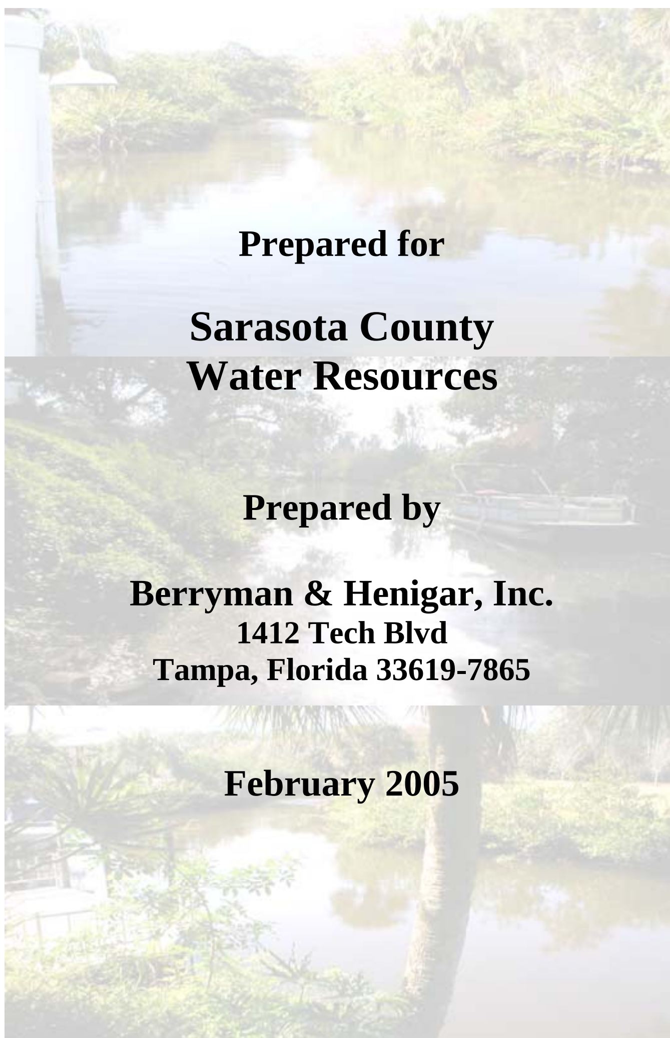
PHILLIPPI COVE
SEDIMENT ABATEMENT STUDY



Prepared for

Sarasota County
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1.0 INTRODUCTION

Sarasota County's Navigable Waterways Program (NWP) routinely conducts feasibility studies for residential canal dredging throughout the unincorporated coastal regions of the County. To compliment some of the feasibility projects, Sarasota County has engaged Berryman & Henigar, Inc. (BHI) to perform a series of sediment abatement analyses to determine if opportunities exist for reducing future land-based sediment accumulation in the canals. Sedimentation is a significant concern to the citizens residing along the canals. Residents with property along canals in the County are typically assessed for the costs of canal dredging.

This report is one of a series of sediment abatement studies being conducted by BHI for the County. The areas being examined include:

- Baywood Canal
- America Drive Canal
- Phillippi Cove
- Hidden Harbor
- South Creek
- Cedar Cove
- Phillippi/Pinecraft

The area being considered for this study is Phillippi Cove (cove) located west of Swift Road and north of Proctor Road. The downstream end of the cove connects to Phillippi Creek, which discharges to Little Sarasota Bay. See Figure 1 for the project location map.

2.0 BACKGROUND

A review of the Natural resources Conservation Service (NRCS) Soil Survey for Sarasota County suggests that the cove was historically a depressional area, but it has been dredged for open water access. Dredging increased draft clearance and navigability and provided fill material for residential developments on Phillippi Cove. The upper portion of the cove is aligned northeast to southwest between Nassau Street and Jamaica Street. The lower portion of the cove runs east to west in between Trinidad Street and Jamaica Street to its confluence with Phillippi Creek. The cove varies in width between 30 and 50 feet, but it widens to approximately 70 feet before it discharges to Phillippi Creek.

A review of Florida Department of Environmental Protection (FDEP) permit files revealed no previous dredge permits for this system. The FDEP permits database did show a notice general permit 62-341.490, FAC that provided that Phillippi Creek could be dredged to a depth of – 4 feet mean low water (MLW). The permit was issued to the West Coast Inland Navigation District (WCIND). The WCIND dredged the mouth of the Cove as it enters Phillippi Creek, but this permit may not have covered the Cove itself. Also, a historical report describes the Phillippi Creek primary conveyance system as open channels, originally dredged in the 1920's to improve drainage for agricultural uses (Smalley, et al, 1961).

One of the concerns voiced by the citizens along several residential canals is the possibility of future sedimentation from stormwater runoff causing a loss of water depth after the expense of the dredging operation. To address those concerns, the County has engaged BHI to analyze the stormwater systems entering the canals and estimate the effects these systems may have on future sediment accumulation.

3.0 SITE CONDITIONS

Canal sedimentation can be the result of many factors, including stormwater discharges, upland erosion, illegal discharges, algae build up from high nutrient levels in the canals, wind blown currents, or tidal influences. Most canals are influenced by a combination of these factors. A careful investigation is required to determine the causes of sedimentation prior to recommending courses of action to reduce sedimentation in canal systems.

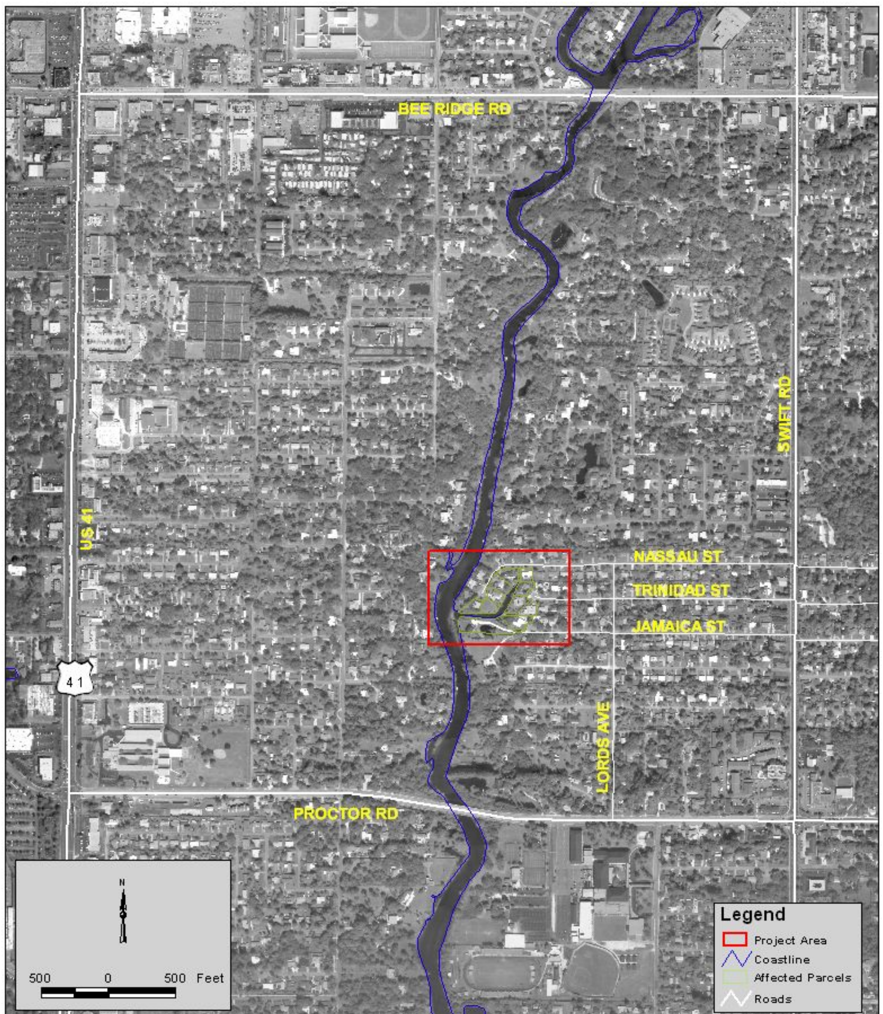

Figure 1 Project Location Map

Field investigations of the cove were made by BHI staff on December 21, 2004 and January 27, 2005. The cove is bordered by single-family medium-density residential properties at most locations, except for the single-family low-density residential properties bordering the southern edge of the lower portion of the cove. The majority of the waterfront property owners are using vegetation and rock rip-rap for stabilization with a few properties having vertical seawalls. There was only one observed failing sea wall which could be a source of sedimentation. Steep slopes with apparent erosion were observed on the eastern end of the northern reach. Most yards and roads in the bordering streets were well vegetated, maintained, and stabilized, showing no significant sedimentation sources.

The drainage basin for the cove is generally bordered by Phillippi Creek on the west, Swift Road on the east, Nassau Street on the north, and Jamaica Street on the south. The overall drainage basin consists of 24 acres of single-family residential. See Figure 2, which shows subbasins within the study area.

Soils in the area consist predominantly of Pople, Pineda, Felda, and Cassia fine sands. The soils are nearly level, somewhat and/or poorly-drained dark gray fine sand. Also, it is assumed that natural soils bordering the cove are covered with dredged material.

Some of the streets bordering the cove have gutters. Street drainage is via roadside swales, with most of the swales being piped as most driveways have culverts. As can be seen in the site photographs, most of the driveway culverts are partially blocked with sediment and grass and the roadside swales have built up with sediment and grass over the years. In other words, the swales are performing as designed and capturing sediment and pollutants before they enter the cove. The rear one-half of all lots bordering the cove drain directly to the cove via sheet flow. The fronts of the lots drain to the street gutters and/or street swales around the cove. As can be seen in the site photographs, most of the yards and streets are clean and well maintained.

There are four stormwater pipes that discharge to the cove. The pipes are shown on the Existing Conditions Outfall Map, Figure 3. Each outfall is identified and discussed below.

3.1 Outfall PC1

A 12" Reinforced Concrete Pipe (RCP) pipe, outfall PC1, discharges to the middle portion of the cove. This pipe drains 4.2 acres of single family residential property from an inlet at the end of Jamaica Street (Figure 4). This drainage basin area has a swale (Figure 6) downstream of the inlet with a control structure (Figure 7) and is performing well as a stormwater treatment system. The pipe discharges above the water line and there was no sediment build up observed at the outfall.

3.2 Outfall PC2

Outfall PC2 is an 18" RCP discharging north of PC1. This pipe drains 12.6 acres of single family residential property from a series of inlets at the end of Trinidad Street (Figure 8). This is the largest drainage basin discharging to the cove and has a series of roadside swales and driveway culverts (Figure 10) along Trinidad Street that act as stormwater treatment systems. There was no sediment build up observed along the shoreline at this outfall.

Figure 2	Existing Features Map	Berryman & Henigar

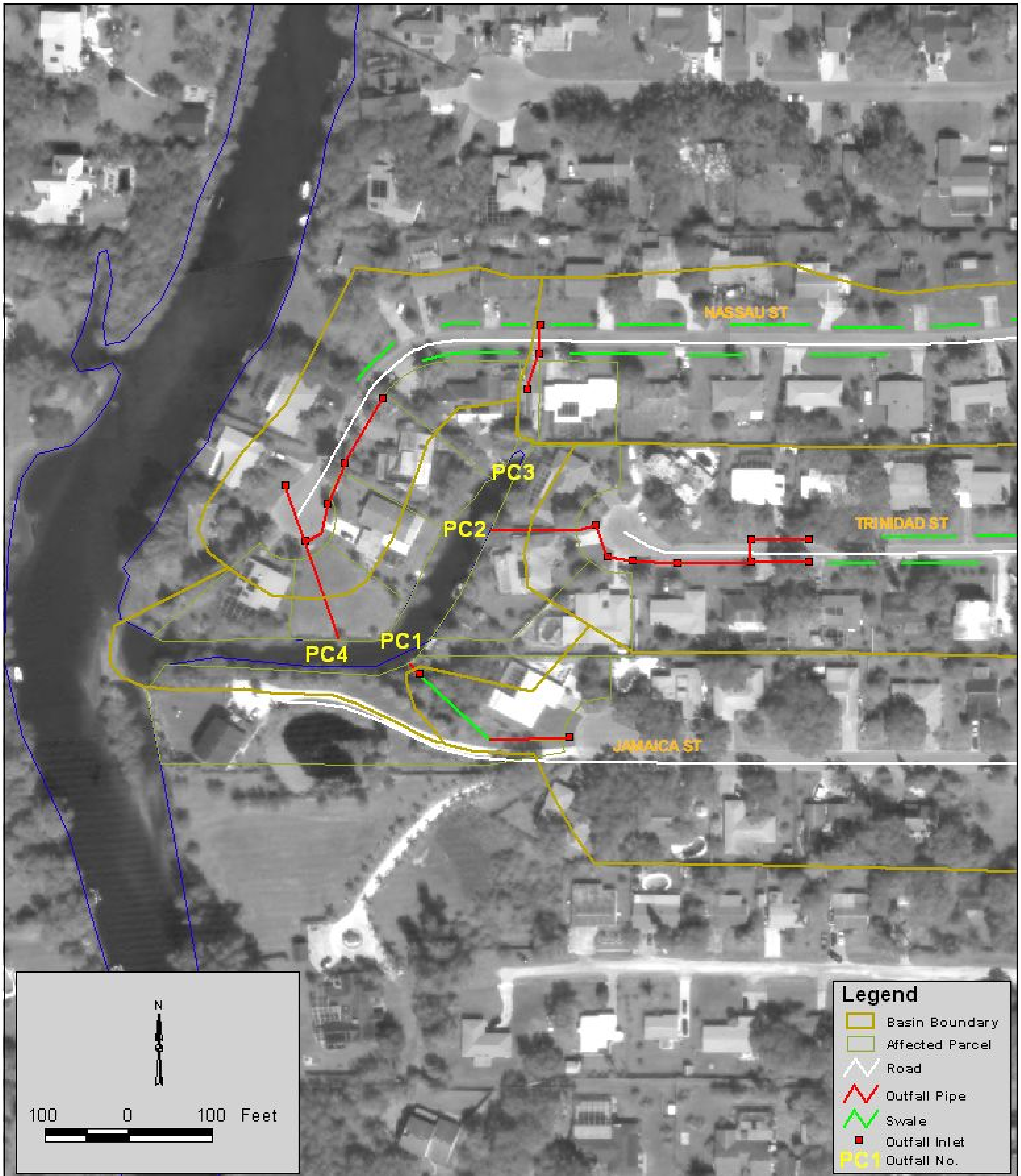

Figure 3	**Existing Conditions Outfall Map**	Berryman & Henigar

Figure 4.
PC1 - Inlet in cul-de-sac at the end of Jamaica St. in Basin B1.

Figure 5.
Inside inlet PC1. Note sediment loads.

Figure 6.
Sediment trapped by the swale on PC1.

Figure 7.
Outlet structure at the end of the swale on PC1.

Figure 8.
PC2 - Inlet in cul-de-sac at the end of Trinidad St. in Basin B2

Figure 9.
Inside inlet PC2. Note foam floating at the bottom of the inlet.

Figure 10.
Swales along Trinidad St. upstream of PC2.

Figure 11.
PC2 outlet mitered end. Note thin layer of muck.

A citizen in the Trinidad Street cul-de-sac mentioned that the series of inlets in the cul-de-sac were installed in the late 90's after some flooding occurred during the "el Niño" rainfall events. Steep slopes with apparent erosion were observed at the outlet in this area, but this might have happened before the new inlet systems were installed.

3.3 Outfall PC3

Outfall PC3 is a 14" x 21" Elliptical Reinforced Concrete Pipe (ERCP) discharging to the uppermost portion of the cove. This pipe drains 3.2 acres of single-family residential property into a series of inlets on Nassau Street (Figure 12) that discharges through a grate on a concrete boat ramp. This drainage basin has a series of roadside swales and driveway culverts (Figure 14) along Nassau Street that act as stormwater treatment systems. There was no sediment build up was observed along the shoreline at this outfall.

3.4 Outfall PC4

Outfall PC4 is a pipe discharging west of PC1 into the lower portion of the cove. This pipe drains 1.99 acres of single-family residential property from a series of inlets at the end of Nassau Street (Figure 15). This drainage basin has also a series of roadside swales and driveway culverts along Nassau Street that act as stormwater treatment systems. The pipe discharges below the water line and there was no sediment build up observed at the outfall (Figure 16). There was one observed failing sea wall near this outfall which could be a source of sedimentation (Figure 17).

Figure 12.
PC3 inlet with diversion structure in Basin B3.

Figure 13.
PC3 outlet discharges through a grate on the boat ramp.

Figure 14.
Outfall PC3 at dead end.

Figure 15.
PC4 inlet at cul-de-sac at the end of Nassau St. in Basin B4

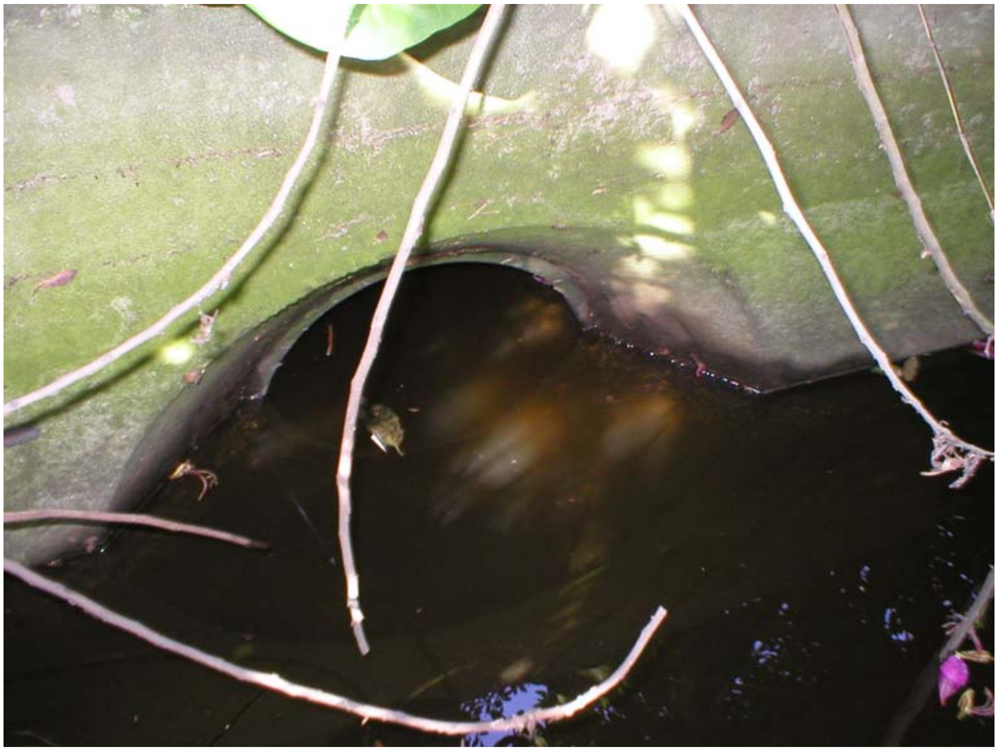

Figure 16.
PC4 submerged outlet pipe

Figure 17.
Failing seawall near PC4 outfall

Figure 18.
Floating trash collecting near outfall PC4.

4.0 POLLUTANT LOADING ASSESSMENT

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

It should be noted that the roadside swales are well established with grass and the swales are providing contact areas for removal of pollutants in all but the largest storms. In addition, most of the swales are being restrained by driveway culverts partially blocked with sediment and grass which retain a volume of runoff and prevent much debris and sediment from entering the cove. These features provide a high level of treatment to runoff, so pollutant reduction factors for grassed swales were used where appropriate.

Pollutant loadings were estimated by multiplying the total acreage in each drainage basin by a composite annual loading rate that 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 estimates current TSS loading at 452 kg/year, TP loading at 10 kg/year, and TN loading at 96 kg/year.

Using a typical unit weight for sandy silt of 90 lb/cubic foot (Dunn et. al., 1980), the 997 lb annual sediment load could contain a volume of approximately 11 cubic feet (0.4 cubic yards), or about 0.0004 inches annually over the area of the cove bottom. However, under field conditions, the sediment would tend to accumulate near the outfalls, although tidal and stream flows would disperse the sediment throughout the cove and into Phillippi Creek.

Table 1.
Summary of unit pollutant loading rates for central and south Florida (ERD, 1994).

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

Table 2.
BMP selection guide (ASCE, 2001).

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

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

*** No Data Available

**** Varies widely

Table 3. Phillippi Cove Pollutant Estimates
Existing Conditions

Basin No.	Area (ac)	Land Use	Type of Treatment System	% TSS Reduction	% TP Reduction	% TN Reduction	TSS Loading Rate (kg/ac-yr)	TP Loading Rate (kg/ac-yr)	TN Loading Rate (kg/ac-yr)	TSS Loading (kg/yr)	TP Loading (kg/yr)	TN Loading (kg/yr)
1	0.08	Low Density Residential					31.9	0.32	2.88	2.5	0.02	0.2
1	4.12	Single Family Residential					56.1	0.59	4.68	230.9	2.4	19.3
1	4.19	Total Basin Land Use	Swale	70	35	15				70.0	1.6	16.6
2	12.59	Single Family Residential	Swales	70	35	15	56.1	0.59	4.68	211.9	4.9	50.1
3	3.21	Single Family Residential	Swales	70	35	15	56.1	0.59	4.68	54.0	1.2	12.8
4	1.99	Single Family Residential	Swales	70	35	15	56.1	0.59	4.68	33.5	0.8	7.9
5	0.25	Low Density Residential					31.9	0.32	2.88	7.8	0.1	0.7
5	1.22	Single Family Residential					56.1	0.59	4.68	68.4	0.7	5.7
5	0.75	Open Water					8.1	0.27	3.23	6.0	0.2	2.4
5	2.21	Total Basin Land Use	None							82.3	1.0	8.8
	TOTAL									**451.6**	**9.5**	**96.1**

5.0 DISCUSSION AND RECOMMENDATIONS

Existing conditions land-based pollutant loadings to the cove were calculated for total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). The estimate loadings are 452 kg/year for TSS, 10 kg/year for TP, and a TN loading of 96 kg/year.

The 997 lb annual sediment load could contain a volume of approximately 11 cubic feet, or about 0.0004 inches annually over the area of the cove bottom. As stated above however, under field conditions, the sediment would tend to accumulate near the outfalls, although tidal and stream flows would disperse the sediment throughout the cove and into Phillippi Creek. It should be noted that nutrient control is an important element of water management. Excess enrichment can result in algae blooms, excess aquatic vegetation growth, and subsequent accumulation of detritus turning to muck. Thick layers of muck were observed in other canals in the general area, mainly in dead-end canals with mangrove or overhanging trees and brush.

This section describes recommendations on how to reduce runoff-borne sediment from entering the cove. Nutrients can become adsorbed onto sediment particles, so trapping sediment also can reduce nutrient loading to the estuarine system.

In the Phillippi Cove watershed, all but one of the five drainage basins currently provide some level of stormwater treatment, accounting for 22 acres out of 24.2 acres with BMP treatment for the stormwater. All of the 2.2 acres not being treated directly discharge to cove or are in the rear of the lots bordering the cove, 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 cove and can be indicative of a combination of sediment from soil erosion and muck from high nutrient levels in the cove. Potential nutrient sources include algae from the bay, fertilizers, leaves, grass, organic yard debris, and pet wastes from local runoff, or stream-borne nutrients from Phillippi Creek. 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 more effectively accomplished with source controls. Educating the homeowners in the area to reduce fertilizer use, prevent grass clippings from entering the coves, and mowing less frequently would benefit the nutrient levels in the canals. Also, small back yard swales to hold runoff instead of letting it run directly into the canal can be effective.

This dead-end canal has limited or no circulation due to tidal exchange and stream flow, therefore, it could have conditions such as low dissolved oxygen levels and silt accumulation. High nutrient levels can lead to algae blooms, which lead to muck accumulations.

There were some areas of grass clippings and leaves in the street and in inlets which could enter the cove. These nutrient sources affect the muck build up in the cove. In addition, lawn mowers should blow leaves and grass back into the yards instead of into the street or the cove. 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 cove.

Specific recommendations for each subbasin outfall are also included in this section. Each outfall to the cove is discussed below.

5.1 Outfall PC1

Jamaica Street has an inlet that drains to the middle portion of the cove through Outfall PC1. No new BMPs are recommended for this outfall because of the small basin size and because the existing swale is working properly.

5.2 Outfall PC2

Trinidad Street has a series of inlets that drain to the middle upper portion of the cove through Outfall PC2. Although this is the largest drainage basin with the largest pollutants loadings, no new BMPs are recommended for this outfall because the existing system of roadside swales and driveway culverts are providing adequate treatment for the basin. However, due to the unstable condition of the cove side slopes near the outfall BHI recommends stabilization with riprap and mangroves to avoid further erosion.

5.3 Outfall PC3

Nassau Street has a series of inlets that drain to the upper most portion of the cove through Outfall PC3. No new BMPs are recommended for this outfall because of the small basin size and because the existing system of roadside swales and driveway culverts are working properly.

5.4 Outfall PC4

The end of Nassau Street has a series of inlets that drain to the lower portion of the cove through Outfall PC4. No new BMPs are recommended for this outfall because of the small basin size and because the existing system of roadside swales and driveway culverts are working properly. However BHI recommends that the observed failing sea wall near this outfall be repaired to avoid possible sedimentation.

6.0 CONCLUSIONS

The Phillippi Cove has some, but not severe, sedimentation problems typical of many residential canals 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 canals where 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 of the cove was undertaken to determine possible causes of sediment build up. Outfall pipes to the cove 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 cove, a pollutant loading analysis of the stormwater runoff from the watershed was undertaken. TSS, TN, and TP loadings were estimated using a spreadsheet calculation accounting for the land areas, land uses, pollutant loadings, and existing stormwater treatment systems. This analysis suggests that the highest pollutant loadings originate in basin B2, the largest basin, despite the roadside swales. Most of the residential basins were small and had treatment systems in place.

There are four stormwater outfalls to the cove. Based on the field investigations and analysis in this report, no structural BMPs are recommended, but the side slopes of the cove near outfall PC2 should be stabilized with rip-rap and mangroves, and the failing sea wall near outfall PC4 should be repaired to avoid further sedimentation and erosion.

One of the most important aspects of pollutant reduction is source control. At some locations it was observed that residents 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 cove and thereby reducing muck accumulations in the cove.

7.0 REFERENCES

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