PIRATE’S PASS
SEDIMENT ABATEMENT STUDY

Prepared for
Sarasota County
Navigable Waterways
Maintenance Management
Program

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July 2007
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1.0 INTRODUCTION

Sarasota County’s Navigable Waterways Maintenance Management Program (NWMMP) routinely conducts feasibility studies for maintenance dredging of residential waterways throughout the unincorporated coastal regions of the County. In parallel with the feasibility projects, Sarasota County contracted GPI Southeast Inc. (GPI), formerly known as Berryman & Henigar, Inc. (BHI), to perform a series of sediment abatement analyses. As sedimentation is a significant concern to citizens residing along waterways, the purpose of these studies is to determine if opportunities exist for reducing future land-based sediment accumulation in the waterways. Waterfront residents in Sarasota County are fully assessed for the costs of canal maintenance dredging.

This report is the sixteenth in a series of sediment abatement studies being conducted by GPI for the County. The areas previously examined include:

- Baywood Canal
- America Drive Canal
- Phillippi Cove
- South Creek
- Hidden Harbor
- Cedar Cove
- Phillippi/Pinecraft
- Grand Canal
- Baywood Avenue D
- Forked Creek Neptune
- Sea Plume Way
- Lyons Bay Sunaire Estil
- Lyons Bay Inlets
- Dale Lakes
- Brucewood Bayou

Additionally, other areas being examined include:

- Phillippi/Tuttle to Hyde Park
- Curry Creek
- Tidewater Canal

2.0 BACKGROUND

The subject project area is the Pirate’s Pass (waterway) located west of Waneta Place, east of Merrimac Drive, and north of Majestic Way. The waterway discharges directly to Phillippi Creek (see Figure 1 for the project location).

One concern voiced by waterfront owners is the possibility of future sedimentation from stormwater runoff, which can cause a decrease in canal depth after the expense of the dredging operation. To address this concern, the County engaged GPI to analyze the stormwater systems
entering the canal and estimate the effects these systems may have on future sediment accumulation.

Figure 1
General Location Map
3.0 SITE CONDITIONS

Canal sedimentation can be the result of many factors, including stormwater discharges, upland erosion, illegal discharges, algae build up from low dissolved oxygen and/or high nutrient levels in the canal, wind blown currents, or tidal influences. Most canals are influenced by a combination of these factors. A careful investigation is required to determine the cause(s) of sedimentation prior to recommending actions to reduce sedimentation in canal systems.

GPI staff performed a field investigation of the Pirate’s Pass waterway on June 12, 2007. The waterway is bordered by single-family residential properties. The majority of the waterfront property owners are using seawalls and vegetation for slope stabilization. Most yards along the bordering streets were well vegetated, maintained, stabilized, and showed no significant sedimentation sources.

The drainage basin around the waterway is bordered by Merrimac Drive to the west, Yorkshire Drive to the north; Yorkshire Way to the east; and Constitution Boulevard to the south. The drainage basin consists of almost six acres of mostly single-family residential property. Most of the parcels on Merrimac Drive and Majestic Way bordering the canal drain to the west to the America Drive Canal. See Figure 2 for the two sub-basins within the study area.

Soils in the area consist predominantly of St. Augustine, Pomello, EauGallie and Myakka fine sands. The soils are nearly level, poorly-drained, or moderately well drained.

Most of the streets bordering the waterway have no gutters, but some have very shallow and or small swales and driveway culverts. The rear portions of all lots bordering the waterway drain directly to the canal via sheet flow, and the fronts of the lots drain to the street. The street flow from Waneta Place is routed into the subject waterway, with street flow from Merrimac Drive being routed into another waterway. Site photographs show most yards and streets are clean and well maintained.

There is one stormwater outfall discharging to the waterway. The outfall is shown on Figure 3, and it is identified and discussed below.

3.1 Outfall PP1

Outfall PP1 discharges through a series of inlets and culverts along Waneta Place near Majestic Way to the waterway. This outfall drains over four acres of single-family residential property (Figures 4 thru 9). There are no stormwater treatment systems within the drainage basin of this outfall. The pipe discharges below the water line, but no sediment build-up was observed at the outfall.
Figure 2
Existing Features Map
Figure 3
Existing Conditions Outfall Map
Figure 4
Looking South at inlet on Waneta Pl. upstream of outfall BB1

Figure 5
Inlets on the intersection of Waneta Pl. and Majestic Way upstream of outfall BB1
Figure 6
Downstream most inlet on Waneta Pl. upstream of outfall BB1

Figure 7
Outfall BB1 submerged under water
Figure 8
Looking north from outfall PP1

Figure 9
Looking south at Pirate’s Pass canal
4.0 POLLUTANT LOADING ASSESSMENT

A pollutant loading analysis was performed to quantify potential land-based sediment and other pollutant loadings entering the canal. The analysis used a spreadsheet-based simple model, with loading estimates based on land uses from the Southwest Florida Water Management District (SWFWMD) Florida Land Use and Cover Classification System (FLUCCS) GIS coverage, drainage basin boundaries obtained from Sarasota County that were modified with further discretization around the outfalls, stormwater treatment efficiency rates for Best Management Practices (BMPs) (ASCE, 2001), and annual pollutant loading unit rates (ERD, 1994). Table 1 summarizes the loading rates used in the analysis. BMP treatment efficiencies are shown in Table 2. Land uses were field verified. Figure 10 shows the land use within drainage area. This type of planning-level analysis does not take into account short-term erosion from sources such as construction sites or leaking pipe joints.

Pollutant loadings were estimated by multiplying the total acreage in each drainage basin by a composite annual loading rate. The composite loading rate was developed by weighting the land use specific loading rates by the relative proportion of basin area in that land use. Where appropriate, the gross loadings were adjusted to account for BMP reduction factors to estimate the net pollutant loadings by parameter.

The existing conditions pollutant loadings are presented in Table 3. Loadings were calculated for total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). While TSS can account for sediment build up in a canal, nutrients from TP and TN can lead to algae blooms and vegetation growth, with subsequent muck accumulation in water bodies. The assessment for the drainage basin estimates total current TSS loading at 327 kg/year, TP loading at 4 kg/year, and TN loading at 22 kg/year.

Using a typical unit weight for sandy silt of 90 lb/cubic foot (Dunn et. al., 1980), the estimated 721 lb annual sediment load could contain a volume of approximately 8 cubic feet (0.3 cubic yards). However, under field conditions, the sediment would tend to accumulate near the outfall, although tidal and stream flows would disperse the sediment throughout the canal and into Phillippi Creek.
Figure 10
Land Use Map
Table 1
Summary of unit pollutant loading rates for central and south Florida (ERD, 1994)

<table>
<thead>
<tr>
<th>LAND USE CATEGORY</th>
<th>TOTAL N</th>
<th>ORTHO-P</th>
<th>TOTAL P</th>
<th>BOD</th>
<th>TSS</th>
<th>TOTAL Zn</th>
<th>TOTAL Pb</th>
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<tbody>
<tr>
<td>Low Density Residential</td>
<td>2.88</td>
<td>0.169</td>
<td>0.320</td>
<td>7.63</td>
<td>31.9</td>
<td>0.06</td>
<td>0.052</td>
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<tr>
<td>Single-Family</td>
<td>4.68</td>
<td>0.335</td>
<td>0.594</td>
<td>14.3</td>
<td>56.1</td>
<td>0.122</td>
<td>0.083</td>
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<tr>
<td>Multi Family</td>
<td>8.51</td>
<td>0.924</td>
<td>1.72</td>
<td>38.4</td>
<td>256</td>
<td>0.188</td>
<td>0.299</td>
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<tr>
<td>Low-Intensity Commercial</td>
<td>5.18</td>
<td>0.157</td>
<td>0.650</td>
<td>36.1</td>
<td>343</td>
<td>0.511</td>
<td>0.635</td>
</tr>
<tr>
<td>High Intensity Commercial</td>
<td>13.0</td>
<td>1.52</td>
<td>1.96</td>
<td>79.3</td>
<td>435</td>
<td>0.782</td>
<td>0.985</td>
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<tr>
<td>Industrial</td>
<td>7.30</td>
<td>0.519</td>
<td>1.24</td>
<td>39.5</td>
<td>383</td>
<td>0.543</td>
<td>0.872</td>
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<td>Highway</td>
<td>6.69</td>
<td>0.361</td>
<td>1.32</td>
<td>21.9</td>
<td>182</td>
<td>0.508</td>
<td>0.727</td>
</tr>
<tr>
<td>Agricultural</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Pasture</td>
<td>4.54</td>
<td>0.732</td>
<td>0.876</td>
<td>7.99</td>
<td>126</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>b. Citrus</td>
<td>2.91</td>
<td>0.123</td>
<td>0.197</td>
<td>3.60</td>
<td>21.9</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>c. Row Crops</td>
<td>2.84</td>
<td>0.421</td>
<td>0.595</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>d. General Agriculture</td>
<td>3.62</td>
<td>0.380</td>
<td>0.551</td>
<td>5.80</td>
<td>74.0</td>
<td>---</td>
<td>---</td>
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<td>Recreational/Open Space</td>
<td>1.07</td>
<td>0.003</td>
<td>0.046</td>
<td>0.956</td>
<td>7.60</td>
<td>0.005</td>
<td>0.021</td>
</tr>
<tr>
<td>Mining</td>
<td>2.21</td>
<td>0.131</td>
<td>0.281</td>
<td>18.0</td>
<td>176</td>
<td>0.229</td>
<td>0.378</td>
</tr>
<tr>
<td>Wetland</td>
<td>1.81</td>
<td>0.204</td>
<td>0.222</td>
<td>4.96</td>
<td>11.2</td>
<td>0.009</td>
<td>0.039</td>
</tr>
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<td>Open Water</td>
<td>3.23</td>
<td>0.130</td>
<td>0.273</td>
<td>4.02</td>
<td>8.05</td>
<td>0.073</td>
<td>0.065</td>
</tr>
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</table>
### Table 2
BMP selection guide (ASCE, 2001)

<table>
<thead>
<tr>
<th>BMP</th>
<th>Land Area Needed</th>
<th>Distance Above Groundwater</th>
<th>Soil Type Needed</th>
<th>Cost</th>
<th>Total Nitrogen % Removal</th>
<th>Total Phosphorus % Removal</th>
<th>Suspended Solids % Removal</th>
<th>Heavy Metals % Removal</th>
<th>Floating Trash Removal</th>
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<tbody>
<tr>
<td><strong>Ponds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Retention Online</td>
<td>High</td>
<td>Low</td>
<td>A or B</td>
<td>High</td>
<td>Medium</td>
<td>60-98</td>
<td>60-98</td>
<td>60-98</td>
<td>High</td>
</tr>
<tr>
<td>Dry Offline Retention or Detention</td>
<td>High</td>
<td>Low</td>
<td>A or B</td>
<td>High</td>
<td>Medium</td>
<td>60</td>
<td>85</td>
<td>90</td>
<td>65-85</td>
</tr>
<tr>
<td>Wet Detention</td>
<td>High</td>
<td>High</td>
<td>Any</td>
<td>High</td>
<td>Low</td>
<td>26</td>
<td>65</td>
<td>75</td>
<td>25-70</td>
</tr>
<tr>
<td>Wet Detention With Filtration</td>
<td>High</td>
<td>Low</td>
<td>Any</td>
<td>High</td>
<td>High</td>
<td>60</td>
<td>65</td>
<td>85</td>
<td>60-85</td>
</tr>
<tr>
<td>Dry Detention</td>
<td>High</td>
<td>Low</td>
<td>A or B</td>
<td>High</td>
<td>Medium</td>
<td>15</td>
<td>25</td>
<td>70</td>
<td>35-70</td>
</tr>
<tr>
<td>Alum System</td>
<td>NA</td>
<td>NA</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>50</td>
<td>90</td>
<td>80</td>
<td>80-90</td>
</tr>
<tr>
<td>Constructed Wetlands</td>
<td>High</td>
<td>0 ft.</td>
<td>C or D</td>
<td>High</td>
<td>****</td>
<td>****</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Sand Filters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Austin Sand Filter</td>
<td>Medium</td>
<td>2 ft.</td>
<td></td>
<td>High</td>
<td>31-47</td>
<td>50-65</td>
<td>70-87</td>
<td>20-84</td>
<td>N/A</td>
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<tr>
<td>D.C. Underground Sand Filter</td>
<td>Medium</td>
<td></td>
<td></td>
<td>High</td>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Delaware Sand Filter</td>
<td>Medium</td>
<td>2 ft.</td>
<td></td>
<td>High</td>
<td>47</td>
<td>41</td>
<td>57</td>
<td>45.2</td>
<td>N/A</td>
</tr>
<tr>
<td>Alexandria Stone Reservoir Trench</td>
<td>High</td>
<td></td>
<td></td>
<td>High</td>
<td>47.2</td>
<td>63-72</td>
<td>79-84</td>
<td>***</td>
<td>N/A</td>
</tr>
<tr>
<td>Texas Vertical Sand Filter</td>
<td>Medium</td>
<td>7 feet</td>
<td>N/A</td>
<td>High</td>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Peat Sand Filter</td>
<td>Medium</td>
<td></td>
<td></td>
<td>High</td>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Washington Compost Filter System</td>
<td>200 S.F/cfs</td>
<td>4 feet</td>
<td>N/A</td>
<td>High</td>
<td>N/A</td>
<td>41</td>
<td>95</td>
<td>75.8</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baffle Boxes</td>
<td>Low</td>
<td>NA</td>
<td>NA</td>
<td>Medium</td>
<td>Medium</td>
<td>0</td>
<td>30-40</td>
<td>20-90</td>
<td>Unknown</td>
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<tr>
<td>Vegetated Swales</td>
<td>Medium</td>
<td>Low</td>
<td>A, B, C</td>
<td>Medium</td>
<td>Low</td>
<td>0-25</td>
<td>29-45</td>
<td>60-83</td>
<td>35</td>
</tr>
<tr>
<td>Buffer Strips</td>
<td>Low</td>
<td>1 ft-2 ft</td>
<td>A, B, C</td>
<td>Medium</td>
<td>Low</td>
<td>20-60</td>
<td>20-60</td>
<td>20-80</td>
<td>20-80</td>
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<tr>
<td>Infiltration Trenches</td>
<td>Low</td>
<td>2-4 ft</td>
<td>A or B</td>
<td>Medium</td>
<td>High</td>
<td>45-70</td>
<td>50-75</td>
<td>75-99</td>
<td>75-99</td>
</tr>
<tr>
<td>Inlet Devices</td>
<td>None</td>
<td>NA</td>
<td>NA</td>
<td>Low</td>
<td>High</td>
<td>**</td>
<td>**</td>
<td>Low-Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>

** Traps particulate phosphorus and nitrogen in the form of leaves and grass - not effective for dissolved nutrients

*** No Data Available

**** Varies widely
Table 3. Pirate’s Pass Pollutant Estimates
Existing Conditions

<table>
<thead>
<tr>
<th>Basin No.</th>
<th>Area (ac)</th>
<th>Land Use</th>
<th>Type of Treatment System</th>
<th>% TSS Reduction</th>
<th>% TP Reduction</th>
<th>% TN Reduction</th>
<th>TSS Loading Rate (kg/ac-yr)</th>
<th>TP Loading Rate (kg/ac-yr)</th>
<th>TN Loading Rate (kg/ac-yr)</th>
<th>TSS Loading (kg/yr)</th>
<th>TP Loading (kg/yr)</th>
<th>TN Loading (kg/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.65</td>
<td>Single-Family</td>
<td>None</td>
<td>56.1</td>
<td>0.59</td>
<td>4.68</td>
<td>260.9</td>
<td>2.8</td>
<td>21.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4.65</td>
<td>Total Basin Land Use</td>
<td>None</td>
<td>56.1</td>
<td>0.59</td>
<td>4.68</td>
<td>260.9</td>
<td>2.8</td>
<td>21.8</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>1.18</td>
<td>Single-Family</td>
<td>None</td>
<td>56.1</td>
<td>0.59</td>
<td>4.68</td>
<td>66.3</td>
<td>0.7</td>
<td>5.5</td>
<td></td>
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<tr>
<td>2</td>
<td>1.18</td>
<td>Total Basin Land Use</td>
<td>None</td>
<td>56.1</td>
<td>0.59</td>
<td>4.68</td>
<td>66.3</td>
<td>0.7</td>
<td>5.5</td>
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<tr>
<td>TOTALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>327.2</td>
<td>3.5</td>
<td>27.3</td>
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</tbody>
</table>
5.0 DISCUSSION AND RECOMMENDATIONS

Existing conditions land-based pollutant loadings to the waterway were calculated for total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). The estimate loadings are 327 kg/year for TSS, 4 kg/year for TP, and 22 kg/year for TN (not including input from the island within the waterway).

The estimated 721 lb annual sediment load for the drainage basin could contain a volume of approximately 8 cubic feet (0.3 cubic yards). As stated previously, the sediment would tend to accumulate near the outfall under field conditions, although tidal flow may disperse the sediment throughout the canal and into Phillippi Creek.

It should be noted that nutrient control is an important element of water quality management. Excess enrichment can result in algae blooms, excess aquatic vegetation growth, and subsequent accumulation of detritus turning to muck. Nutrients can become adsorbed onto sediment particles, so trapping sediment also can reduce nutrient loading to the estuarine system. The following discussion provides recommendations on how to reduce runoff-borne sediment from entering the canal.

In the Pirate’s Pass watershed, one of the two drainage basins discharges over four acres through an outfall that does not provide any level of stormwater treatment. In the other drainage basin, over an acre directly discharges into the canal and is located in rear lots bordering the canal, where it is not generally feasible to install BMPs other than rear lot swales.

Although not widely observed, some silt accumulation was noted on the bottom of the waterway and could be indicative of dead end canals and a combination of muck from high nutrient levels in the system, or sediment of marine origin. Potential nutrient sources include algae from the bay, fertilizers, leaves, grass, organic yard debris, and pet wastes from local runoff. Inlet devices and other land-limited BMPs can be effective in capturing TSS from runoff, but not nutrients.

Reduction of nutrients in urban settings can be effectively accomplished with source controls. Educating the homeowners in the area to reduce fertilizer use, prevent grass clippings from entering the canals, and mowing less frequently would reduce the nutrient levels in the canals. Small back yard swales to hold runoff instead of letting it run directly into the canal may also be effective.

Although not widely observed there were some areas of grass clippings and leaves in the street and in inlets that could end up in the canal. These nutrient sources affect the muck build up in the canal. In addition, lawn mowers should blow the leaves and grass back into the yards instead of into the street or the canal. It is therefore recommended that the County continue to provide public education regarding methods of source control and single lot design that could reduce sediment and nutrient loadings to the canal.

Specific discussion regarding the single outfall is included below.

5.1 Outfall PP1

Outfall PP1 discharges through a series of inlets and culverts along Waneta Place near Majestic Way to the southern portion of the waterway. As no stormwater treatment is provided, GPI recommends the installation of inlet devices to provide some level of treatment for the basin.
6.0 CONCLUSIONS

Pirate’s Pass has isolated areas of sedimentation problems typical of many residential waterways along the coastline. Accumulations of sediment occur from natural erosion and anthropogenic activities such as construction and land clearing. In addition, muck accumulates in canal bottoms from algae blooms caused by elevated nutrient levels in the canal waters. Stormwater runoff brings nutrients and other pollutants to the waterways and poor circulation allows the pollutants to settle to the bottom. With the dredging project being investigated by the County, it is natural that the affected property owners would inquire as to possible methods to reduce future sedimentation and dredging expenses.

An analysis of the land uses and drainage basins contributing to the waterway was undertaken to determine possible causes of sediment build-up. Outfall pipes to the waterway were inspected for obvious joint leakage or erosion problems. There were no obvious signs of sediment in the pipes themselves, indicating that there were no significant structural problems to the system.

To further examine potential pollution sources to the waterway, a pollutant loading analysis of the stormwater runoff from the watershed was produced. TSS, TN, and TP loadings were estimated using calculations accounting for the land areas, land uses, pollutant loadings, and existing stormwater treatment systems. This analysis suggests that most of the pollutant loadings originate in basin 1, which has the following loadings: TSS loading of 327 kg/year, TP loading at 4 kg/year, and TN loading at 27 kg/year.

There is one stormwater outfall to the waterway. Based on the field investigations and analysis in this report, GPI recommends the installation of inlet devices in basin 1. Recommendations are summarized in Figure 11.

One of the most important aspects of pollutant reduction is source control. At some locations it was observed that residents or landscape maintenance crews were allowing grass clippings to wash or blow into the inlets. A strong public education effort will inform residents that changing their day to day activities can be one of the best methods of pollution control. By reducing fertilizer application amounts and frequencies, reducing lawn sprinkling to twice a week, reducing mowing, controlling disposal of grass and yard debris, and cleaning pet refuse, the homeowners can take a large part in reducing nutrient loading to the canals and thereby reducing muck accumulations in the waterway.
Figure 11
Recommended Sediment Abatement Facilities
7.0 REFERENCES


