is deeper. Stiff soils present.
1+50			Steep slope present (30 deg.). Large bushes and cypress tree.
1+15	6	3.5	Sandy soils with roots. Escarpment present.
0+75			Escarpment present. Very crusty, clayey surface.
0+50		3	(40 deg. Angle) erosion and escarpment present. Stiffer soils.
0+00	10	3.5	Stiff soils present.

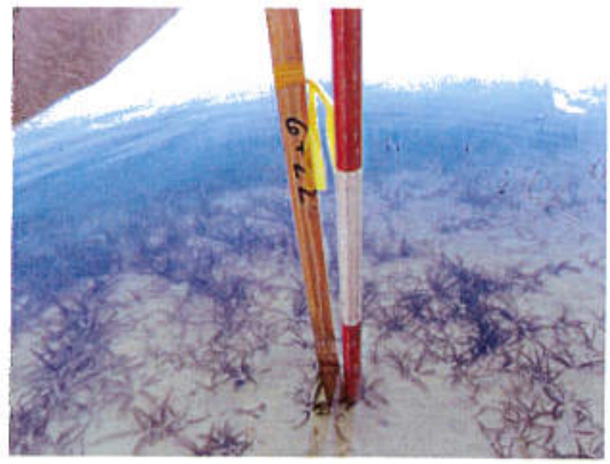
APPENDIX C:
Field Observation Pictures

The Village - Morse Blvd Erosion

Mar23 DWS 001

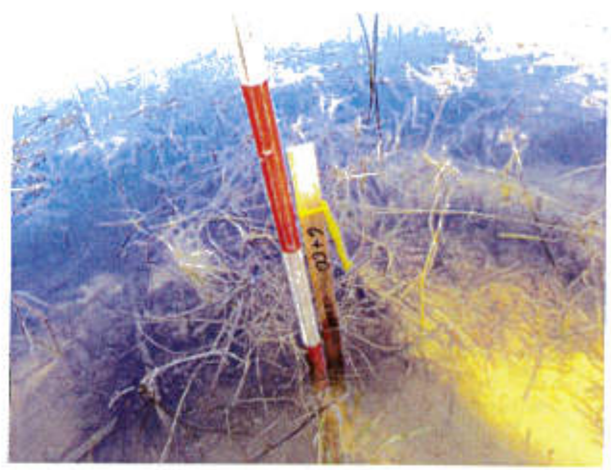
Mar23 DWS 002

Mar23 DWS 003



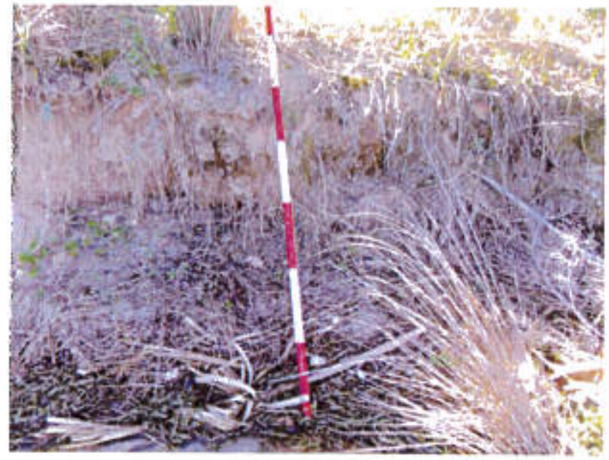
Mar23 DWS 004_W622

Mar23 DWS 005

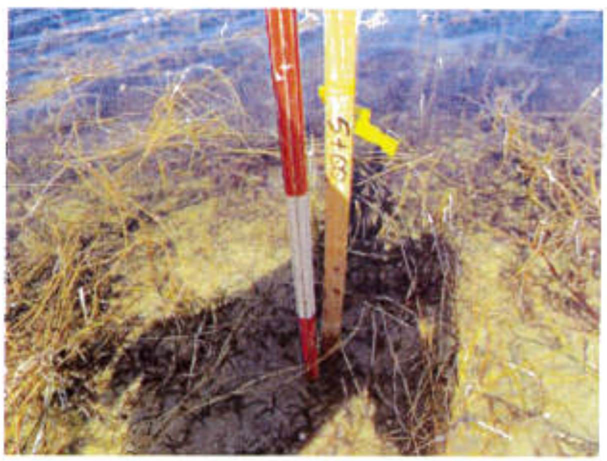


Mar23 DWS 006_W600

Mar23 DWS 007



Mar23 DWS 008



Mar23 DWS 009_W500

Mar23 DWS 010

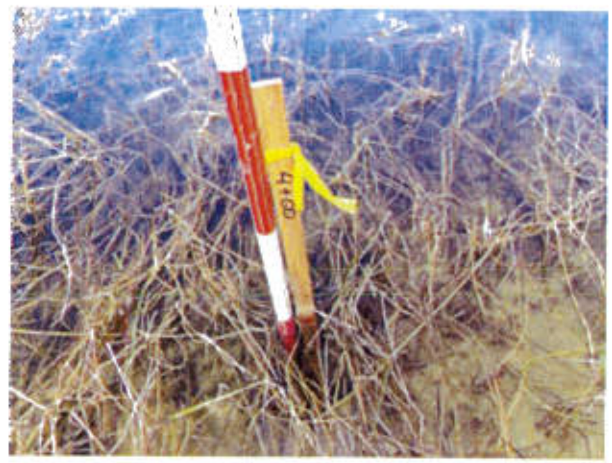
Mar23 DWS 011

Mar23 DWS 012

Mar23 DWS 013

Mar23 DWS 014

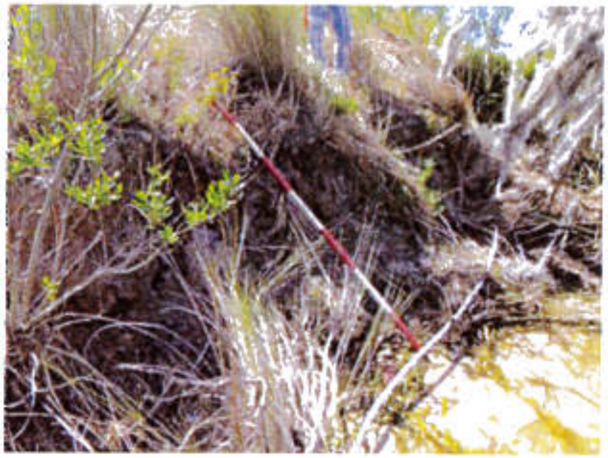
Mar23 DWS 015



Mar23 DWS 016_W400

Mar23 DWS 020

Mar23 DWS 021



Mar23 DWS 022

Mar23 DWS 023

Mar23 DWS 024

Mar23 DWS 025

Mar23 DWS 026_TP

Mar23 DWS 027

Mar23 DWS 028

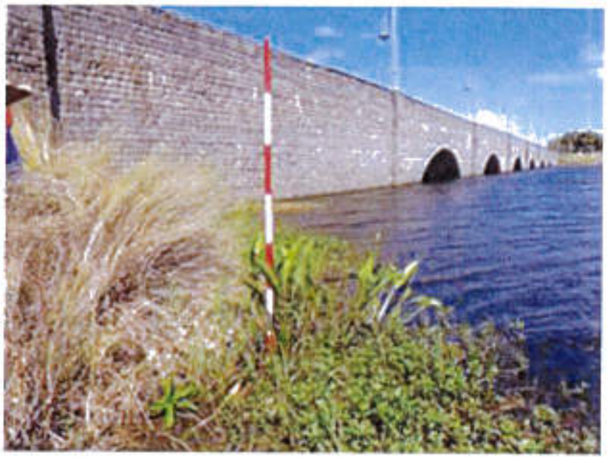
Mar23 DWS 029_E700

Mar23 DWS 030

Mar23 DWS 031

Mar23 DWS 031

Mar23 DWS 032



Mar23 DWS 034

Mar23 DWS 035

Mar23 DWS 036

Mar23 DWS 037

Mar23 DWS 038

Mar23 DWS 039

Mar23 DWS 040

Mar23 DWS 041_E600

Mar23 DWS 042

Mar23 DWS 043

Mar23 DWS 044

Mar23 DWS 045

Mar23 DWS 046

Mar23 DWS 047_E500

Mar23 DWS 048

Mar23 DWS 049

Mar23 DWS 050

Mar23 DWS 051_E400

Mar23 DWS 052

Mar23 DWS 053

Mar23 DWS 054_E300

Mar23 DWS 055

Mar23 DWS 056

Mar23 DWS 057_E200

Mar23 DWS 058

Mar23 DWS 059

Mar23 DWS 060

Mar23 DWS 063_E100

Mar23 DWS 064

Mar23 DWS 065

Mar23 DWS 066

Mar23 DWS 067

Mar23 DWS 068

Mar23 DWS 069

Mar23 DWS 070

Mar23 DWS 073

Mar23 DWS 074

Mar23 DWS 075_W

Mar23 DWS 076

Mar23 DWS 077_W000

Mar23 DWS 078

Mar23 DWS 079

Mar23 DWS 080

Mar23 DWS 081

Mar23 DWS 082

Mar23 DWS 083

Mar23 DWS 084

Mar23 DWS 085

Mar23 DWS 086

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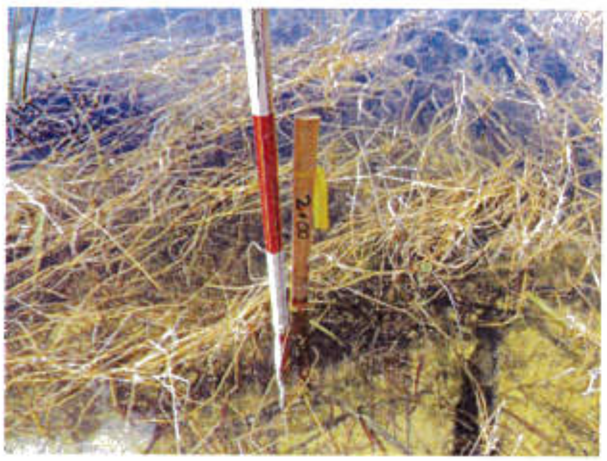
Mar23 DWS 088

Mar23 DWS 089_W100

Mar23 DWS 090

Mar23 DWS 091

Mar23 DWS 092



Mar23 DWS 093_W200

Mar23 DWS 094

Mar23 DWS 095

Mar23 DWS 096

Mar23 DWS 097

Mar23 DWS 098

Mar23 DWS 099_WPipe

Mar23 DWS 100

Mar23 DWS 101

Mar23 DWS 102

Mar23 DWS 103

Mar23 DWS 104

Mar23 DWS 105

Mar23 DWS 106_W

Mar23 DWS 107

Mar23 DWS 108

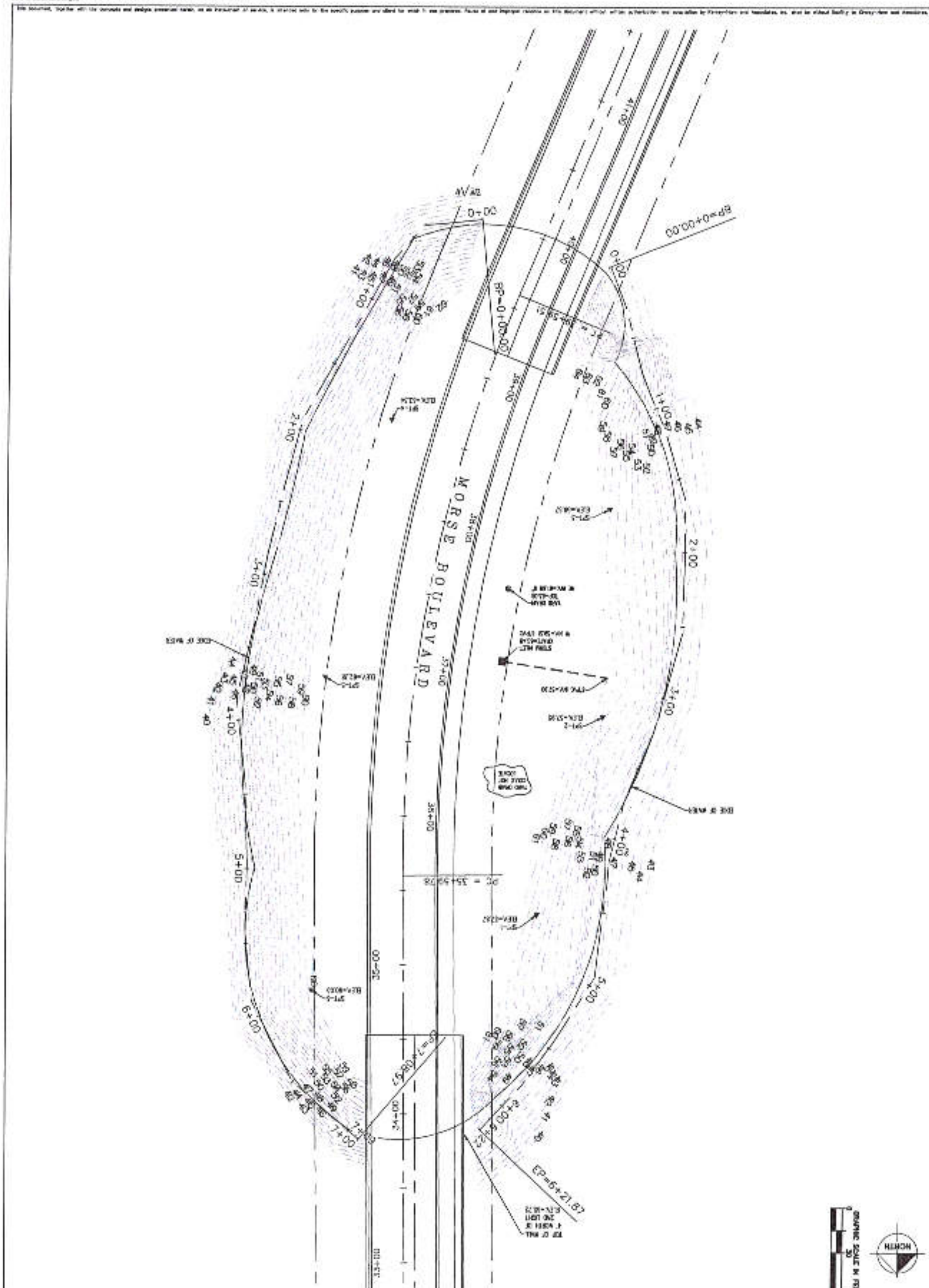
Mar23 DWS 109

Mar23 DWS 110_E

Mar23 DWS 111

Mar23 DWS 112

APPENDIX D:
Survey Exhibit



01	THE SUMTER LANDING COMMUNITY DEVELOPMENT DISTRICT THE VILLAGES FLORIDA	MORSE BOULEVARD LAKE SUMTER SLOPE STABILITY ANALYSIS SURVEY EXHIBIT	KHA PROJECT 142202018 DATE JULY 2018 SCALE AS SHOWN DESIGNED BY KHA DRAWN BY KHA CHECKED BY KHA	LICENSED PROFESSIONAL RICHARD A. BUSCHE, P.E. FLORIDA LICENSE NUMBER 58568 DATE	Kimley»Horn

No.	REVISIONS	DATE	BY

APPENDIX E: Professional Service Industries, Inc (PSI) report dated June 6, 2016

Information To Build On
Engineering • Consulting • Testing

Report
Geotechnical Engineering Services
Morse Island Slope Stability Analysis
The Village, Sumter County, Florida
PSI Project No. 07571518

psi *Information To Build On*
Engineering • Consulting • Testing

June 6, 2016

Kimley-Horn & Associates, Inc.
1823 Southeast Fort King Street
Suite 200
Ocala, Florida 34471

Attention: Mr. Richard V. Busche, P.E., CFM

RE: Report
Geotechnical Engineering Services
Morse Island Slope Stability Analysis
The Villages, Sumter County, Florida
PSI Project No. 07571518

Dear Mr. Busche:

In accordance with PSI Proposal No 0757-169311 and your authorization, Professional Service Industries, Inc. (PSI) has completed a subsurface exploration program at the site of the referenced project. The subsurface exploration was conducted to provide geotechnical information to assist with slope stability analysis and evaluations of potential causes of the reported slope erosion/failure at the northeast corner of Morse Island.

PROJECT INFORMATION

The project concerns the Morse Boulevard causeway over Cherry Lake in The Villages, Sumter County, Florida. The causeway is divided into two spans with Morse Island being located in the middle. The causeways from Morse Island to the main land were constructed using a series of arch culverts (refer to **Sheet 1**). Based on information provided to PSI, the arch culverts that make up the two causeways are supported on shallow foundations. It is PSI's understanding organic soils were removed from the culvert locations prior to construction. It is also PSI's understanding from conversations with Kimley-Horn that Morse Island was constructed over deep deposits of highly organic soils and a surcharge program was utilized to consolidate the organic soil deposits. Geotechnical information and plans from the original design and construction of Morse Island were not available for review by PSI.

We understand that recently a slope instability occurred on the northeast corner of the island. The area that exhibited the slope instability has since been repaired by placing fill in the erosion channels and planting vegetation (ornamental grasses). Review of historical aerial photographs of the site indicate rehabilitation work in this area in late 2013 (see **Sheet 1A**). It is unknown to PSI if other instances of slope erosion/stability have occurred.

The above listed information/assumptions have been used for the purpose of preparing this report. Adjustments to our findings and recommendations may be necessary if project data differs from the noted information/assumptions.

SCOPE OF GEOTECHNICAL SERVICES

The purpose of our exploration was to obtain information on the subsurface soil and groundwater conditions along the existing Morse Boulevard causeway where it crosses Morse Island. The subsurface conditions encountered were then evaluated with respect to the project characteristics. In this regard, geotechnical engineering assessments for the following items have been formulated.

1. Suitability of the existing soils for support of the existing slope geometry.
2. Performed stability analyses of the failed slope to determine recommendations to rehabilitate the slope.
3. General location and description of potentially deleterious materials encountered in the borings that may affect the existing slope stability.
4. Identification of near surface soil conditions that may contribute to the reported slope instability.

The following services were provided in order to achieve the preceding objectives.

1. Reviewed readily available published geologic and topographic information. This published information was obtained from the "Lady Lake, Florida" quadrangle map published by the United States Geological Survey (USGS) and the "Soil Survey of Sumter County, Florida" published by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Reviewed available geotechnical data provided by others.
2. Executed a program of subsurface sampling and field testing. As requested, the subsurface sampling/exploration included:
   - Six (6) Standard Penetration Test (SPT) borings to a depth of 30 feet below the existing grade in the existing slopes on the east and west sides of the existing roadway on Morse Island. The field exploration on the east side of the island included a single lane closure for one day and required Maintenance of Traffic (MOT) to perform the borings. MOT was performed in general accordance with FDOT requirements. The boreholes were backfilled with native soils upon completion.
   - One (1) day of muck probing/hand auger borings along the shoreline of Morse Island.
3. Visually classified and stratified representative soil samples in the laboratory using the Unified Soil Classification System. Conducted a limited laboratory testing program to confirm soil classification and to determine pertinent engineering parameters. Identified soil conditions at each boring location and formed an opinion of the site soil stratigraphy.

4. The results of the field exploration and laboratory tests were used in the engineering analysis and the formulation of our geotechnical evaluations and recommendations for the project. The results of the subsurface exploration, including PSI's geotechnical recommendations and the data on which they are based, are presented in this report.

REVIEW OF PUBLISHED DATA

USGS Topographic Map

The topographic survey map published by the (USGS) entitled "Lady Lake, Florida" was reviewed for ground surface features in the area of the proposed development. However, Morse Island's artificial construction occurred after the publication of the map in 1980. The approximate location of Morse Island has been drawn on the topographic map. An excerpt of the USGS topographic map is shown on **Figure 1** of the **Appendix**. The USGS map shows that the shoreline of Cherry Lake is between elevations +55 to +60 feet, NGVD. A water level elevation of +56 feet, NAVD is shown on the USGS map.

Review of the topographic survey performed by Kimley-Horn shows ground surface elevations range from approximately +63 feet at Morse Boulevard to +40 feet at the toe of the island slope. The water level observed in Cherry Lake at the time of the survey is between elevations +47 and +48 feet, NAVD.

NRCS Soil Survey

The "Soil Survey of Sumter County, Florida" published by the USDA Natural Resources Conservation Service (NRSC), was reviewed for general near-surface soil information within the general project vicinity. This information indicates that there is one soil group within the project limits. The mapped soil unit is summarized in the following table.

Soil Series	Depth (inches)	Unified Classification	USDA Seasonal High Groundwater Table
			Depth (feet)
41 – Everglades muck, frequently flooded	0 to 80	PT	0 to 1.0

An excerpt of the NRCS Sumter County Soil Survey Map is shown on **Figure 2** of the **Appendix**. Note, that when reviewing the soils map, the maps were generated before Morse Boulevard and the causeway were constructed. The included **Figure 1** shows the island in Soil Series 41 and 99. Soil Unit 99 is water. The soil survey maps have not been updated since the construction of Morse Island.

SITE VISIT

On March 29, 2016, PSI visited the project site to stake the proposed boring locations and perform reconnaissance of the island. Morse Boulevard bisects the island and consists of two travel lanes northbound and southbound. The slopes on the east and west sides of Morse Boulevard are heavily vegetated with ornamental grass, shrubs and trees (**Photograph 1**). An irrigation system is used to water the vegetation. Portions of the irrigation system have been exposed due to soil erosion and need service (**Photographs 2** and **3**). The toe of the slope around the perimeter of the majority of the island appears to have been eroded exposing the irrigation system as well as other drainage pipes and utilities. Examples of the exposed utilities and toe erosion can be seen in **Photographs 2, 4, 5, 6** and 7. The outfall for a drainage pipe was observed terminating halfway up the west slope (**Photograph 8**). The source of this pipe is unknown. Erosion of surficial soils was observed at the northeast slope recently reconstructed. Multiple erosion channels were observed. Examples of the erosion can be seen in **Photographs 9** through **14**.

FIELD EXPLORATION

General

To evaluate subsurface conditions at the project location, PSI drilled and sampled six (6) Standard Penetration Test (SPT) borings to depths of 30 feet below the existing ground surface. The borings were marked in the field by Kimley-Horn & Associates surveying at locations determined by PSI. Muck probing was performed in the shallow water around the island's perimeter. The approximate boring and probe locations are shown on **Sheet 1** in the **Appendix**.

The SPT borings were performed in general accordance with ASTM D-1586. In each SPT boring, samples were collected and Standard Penetration Test resistances (N-values) were measured virtually continuously for the top ten (10) feet and at intervals of five (5) feet thereafter. The borings were backfilled with native soils upon completion of PSI's work at the site.

The soil samples recovered from the borings were returned to our Orlando laboratory for stratification and laboratory testing. Soils were visually stratified following the guidelines contained in the Unified Soil Classification System (USCS). A limited laboratory testing program was conducted to confirm soil classifications and necessary engineering properties.

Records of the materials encountered in the borings are presented as soil profiles on **Sheet 2** in the **Appendix**, along with a legend describing the encountered subsoils in USCS format, measured groundwater levels and laboratory testing results.

The stratification presented is based on visual observation of the recovered soil samples, laboratory testing and interpretation of field logs by a geotechnical engineer. It should be noted that variations in the subsurface conditions are expected and may be encountered between and away from the borings. Also, whereas the individual boring logs indicate distinct strata breaks, the actual transition between the soil layers may be more gradual than shown on the soil profiles.

Soil Conditions

Based on the borings PSI completed for the project, subsurface conditions are relatively consistent across the site. In general, the borings revealed a series of fine sands grading from clean to slightly silty, silty and clayey in composition (i.e. SP, SP-SM, SM and SC materials). The borings also revealed localized zones of clay soil (CL and CH materials) typically in the deeper (18.5 to 28.5 feet below the ground surface) boring samples. The muck probes indicated 0.5 to 15.5 feet of soft/loose soil. In the upper profile, the loose soils comprised sands. No organic soils were observed in the near surface profile. The composition of the deeper soft/loose soils is unknown.

Based on the SPT blow counts recorded during our field exploration, the sands generally grade from loose to medium dense with localized zones of very loose or dense material. The relative density of the encountered clay layer was firm to stiff.

Detailed descriptions of the individual borings are shown on the soil profiles on **Sheet 2** in the **Appendix**.

Groundwater Conditions

Groundwater was not encountered in the upper 10 feet of the borings. Below 10 feet, the use of drilling slurry to maintain the boreholes inhibits observation of groundwater below 10 feet.

Corrosion Potential

As requested, six samples were tested to assess the subsurface environmental conditions using FDOT guidelines. Corrosion series testing including pH, resistivity, chloride content and sulfate content were performed on the six samples. The results of the corrosion series testing are presented in the table below. Based on FDOT criteria, the subsurface environmental classification should be considered moderately aggressive for concrete and extremely aggressive for steel underground components.

Corrosion Series Test Results Summary Table
Morse Island

Sample Number	Sample Depth (feet)	Stratum No./AASHTO Class.	pH (Water)	pH (Soil)	Resistivity (ohm cm) (Soil)	Sulfate (ppm) (Soil)	Chloride (ppm) (Soil)	Substructure Environmental Classification	
								Concrete	Steel
A	0 to 1	4/SP, SP-SM	5.61	6.72	24,000	14.7	120	MA	EA
B	0 to 1	4/SP, SP-SM	5.44	6.23	19,000	9.9	60	MA	EA
C	0 to 1	4/SP, SP-SM	5.41	6.03	26,000	10.0	60	MA	EA
D	0 to 1	4/SP, SP-SM	5.28	5.91	35,000	67.5	900	MA	EA
E	0 to 1	4/SP, SP-SM	5.37	5.52	28,000	24.9	60	MA	EA
F	0 to 1	4/SP, SP-SM	5.25	5.42	21,000	51.6	600	MA	EA

SLOPE STABILITY ANALYSIS

PSI performed a slope stability analysis for the embankment slopes located on the east and west side of the Morse Island. The analysis was performed using the computer program STABL for Windows, Version 3. The geometry for the analysis was based on survey data provided by Kimley-Horn & Associates. Soil and groundwater properties for the analysis were estimated based on the results of borings performed by PSI. The slope stability analysis was performed for two locations. The first was at the location of the slope failure at the northeast corner where boring B-6 was performed. The second location analyzed was where boring B-2 was performed on the west side of the island. The location of boring B-2 was chosen because the relative soil densities recorded in boring B-2 were lower than at the other two borings performed on the west side of the island. The analysis included groundwater seepage through the face of the slope. According to the FDOT, the minimum required factor of safety for a permanent slope is 1.5. The calculated factor of safety for each location is shown in the table below and copies of the STABL computer printouts are included in the **Appendix**.

Location	Calculated Factor of Safety
B-2	2.2
B-6	1.7

Based on the survey provided, PSI estimates the existing island embankment slopes range from 1V:3H to 1V:4H.

RECOMMENDATIONS

The existing embankment slopes range from approximately 1V:3H to 1V:4H. Generally, slopes such as these in sandy soil are regarded as having a low potential for a global stability failure. Based on the observed site conditions and the results of the slope stability analysis, the failure that occurred at the northeast slope of the island can be categorized as a translational failure or surface erosion failure and not a global failure. A translational slope failure is a result of a sliding mass of soil along a failure plane parallel to the surface of the slope. In this case, the clayey fine sands may have acted as this failure plane. Surface water run-off will permeate through the upper relatively cleans sands until it reaches the clayey sand. Due to the clay and fines content of the clayey sand, this material has a relatively low permeability. Once the surface water reaches the clayey sand, the surface water can perch on this soil layer and then begin to flow towards the slope. This can result in the type of failure observed at the northeast slope.

To reduce the likelihood of future slope failures similar to that observed as well as the newly observe surface erosion, additional erosion protection should be added to the slopes. PSI recommends the following options for your consideration:

Option 1: Vegetation and Maintenance

As stated earlier, new signs of surface erosion at the recently reconstructed northeast slope were observed by PSI during our site visit. The erosion appears to be caused by surface water flowing down the slope face, washing the slope soils into Cherry Lake. **Photographs** showing the erosion are included in the **Appendix**. To reduce the surface erosion, maintaining the existing slope by vegetating the slope surface and regular inspection and maintenance should be considered.

Option 2: Surface Reinforcement

Employing surface reinforcement systems from the FDOT approved geosynthetic products in the area of the exposed slope along with vegetation maintenance will reduce the chances of future slope failures and erosion. Using geosynthetic reinforcement should also reduce future maintenance cost compared to Option 1. It should be noted that if this option is selected, the installation of the geosynthetic material requires clearing all the existing vegetation, re-grading the slope and re-planting over the geosynthetic erosion protection material.

Among the available surface reinforcement systems, Geoweb and erosion control blankets are the most common systems. Geoweb is a cellular confinement system constructed of high-density polyethylene. The ability to infill the cells with a variety of materials, such as concrete, rock or soil allows tailoring the Geoweb system to meet project requirements, including allowing landscaping.

Erosion control blankets are usually woven from a chosen material and are meant to slow down the velocity at which water moves across the ground surface. The material chosen usually consists of a series of ridges and obstructions which reduce the velocity of the water. Erosion control blankets can be constructed of synthetic or natural materials. Common materials used to construct the erosion blankets are straw, coconut fiber, aspen fiber, jute, and polypropylene (plastic).

Slope Toe Protection

During PSI's site visit, visible erosion of the slope toe at the water's edge was observed. This condition was observed around a majority of the island's perimeter. If gravel or stone rip-rap is used, a filter fabric material should be placed between the existing slope and gravel/stone to prevent soil from migrating into the gravel/stone layer. A woven geotextile fabric meeting the requirements of FDOT is recommended.

Another option to consider is the installation of vinyl sheet pile around the perimeter of the island. Vinyl sheet pile is lightweight and relatively easy to install. In a limited access area such as Morse Island, standard equipment such as a jack hammer or small vibratory hammer could be used to install the sheet pile.

REPORT LIMITATIONS

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This company is not responsible for the conclusions, opinions or recommendations made by others based on these data.

The scope of our exploration was intended to evaluate soil conditions at Morse Island and does not include an evaluation of potential deep soil problems such as sinkholes. The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated. If any subsoil variations become evident during the course of this project, a re-evaluation of the recommendations contained in this report will be necessary after we have had an opportunity to observe the characteristics of the conditions encountered. The applicability of the report should also be reviewed in the event significant changes occur at the sight location.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

CLOSURE

PSI appreciates the opportunity to be of service on this project, and we trust the information presented herein is sufficient for your needs at this time. If you have any questions regarding the information provided in this report, or if we may be of further service, please contact the undersigned.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.
Certificate of Authorization No. 3684

Behnam Golestani, Ph.D.
Staff Engineer

Eric W. Nagowski, E.I.
Project Engineer

ROBERT A. TROMPKE LICENSE No 55456 STATE OF FLORIDA PROFESSIONAL ENGINEER 6/6/16

Robert A. Trompke, P.E.
Principal Consultant/Department Manager

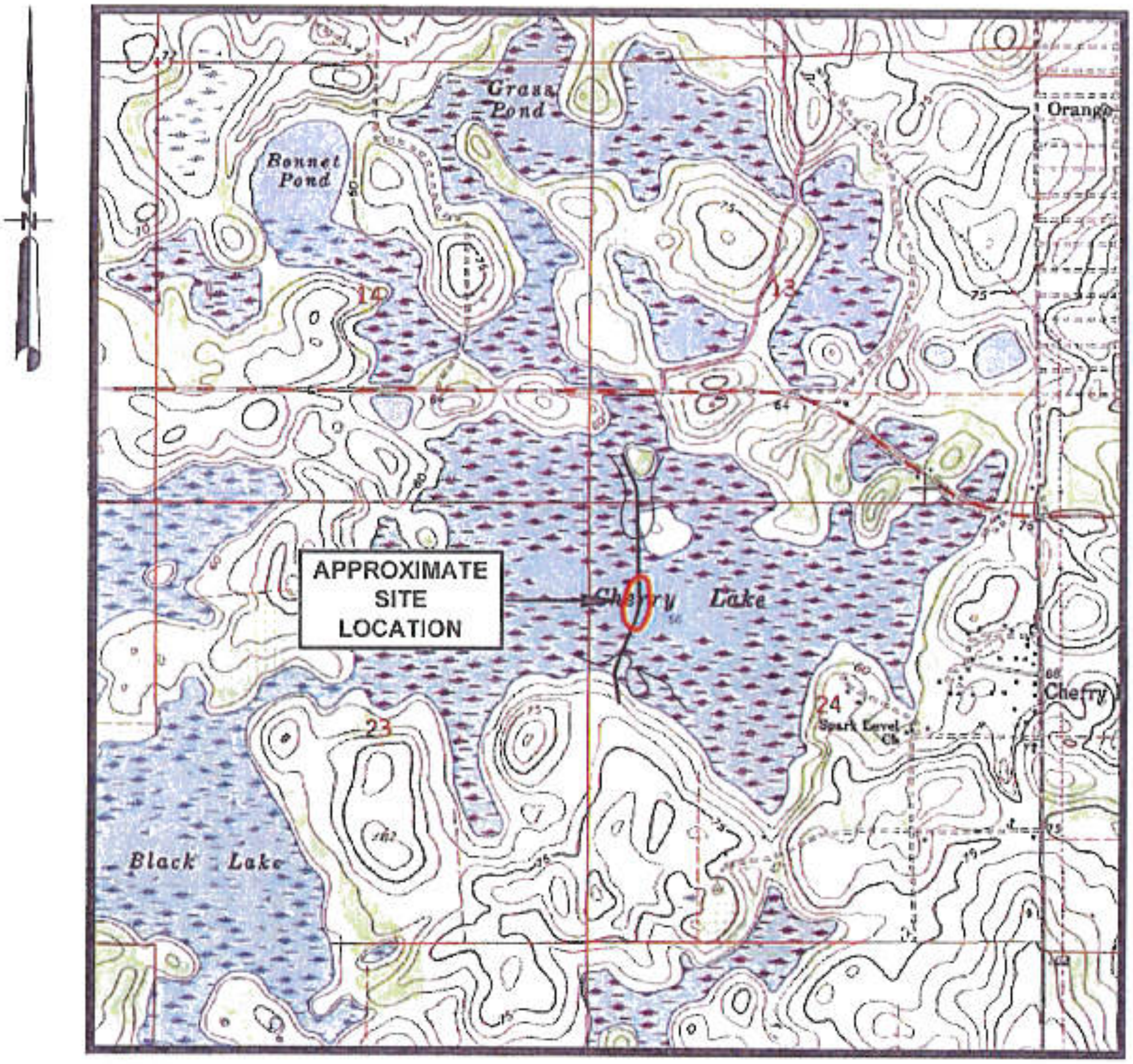
07571518 (Morse Island Slope Stability - Final Report)

cc: Mr. David Orr – PSI

Appendix

- Figure 1 – USGS Vicinity Map
- Figure 2 – SCS Soils Map
- Sheet 1 – Boring Location Plan
- Sheet 1A – 2013 Aerial Photograph
- Sheet 2 – Boring Profiles
- Photographs 1 through 14 – Site Visit
- STABL Output

APPENDIX



REFERENCE: U.S.G.S. "LADY LAKE, FLORIDA" QUADRANGLE MAP

SECTION: 24
TOWNSHIP: 18 SOUTH
RANGE: 23 EAST

ISSUED: 1977
PHOTOREVISED: 1980
SCALE: 1"=2000'

VICINITY MAP

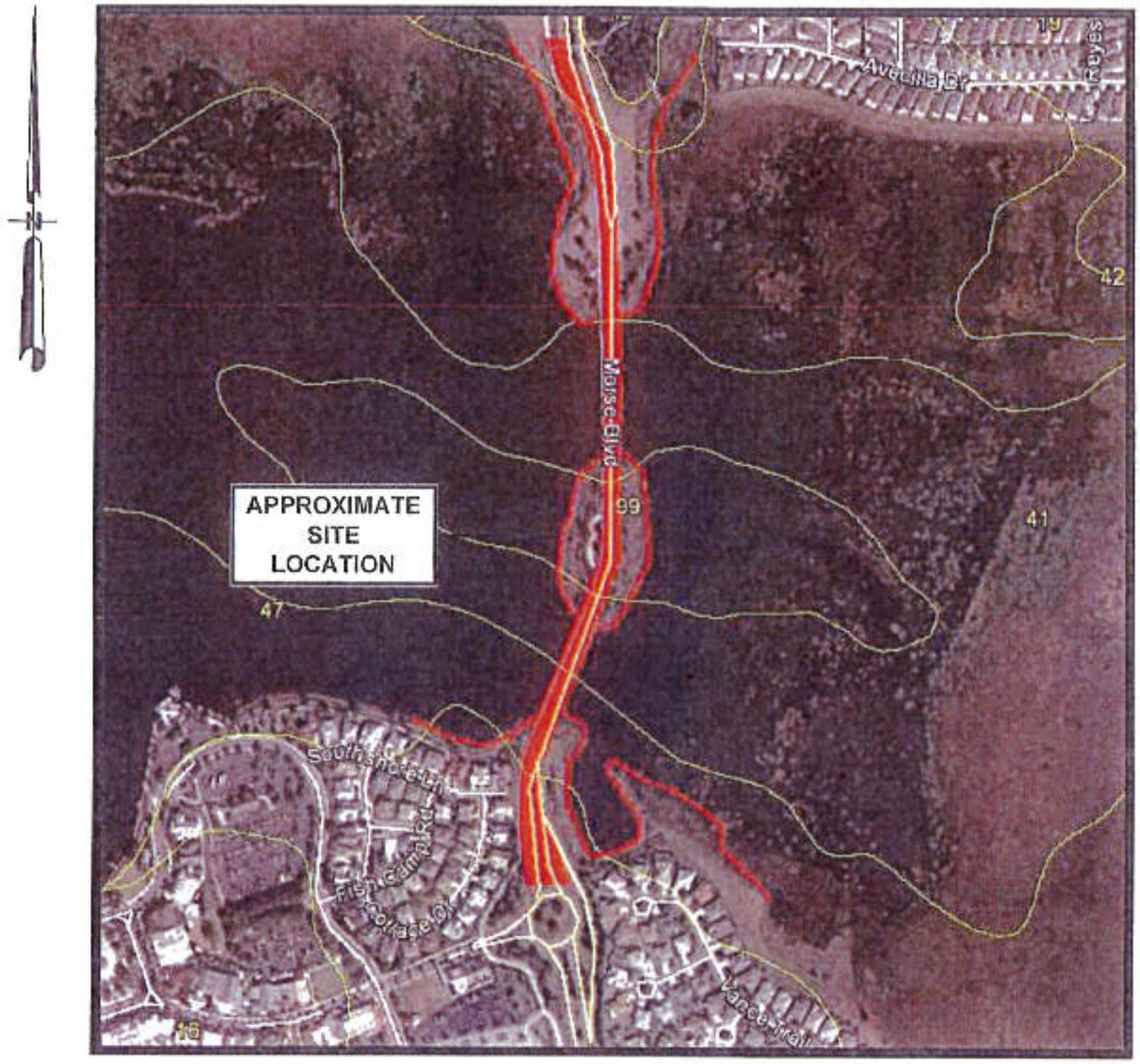
MORSE ISLAND SLOPE STABILITY ANALYSIS

THE VILLAGES, SUMTER COUNTY, FLORIDA

psi Information To Build On

Engineering • Consulting • Testing

DRAWN:	DJW	SCALE:	NOTED	PROJ. NO:	07571518
CHKD:	EWN	DATE:	5-24-16	FIGURE:	1



REFERENCE: U.S.D.A.-S.C.S. "SUMTER COUNTY, FLORIDA" SOILS MAP

SECTION: 24
TOWNSHIP: 18 SOUTH
RANGE: 23 EAST

ISSUED: N/A
SCALE: 1"=600'

SOILS LEGEND

41 EVERGLADES MUCK, FREQUENTLY FLOODED

47 OKEELANTA MUCK, FREQUENTLY FLOODED

99 WATER

SOILS MAP

MORSE ISLAND SLOPE STABILITY ANALYSIS

THE VILLAGES, SUMTER COUNTY, FLORIDA

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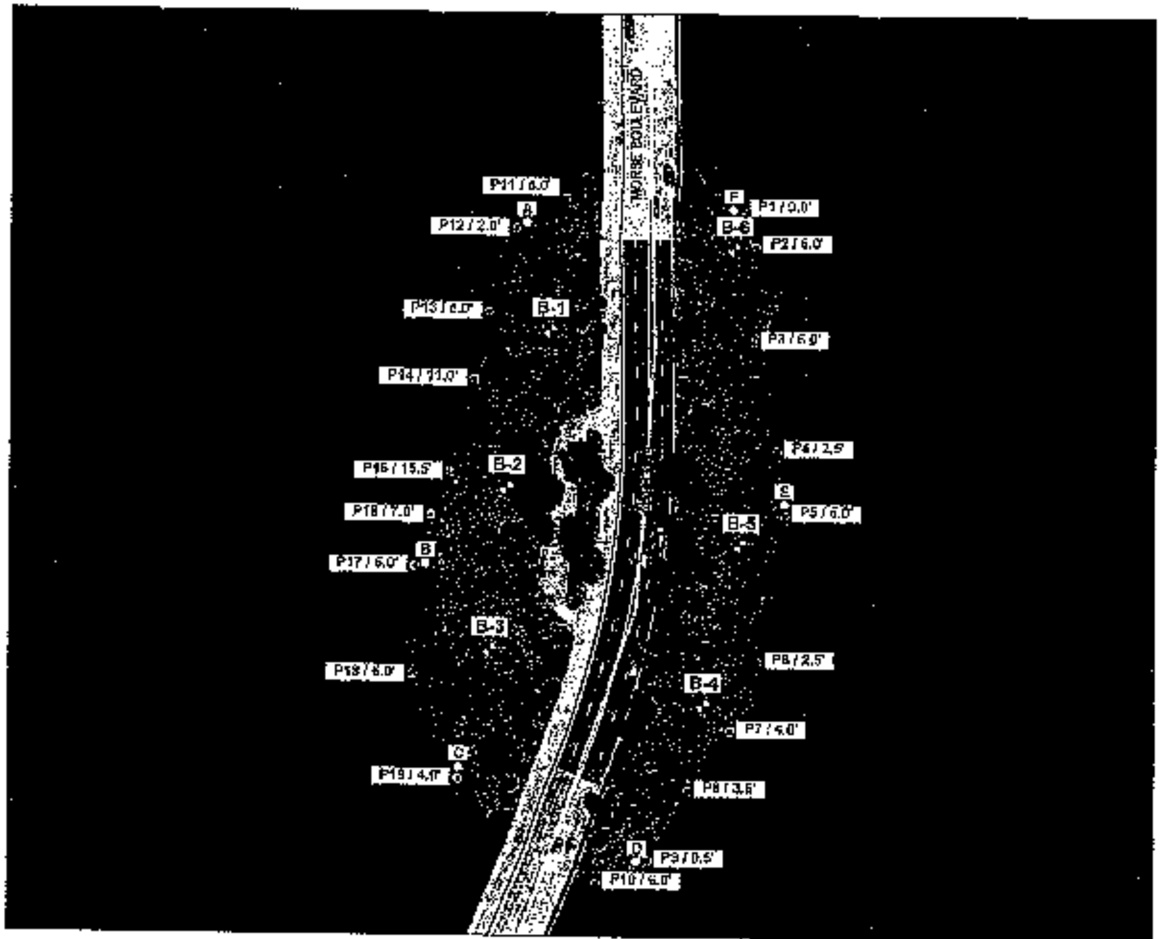
DRAWN:	DJW	SCALE:	NOTED	PROJ. NO:	07571518
CHKD:	EWN	DATE:	5-24-16	FIGURE:	2



REFERENCE: "GOOGLE EARTH PRO"
DECEMBER 2013

LOCATION PLAN
SCALE: 1"=100'

LEGEND

- APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING
- CORROSION SAMPLE LOCATION
- PROBE LOCATION WITH DEPTH OF PENETRATION

NOTE: PROBE DATA SHOWN FOR SUBSOIL CHARACTERIZATION PURPOSES ONLY. DATA IS INSUFFICIENT FOR QUANTITY TAKE-OFF USE. PSI IS NOT RESPONSIBLE FOR INTERPRETATION OF PROBE DATA BY OTHERS. ROOTS, SAND LENSES OR OTHER OBSTRUCTIONS MAY PREVENT HAND PROBES FROM PENETRATING FULL DEPTH OF ORGANICS OR SOFT/LOOSE SANDY SOILS.

GEOTECHNICAL ENGINEERING SERVICES

MORSE ISLAND SLOPE STABILITY ANALYSIS

THE VILLAGES, SUMTER COUNTY, FLORIDA

PSI Information To Build On
Engineering • Consulting • Testing

DRAWN	DJW	SCALE	NOTED	PROJ. NO.	0757151S
CHKD	BG	DATE	4-26-16	SHEET	1

REFERENCE: "GOOGLE EARTH PRO"
DECEMBER 2013

LOCATION PLAN
SCALE: 1"=100'

GEOTECHNICAL ENGINEERING SERVICES

MORSE ISLAND SLOPE STABILITY ANALYSIS

THE VILLAGES, SUMTER COUNTY, FLORIDA

psi *Information To Build On*
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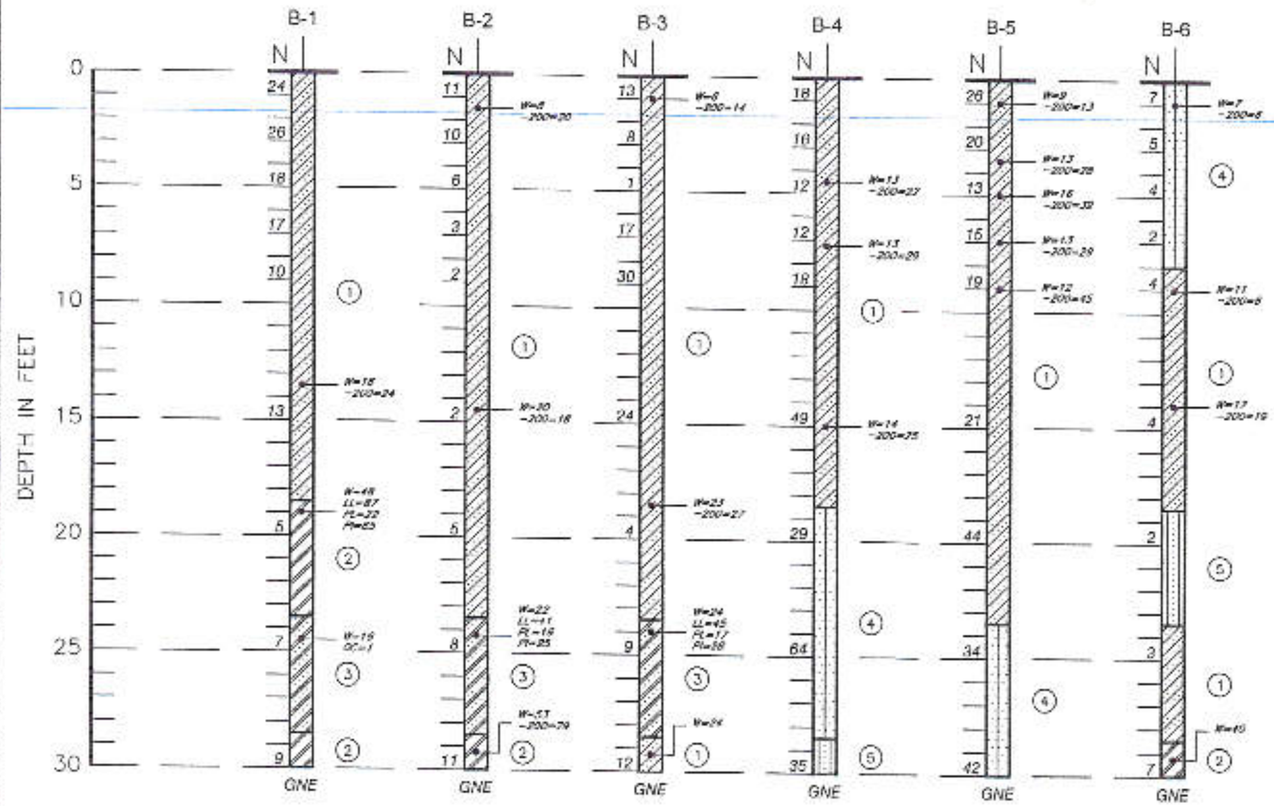
CHKD:	BG	DATE:	4-26-16	SHEET:	1A



SOIL PROFILES

SCALE: 1"=5'

LEGEND

①	BROWN TO ORANGE-BROWN SLIGHTLY CLAYEY TO CLAYEY FINE SAND, (SP-SC), (SC)
②	GRAY TO DARK GRAY CLAY, (CH)
③	GRAY TO DARK GRAY SANDY CLAY, (CL)
④	GRAY TO BROWN FINE SAND TO SLIGHTLY SILTY FINE SAND, (SP), (SP-SM)
⑤	LIGHT BROWN SILTY FINE SAND, (SM)
(SP)	UNIFIED SOIL CLASSIFICATION GROUP SYMBOL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT USING AN AUTOMATIC HAMMER
GNE	GROUNDWATER LEVEL NOT EVIDENT IN UPPER 10 FEET OF BORING
W	NATURAL MOISTURE CONTENT IN PERCENT
-200	FINES PASSING #200 SIEVE IN PERCENT
OC	ORGANIC CONTENT IN PERCENT
LL	LIQUID LIMIT IN PERCENT
PL	PLASTIC LIMIT IN PERCENT
PI	PLASTICITY INDEX

GEOTECHNICAL ENGINEERING SERVICES

MORSE ISLAND SLOPE STABILITY ANALYSIS

THE VILLAGES, SUMTER COUNTY, FLORIDA

psi Information To Build On

Engineering • Consulting • Testing

DRAWN:	DJW	SCALE:	NOTED	PROJ. NO:	07571618
CHKD:	BG	DATE:	4-25-16	SHEET:	2

Photo 1: Morse Island vegetation cover.

Photo 2: Exposed utility and irrigation pipes, northwest corner.

Photo 3: Exposed utility and irrigation pipes, northwest corner.

Photo 4: Slope toe erosion.

Photo 5: Slope toe erosion.

Photo 6: Exposed utilities due to slope erosion.

Photo 7: Exposed utilities due to slope erosion.

Photo 8: Drainage outfall – west side.

Photo 9: Slope erosion – northeast corner.

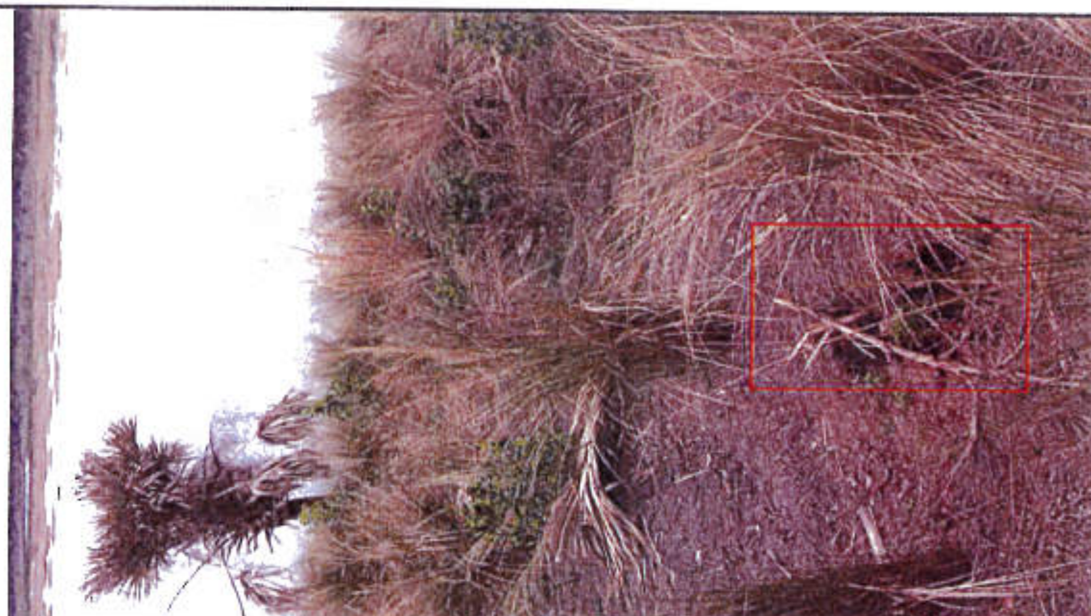


Photo 10: Slope erosion – northeast corner.

Photo 11: Slope erosion – northeast corner.

Photo 12: Slope erosion – northeast corner.

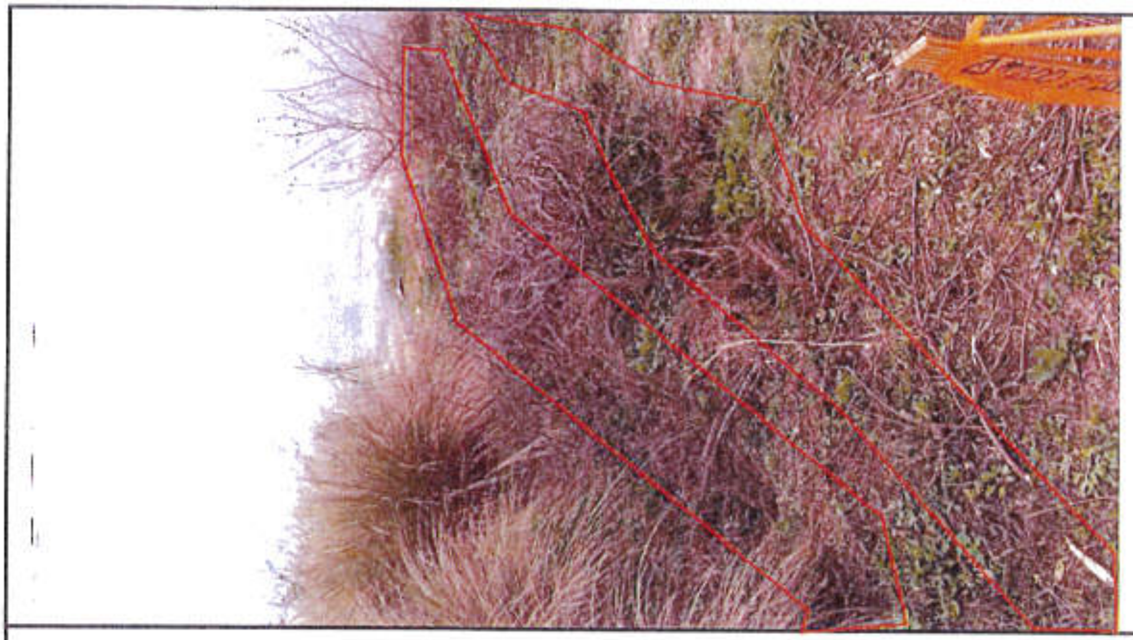
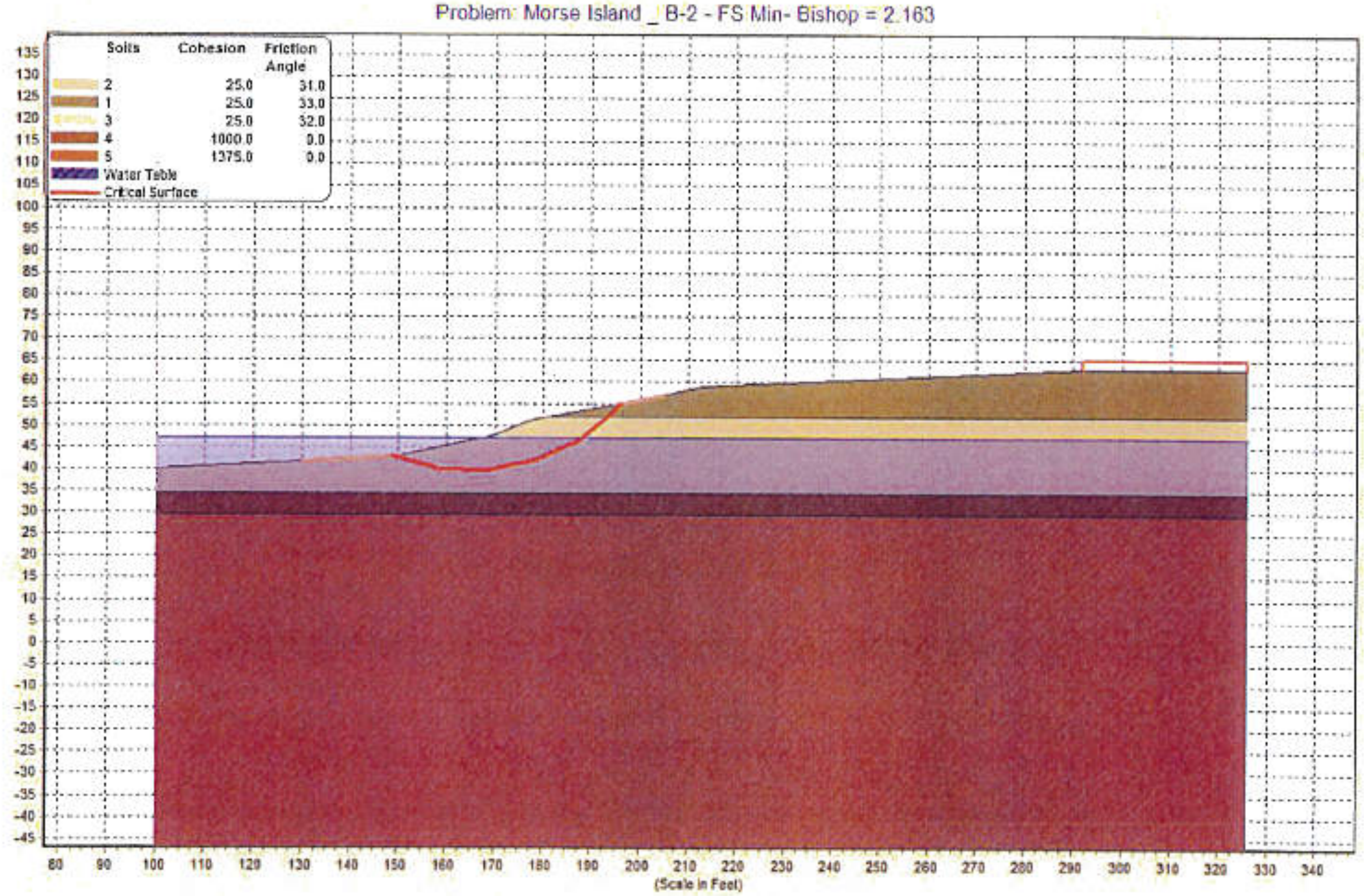


Photo 13: Slope erosion – northeast corner

Photo 14: Slope erosion – northeast corner.

Problem: Morse Island _ B-2 - FS Min- Bishop = 2.163



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Morse Island .. B-2

BOUNDARY COORDINATES

8 Top Boundaries
12 Total Boundaries

**** ERROR - P206 **** Boundaries 10 and 11

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	100.00	40.00	150.00	43.00	2
2	150.00	43.00	170.00	48.00	2
3	170.00	48.00	177.00	51.00	2
4	177.00	51.00	181.00	52.00	2
5	181.00	52.00	201.00	56.00	1
6	201.00	56.00	213.00	59.00	1
7	213.00	59.00	292.00	63.00	1
8	292.00	63.00	326.00	63.00	1
9	181.00	52.00	326.00	52.00	2
10	100.00	31.00	326.00	31.00	3
11	100.00	34.50	326.00	34.50	4
12	100.00	29.50	326.00	29.50	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.

1	105.0	110.0	0.0	33.0	0.00	0.0	1
2	100.0	105.0	0.0	31.0	0.00	0.0	1
3	100.0	105.0	0.0	32.0	0.00	0.0	1
4	110.0	115.0	500.0	0.0	0.00	0.0	1
5	115.0	120.0	1375.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	100.00	47.00
2	326.00	47.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	292.00	326.00	240.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

200 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 100.00 ft.
and X = 150.00 ft.

Each Surface Terminates Between X = 195.00 ft.
and X = 280.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

15.00 ft. Line Segments Define Each Trial Failure Surface.

1

```
           Y            A     X    I    S            F     T

           0.00      40.75    81.50    122.25    163.00    203.75
X      0.00 +---------+---------+---------+---------+---------+
            -
            -
            -
            -
            -
      40.75 +
            -
            -
            -
            -
            -
A     81.50 +
            -
            -
            -      ** * W
            -
            -
X    122.25 +
            -
            -
            -
            -          *
            -
I    163.00 +
            -           *
            -            *
            -            *
            -
            -
S    203.75 +             *
            -             *
            -
            -
            -
            -
     244.50 +
            -
            -
            -
            -
            -
F    285.25 +
            -             */1
            -
            -
            -
            -
T    326.00 +     **    W* *1/
```

****

****** EXECUTION OF STABL ABORTED ******
****

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	42.53
2	156.77	39.39
3	171.73	40.53
4	185.75	45.85
5	197.70	54.92
6	198.06	55.41

Circle Center At X = 160.3 ; Y = 91.5 and Radius, 52.2

*** 1.931 ***

Individual data on the 11 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	7.9	896.5	2090.8	2679.2	0.0	0.0	0.0	0.0	0.0
2	6.8	2656.1	1373.8	2977.2	0.0	0.0	0.0	0.0	0.0
3	13.2	8965.5	555.8	5884.3	0.0	0.0	0.0	0.0	0.0
4	1.7	1425.3	0.0	708.1	0.0	0.0	0.0	0.0	0.0
5	5.3	4541.3	0.0	1925.1	0.0	0.0	0.0	0.0	0.0
6	4.0	3359.7	0.0	991.5	0.0	0.0	0.0	0.0	0.0
7	4.8	3638.3	0.0	651.1	0.0	0.0	0.0	0.0	0.0
8	1.5	1023.1	0.0	68.2	0.0	0.0	0.0	0.0	0.0
9	6.6	2966.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	3.8	603.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.4	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	147.37	42.84
2	162.35	42.12
3	177.15	44.58

4	191.09	50.12
5	199.33	55.67

Circle Center At X = 158.2 ; Y = 112.4 and Radius, 70.4

*** 1.962 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	42.53
2	157.01	40.84
3	171.95	42.21
4	186.30	46.58
5	199.46	53.78
6	202.53	56.38

Circle Center At X = 157.8 ; Y = 112.9 and Radius, 72.1

*** 1.976 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	42.53
2	156.53	38.41
3	171.53	38.69
4	185.79	43.33
5	198.08	51.93
6	201.33	56.08

Circle Center At X = 163.0 ; Y = 87.6 and Radius, 49.7

*** 1.995 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	42.53
2	156.48	38.24

3	171.48	38.13
4	185.92	42.21
5	198.64	50.14
6	204.72	56.93

Circle Center At X = 164.2 ; Y = 89.8 and Radius, 52.2

*** 2.026 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	142.11	42.53
2	156.67	38.93
3	171.67	38.85
4	186.26	42.31
5	199.63	49.11
6	210.45	58.36

Circle Center At X = 164.4 ; Y = 101.5 and Radius, 63.1

*** 2.028 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.74	42.68
2	159.38	39.41
3	174.37	39.68
4	188.89	43.47
5	202.10	50.57
6	210.94	58.48

Circle Center At X = 165.7 ; Y = 101.5 and Radius, 62.5

*** 2.031 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	144.74	42.68

2	158.78	37.42
3	173.76	38.27
4	187.12	45.09
5	195.04	54.81

Circle Center At X = 164.3 ; Y = 73.4 and Radius, 36.4

*** 2.058 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	147.37	42.84
2	161.73	38.50
3	176.73	38.66
4	190.99	43.32
5	203.20	52.03
6	207.41	57.60

Circle Center At X = 168.5 ; Y = 86.3 and Radius, 48.3

*** 2.060 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	136.84	42.21
2	151.70	40.18
3	166.69	40.77
4	181.35	43.96
5	195.23	49.64
6	207.91	57.66
7	208.02	57.76

Circle Center At X = 155.8 ; Y = 126.0 and Radius, 85.9

*** 2.064 ***

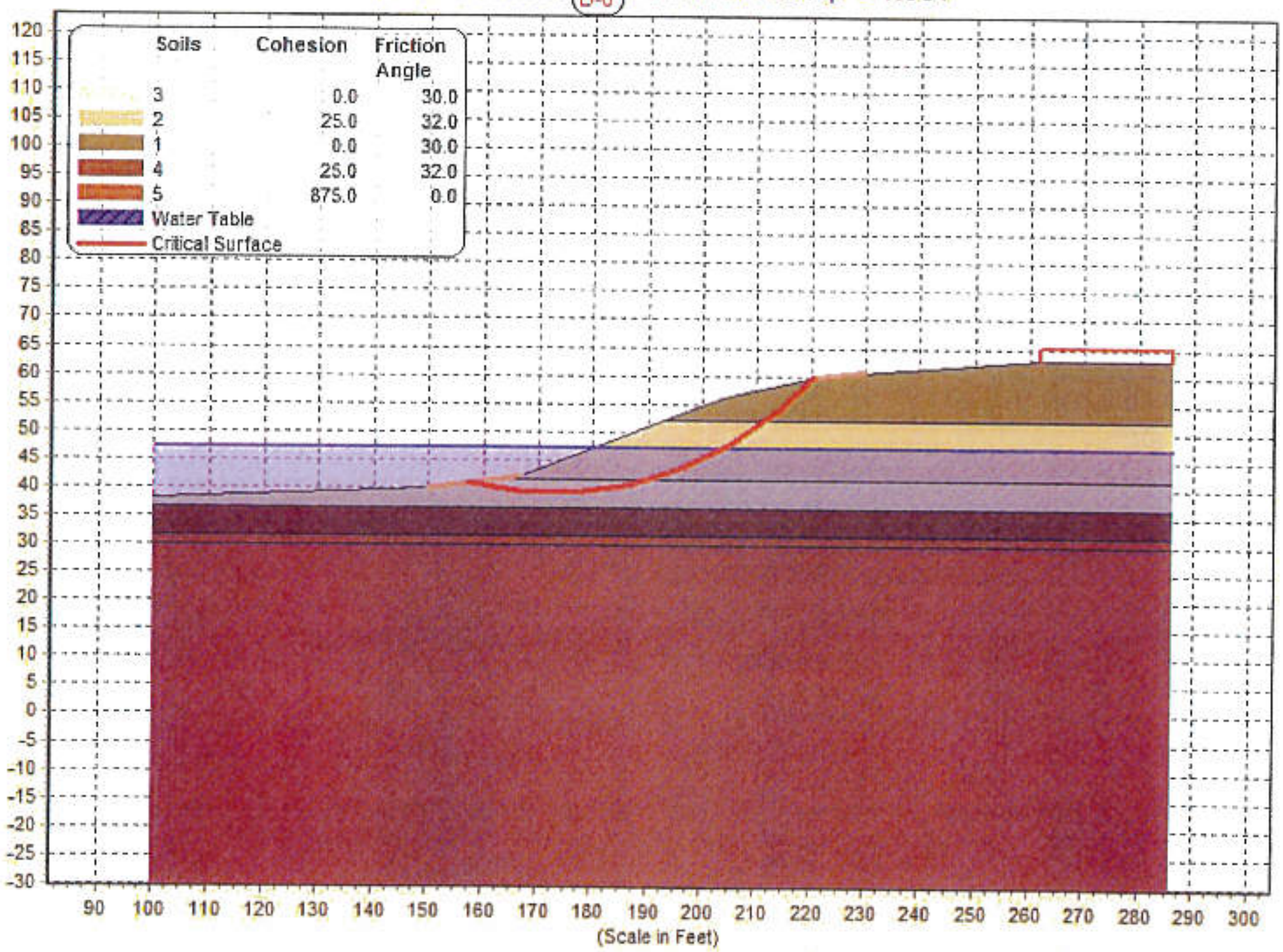
1

Y A X I S F T

0.00 40.75 81.50 122.25 163.00 203.75

```
X      0.00 +---------+---------+---------+---------+---------+
            -
            -
            -
            -
            -
           40.75 +
            -
            -
            -
            -
            -
A      81.50 +
            -
            -
            -        ** * W
            -         .  .
            -         ....
X     122.25 +      ......
            -       ......
            -      ......0
            -      ......1
            -     .......0*
            -     ......41
I     163.00 +   .......92.
            -    .......41.*
            -    .......872.*
            -    .........51.*
            -    ..........72.
            -    ..........511
S     203.75 +   ..........79*
            -     ...........*
            -     .............
            -      ............
            -      ............
            -        ..........
      244.50 +       ..........
            -          ........
            -          ........
            -            ......
            -              ....
            -                ..
F     285.25 +
            -                 */I
            -
            -
            -
            -
T     326.00 +      **    W* *1/
```

Problem: Morse Isl B-6 - FS Min- Bishop = 1.681



result.out
** STABL for WINDOWS **
by
Geotechnical Software Solutions

1

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:
Time of Run:
Run By:
Input Data Filename: run.in
Output Filename: result.out
Unit: U.S.C.
Plotted Output Filename: result.plt

PROBLEM DESCRIPTION Morse Island- B-6

BOUNDARY COORDINATES

7 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	100.00	38.00	150.00	40.00	3
2	150.00	40.00	167.00	42.00	3
3	167.00	42.00	193.00	52.00	2
4	193.00	52.00	204.00	56.00	1
5	204.00	56.00	221.00	60.00	1
6	221.00	60.00	262.00	63.00	1
7	262.00	63.00	286.00	63.00	1
8	193.00	52.00	286.00	52.00	2
9	162.00	41.50	286.00	41.50	3
10	100.00	36.50	286.00	36.50	4
11	100.00	31.50	286.00	31.50	5
12	100.00	30.00	286.00	30.00	5

1

ISOTROPIC SOIL PARAMETERS

5 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	100.0	105.0	0.0	30.0	0.00	0.0	1
2	100.0	105.0	25.0	32.0	0.00	0.0	1

3	100.0	105.0	0.0	30.0	0.00	0.0	1
4	105.0	110.0	25.0	32.0	0.00	0.0	1
5	110.0	115.0	875.0	0.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	100.00	47.00
2	286.00	47.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (psf)	Deflection (deg)
1	262.00	286.00	240.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

200 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 20 Points Equally Spaced Along The Ground Surface Between X = 150.00 ft. and X = 167.00 ft.

Each Surface Terminates Between X = 220.00 ft. and X = 230.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

10.00 ft. Line Segments Define Each Trial Failure Surface.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	157.16	40.84
2	167.04	39.29
3	177.04	39.24
4	186.93	40.69
5	196.50	43.61
6	205.52	47.92
7	213.79	53.54
8	220.67	59.92

Circle Center At X = 172.4 ; Y = 105.4 and Radius, 66.4

*** 1.681 ***

Individual data on the 14 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Force Norm (lbs)	Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.8	337.8	1786.6	1999.3	0.0	0.0	0.0	0.0	0.0
2	5.0	1058.0	1663.2	2308.4	0.0	0.0	0.0	0.0	0.0
3	0.0	10.7	12.5	18.3	0.0	0.0	0.0	0.0	0.0
4	10.0	4903.7	2047.4	4825.2	0.0	0.0	0.0	0.0	0.0
5	9.9	8062.7	0.0	4389.0	0.0	0.0	0.0	0.0	0.0
6	2.7	2488.9	0.0	1022.5	0.0	0.0	0.0	0.0	0.0
7	3.4	3267.6	0.0	1108.9	0.0	0.0	0.0	0.0	0.0
8	3.5	3412.8	0.0	895.8	0.0	0.0	0.0	0.0	0.0
9	7.1	6623.2	0.0	832.1	0.0	0.0	0.0	0.0	0.0
10	0.4	364.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	1.5	1307.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	6.0	4258.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	2.3	1196.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	6.9	1637.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	155.37	40.63
2	165.18	38.68
3	175.16	38.17
4	185.12	39.11
5	194.83	41.50
6	204.09	45.27
7	212.71	50.34
8	220.49	56.62
9	223.81	60.21

Circle Center At X = 173.7 ; Y = 106.8 and Radius, 68.6

*** 1.683 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	159.84	41.16
2	169.47	38.44
3	179.43	37.61
4	189.37	38.70
5	198.92	41.68
6	207.72	46.43
7	215.45	52.77
8	221.46	60.03

Circle Center At X = 178.7 ; Y = 89.5 and Radius, 51.9

*** 1.686 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.32	41.68
2	174.18	40.02
3	184.18	40.16
4	193.98	42.11
5	203.28	45.79
6	211.76	51.10
7	219.13	57.85
8	220.71	59.93

Circle Center At X = 178.4 ; Y = 94.4 and Radius, 54.6

*** 1.689 ***

1

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	151.79	40.21
2	161.66	38.58
3	171.65	38.30
4	181.59	39.39
5	191.29	41.82
6	200.57	45.55
7	209.25	50.51
8	217.18	56.60
9	220.39	59.86

Circle Center At X = 168.7 ; Y = 111.5 and Radius, 73.3

*** 1.691 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.32	41.68
2	174.03	39.31
3	184.02	38.92
4	193.89	40.52
5	203.25	44.05
6	211.71	49.38
7	218.95	56.28
8	221.57	60.04

Circle Center At X = 181.0 ; Y = 88.2 and Radius, 49.4

*** 1.696 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.21	41.79
2	174.85	39.14
3	184.84	38.59
4	194.71	40.18
5	204.02	43.82
6	212.35	49.36

7	219.30	56.55
8	221.47	60.03

Circle Center At X = 182.4 ; Y = 84.8 and Radius, 46.3

*** 1.700 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.32	41.68
2	174.00	39.19
3	183.99	38.67
4	193.87	40.16
5	203.27	43.59
6	211.79	48.82
7	219.09	55.65
8	222.25	60.09

Circle Center At X = 181.5 ; Y = 87.9 and Radius, 49.3

*** 1.706 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	165.21	41.79
2	174.75	38.79
3	184.72	38.00
4	194.61	39.46
5	203.93	43.09
6	212.19	48.72
7	218.99	56.06
8	221.27	60.02

Circle Center At X = 183.2 ; Y = 81.8 and Radius, 43.9

*** 1.711 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

```
    1          164.32        41.68
    2          174.11        39.68
    3          184.11        39.48
    4          193.98        41.08
    5          203.40        44.44
    6          212.06        49.44
    7          219.68        55.92
    8          223.14        60.16

Circle Center At X =  180.2 ; Y =    94.0  and Radius,    54.6

      ***      1.713    ***


1

              Y             A     X     I     S            F     T

              0.00      35.75     71.50    107.25    143.00    178.75
 X       0.00 +---------+---------+---------+---------+---------+
              -
              -
              -
              -
              -
        35.75 +
              -
              -
              -
              -
              -
 A      71.50 +
              -
              -
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APPENDIX F:
Opinion of Probable Costs

Kimley»Horn

Morse Island

Conceptual Phase Opinion of Probable Construction Costs

Alternative 1 - Revetment

	Item	Estimated Quantity	Unit	Unit Cost	Cost
1	Mob./demob.	1	LS	$ 100,000	$ 100,000
2	Fill	2,000	CY	$ 25	$ 50,000
3	Rock	5,000	Ton	$ 150	$ 750,000
4	Filter Cloth	60,000	SF	$ 3.00	$ 180,000
5	Plantings	7,000	Each	$ 4.00	$ 28,000
6	Site Restoration	1	LS	$ 25,000	$ 25,000
7	Contingency	30	%	$ 339,900	$ 339,900
				Total	$ 1,472,900

Alternative 2 - Living Shoreline with Toe Structure

	Item	Estimated Quantity	Unit	Unit Cost	Cost
1	Mob./demob.	1	LS	$ 100,000	$ 100,000
2	Fill	5,000	CY	$ 25	$ 125,000
3	Rock	2,600	Ton	$ 150	$ 390,000
4	Filter Cloth	30,000	SF	$ 3.00	$ 90,000
5	Plantings	10,000	Each	$ 4.00	$ 40,000
6	Site Restoration	1	LS	$ 25,000	$ 25,000
7	Contingency	30	%	$ 230,000	$ 230,000
				Total	$ 1,000,000

Alternative 3 - Living Shoreline

	Item	Estimated Quantity	Unit	Unit Cost	Cost
1	Mob./demob.	1	LS	$ 50,000	$ 50,000
2	Fill	10,000	CY	$ 25	$ 250,000
3	Rock	100	Ton	$ 150	$ 15,000
4	Filter Cloth	-	SF	$ 3.00	$ -
5	Plantings	15,000	Each	$ 4.00	$ 60,000
6	Site Restoration	1	LS	$ 25,000	$ 25,000
7	Contingency	30	%	$ 120,000	$ 120,000
				Total	$ 520,000

The Consultant has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Consultant at this time and represent only the Consultant's judgment as a design professional familiar with the construction industry. The Consultant cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

Project Wide Advisory Committee

Agenda Item No. 4

Fiscal Year 2016/2017 SLCDD Project Wide Fund Budget Process

The Villages
Community Development Districts
Office of Management and Budget

To: Project Wide Advisory Committee

From: Barbara E. Kays, Budget Director BEK

Date: August 1, 2016

ISSUE:

To discuss the Fiscal Year 2016-17 Project Wide Fund Budget and determine when to provide a recommendation to the Sumter Landing Community Development District Board the approval of the Project Wide Fund Fiscal Year 2016-17 Budget.

BACKGROUND:

Attached is the Fiscal Year 2016-17 Project Wide Fund Budget as it stands at this point and does not reflect any adjustments to the allocated amounts. As you know the cost allocation process takes place at the end of the budget process thus we do not know the final allocation amounts at this time.

The Project Wide Advisory Committee needs to determine how to move forward with the Fiscal Year 2016-17 Budget and recommendation. Staff would suggest that the Committee selects one of the two options below:

1) During today's meeting, the Committee proceeds with a motion to recommend to the Sumter Landing Community Development District Board the approval of the Fiscal Year 2016-17 Project Wide Fund Final Budget. We will email the Final Budget to the Committee once all of the final adjustments have been completed.

2) The Committee may decide to meet on Monday, August 29, 2016 to review the final allocation adjustments and then proceed with a motion to recommend to the Sumter Landing Community Development District Board the approval of the Fiscal Year 2016-17 Project Wide Fund Final Budget. This date was included on the original Budget Calendar as a placeholder if necessary as your September meeting date falls on the Labor Day holiday.

The Project Wide Advisory Committee has reviewed and discussed the Fiscal Year 2016-17 Project Wide Fund budget during its May and June meetings. Staff has continued to work on the budget over the past few months and is currently working on the cost allocation calculations.

984 Old Mill Run, The Villages, Florida 32162
Business Phone: 352-751-3939 Business Fax: 352-753-6430

The Project Wide Advisory Committee should provide a recommendation to Sumter Landing Community Development District Board to approve the Fiscal Year 2016-17 Final Budget for the Project Wide Fund. In accordance with Chapter 190, the Sumter Landing Community Development District Board must adopt a resolution to approve the final budget by September 15, 2016. The Sumter Landing Community Development District Board will meet on September 12, 2016 to approve the appropriate Fiscal Year 2016-17 Final Budget.

STAFF RECOMMENDATION:
Staff recommends that the Project Wide Advisory Committee selects one of the options listed above.

MOTION:
If the Project Wide Committee decides to provide a recommendation at today's meeting then the following motion would be necessary:

Move to recommend to the Sumter Landing Community Development District Board the approval of the Fiscal Year 2016-17 Project Wide Fund Final Budget.

SUMTER LANDING COMMUNITY DEVELOPMENT DISTRICT
Project Wide
FY 2016-17 Budget

16-17 Object Codes	30-132-50-00-000	2014-15 Actual	2015-16 Original Budget	2015-16 Amended Budget	2015-16 9-Month Actual	2016-17 Proposed Budget	(As of 7-28-16) 2016-17 Final Budget
	SOURCES						
337400	*Transportation*	*310,808*	*310,843*	*310,843*	*233,107*	*310,843*	*310,843*
337405	PW SC Rd Agrmt-D5	136,222	136,223	136,223	102,167	136,223	136,223
337406	PW SC Rd Agrmt-D6	42,450	42,451	42,451	31,838	42,451	42,451
337407	PW SC Rd Agrmt-D7	73,608	73,608	73,608	55,206	73,608	73,608
337409	PW SC Rd Agrmt-D9	17,693	17,693	17,693	13,270	17,693	17,693
337410	PW SC Rd Agrmt-D10	22,778	22,810	22,810	17,083	22,810	22,810
337411	PW SC Rd Agrmt-BW	18,057	18,058	18,058	13,543	18,058	18,058
338000	*Shared Revenues From Other Loc*	*9,459,683*	*10,027,027*	*10,027,027*	*7,536,142*	*10,026,792*	*10,048,192*
338026	Project Wide Fees-Dist #5	1,650,168	1,615,355	1,615,355	1,211,519	1,615,316	1,615,316
338027	Project Wide Fees-Dist #6	1,634,894	1,792,838	1,792,838	1,344,629	1,792,709	1,792,709
338028	Project Wide Fees-Dist #7	1,159,203	1,142,077	1,142,077	856,558	1,142,051	1,142,051
338029	Project Wide Fees-Dist #8	1,012,096	1,282,455	1,282,455	961,842	1,282,425	1,282,425
338030	Project Wide Fees-Dist #9	1,469,260	1,435,870	1,435,870	1,076,905	1,434,835	1,434,835
338031	Proj Wide Fees-Dist #10	1,736,498	1,851,991	1,851,991	1,388,936	1,852,951	1,852,951
338032	Project Wide Fees Frm LSL	64,852	92,248	92,248	69,187	92,248	92,248
338064	Proj Wide Fees-Dist #11		621,675	621,675	466,257	621,662	621,662
338084	Proj Wide Fees Frm Brownwood	189,042	192,518	192,515	144,359	192,515	192,515
338095	Refund - General Fund - VCCD				15,920		21,400
341900	*Other General Government Chg &*	*85,487*	*6,761*	*6,761*	*52,165*	*6,761*	*6,761*
341905	Property Damage Reimbursemen	31,900			3,765		
341908	Electric Reimbursement				26		
341990	Misc Revenue	55,587	6,761	6,761	48,374	6,761	6,761
361100	*Interest*	*3,345*	*3,000*	*3,000*	*7,884*	*5,000*	*5,000*
361102	Int Income - SBA	3,345	3,000	3,000	7,884	5,000	5,000
361300	*Net Inc(Dec) Fair Value Invest*	*33,603*			*69,168*		
361304	FMIVT-Unrealized Gain/Loss	12,525			6,250		
361306	FLGIT-Unrealized Gain/Loss	15,230			3,872		
361307	LTP Unrealized Gain/Loss	5,849			64,058		
499995	*TOTAL REVENUE*	*9,892,926*	*10,347,631*	*10,347,631*	*7,898,466*	*10,349,396*	*10,370,796*
669900	*Budget Funding Sources*		*500,000*	*584,765*		*253,300*	*231,973*
669901	(Add)/Use-Working Capita		500,000	584,765		253,300	231,973
499998	*TOTAL SOURCES*	*9,892,926*	*10,847,631*	*10,932,396*	*7,898,466*	*10,602,696*	*10,602,769*
	DISBURSEMENTS						
500310	*Professional Services*	*620,824*	*926,552*	*926,552*	*568,267*	*955,011*	*955,011*
539311	Management Fees	342,913	399,498	399,498	299,022	439,448	439,448
539312	Engineering Services	55,969	111,700	111,700	100,806	76,000	76,000
539316	Technology Services	8,813	11,218	11,218	8,412	12,340	12,340
539319	Other Professional Services	210,129	404,136	404,136	159,820	427,223	427,223
500340	*Other Contractual Services*	*917*	*12,117*	*12,117*	*961*	*26,575*	*26,648*
539343	Systems Management Support	917	12,117	12,117	961	26,575	26,648
500430	*Utilities Services*	*1,019,652*	*1,097,571*	*1,097,571*	*816,519*	*1,128,370*	*1,128,370*
539431	Electricity	675,572	716,195	716,195	459,173	697,212	697,212
539434	Irrigation Water	335,414	373,103	373,103	349,184	430,158	430,158
539455	Irrigation Phones	10,856	8,273	8,273	8,162	1,000	1,000
500440	*Rentals & Leases*		*1,000*	*1,000*		*1,000*	*1,000*
539442	Equipment Rental		1,000	1,000		1,000	1,000
500460	*Repairs & Maintenance Services*	*6,059,925*	*8,642,856*	*8,694,455*	*5,842,550*	*8,411,686*	*8,411,686*
539461	Equipment Maintenance	30	1,000	1,000		1,000	1,000
539462	Building/Structure Maintenan	261,915	1,029,727	1,029,727	345,204	612,898	612,898
539463	Landscape Maint.- Recurring	4,835,720	5,100,352	5,100,352	3,566,772	4,961,180	4,961,180
539464	Landscape Maint.-Non-Recurri	134,915	137,387	158,960	189,842	280,845	280,845
539438	Irrigation Repair	101,764	106,500	106,500	148,959	110,500	110,500
539439	Other Maintenance	1,725,577	2,267,890	2,297,890	1,595,973	2,425,465	2,425,465
500470	*Printing & Binding*	*378*	*500*	*500*	*63*	*500*	*500*
539471	Printing & Binding	378	500	500	63	500	500
500520	*Operating Supplies*	*7,931*	*4,900*	*4,900*	*1,145*	*20,800*	*20,800*
539522	Operating Supplies	5,731	3,600	3,600	1,145	6,600	6,600
539524	Non-Capital FF&E		1,300	1,300		1,800	1,800
539525	Non-Capital Hardware/Softwar	2,200				12,400	12,400
500600	*Capital Outlay*	*172,925*	*162,135*	*195,301*	*193,157*	*58,754*	*58,754*
539653	Infrastructure	172,925	162,135	195,301	193,157	58,754	58,754
500990	*Other Uses*	*265*					
539992	Bad Debt Expense-Govt	265					
599999	*TOTAL DISBURSEMENTS*	*8,882,807*	*10,847,631*	*10,932,396*	*7,422,662*	*10,602,696*	*10,602,769*

PROJECT WIDE FUND
Adjustments since Proposed Budget
FY2016-17

(As of 7-28-16)

Revenues

- **338095: Refund – General Fund** - Increase $21,400 for Project Wide Fund's portion of a refund from the General Fund.

Expenditures

- **343: System Management Support** – Increase $73 for Project Wide Fund's portion of Board IT costs

Proposed Budget	**$10,602,696**
System Management Support	73
Final Budget	**$10,602,769**

FY 2016-17
PROJECT WIDE
CAPITAL PROJECTS

PROJECT WIDE CAPITAL PROJECTS						
Account	Location	Description	Recommended	Proposed	Final	Funding Source
633	Stillwater Trail Multi Modal Path	Mill & Overlay	$ 58,754	$ 58,754	$ 58,754	Working Capital
	Total - 539633		$ 58,754	$ 58,754	$ 58,754	

Total Project Wide Capital Projects		**$ 58,754**	**$ 58,754**	**$ 58,754**	

PROJECT WIDE FUND
ALLOCATION SCHEDULE
FY2016-17 RECOMMENDED BUDGET

	TOTALS	ALLOCATION FORMULAS: LAKE SUMTER LANDING	Brownwood	DISTRICT #5	DISTRICT #6	DISTRICT #7	DISTRICT #8	DISTRICT #9	DISTRICT #10	DISTRICT #11	ALLOCATED COSTS: LAKE SUMTER LANDING	Brownwood	DISTRICT #5	DISTRICT #6	DISTRICT #7	DISTRICT #8	DISTRICT #9	DISTRICT #10	DISTRICT #11
Project Wide Revenues																			
Sumter Landing	$ 92,248										92,248								
Brownwood	192,515											$ 192,515							
District 5	1,615,316												1,615,316						
District 6	1,792,789													1,792,789					
District 7	1,142,051														1,142,051				
District 8	1,282,425															1,282,425			
District 9	1,434,835																1,434,835		
District 10	1,852,951																	1,852,951	
District 11	621,882																		621,882
Interest Income	6,000																		
Misc. Revenues																			
District 7 Grant Appurtenant Easement	2,551																		
District 9 Grant Appurtenant Easement	3,062																		
Laurel Manor POA - Signage & Landscape Maint Agreement	1,148																		
Sumter County ROW	310,843																		
Working Capital Usage	253,300																		
Total Revenues	$ 10,602,696										$ 92,248	$ 192,516	$ 1,615,316	$ 1,792,789	$ 1,142,051	$ 1,282,425	$ 1,434,835	$ 1,852,951	$ 621,882
Project Wide Expenses																			
Management Fees	$ 439,448	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	4,049	8,437	70,795	78,573	50,053	56,205	62,885	81,210	27,246
Engineering Services	146,000	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	1,343	2,803	23,521	26,106	16,629	18,673	20,890	26,981	9,052
Technology Services	17,340	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	114	237	1,988	2,206	1,406	1,578	1,766	2,280	765
Other Professional Svs.	427,223	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	3,930	8,203	68,825	76,387	48,661	54,642	61,136	78,961	26,488
Systems Management Support	26,575	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	244	510	4,281	4,752	3,027	3,399	3,803	4,911	1,648
Utilities (Electric, Irrigation, water/phones)	1,128,370	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	10,381	21,665	181,780	201,753	128,521	144,318	161,470	208,523	69,959
Equipment Rental	1,000	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	9	19	161	179	114	128	143	185	62
Equipment Maintenance	1,000	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	9	19	161	179	114	128	143	185	62
Buildings/Infrastructure Maintenance	542,696	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	4,993	10,420	87,420	97,034	61,813	69,411	77,660	100,290	33,647
Landscape Maintenance - Recurring	4,981,160	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	45,827	95,638	802,465	890,631	567,364	637,090	712,804	920,518	308,832
Landscape Maintenance - Non-Recurring	280,845	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	2,584	5,392	45,244	50,215	31,988	35,920	40,189	51,900	17,412
Irrigation Repair	110,500	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	1,017	2,122	17,802	19,757	12,586	14,133	15,813	20,420	6,851
Other Misc Maintenance	2,425,485	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	22,314	46,569	390,746	433,677	276,268	310,220	347,087	448,230	150,380
Printing & Binding/Misc Current Charges	500	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	5	10	81	89	57	64	72	92	31
Operating Supplies	6,600	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	61	127	1,063	1,180	752	844	944	1,220	409
Non-Capital FF&E	1,800	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	17	35	290	322	205	230	258	333	112
Non-Capital Hardware/Software	12,400	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	114	238	1,998	2,217	1,412	1,586	1,774	2,292	769
Capital	58,754	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	541	1,128	9,465	10,505	6,692	7,516	8,408	10,858	3,643
Total Expenditures	$ 10,602,696	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	97,540	$ 203,572	$ 1,708,094	$ 1,895,760	$ 1,207,847	$ 1,356,064	$ 1,517,247	$ 1,959,978	$ 657,368
	10,602,696																		
LESS: Interest Income	6,000	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	46	96	805	894	569	640	716	924	310
LESS: Kiosk/Square Rental	-	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	-	-	-	-	-	-	-	-	-
LESS: Dist 7 Grant Appurtenant Easement	2,551	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	23	49	411	456	291	326	365	471	158
LESS: Dist 9 Grant Appurtenant Easement	3,062	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	28	59	493	547	349	392	438	566	190
LESS: Sweetbay Annual District Fees	-	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	-	-	-	-	-	-	-	-	-
LESS: LM POA - Signage & Landscape Maint Agreement	1,148	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	11	22	185	205	131	147	164	212	71
LESS: LSL POA - CAM Agreement	-	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	-	-	-	-	-	-	-	-	-
LESS: LSL Outer Properties	-	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	-	-	-	-	-	-	-	-	-
LESS: Sumter County ROW	310,843	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	2,860	5,968	50,077	55,579	35,405	39,757	44,482	57,444	19,272
LESS: Working Capital Usage	253,300	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%	2,330	4,863	40,807	45,290	28,851	32,397	36,247	46,810	15,705
Total Allocation	$ 10,025,792										$92,248	$192,515	$1,615,316	$1,792,789	$1,142,051	$1,282,425	$1,434,835	$1,852,951	$621,882
									FY15-16 Difference		92,248	192,518	1,615,355	1,792,838	1,142,077	1,282,455	1,435,870	1,851,991	621,895
											0	(3)	(39)	(49)	(26)	(30)	(1,035)	960	(13)
											0%	0%	0%	0%	0%	0%	0%	0%	0%
											LSL	Brownwood	5	6	7	8	9	10	11
Acreage:																			
Assessable Acres	8,056.41	74.48	154.54	1,297.59	1,440.31	917.72	1,030.35	1,153.14	1,489.04	499.27									
Percentages	100.00%	0.92%	1.92%	16.11%	17.88%	11.39%	12.79%	14.31%	18.48%	6.20%									

PROJECT WIDE - WORKING CAPITAL AND RESERVE BALANCES

Working Capital

	2014-15 Actual (per 6/30/15 Audit)	2015-16 Amended Budget	2016-17 Recommd. Budget	2016-17 Proposed Budget	2016-17 Final Budget
Beginning Balance		3,852,217	3,267,452	3,267,452	3,267,452
Deposits		10,347,631	10,349,396	10,349,396	10,370,796
Expenditures		10,932,396	10,602,696	10,602,696	10,602,769
Ending Balance	3,852,217	3,267,452	3,014,152	3,014,152	3,035,479

***Unrealized gain of $197,038 is not included in FY15-16 beginning balance

RESERVES

General R&R

	2014-15 Actual	2015-16 Amended Budget	2016-17 Recommd. Budget	2016-17 Proposed Budget	2016-17 Final Budget
Beginning Balance		2,112,220	2,112,220	2,112,220	2,112,220
Deposits					
Expenditures					
Ending Balance	2,112,220	2,112,220	2,112,220	2,112,220	2,112,220

FY15-16 Operating Budget	10,652,330
3 Months	2,663,083
4 Months	3,550,777