

### 4.15. Lake Mariana

#### Background

Physical and chemical characteristics specific to Lake Mariana are presented here in the context of relevant regulatory criteria and requirements (Table 4-30). Lake Mariana (WBID 1521L) is hydrologically connected to the Southern Chain of the WHCL and discharges water to Lake Jessie via a structure and constructed outflow ditch (non-navigable) (Photo 4-18, Figure 4-60). In 2010, Lake Mariana was declared verified impaired based on elevated TSI values (>60). A TMDL is required for Lake Mariana to calculate load reductions necessary to satisfy the TSI criteria. The TP, TN, and chlorophyll *a* geometric mean for Lake Mariana for the period of 1997 to 2007 and corresponding EPA NNC water quality targets are listed in Table 4-30. To comply with the NNC, concentration reductions of 3 percent for TP, 9 percent for TN and 12 percent for chlorophyll *a* are required.

A summary of water quality statistics for Lake Mariana is presented in Table 4-31. The median chlorophyll *a*, TN and TP concentrations exceed the NNC targets provided by EPA for Lake Mariana. Chlorophyll *a* concentrations in Lake Mariana fluctuate with values regularly elevated above 20 µg/L (Figure 4-61). A statistically significant increase in chlorophyll *a* concentrations from 1992 to 2007 was observed (seasonal Kendall-Tau,  $p < 0.02$ ). *Hydrilla* has not been treated in Lake Mariana since there is no public access. A significant water quality improvement project has been implemented for Lake Mariana in an effort to restore water quality. In 2005, a wetland treatment project was constructed by Polk County in the southwest corner of the lake that treated 546 acres of an urban watershed. Lake Mariana is a headwater lake; therefore, improvements in water quality of the lake could result in some benefit farther downstream.

The Lake Mariana watershed is 1,445 acres in size and includes 896 acres (62 percent) of developed lands compared to 548 acres (38 percent) of undeveloped lands. The 2000-2007 median color value (17 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 136 feet in October 2009. Bathymetry data are available for Lake Mariana for the October 2009 water level (Figure 4-62).

A water level of 138 feet was reported in August 2010, reflecting a 2.0 foot increase in water elevation when compared to 2009. The subsequent 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 Mariana water quality and the surrounding watershed characteristics, four potential water quality restoration projects were identified using the WHCL WQMP decision key (Figure 4-63). 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.

## Lake-Specific Restoration Projects

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

**Table 4-30. Physical, chemical, and regulatory characteristics of Lake Mariana.**

| Physical                                   |              |  |                  |
|--|--------------|--|------------------|
| Location in chain                          | Southern     | High infiltration soils (acres)        | 765 (53 percent) |
| Relation to other lakes                    | Headwater    | Developed land (acres)                 | 896 (62 percent) |
| Watershed area (acres)                     | 1,145        | Undeveloped land (acres)               | 548 (38 percent) |
| Lake area (acres)*                         | 518          | Median water depth (feet)*             | 8.0              |
| Perimeter (feet)*                          | 29,366       | Maximum water depth (feet)*            | 18.4             |
| Surface area: lake volume ratio*           | 0.11         | Volume (acre-feet)*                    | 4,725            |
| Watershed to surface area ratio*           | 2.21         |  |                  |
| Water Chemistry                            |              |  |                  |
| Locally-derived: acidic or alkaline        | Alkaline     | Clear or colored                       | Clear            |
| Geometric mean chlorophyll <i>a</i> (µg/L) | 23           | NNC chlorophyll <i>a</i> target (µg/L) | 20               |
| Geometric mean TN (mg/L)                   | 1.10         | NNC TN target (mg/L)                   | 1.00             |
| Geometric mean TP (mg/L)                   | 0.031        | NNC TP target (mg/L)                   | 0.030            |
| Regulatory Data                            |              |  |                  |
| Impaired                                   | Yes          | TMDL status                            | Required         |
| Chlorophyll <i>a</i> trend                 | Increasing** | TP concentration reduction required    | 3 percent        |

\*at a water level elevation of 136 feet

\*\*presented in section 5.0

**Photo 4-18. Lake Mariana.**



**Table 4-31. Lake Mariana water quality summary for 1997 to 2007.**

| Parameter                   | N  | Minimum | Median | Maximum |
|-----------------------------|----|---------|--------|---------|
| Chlorophyll <i>a</i> (µg/L) | 46 | 10      | 23     | 57      |
| Color (PCU)                 | 32 | 5       | 17     | 40      |
| Conductivity (µmhos/cm)     | 30 | 183     | 212    | 262     |
| Dissolved oxygen (mg/L)     | 30 | 5.36    | 8.43   | 11.17   |
| pH                          | 30 | 6.25    | 7.62   | 9.3     |
| Secchi depth (feet)         | 47 | 1.2     | 2.4    | 3.9     |
| Total nitrogen (mg/L)       | 50 | 0.74    | 1.09   | 1.81    |
| Total phosphorus (mg/L)     | 45 | 0.006   | 0.034  | 0.093   |

Figure 4-60. Lake Mariana and associated watershed.

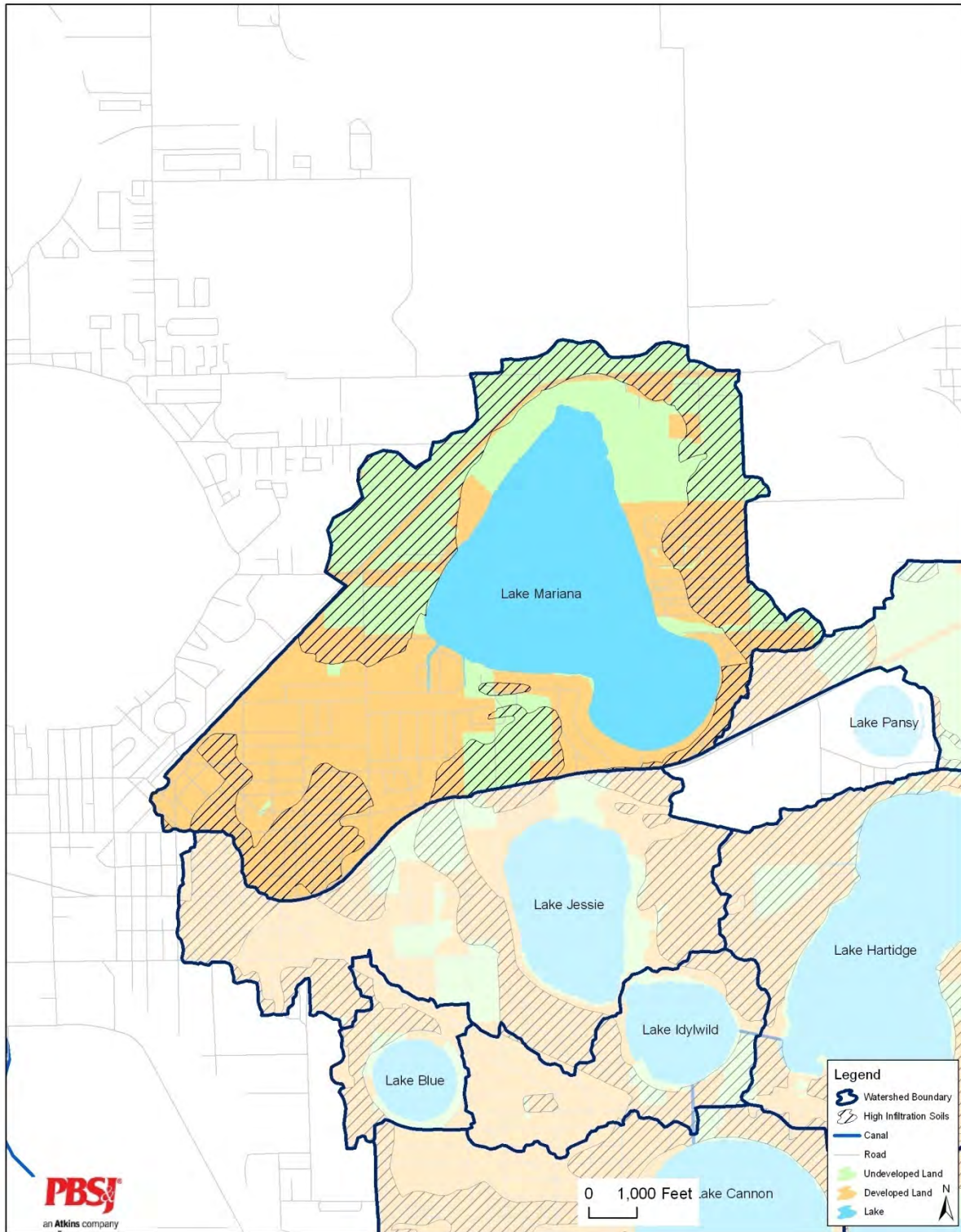


Figure 4-61. Lake Mariana chlorophyll a concentrations using available data from 1992 to 2007.

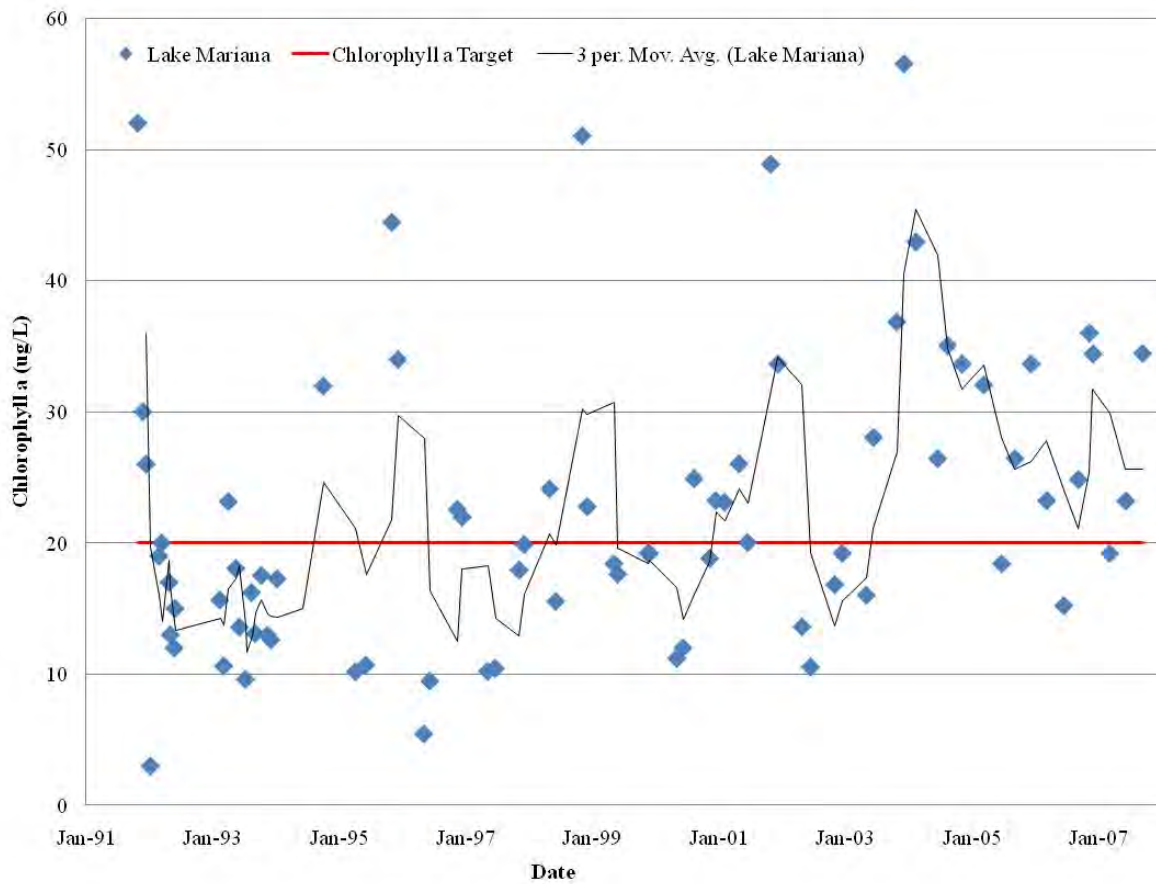
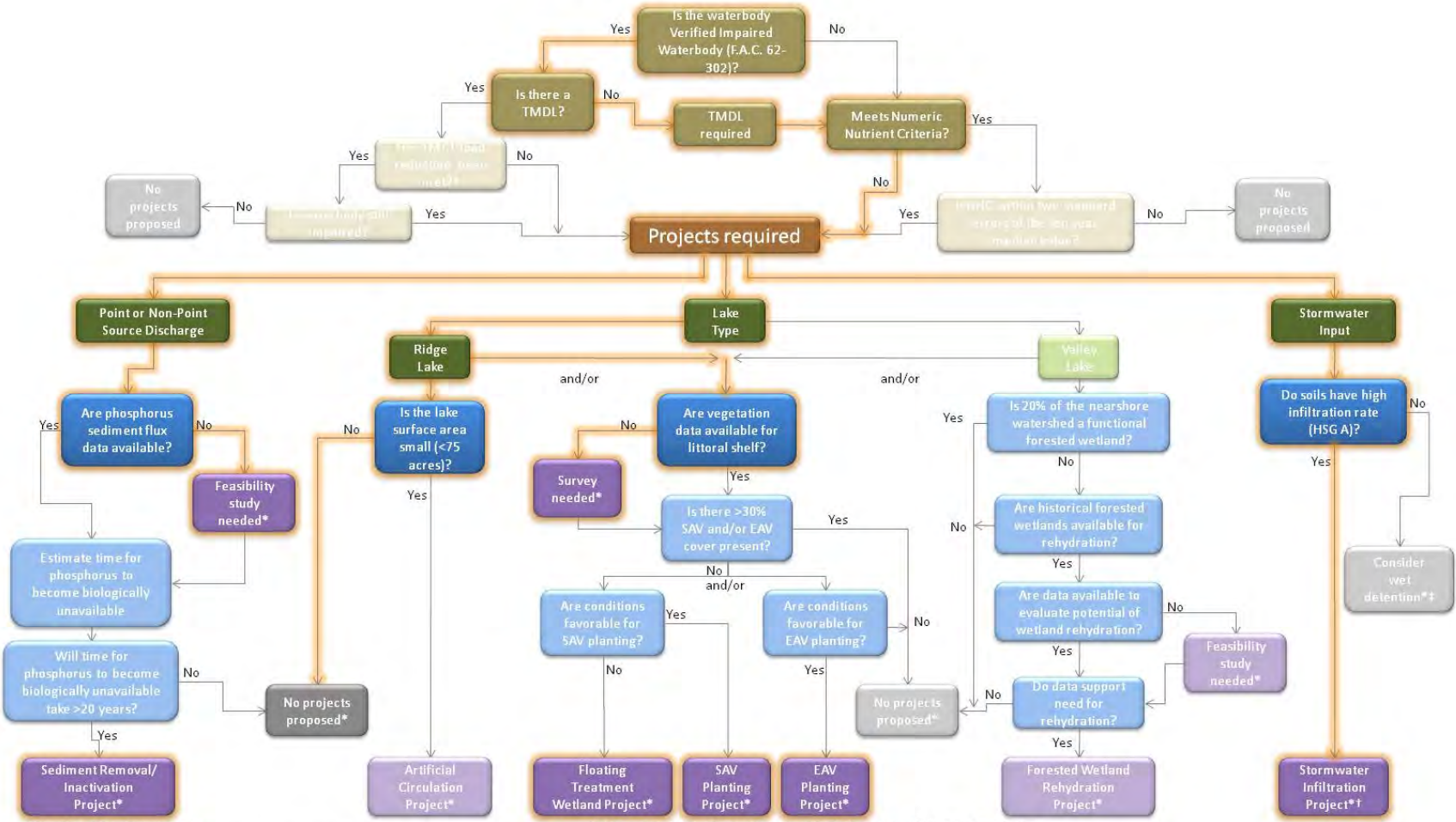




Figure 4-62. Lake Mariana bathymetry (October 2009) at water level elevation = 136 feet (Polk County Water Atlas).



Figure 4-63. Lake Mariana 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: Stormwater Infiltration Areas (SIAs)**

The Lake Mariana watershed has approximately 765 acres (53 percent of the watershed) classified as high infiltration soils. Lake Mariana does not have a TMDL, therefore, SIA acres estimates were calculated using data from the PLRG (USF 2005). The SIA estimate for Lake Mariana was 31 acres (approximately 3 percent of the watershed) to meet a 17 percent PLRG. Acres of SIA estimated to meet the TP NNC was 7 (one percent of the watershed) for an 3 percent phosphorus reduction in Lake Mariana to meet its NNC. Fifty-three percent of the watershed is characterized by high infiltration soils; therefore, it may not be feasible to satisfy the load reductions through SIA implementation.

### **Project 2: Sediment Removal/Inactivation**

Non-point source discharges to Lake Mariana may have resulted in substantial internal nutrient loads due to phosphorus release from sediments. Presently, sufficient data are not available to evaluate the internal phosphorus load and calculate the phosphorus decay rate and the time at which the phosphorus will ultimately become biologically unavailable in the lake sediments. A feasibility study is required to determine whether sediment removal/inactivation is necessary to reduce internal phosphorus loads to the lake.

Cost Estimate: \$10,000.

### **Project 3: SAV Planting or FTWs**

#### ***SAV Planting***

*Hydrilla* infestations have not been a chronic problem in Lake Mariana. However, *Hydrilla* eradication was necessary in 2008. A survey of existing SAV cover in Lake Mariana 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.

Based on the median secchi depth (2.4 feet) from 1997-2007, plants would not be planted in water depths greater than 2 feet. The maximum planting effort could result in vegetation cover of approximately six percent of the lake bottom (32 acres).

Cost Estimate: \$165,000 (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 Mariana 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 Mariana 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.