4.16. Lake May

Background

Physical and chemical characteristics specific to Lake May are presented here in the context of relevant regulatory criteria and requirements (Table 4-32). Lake May (WBID 1521E), a lake in the WHCL Southern Chain, is hydrologically connected to Lake Howard to the north and to Lake ship to the south via navigable canals (Photo 4-19, Figure 4-64). In 2005, Lake May was declared verified impaired based on elevated TSI values (>60). A TMDL was adopted for the Southern Chain of the WHCL, including Lake May (FDEP 2007), and Lake May was subsequently delisted from impairment by FDEP in 2010. Based on the modeled external TP load to Lake May, a 57.5 percent reduction in TP load (97 kg TP/year) is required to comply with the TSI criteria of 60 (FDEP 2007). The TP, TN, and chlorophyll *a* geometric mean for Lake May for the period of 1997 to 2007 and corresponding EPA NNC water quality targets are listed in Table 4-32. To comply with the NNC, concentration reductions of 47 percent for TP, 26 percent for TN, and 53 percent for chlorophyll *a* are required.

A summary of water quality statistics for Lake May is presented in Table 4-33 Lake May historically received point source discharges from three WWTF (Imhoff, Citrus, and Velda). While the effluent discharges have been eliminated, the discharges resulted in nutrient and sediment accumulation in the lake bottom. An inverse relationship between lake levels and TP concentrations may suggest sediment resuspension resulting in a decline in water quality. In response to the TMDL, the City of Winter Haven and the SWFWMD implemented a stormwater alum injection treatment project. Based on TP load reduction estimates for projects constructed on Lake May (357 kg/year), it appears that required TP load reductions (97 kg/year) have already been accomplished. There is no clear evidence of water quality improvement after the implementation of the stormwater retrofit project in 2005. The chlorophyll *a* values consistently exceed 20 µg/liter, indicating that TSI_{CHLA} values less than or equal to 60 (which would require chlorophyll *a* levels to be below 20 µg/L) were not reached (Figure 4-65). A statistically significant trend in chlorophyll *a* concentrations from 1983 to 2007 was not observed (seasonal Kendall-Tau, $p > 0.10$). The median chlorophyll *a*, TN and TP concentrations continue to exceed the NNC targets provided by EPA for Lake May. *Hydrilla* eradication projects have been completed annually since 2001 treating up to 20 percent of the lake surface area. Lake May is an intermediate lake so improvements in water quality could result in some benefit farther downstream.

The Lake May watershed is 610 acres in size and includes 563 acres (92 percent) of developed lands compared to 47 acres (8 percent) of undeveloped lands (Table 4-32). The 2000-2007 median color value (20 PCU) was below 40 PCU indicating the lake is a clear (non-colored) lake and specific conductivity data indicate the lake is alkaline. The lake area, perimeter, water depth, and volume statistics are based on a water level elevation of 130 feet in September 2009 (Table 4-32). Bathymetry data are available for Lake May for the September 2009 water level elevation (Figure 4-66). A water level of 130 feet was reported in August 2010, indicating similar water elevations when compared to 2009. Changes in overall surface area, water depth, and volume of the lake should be considered during the development and implementation of water quality restoration projects.

Water Quality Restoration Project Selection and Priorities

Based on Lake May water quality and the surrounding watershed characteristics, five potential water quality restoration projects were identified using the WHCL WQMP decision key (Figure 4-67). The decision key presents the factors on which yes/no decisions were based and used to identify and select water quality improvement projects. Projects to address water quality, nutrient and sediment loading, and reduced lake levels are proposed. The projects are listed in order of priority, based on expected water quality improvements. A detailed discussion of the potential water quality restoration implications for each project can be found in Section 3.0.

- Project 1: Sediment Removal/Inactivation
- Project 2: Stormwater Infiltration Areas (SIAs)
- Project 3: SAV Planting/Management or FTWs
- Project 4: EAV Planting/Management
- Project 5: Artificial Circulation

Table 4-32. Physical, chemical, and regulatory characteristics of Lake May.

Physical			
Location in chain	Southern	**High infiltration soils (acres)**	279 (46 percent)
Relation to other lakes	Intermediate	**Developed land (acres)**	563 (92 percent)
Watershed area (acres)	610	**Undeveloped land (acres)**	47 (8 percent)
Lake area (acres)*	52	**Median water depth (feet)***	3.4
Perimeter (feet)*	15,008	**Maximum water depth (feet)***	8.4
Surface area: lake volume ratio*	0.39	**Volume (acre-feet)***	132
Watershed to surface area ratio*	11.73		
Water Chemistry			
Locally-derived: acidic or alkaline	Alkaline	**Clear or colored**	Clear
Geometric mean chlorophyll *a* (µg/L)	42	**NNC chlorophyll *a* target (µg/L)**	20
Geometric mean TN (mg/L)	1.35	**NNC TN target (mg/L)**	1.00
Geometric mean TP (mg/L)	0.057	**NNC TP target (mg/L)**	0.030
Regulatory Data			
Impaired	Yes	**TMDL status**	Required†
Chlorophyll *a* trend	No trend**	**TP concentration reduction required**	47 percent

*at a water level elevation of 130 feet †TMDL adopted
**presented in section 5.0

Photo 4-19. View of Lake May during incubation study.

Table 4-33. Lake May water quality summary for 1997 to 2007.

Parameter	N	Minimum	Median	Maximum
Chlorophyll *a* (µg/L)	101	22	46	92
Color (PCU)	27	5	20	25
Conductivity (µmhos/cm)	32	191	227	365
Dissolved oxygen (mg/L)	32	5.85	8.59	10.27
pH	32	6.8	7.79	8.71
Secchi depth (feet)	102	0.8	1.4	3.2
Total nitrogen (mg/L)	103	0.09	1.41	2.58
Total phosphorus (mg/L)	98	0.01	0.058	0.139

Figure 4-64. Lake May and associated watershed.

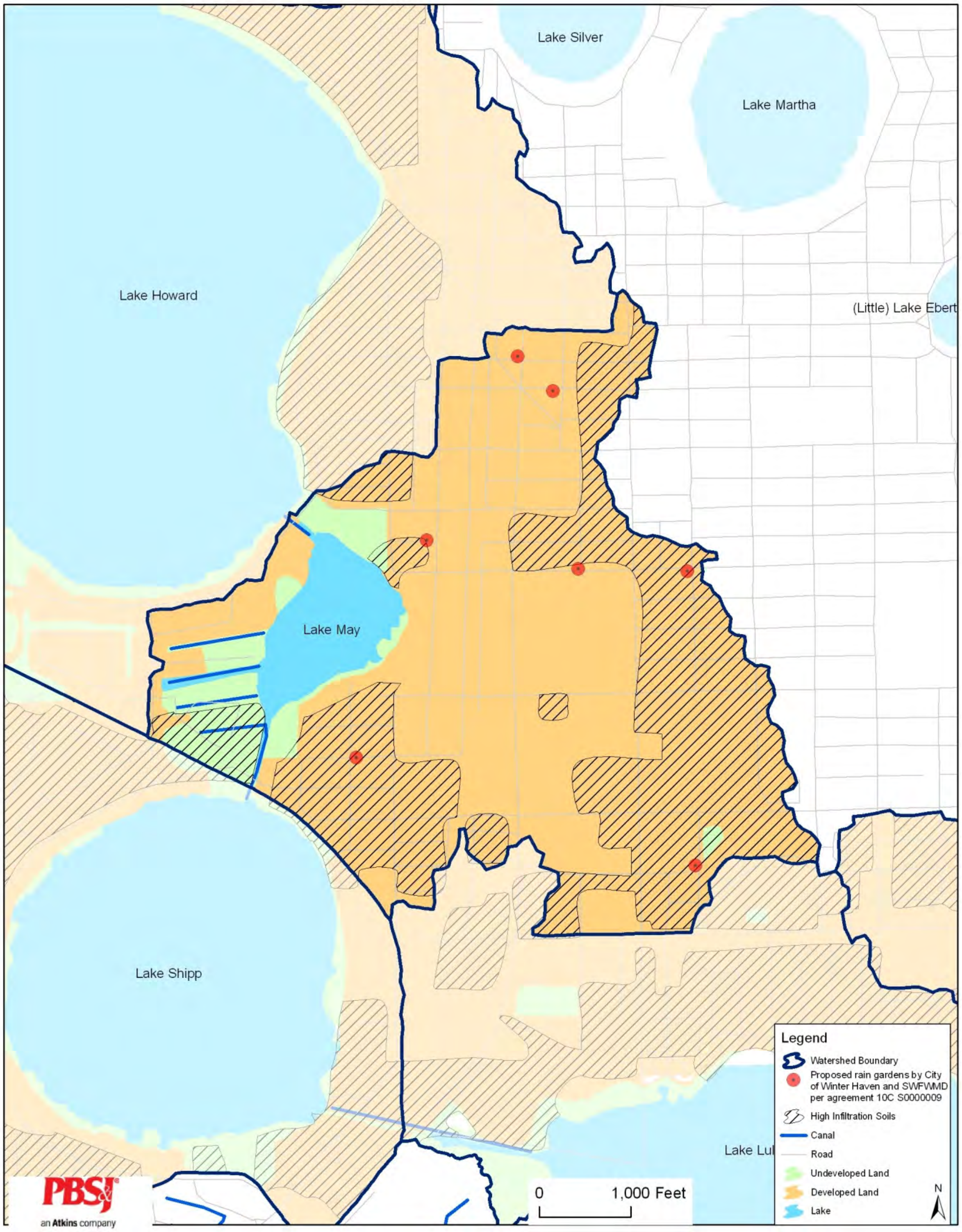


Figure 4-65. Lake May chlorophyll *a* concentrations and *Hydrilla* treatment history using available data from 1983 to 2007.

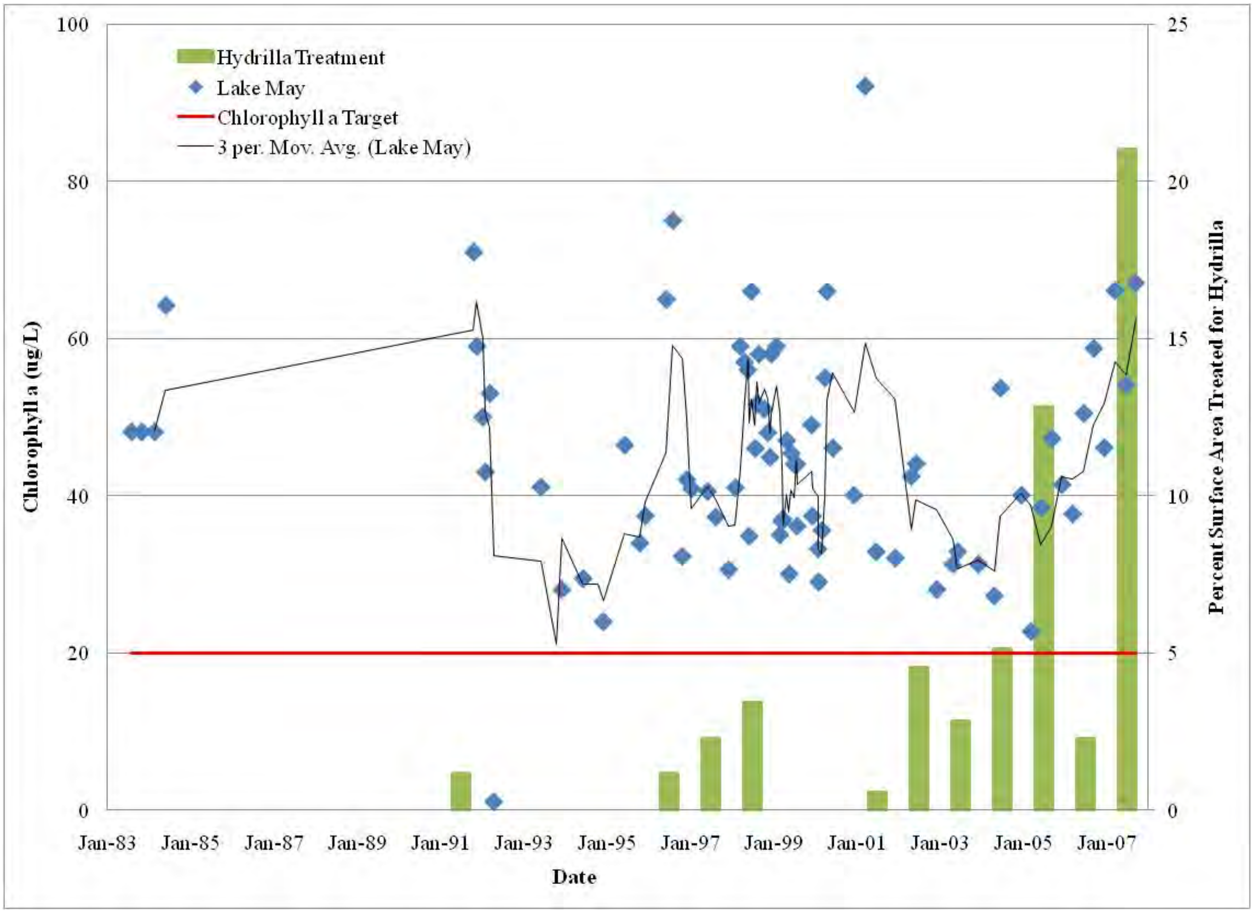
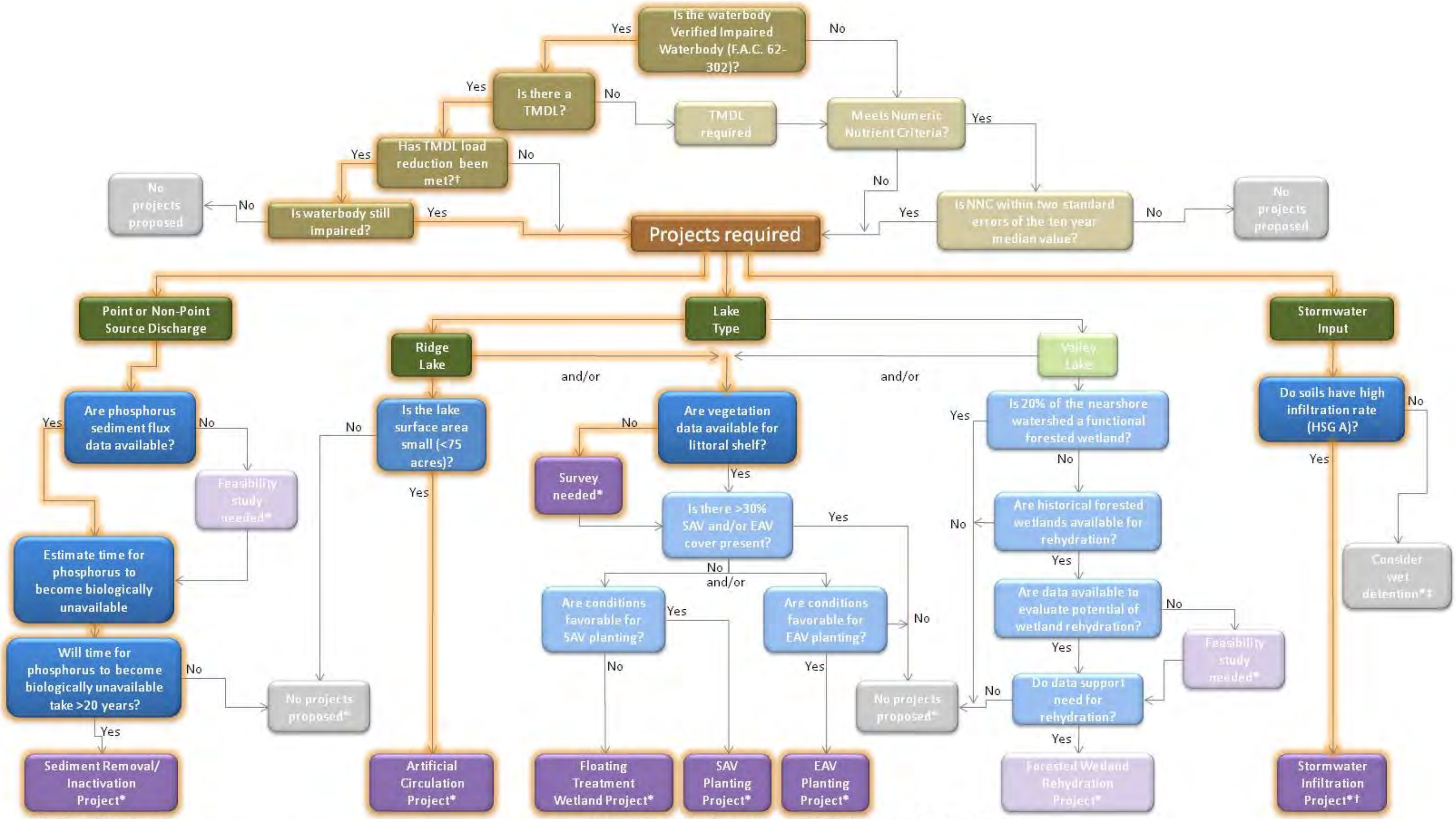


Figure 4-66. Lake May bathymetry (September 2009) at water level elevation = 130 feet (Polk County Water Atlas).

Figure 4-67. Lake May decision key: highlighted path shows decision process.



•Consider alternative projects

‡Wet detention may also be required if sufficient area is unavailable for dry retention

† Stormwater Infiltration projects could satisfy required TMDL Load reduction

Project 1: Sediment Removal/inactivation

The City of Winter Haven and the SWFWMD recognized the potential issues associated with the organic sediments in Lake May and funded the Sediment Removal Feasibility Study performed by ERD to evaluate the sediment characteristics, phosphorus flux, and volume (ERD 2010). An estimate of the length of time until the pool of available phosphorus within the bottom sediments returns to background conditions was calculated using TP concentration in the sediments, the percent of available phosphorus and bulk density. Approximately 403 years are required for phosphorus concentrations to return to background conditions. Therefore, sediment removal/inactivation is recommended to address internal phosphorus loads. A cost estimate for sediment removal/inactivation has been completed by ERD (2010). The use of alum for sediment inactivation is not recommended for Lake May due to shallow water depths increasing the possibility of wind/wave action resuspension of the extensive organic sediment material in the lake. Resuspension of the organic material may allow of the incorporation of the alum material thereby reducing its efficiency to remove phosphorus.

Sediment Removal: Costs associated with hydraulic dredging can be highly variable depending upon a variety of factors such as dredge capacity, availability of disposal areas, and distance to disposal areas, sludge dewatering requirements, booster pump requirements, and final sediment disposal. Since none of these factors have been fully evaluated at this time, a general sediment dredging cost of approximately $10.00 per cubic yard is assumed for this analysis. This value assumes that a shoreline dewatering facility would be used. A summary of estimated costs for hydraulic dredging in Lake May based on the previously determined organic sediment volumes, estimated dredging costs is $4,872,300. An estimated 302 ac-ft (487,227 cubic yards) of organic material would be removed.

Project 2: Stormwater Infiltration Areas (SIAs)

The Lake May watershed has approximately 279 acres (46 percent of the watershed) classified as high infiltration soils. A TMDL has been established for Lake May, and as such, the SIA design should be focused on satisfying the TMDL requirements. In order to calculate the percentage of the Lake May watershed for SIA construction, a modification to the PLRG runoff statistic was required. The University of South Florida will be contacted to verify the modification. SIA projects would need to encompass approximately six percent (34 acres) of the watershed in order to accomplish an annual 97 kg reduction in TP loads to Lake May. Acres of SIA estimated to meet the TP NNC was 33 (5 percent of the watershed) for a 47 percent phosphorus reduction in Lake May to meet its NNC. Forty-six percent of the watershed is characterized by high infiltration soils; therefore, it may be feasible to satisfy the TMDL load reduction through SIA implementation.

Presently, the City of Winter Haven has preliminarily identified seven rain garden projects within the contributing drainage basin for Lake May as part of SWFWMD funded agreement. The rain garden size ranges from 200 to 1,000 feet^2 providing treatment to 3,000 to 12,500 feet^2. A brief description of the project is identified below as provided by the City of Winter Haven.

Site 13: City of Winter Haven Utility Services parking lot along Ave. F SW:

Type of Project: Rain Garden
Objective: To capture and percolate the runoff coming from the roof of the building and parts of the adjacent parking lot. An area of the parking lot would be removed and a rain garden constructed in its place. The runoff would be directed into the rain garden at this location as the site generally slopes down to that area.
Drainage Area: 10,000 SF
Rain Garden: 1,000 SF
Treatment Volume: 720 CF (provided).
Cost Estimate: $ 9,200

Site 14: The Federal Building at the northeast corner of Third Street SW and Ave. A SW:

Type of Project: Rain Gardens (two), one along Third Street and one along Ave. A.
Objective: To capture and percolate the runoff coming from the roof of the building and the adjacent area. The runoff can be easily directed into the depressional areas/rain gardens at these two locations as the existing down spouts discharge to those areas.
Drainage Area: 5200 SF
Rain Garden: 2 x 200 SF
Treatment Volume: 290 CF (provided)
Cost Estimate: $ 2,350

Site 27: Southwest corner of Second Street SW and Ave. B SW:

Type of Project: Rain Garden (open cut the curb and dig out to depression).
Objective: To capture and percolate the runoff coming down the south side of Ave. B SW. The runoff would be directed into the depressional area/rain garden at this location by creating an opening in the existing curb and constructing a concrete flume.
Drainage Area: 3,000 SF
Rain Garden: 200 SF
Treatment Volume: 150 CF (provided)
Cost Estimate: $ 2,200

Site 30: Northwest corner of Third Street SE and Post Ave. SE:

Type of Project: Storm Inlet and perforated pipe (French Drain)
Objective: To capture and percolate the runoff coming down the west side of Third Street SE. In addition to increasing the percolation/infiltration into the ground, this would help reduce the runoff coming down onto the adjacent roads.

Drainage Area: 5,400 SF
Perforated Pipe: 60 L.F. of 18 inch pipe surrounded by 1 foot thick stone layer.
Treatment Volume: 580 CF
Cost Estimate: $ 5,350

Site 42: Southwest corner of Second Street SE and Ave. G SE at Grace Baptist Church:

Type of Project: Rain Garden (remove existing paved area to create a rain garden).
Objective: To capture and percolate the runoff coming down the south side of Ave. G SE. The runoff can be easily directed into the depressional area/rain garden at this location as the area is the low point at that corner of the intersection.
Drainage Area: 11,300 SF
Rain Garden: 650 SF
Treatment Volume: 470 CF (provided)
Cost Estimate: $ 5,700

Site 43: East side of Second Street SW at Ave. G SW:

Type of Project: Rain Garden along Second Street SW.
Objective: To capture and percolate the runoff coming down the east side of Second Street SW. The runoff can be easily directed into the depressional area/rain garden at this location as the area is lower than the adjacent edge of pavement.
Drainage Area: 5,000 SF
Rain Garden: 750 SF
Treatment Volume: 540 CF (provided)
Cost Estimate: $ 4,175

Site 45: South side of Ave. M SW between Seventh St. SW and Eighth St. SW adjacent to Southside Baptist Church:

Type of Project: Rain Garden along Ave. M SW.
Objective: To capture and percolate the runoff coming down the south side of Ave. M SW. The runoff can be easily directed into the depressional area/rain garden at this location as the area is lower than the adjacent edge of pavement.
Drainage Area: 12,500 SF
Rain Garden: 750 SF
Treatment Volume: 540 CF (provided)
Cost Estimate: $ 4,175

Project 3: SAV Planting or FTWs

SAV Planting

In Lake May, *Hydrilla* eradication has been completed over as much as 26 percent of the lake surface area attributing to the continued degradation in water quality. A survey of existing SAV cover in Lake May is recommended due to the lack of sufficient data to calculate percent lake cover. Based on the results of the SAV survey, conclusions regarding SAV planting can be determined. If SAV cover is less than 30 percent, lake conditions should be evaluated to assess if additional SAV is viable based on the soil condition, water clarity and water depth. *Hydrilla* harvesting may be required for successful establishment of selected SAV plants.

SAV plants should not be planted in water depths greater than 2 feet based on the median secchi depth values (1.4 feet). The maximum planting effort could result in vegetation cover of approximately 30 percent of the lake bottom (15 acres). Due to the extensive organic material located in Lake May, it is recommended that SAV planting be performed after sediment removal/inactivation, if completed. If sediment removal is completed, the planting area would need to be recalculated using updated bathymetry data.

Cost Estimate: $100,000 (estimate based on previous purchase and installation cost of $0.90 per plant provided by EarthBalance®, additional funds included for maintenance).

FTWs

If the feasibility study indicates that more than 30 percent of Lake May has SAV cover, FTW may be considered. The installation of floating mats with appropriate aquatic vegetation would be expected to assimilate nutrients from the water column.

Project 4: EAV Planting

A survey of existing shoreline vegetation surrounding Lake May is recommended due to the lack of sufficient data at this time. Based on the results of the shoreline survey, conclusions and recommendations regarding emergent aquatic or woody vegetation planting can be determined. If limited shoreline vegetation is present, shoreline conditions should be evaluated to assess if vegetation planting is viable based on the soil conditions, slope, water level and inundation frequency and wave disturbance.

Project 5: Artificial Circulation

Due to the shallow water depths recorded in Lake May (median of 3.4 feet), artificial circulation is not initially recommended as a restoration project for the Lake (ERD 2010). After sediment removal, conditions in Lake May could be conducive for artificial circulation. A reevaluation of water quality conditions should be performed prior to the project design for artificial circulation.