Preliminary Minimum Levels Determination

Lake Apshawa North
Lake Apshawa South

Lake County, Florida

Prepared by

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September 27, 2001

Summary

This report explains the St. Johns River Water Management District (SJRWMD) Minimum Flows and Levels (MFLs) determination for lakes Apshawa North and Apshawa South in Lake County (Tables 1 and 2). Because of their proximity and hydrologic history, MFLs are recommended for each waterbody although only Lake Apshawa North is listed on the *MFLs Priority Water Body List* (Florida Administrative Weekly 1997). The published list schedules MFLs pursuant to Chapter 373.042(2), *Florida Statutes* (*F.S.*). Terms used in the tables are defined in Chapter 40C-8.021, *Florida Administrative Code, F.A.C*. Hydroperiod categories and their definitions are adapted from the water regime modifiers of Cowardin et al. (1979).

Table 1. Preliminary minimum surface water levels for Lake Apshawa North, Lake Co.

Preliminary Minimum Level	Elevation (ft NGVD)	Hydroperiod Category
Minimum Frequent High Level	85.0	Seasonally Flooded
Minimum Average Level	83.3	Typically Saturated
Minimum Frequent Low Level	81.3	Semi-permanently Flooded

Table 2. Preliminary minimum surface water levels for Lake Apshawa South, Lake Co.

Preliminary Minimum Level	Elevation (ft NGVD)	Hydroperiod Category
Minimum Frequent High Level	86.0	Seasonally Flooded
Minimum Average Level	84.7	Typically Saturated
Minimum Frequent Low Level	83.2	Semi-permanently Flooded

The SJRWMD multiple MFLs method (St. Johns River Water Management District 2000) was used to determine the minimum lake levels. Determination of MFLs is based on evaluations of topographic, soils, and vegetation data collected within plant communities associated with the lakes, in conjunction with results from the Streamflow Synthesis and Reservoir Regulation (SSARR) model. Results presented in this report are considered preliminary until the MFLs are adopted for inclusion into Chapter 40C-8, *F.A.C.*

Program Overview

The SJRWMD MFLs Program, mandated by state water policy (Chapter 373.042, *F.S*.), establishes MFLs for lakes, streams and rivers, springs, wetlands, and groundwater aquifers. The MFLs Program is subject to rule (Chapter 40C-8, *F.A.C*.) and provides technical support to the SJRWMD regional water supply planning process (Chapter 373.0361, *F.S*.) and the consumptive use permitting program (Chapter 40C-2, *F.A.C.*). Regarding MFLs, policy states, "…the Governing Board shall use the best information and methods available to establish limits which prevent significant harm to the water resources or ecology" (Chapter 40C-8.011(3), *F.A.C*.). Significant harm, or the environmental effects resulting from the reduction of long-term water levels and/or flows below MFLs, is prohibited by Chapter 373.042(1a)(1b), *F.S*. The determinations of MFLs are also to consider the protection of nonconsumptive uses of water, including navigation, recreation, fish and wildlife habitat, and

other natural resources (Chapter 40C-8.011(3), *F.A.C.*). The establishment of MFLs shall give priority to waters which are located within: (a) an Outstanding Florida Water; (b) an Aquatic Preserve; (c) an Area of Critical State Concern; or (d) an area subject to Chapter 380 Resource Management Plans (Chapter 62-40.473(3), *F.A.C.*).

The MFLs designate hydrologic conditions that prevent significant harm and identify levels and/or flows above which water is available for reasonable beneficial use. Reasonable beneficial use is defined as "the use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner which is both reasonable and consistent with the public interest" (Chapter 373.019 (13), *F.S.*). In addition, "…the Governing Board…may reserve from use by permit applicants, water in such locations and quantities, and for such seasons of the year, as in its judgement may be required for the protection of fish and wildlife or the public health and safety" (Chapter 373.223, *F.S.*).

The MFLs define the frequency and duration of high, average, and low water events necessary to prevent significant harm to aquatic habitats and wetlands. Three to five MFLs are usually defined for each system - *Minimum Infrequent High, Minimum Frequent High, Minimum Average, Minimum Frequent Low*, and *Minimum Infrequent Low* flows and/or water levels. The MFLs represent hydrologic statistics comprised of three components: a water level and/or flow, a duration, and a frequency. The MFLs Program has synthesized the continuous duration and frequency components of the MFLs into seven discrete *Hydroperiod Categories*. The *Hydroperiod Categories* and the related frequencies and durations are defined in 40C-8.021, *F.A.C.*, and summarized in Table 3.

Table 3. MFLs hydroperiod categories and approximate frequencies and durations.

Hydroperiod Category	Approximate Frequency	Approximate Duration
Intermittently flooded	Once every 10 years high	Weeks to months
Temporarily flooded	Once every 5 years high	Weeks to months
Seasonally flooded	Once every 2 years high	Weeks to months
Typically saturated	Once every 2 years low	Months
Semi-permanently flooded	Once every 5 to 10 years low	Months
Intermittently exposed	Once every 20 years low	Weeks to months
Permanently flooded	More extreme drought	Days to weeks

MFLs take into account the capability of wetlands and aquatic communities to adjust to changes in hydrologic conditions relative to historical conditions. Therefore, MFLs allow for an acceptable level of change to occur relative to the existing hydrologic conditions (gray shaded area, Figure 1). However, when use of water resources shifts the hydrologic conditions below that defined by the MFLs, significant harm can occur (diagonally shaded area; Figure 1). As it applies to wetland and aquatic communities, significant harm is a function of change in the frequency and duration of water level and/or flow events, causing impairment or destruction of ecological structures and functions.

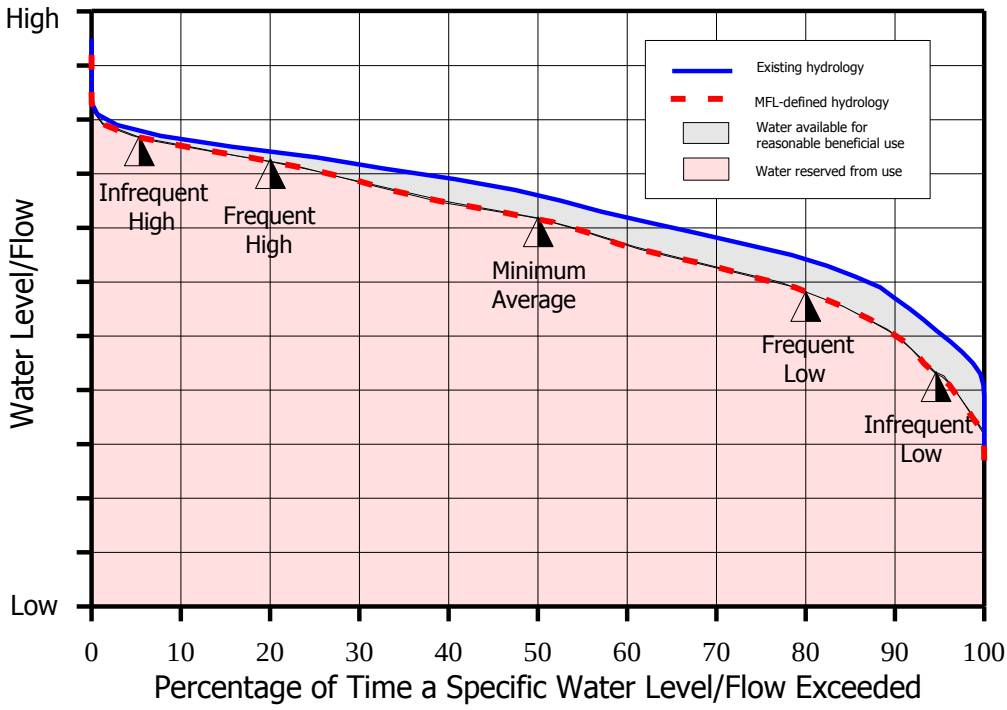

Figure 1. Percentage exceedance curves for existing and MFLs-defined hydrologic conditions.

MFLs apply to decisions affecting permit applications, declarations of water shortages, and assessments of water supply sources. Surface and groundwater computer simulation models are used to evaluate existing and/or proposed consumptive uses and the likelihood they may cause significant harm. Actual or projected violations of MFLs require the Governing Board to develop recovery or prevention strategies (Chapter 373.0421(2), *F.S.*). MFLs must be reviewed periodically and revised as needed (Chapter 373.0421(3), *F.S.*).

Background

Lake Apshawa North and South are located about 4 mi. northwest of the town of Minneola in south Lake County, Florida (Figure 2); in Sections 1 and 2, Township 22 South, Range 25 East of the USGS Clermont West 7.5 minute topographic quadrangle. Collectively, the Lake Apshawa system comprises a total surface area of 98.4 acres (@ 80 ft. NGVD). Land uses in the vicinity of the lakes once consisted predominately of citrus groves developed in the 1940s from native long leaf pine scrub. By the year 1999, most citrus acreage had been converted to low-density housing.

Based on a review of aerial photos, declining water levels over the years have caused noticeable morphological changes within the lake Apshawa system (Figures 3a. - 3b.). In 1941, historic Lake Apshawa consisted of about 158 acres of open water and floodplain wetlands. A ditch connected two main waterbodies (now Lake Apshawa North and Lake Apshawa South). In 1953, water levels were somewhat lower than in 1941. About that time, a fill road, presumably with a culvert, was constructed across the Lake Apshawa system. By 1966, the waterbodies were hydrologically isolated from each other.

Figure 3a. Historic Lake Apshawa, Lake Co., USDA Soil Conservation Service aerial photo (1941).

Figure 3b. Lake Apshawa North and Lake Apshawa South, Lake Co. Digital ortho photo (2000).

From the 1940s to present, wetlands fragmentation and attrition in the Lake Apshawa system have resulted in an estimated 39 percent reduction of wetlands and an 18 percent reduction of open water (Table 4).

Table 4. Land Cover Changes (1941 - 1985) - Lake Apshawa North / Lake Apshawa South, Lake Co. Based on 1941 USDA Soil Conservation Service black and white photo; SJRWMD1985 wetlands map.

Community	Lake Apshawa (1941)	Lake Apshawa North (1985)	Lake Apshawa South (1985)	Other (1985)	Change (acres)	Percent Change
Wetlands	34.1	0	20.9	0	13.2	39
Open Water	124	36	62.4	2.7	22.9	18

Lake Hydrology

The lakes are situated within a 960-acre drainage basin bordered by high sand ridges. Local topographic relief represents a transitional zone occurring between the Lake Wales Ridge and the Groveland Karst (Brooks 1982). Ridge crests can exceed 145 ft. NGVD, contrasting with the low floodplain of the Lake Apshawa system where surface elevations decline to less than 80 ft. NGVD.

The ridges isolate the Lake Apshawa system from other surface waters in the area. Surface inflows are contributed from rainfall and sheet flow. Ground water inflows vary corresponding to Floridan recharge potentials for the area, exceeding 12 in. per year along the ridges east of the lakes (Boniol et al. 1993).

As this report is prepared, Lake Apshawa North lacks a stage record; however, a long-term hydrologic record is available for Lake Apshawa South. Lake stage conditions are presented for data collected from April 1953 to January 1998 (Figures 4 - 5). During the

45-year period, Lake Apshawa South fluctuated 10.6 ft. NGVD, with a minimum of 82.1 ft. NGVD (November 17, 1977), and a maximum of 92.7 ft. NGVD (October 8, 1960). Mean stage for the period of record was ($\bar{x}$ =) 84.9 ft. NGVD.

Hydric Soils

Lake hydrology affects the development of hydric soils. These substrates are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service 1987). Hydric conditions are sufficient to support the growth of vegetation typical of wetland communities.

Placid and Myakka sands are mapped for the Lake Apshawa system (USDA Soil Conservation Service 1975; Figure 6). These very poorly drained hydric soils extend from the southwest side of Lake Apshawa North to the floodplain of Lake Apshawa South. Typically, Placid and Myakka sands occur in low marshy depressions that are covered by water four to six months per year (USDA Soil Conservation Service 1975). This hydric soil complex meets criteria for saturation and ponding, but not flooding (Kriz 1995).

Wetlands

The term “wetlands” is defined by Chapter 373, *F.S.*, as “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. … The prevalent vegetation generally consists of facultative or obligate hydrophytic macrophytes … . These species, due to morphological, physiological, or reproductive adaptations, have the ability to grow, reproduce, or persist in aquatic environments or anaerobic soil conditions.”

Wetland values for both lakes are heavily influenced by anthropogenic disturbances from past and existing land uses. Typical wetlands associated with Lake Apshawa North consist of shallow marshes, transitional shrub and wet prairie communities (Figure 7). The invasive species primrose willow (*Ludwigia peruviana*) is common. Wetlands associated with Lake Apshawa South consist of shallow marshes vegetated by maidencane (*Panicum hemitomon*) and torpedo grass (*P. repens*) (Figure 7).

Field Data

Lake Apshawa North

Two line transects were established (Figures 8 - 9). Summary statistics are provided (Table 5). Observed plant species are listed (Tables 6 – 7). General on-site soil conditions are described in terms of texture and presence of organics.

Table 5. Summary Statistics for Lake Apshawa North, Lake Co. A shaded value indicates an elevation used for a preliminary minimum level.

Location	Feature	n	Mean (ft. NGVD)	Median (ft. NGVD)	Max. (ft. NGVD)	Min (ft. NGVD)
Transect 1	**Vegetation Communities**					
STA 0+00 (POB) – STA 0+45	Upland	11	86.6	86.4	87.8	85.8
STA 0+45 – STA 0 +73	Shrub Swamp	8	85.0	85.0	85.8	84.2
STA 0+73 – STA 1+80	Littoral Zone	22	80.9	80.9	84.2	78.2
Transect 2	**Vegetation Communities**					
STA 0+00 (POB) – STA 0+40	Upland	10	87.6	87.5	88.8	86.6
STA 0+40 – STA 0+89	Transitional Shrub	11	86.0	85.9	86.6	85.4
STA 0+89 – STA 1+20	Shrub Swamp	8	84.9	84.9	85.4	84.4
STA 1+20- STA 1+95	Littoral Zone	16	81.8	81.7	84.4	79.9
Transects 1 & 2	Shrub Swamps	16	**85.0**	85.0	85.8	84.2
	Littoral Zones	38	81.3	81.3	84.4	78.2

Transect elevation data were recorded at approximate 5-ft. intervals. Additional spot elevations were recorded to approximate the extent of vegetation communities and the occurrence of hydric soil indicators. Each line transect originated at a point of beginning (POB) associated with a specified vegetation community, and extended roughly perpendicular to the lake, approximately to the edge of the littoral zone and open water. The POB does not necessarily represent the landward extent of the specified community, but rather the transect origin respective of that community (POB corresponds to survey station STA 0+00, or 0.0 ft.). From the POB, each surveyed distance interval (STA) was recorded in linear feet.

Transect 1

Located on the west shore of Lake Apshawa North, Transect 1 was surveyed on 17 September 1998 when lake stage was 85.1 ft. NGVD (Figure 8). The POB was set within an upland community. From this point the line was extended down slope to the lake traversing shrub swamp and littoral zone communities. The total linear distance was 180 ft. with a vertical change of 9.6 ft

Community vegetation and soils were observed (Tables 5 - 6; Figure 8): Beginning within the upland community, the line extended from the POB at STA 0+00 to STA 0+45 (minimum elevation, 85.8 ft. NGVD; Table 5). This community consisted of an association of ruderal herbaceous vegetation rooted in sandy soils, merging into oaks of secondary growth rooted in mucky sand. Down slope, the line traversed a shrub swamp on mucky sand (STA 0+45 to STA 0+73 [$\bar{x}$ = 85.0 ft. NGVD]; Table 5). This community had a dominant cover of primrose willow (*Ludwigia peruviana*) with cattails (*Typha domingensis*), both wetland obligates. From this community, the line traversed a littoral zone (STA 0+73 to STA 1+80 [$\bar{x}$ = 80.9 ft. NGVD]; Table 5). This community had a dominant cover of cattails rooted in mucky sand.

Table 6. Lake Apshawa North, Lake Co. – Transect 1. Species and hydric designations are taken from Chapter 62-340.450, *Florida Administrative Code;* UPL = Upland; FAC = Facultative; FACW = Facultative Wet; OBL = Obligate. Species not in the rule are assumed to be upland (UPL) unless they are obvious aquatics; unlisted aquatic plants are designated as obligates (OBL). Shaded bars indicate occurrence by vegetation community. Cover estimates by aerial extent: 0 = <1% (rare); 1 = 1-10% (scattered); 2 = 11-25% (numerous); 3 = 26-50% (abundant); 4 = 51-75% (co-dominant); 5 = >75% (dominant).

Species	Hydric Designation	Upland	Shrub Swamp	Littoral Zone
Live oak (*Quercus virginiana*)	UPL	5		
Laurel oak (*Quercus laurifolia*)	UPL	1		
Common ragweed (*Ambrosia artemisifolia*)	UPL	1		
Dwarf horseweed (*Conyza canadensis*)	UPL	0		
Bahia grass (*Paspalum notatum*)	UPL	0		
Milk pea (*Galactia elliottii)*	UPL	2		
Camphorweed (*Heterotheca subaxillaris*)	UPL	0		
Crotalaria sp.	UPL	0		
Thoroughworts (*Eupatorium sp.*)	FAC	1		
Andropogon sp.	?	1		
Blackberry (*Rubus* sp.)	FAC	1		
Wax myrtle (*Myrica cerifera*)	FAC		1	
Pennywort (*Hydrocotlye* sp.)	FACW		0	
Primrose willow (*Ludwigia peruviana*)	OBL		3	
Sheathed flatsedge (*Cyperus haspan*)	OBL		0	
Cattail (*Typha domingensis*)	OBL		3	5

Transect 2

Located on the north side of Lake Apshawa North, Transect 2 was surveyed on 22 September 1998 when lake stage was 85.3 ft. NGVD (Figure 9). The POB was set within an upland community. From this point the line was extended down slope to the lake traversing transitional shrub, shrub swamp, and littoral zone communities. The total linear distance was 195 ft. with a vertical change of 8.9 ft

Community vegetation and soils were observed (Tables 5 - 7; Figure 9): Beginning within the upland community, the line extended from the POB at STA 0+00 to STA 0+ 40 (minimum elevation, 86.6 ft. NGVD; Table 5). This community consisted of an upland association of ruderal herbaceous vegetation and oaks growing mostly in sandy soils. Down slope, the line traversed a saturation zone supporting a transitional shrub association of upland and wetland vegetation rooted in mucky sand (STA 0+40 to STA 0+89 [$\bar{x}$ = 86.0 ft. NGVD]; Table 5). Down slope, the line traversed an inundation zone supporting a shrub swamp on mucky sand (STA 0+89 to STA 1+20 [$\bar{x}$ = 84.9 ft. NGVD]; Table 5). Down slope, the line traversed a littoral zone dominated by cattails rooted in mucky sand (STA 1+20 to STA 1+95 [$\bar{x}$ = 81.8 ft. NGVD]; Table 5).

Table 7. Lake Apshawa North, Lake Co. – Transect 2. Species and hydric designations are taken from Chapter 62-340.450, *Florida Administrative Code;* UPL = Upland; FAC = Facultative; FACW = Facultative Wet; OBL = Obligate. Species not in the rule are assumed to be upland (UPL) unless they are obvious aquatics; unlisted aquatic plants are designated as obligates (OBL). Shaded bars indicate occurrence by vegetation community. Cover estimates by aerial extent: 0 = <1% (rare); 1 = 1-10% (scattered); 2 = 11-25% (numerous); 3 = 26-50% (abundant); 4 = 51-75% (co-dominant); 5 = >75% (dominant).

Species	Hydric Designation	Upland	Transitional Shrub	Shrub Swamp	Littoral Zone
Live oak (*Quercus virginiana*)	UPL	2			
Laurel oak (*Quercus laurifolia*)	UPL	3			
Dwarf horseweed (*Conyza canadensis*)	UPL	0			
Camphorweed (*Heterotheca subaxillaris*)	UPL	0			
Common ragweed (*Ambrosia artemisifolia*)	UPL	1			
Natalgrass (*Rhynchelytrum repens*)	UPL	1			
Prunus sp.	UPL		1		
Eastern false-willow (*Baccharis halimifolia*)	FAC	1	3		
Blackberry (*Rubus* sp.)	FAC		4		
Wax myrtle (*Myrica cerifera*)	FAC		3		0
Sweetgum (*Liquidamber styraciflua*)	FACW		1		
Primrose willow (*Ludwigia peruviana*)	OBL		3	4	
Sheathed flatsedge (*Cyperus haspan*)	OBL			0	0
Cattail (*Typha domingensis*)	OBL			1	5

Lake Apshawa South

Two line transects were established for Lake Apshawa South (Figures 10 - 11). At 87.3 ft. NGVD, lake stage was 2.4 ft. above mean stage. This high water level was attributed to *el Nino*-related storm events during the winter of 1997 - 1998. The high water sometimes obscured vegetation transitions. Dock heights were not collected. Summary statistics are provided (Table 8). Observed plant species are listed (Tables 9 – 10). On-site soil conditions are described in general terms of texture and presence of organics.

Table 8. Summary Statistics for Lake Apshawa South, Lake Co. A shaded value indicates an elevation used for a preliminary minimum level.

Location	**Feature**	**n**	**Mean** (ft. NGVD)	**Median** (ft. NGVD)	**Max** (ft. NGVD)	**Min** (ft. NGVD)
Lake	Stage Data	6674	84.9	84.9	92.7	82.1
Transect 1	**Vegetation Communities**					
STA 0+00 (POB) – STA 0+84	Upland	10	91.3	91.1	93.9	89.1
STA 0+84 – STA 1+35	Disturbed Floodplain Marsh	13	87.6	87.5	89.1	86.1
STA 1+35 – STA 5+75	Littoral Zone	21	83.7	84.5	86.1	79.7
STA 1+35 – STA 2+00	Emergent Marsh #1	6	**84.9**	85.7	86.1	82.1
STA 2+00 – STA 3+75	Deep Marsh	8	82.2	81.7	85.1	79.7
STA 3+75 –STA 5+75	Emergent Marsh #2	9	84.2	84.7	85.1	81.1
	Muck soils	11	83.3	83.1	86.2	79.7
Transect 2	**Vegetation Communities**					
STA 0+00 (POB) – STA 0+31	Upland	11	88.3	88.2	89.6	87.3
STA 0+31 – STA 0+40	Disturbed Floodplain Marsh	5	86.8	86.9	87.3	86.1
STA 0+40 – STA 1+10	Floodplain Marsh-Littoral Zone	16	83.8	83.8	86.1	81.7
Transects 1 & 2	Disturbed Floodplain Marshes	18	87.4	87.25	89.1	86.1
	Littoral Zones	37	83.7	84.3	86.2	79.7

Transect 1

Located on the northwest side of Lake Apshawa South, Transect 1 was surveyed on 21 May 1998 when the lake stage was 87.3 ft. NGVD (Figure 10). The POB was set at the rear of a residential lot characterized as upland. From this point the line extended to the lake traversing disturbed floodplain marsh and littoral zone communities. The total linear distance was 575 ft. with a vertical change of 12.8 ft.

Community vegetation and soils were observed (Tables 8 - 9; Figure 10). Beginning within the upland, the line extended from the POB at STA 0+00 to STA 0+84 (minimum elevation, 89.1 ft. NGVD; Table 8). This community consisted of an association of ruderal herbaceous vegetation rooted in sandy soils. Down slope, the line traversed a wetland ecotone described as disturbed floodplain marsh consisting of upland and emergent wetland vegetation rooted in mucky sands (STA 0+84 to STA 1+35 [$\bar{x}$ = 87.6 ft. NGVD]; Table 8). Down slope, the line traversed a littoral zone divided into three plant associations – an emergent marsh (STA 1+35 to STA 2+00 [$\bar{x}$ = 84.9 ft. NGVD]; Table 8); a deep marsh (STA 2+00 to STA 3+75; [$\bar{x}$ = 82.2 ft. NGVD]; Table 8); and, a second zone of emergent marsh (STA 3+75 to STA 5+75 [$\bar{x}$ = 84.2 ft. NGVD]; Table 8). The first emergent marsh and deep marsh zones consisted of obligate wetland vegetation rooted in muck. The second zone of emergent marsh consisted of obligate wetland vegetation rooted in sand (Figure 10).

Transect 2

Located on the south side of Lake Apshawa South, Transect 2 was also surveyed on 21 May 1998 (Figure 11). The POB was set within an upland community. From this point the line extended down slope to the lake traversing a disturbed floodplain marsh and a community described as floodplain marsh/littoral zone. The total linear distance was 110 ft. with a vertical change of 7.9 ft.

Community vegetation and soils were observed (Table 8; Figure 11). Beginning within the upland community, the line extended from the POB at STA 0+00 to STA 0+31 (minimum elevation, 87.3 ft. NGVD; Table 8). This community consisted of a ruderal association of herbaceous vegetation growing on sandy and mucky-sand soils. Down slope, the line traversed a disturbed floodplain marsh consisting of emergent wetland vegetation rooted in mucky sand (STA 0+31 to STA 0+40; [$\bar{x}$ = 86.8 ft. NGVD]; Table 8). Down slope, the line traversed an area of floodplain marsh / littoral zone consisting of emergent and deep marsh vegetation rooted in mucky sand (STA 0+40 to STA 1+10 ($\bar{x}$ = 83.8 ft. NGVD; Table 8).

Table 9. Lake Apshawa South, Lake Co. - Transect 1. Species and hydric designations are taken from Chapter 62-340.450, *Florida Administrative Code;* UPL = Upland; FAC = Facultative; FACW = Facultative Wet; OBL = Obligate. Species not in the rule are assumed to be upland (UPL) unless they are obvious aquatics; unlisted aquatic plants are designated as obligates (OBL). Shaded bars indicate occurrence by vegetation community. Cover estimates by aerial extent: 0 = <1% (rare); 1 = 1-10% (scattered); 2 = 11-25% (numerous); 3 = 26-50% (abundant); 4 = 51-75% (co-dominant); 5 = >75% (dominant).

Species	Hydric Designation	Upland	Disturbed Floodplain Marsh	Littoral Zone
Lantana sp.	UPL	1		
Lepidium sp..	UPL	1		
Milk pea (*Galactia elliottii)*	UPL	2		
Richardia scabra	UPL	1		
Natalgrass (*Rhynchelytrum* sp.)	UPL	1		
Bahia grass (*Paspalum notatum)*	UPL	3	3	
Thouroughworts (*Eupatorium* sp.)	FAC		1	
Vasey grass (*Paspalum urvillei*)	FAC		1	
Coinwort *(Centella asiatica)*	FACW		1	
Carex sp.	FACW		1	
Carex albolutescens	FACW	1		0
Floating pennywort (*Hydrocotyl sp.)*	FACW		1	2
Shore rush *(Juncus marginatus)*	FACW		1	
Torpedo grass (*Panicum repens*)	FACW			2
Arrowhead (*Sagittaria lancifolia*)	OBL			2
Southern cattail (*Typha domengensis*)	OBL			2
Sawgrass (*Cladium jamaicense)*	OBL			0
Spikerush (*Eleocharis sp.)*	OBL			2
Primrose willow (*Ludwigia peruviana)*	OBL		1	
Maidencane (*Panicum hemitomon)*	OBL		3	2
Rush furiena (*Fuirena scirpoidea)*	OBL			2
Water lily (*Nymphaea odorata)*	OBL			3
Websteria sp.	OBL			1

Table 10. Lake Apshawa South, Lake Co. - Transect 2. Species and hydric designations are taken from Chapter 62-340.450, *Florida Administrative Code;* UPL = Upland; FAC = Facultative; FACW = Facultative Wet; OBL = Obligate. Species not in the rule are assumed to be upland (UPL) unless they are obvious aquatics; unlisted aquatic plants are designated as obligates (OBL). Shaded bars indicate occurrence by vegetation community. Cover estimates by aerial extent: 0 = <1% (rare); 1 = 1-10% (scattered); 2 = 11-25% (numerous); 3 = 26-50% (abundant); 4 = 51-75% (co-dominant); 5 = >75% (dominant).

Species	Hydric Designation	Upland	Disturbed Floodplain Marsh	Floodplain Marsh - Littoral Zone
Bahia grass (*Paspalum notatum*)	UPL	2		
Common ragweed (*Ambrosia artemisifolia*)	UPL	0		
Lepidium sp.	UPL	0		
Passion flower (*Passiflora* sp.)	UPL	0		
Thoroughworts (*Eupatorium sp.*)	FAC	1	1	
Wax myrtle (*Myrica cerifera*)	FAC			1
Vasey grasss (*Paspalum urvillei*)	FAC	1		
Coinwort (*Centella asiatica*)	FACW	0		
Flatsedge (*Cyperus* sp.)	FACW	1	0	
Pennyworts (*Hydrocotyl sp.*)	FACW		0	2
Torpedo grass (*Panicum repens*)	FACW	1	3	2
Rush fuirena (*Fuirena scirpoidea)*	OBL		0	2
Arrowhead (*Sagittaria lancifolia*)	OBL			2
Maidencane (*Panicum hemitomon*)	OBL	4	3	2
Primrose willow (*Ludwigia peruviana)*	OBL	1	2	2
Waterlily (*Nymphaea odorata)*	OBL			2

Hydrologic Model

An important part of the SJRWMD MFLs process is an understanding of the hydrologic dynamics of each body of water. An indispensable tool for obtaining a more complete understanding of these dynamics is the hydrologic mathematical model, also known as a water budget model. Thus, the SJRWMD has developed a hydrologic model for Lake Apshawa North and Lake Apshawa South. The model will enable the SJRWMD to better establish limits for the lakes' water resources from a permitting standpoint.

A hydrologic model can be a powerful tool for management decisions, in particular with respect to MFLs. Hydrologic modeling and analysis provide the framework to implement MFLs. By analyzing the output from a hydrologic model, decisions can be made as how to best manage consumptive uses in and around the lakes.

The SJRWMD used the SSARR model to simulate existing conditions (circa 1998) for the lakes. This scenario assumed that such things as land use, permitted Floridan aquifer withdrawals, and lake outlet elevations remained essentially as they were in 1998 for the entire period of simulation. The model used rainfall, evaporation, and data from a Floridan aquifer well to simulate long-term hydrographs for the lakes (Figures 12, 14). An elevation duration curve of the simulated hydrograph indicates the likelihood that a given elevation

will be inundated. The MFLs are superimposed on elevation duration curves to provide a representation of how the levels correspond to the simulated hydrology (Figures 13, 15).

Preliminary Minimum Levels Determination

The preliminary minimum levels are based on consideration of vegetation and organic soil features associated with long-term typical water levels, as well as results from the SSARR model. Three levels – the Minimum Frequent High, Minimum Average, and Minimum Frequent Low – are recommended for the lakes to define a long-term minimum hydrologic regime of high, intermediate, and low water conditions. Each minimum level has an associated hydroperiod category that defines a minimum duration and recurrence interval. Together these levels define a hydrologic threshold for water management decisions that should protect wetlands and aquatic habitats.

Lake Apshawa North

Minimum Frequent High

The preliminary Minimum Frequent High level for Lake Apshawa North consists of a stage elevation of 85.0 ft. NGVD, and a hydroperiod category of Seasonally Flooded. The Minimum Frequent High stage elevation is " a chronically high surface water level … with an associated frequency and duration that allows for inundation of the floodplain at a depth and duration sufficient to maintain wetland functions" (Chapter 40C-8.021(7), *F.A.C*.). The hydroperiod category of Seasonally Flooded means "…surface water is typically present for extended periods (30 days or more) during the growing season" (Chapter 40C-8.021(15), *F.A.C*.). The hydroperiod category has an approximate duration of several weeks to several months, and a return interval of every one to two years for a long-term period of record (Chapter 40C-8.021(15), *F.A.C*.).

The Minimum Frequent High level of 85.0 ft. NGVD is derived from the mean of the shrub swamp surface elevations recorded for Transects 1 and 2 (Table 5). Model results for Lake Apshawa North indicate an expected exceedance of about 20 percent (Figure 13).

For the stage elevation and hydroperiod category described, the preliminary Minimum Frequent High Level should protect the spatial extent and functions of the floodplain and littoral zone communities. The Minimum Frequent High stage provides 3.7 ft. of water over the observed mean of the littoral zone elevations for both transects ($\bar{x}$ = 81.3 ft.; Table 5). Sufficient water depths should be provided for fish and other aquatic organisms to feed and spawn on the lake floodplain.

Minimum Average

The preliminary Minimum Average level for Lake Apshawa North consists of a stage elevation of 83.3 ft. NGVD, and a hydroperiod category of Typically Saturated. The Minimum Average stage elevation is "the surface water level … necessary over a long period to maintain the integrity of hydric soils and wetland plant communities" (Chapter 40C-8.021(9), *F.A.C.*). The hydroperiod category of Typically Saturated allows "saturated substrates for periods of one-half year or more during non-flooding periods of typical years", and a return interval of "…one or two years for a long-term period of record" (Chapter 40C-8.021(18), *F.A.C*). The hydroperiod category of Typically Saturated has an expected duration time or exceedance of 50 - 60 percent over a long-term period of record (Chapter 40C-8.021(18), *F.A.C.*).

The lack of organic soils and the dominance of an invasive species (primrose willow) in the shrub swamps necessitated the derivation of the stage elevation from the SSARR simulation. The value of 83.3 ft. NGVD corresponds to the median of annual 180-day (average) minimum values. Model results for Lake Apshawa North indicate an expected exceedance of about 63 percent (Figure 13). A recurrence interval of one to two years is expected.

The preliminary Minimum Average Level provides saturation or inundation of a frequency and duration that should protect wetland functions of the lake littoral zones. The stage elevation of 83.3 ft. NGVD provides two ft. of water over the observed mean elevation of the littoral zones for Transects 1 and 2 ($\bar{x}$ = 81.3 ft. NGVD; Table 5). Additionally, the minimum level should provide sufficient water depths to provide refugia, nesting, and foraging habitats for aquatic and many wetland-dependent fauna associated with the lake.

Minimum Frequent Low

The preliminary Minimum Frequent Low level for Lake Apshawa North consists of a stage elevation of 81.3 ft. NGVD, and a hydroperiod category of Semi-permanently Flooded. The Minimum Frequent Low stage elevation is "a chronically low surface water level … that generally occurs only during periods of reduced rainfall. This level is intended to prevent deleterious effects to the composition and structure of floodplain soils, the species composition and structure of floodplain biotic communities, and the linkage of aquatic and floodplain food webs" (Chapter 40C-8.021(10), *F.A.C.*). As it affects the lake littoral zones, the hydroperiod category of Semi-permanently Flooded means that inundation in these areas persists in most years …" Chapter 40C-8.021(16), *F.A.C.*). The Minimum Frequent Low stage elevation of 81.3 ft. NGVD, when combined with the hydroperiod category of Semi-permanently Flooded, has an expected exceedance of approximately eighty percent for a long-term period of record (Chapter 40C-8.021(16), *F.A.C.*). Receding water levels are expected about every five to ten years for extended periods (several months or more) during moderate droughts.

The stage elevation is derived from the mean elevations of the littoral zones for Transects 1 and 2 (Table 5). Model results for Lake Apshawa North indicate an expected exceedance of about 95 percent (Figure 13).

The preliminary Minimum Frequent Low Level allows periodic drying within the upper reaches of the littoral zone communities for a duration brief enough to prevent long-term deleterious effects to wetlands. During moderate droughts, the stage elevation of 81.3 ft. NGVD should inundate the lake's lower littoral zones and aquatic beds providing foraging habitats for aquatic and wetland-dependent fauna associated with the lake (Table 5).

Lake Apshawa South

Minimum Frequent High

The preliminary Minimum Frequent High level for Lake Apshawa South consists of a stage elevation of 86.0 ft. NGVD, and a hydroperiod category of Seasonally Flooded. Explanation of these MFL terms is provided in the corresponding section for Lake Apshawa North.

The stage elevation is derived from the SSARR model simulation where 86.0 ft. NGVD represents the median of annual 30-day (continuously exceeded) maximum values. Based on model results, this elevation has an exceedance of 25 percent (Figure 15). Model results support an approximate duration of several weeks to several months, and a return interval of every one to two years for a long-term period of record, which corresponds to a Seasonally Flooded hydroperiod (Chapter 40C-8.021(15), *F.A.C.*). Normally, the Minimum Frequent High level is derived from the mean of the seasonally flooded community, which was not possible in this case because of the disturbed condition of floodplain wetlands.

The Minimum Frequent High stage elevation of 86.0 ft. NGVD is 1.4 ft. lower than the mean derived from the disturbed floodplain marsh communities ($\bar{x}$ = 87.4 ft. NGVD; Table 8). The stage elevation provides 2.3 ft. of water over the observed mean of the littoral zones for Transects 1 and 2 ($\bar{x}$ = 83.7 ft. NGVD; Table 8). The preliminary Minimum Frequent High Level should protect the spatial extent and functions of the floodplain and littoral zone communities. Sufficient water depths should occur for fish and other aquatic organisms to feed and spawn on the lake floodplain.

Minimum Average

The preliminary Minimum Average level for Lake Apshawa South consists of a stage elevation of 84.7 ft. NGVD and a hydroperiod category of Typically Saturated. Explanation of these MFL terms is provided in the corresponding section for Lake Apshawa North.

The preliminary Minimum Average level of 84.7 ft. NGVD is derived by subtracting 0.25 ft. from the mean elevation of the muck soils encountered within Transect 1 Emergent Marsh #1 ($\bar{x}$ = 84.9 ft. NGVD; Table 8; Figure 10). The 0.25 ft. constant is applied from Stephens (1974), who demonstrated that oxidation and subsidence of peat soils occurred when the mean elevation of the water table dropped more than 0.25 ft. below the surface.

Results from the SSARR hydrologic model indicate an expected exceedance of about 55 percent for a stage elevation of 84.7 ft. NGVD (Figure 15). Model results support a Typically Saturated hydroperiod allowing an approximate duration of six months or more

during non-flooding periods of typical years, and a recurrence interval of one to two years (Chapter 40C-8.021(18), *F.A.C.*).

The Minimum Average stage elevation of 84.7 ft. NGVD should provide, over the long-term, about one ft. of water over the observed mean of the lake littoral zones ($\bar{x}$ = 83.7 ft. NGVD, Table 8). The Minimum Average level provides saturation or inundation of a frequency and duration that should protect wetland functions, and maintain anaerobic conditions for muck soils. This recommended minimum level should allow sufficient water depths in the lake's littoral zones to provide refugia, nesting, and foraging habitat for aquatic and wetland-dependent fauna.

Minimum Frequent Low

The preliminary Minimum Frequent Low level for Lake Apshawa South consists of a stage elevation of 83.2 ft. NGVD and a hydroperiod category of Semi-permanently Flooded. Explanation of these MFL terms is provided in the corresponding section for Lake Apshawa North.

The Minimum Frequent Low stage elevation of 83.2 ft. NGVD is derived by subtracting 1.67 ft. from the mean surface elevation of the muck soils encountered within Transect 1 Emergent Marsh #1 ($\bar{x}$ = 84.9 ft. NGVD; Table 8; Figure 10). The stage elevation approximates the mean of muck soils observed on Transect 1 ($\bar{x}$ = 83.3 ft. NGVD; Table 8). The 1.67 ft. constant corresponds to a 20 in. reduction in the soil water table, which is considered a reasonable low water table depth for muck soils during a moderate drought. The Minimum Flows and Levels Program uses the 1.67 ft. constant to calculate minimum frequent lows where organic soils or organic hydric soil indicators are present. The constant value is derived from the mean of the range of dry-season water tables for many organic soils occurring within the District (e.g., USDA Soil Conservation Service 1974, 1980), and from seasonally flooded freshwater marshes (Environmental Science and Engineering, Inc. 1991).

Results from the SSARR hydrologic model indicate an expected exceedance of about 86 percent for a stage elevation of 83.2 ft. NGVD (Figure 15). Model results support a Semi-permanently Flooded hydroperiod where inundation persists in most years (Chapter 40C-8.021(16), *F.A.C.*) Receding water levels are expected about every five to ten years for extended periods (several or months) during moderate droughts.

Relative to the lake's long-term hydrologic regime, the minimum frequent low level should provide sufficient water to protect the muck soils and associated seed banks in the floodplain marsh communities. Exposure of the lake's shoreline will promote seed germination of littoral zone vegetation although cattail marshes may proliferate. At this level, the lower elevations within the littoral zones will be inundated along with aquatic beds, which should provide refugia and foraging habitat for aquatic and wetland-dependent fauna.

Results presented in this report are considered preliminary and on-going until the MFLs are adopted as rule and listed in Chapter 40C-8.031, *F.A.C*.

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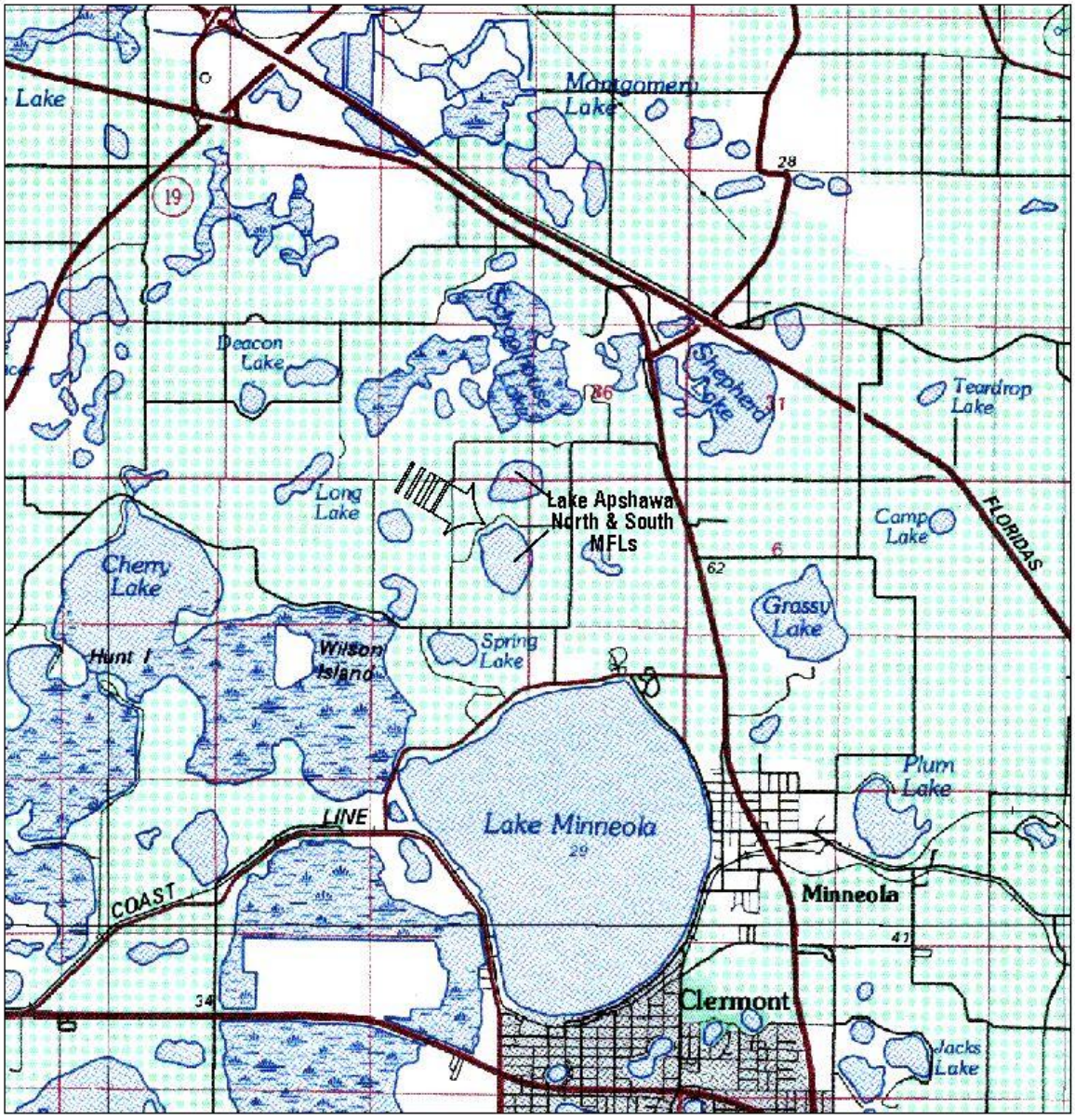
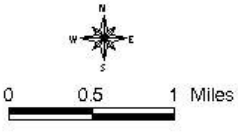


Figure 2.

Lake Apshawa North
Lake Apshawa South

Lake Co.



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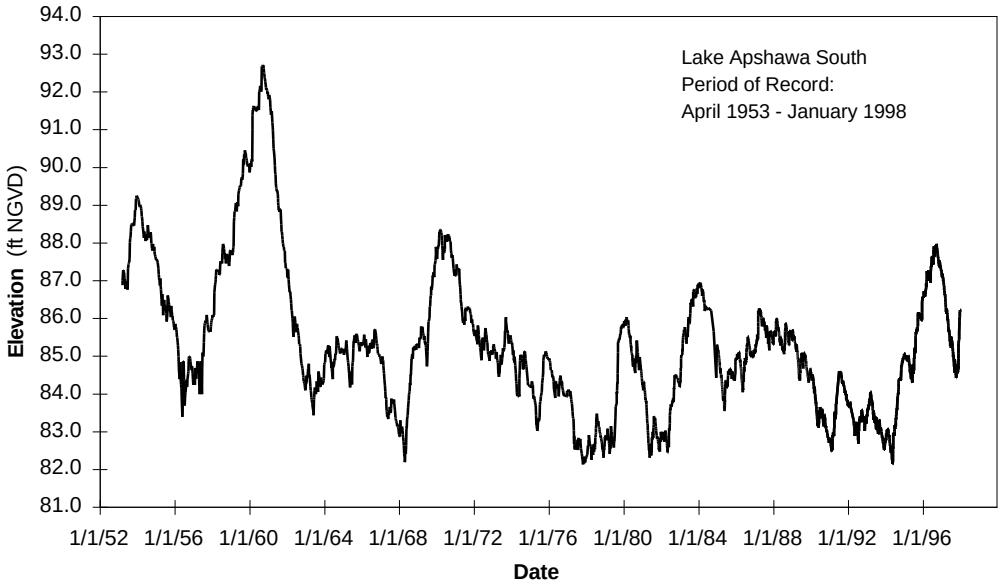


Figure 4. Hydrograph for Lake Apshawa South, Lake Co.

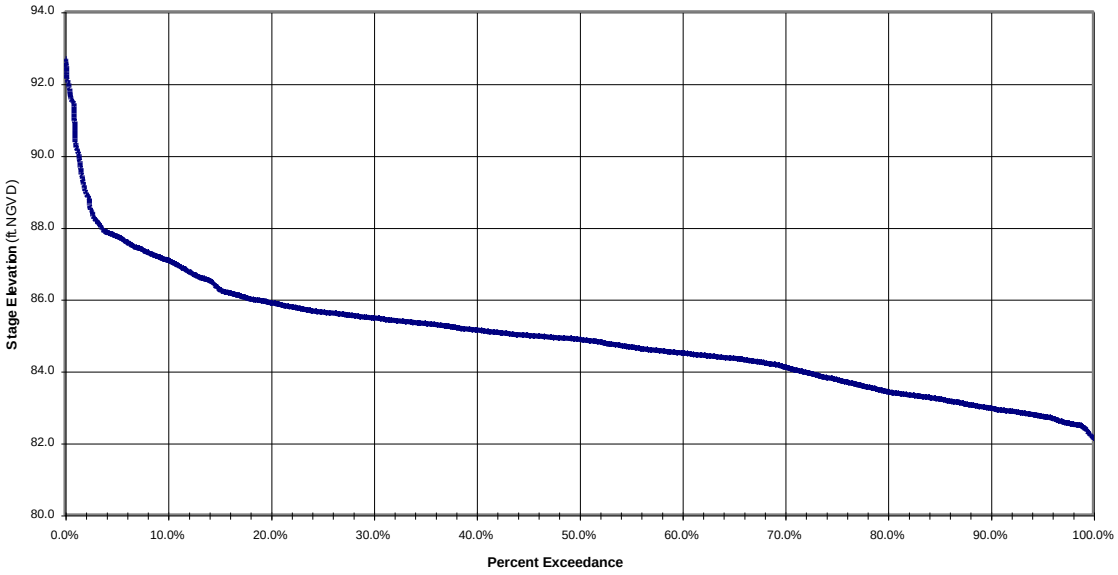
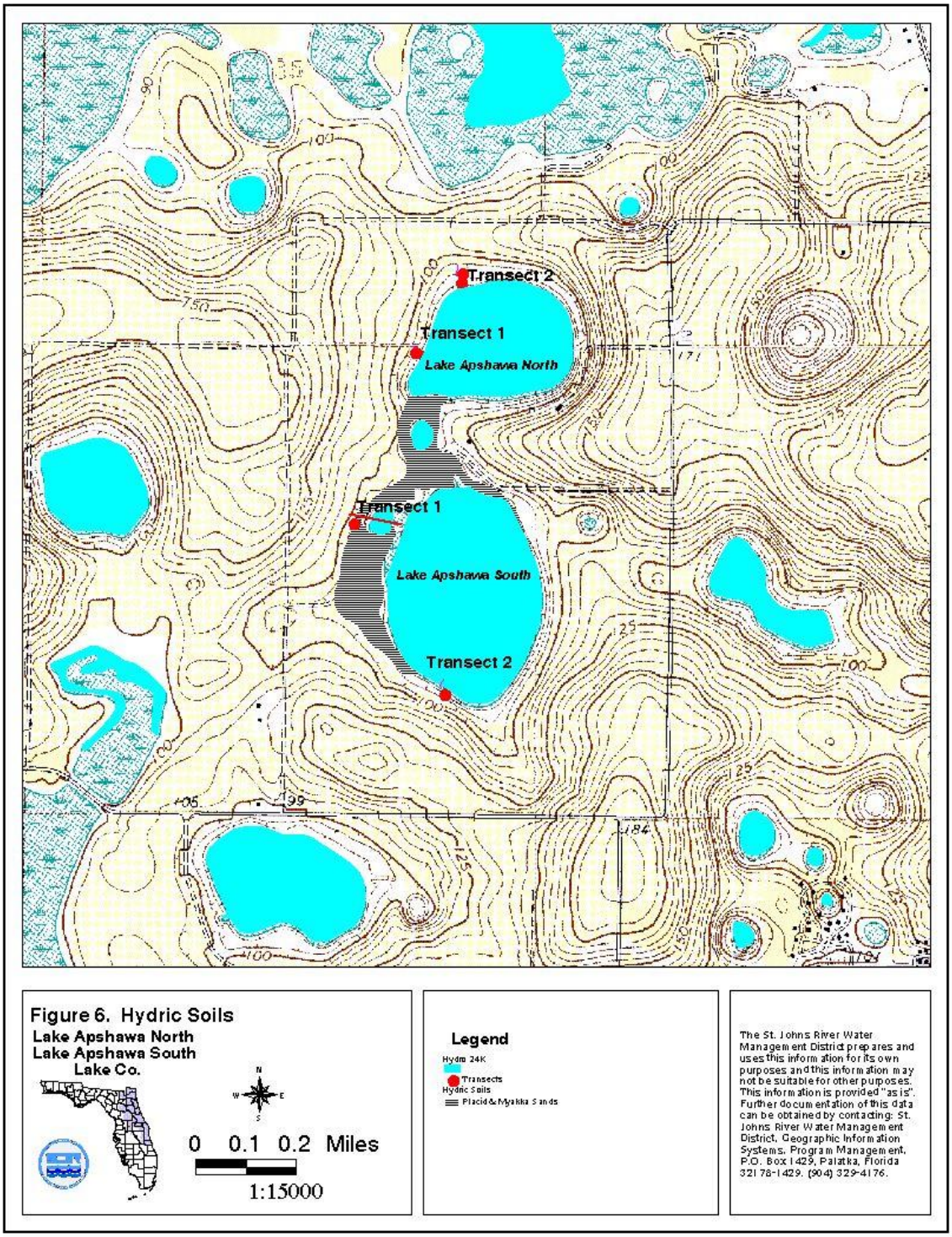


Figure 5. Stage Duration Curve – Lake Apshawa South, Lake Co.



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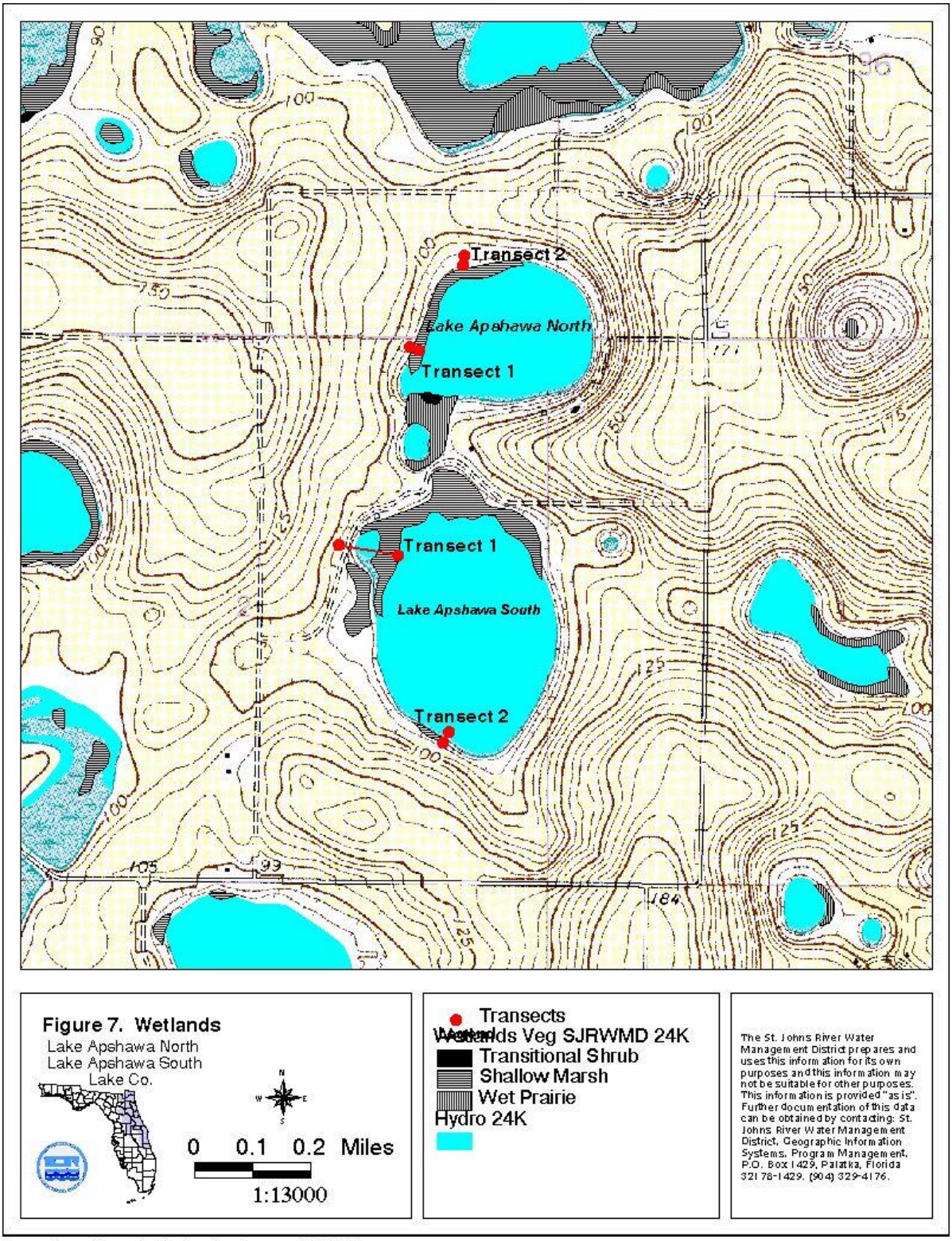
Transect 2
Lake Apshawa North
Transect 1
Transect 1
Lake Apshawa South
Transect 2
Figure 7. Wetlands
Lake Apshawa North
Lake Apshawa South
Lake Co.
0 0.1 0.2 Miles
1:13000
Transects
Wetlands Veg SJRWMD 24K
Transitional Shrub
Shallow Marsh
Wet Prairie
Hydro 24K
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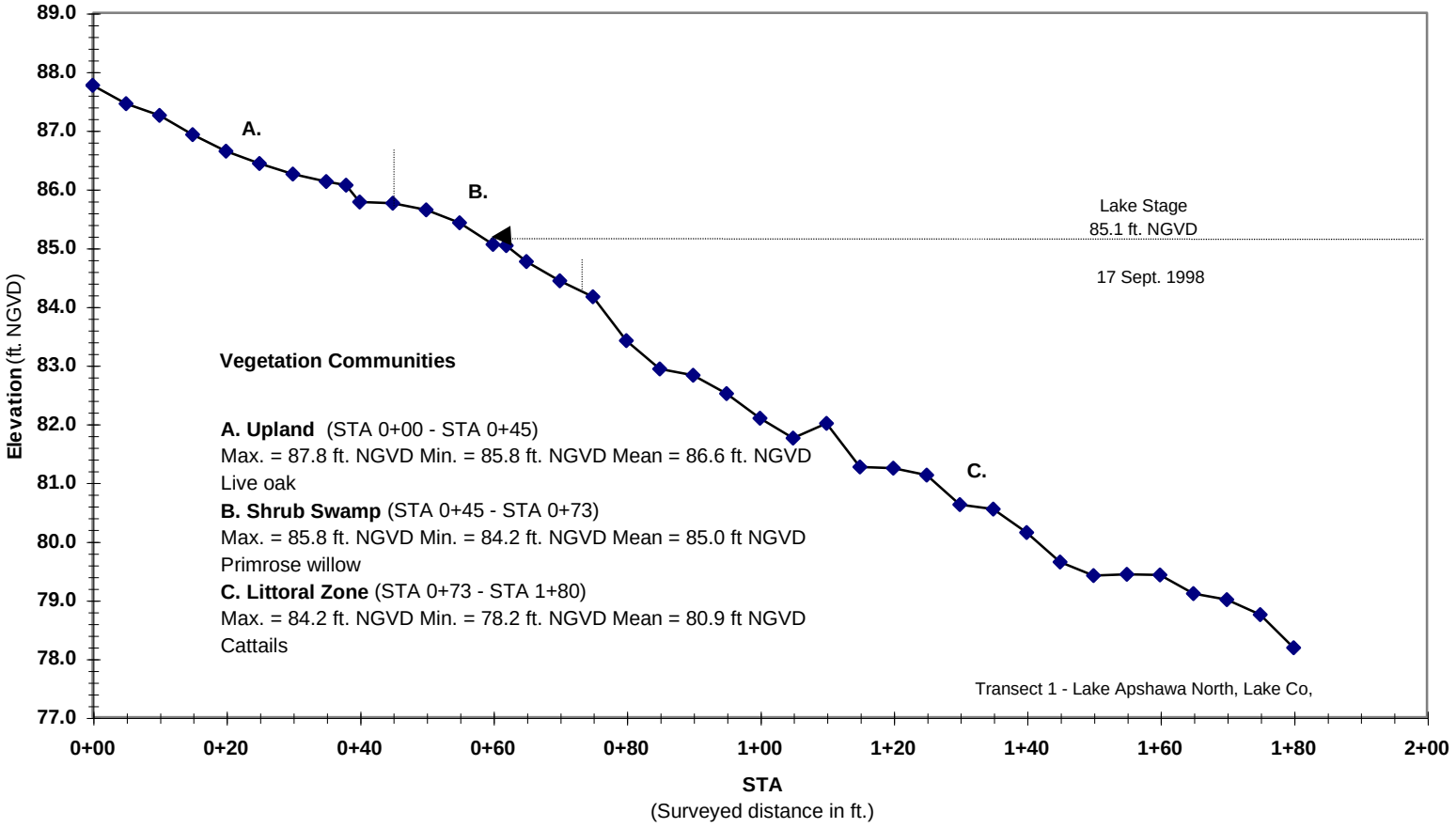

Figure 8. Transect 1 - Lake Apshawa North, Lake Co.

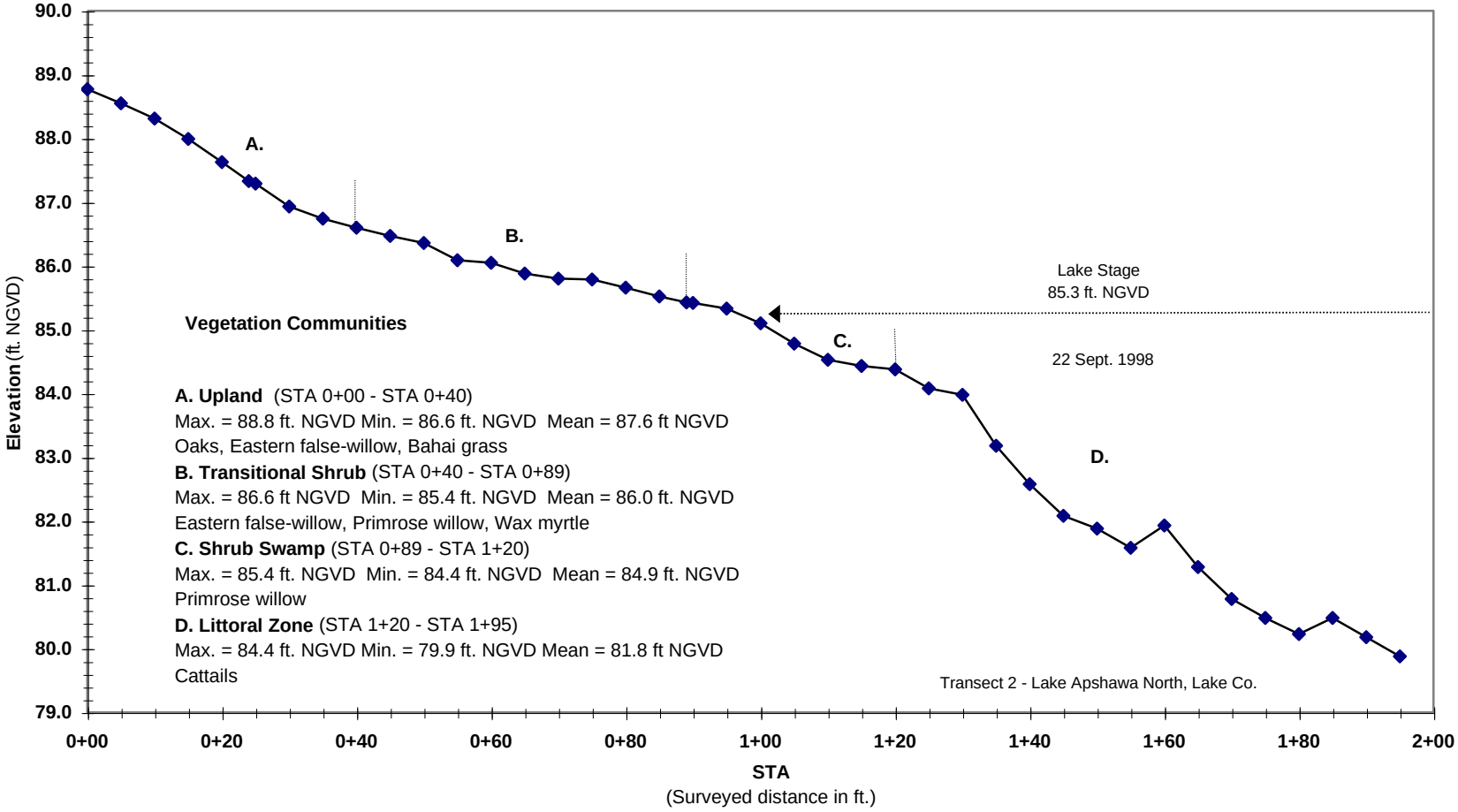

Figure 9. Transect 2 - Lake Apshawa North, Lake Co.

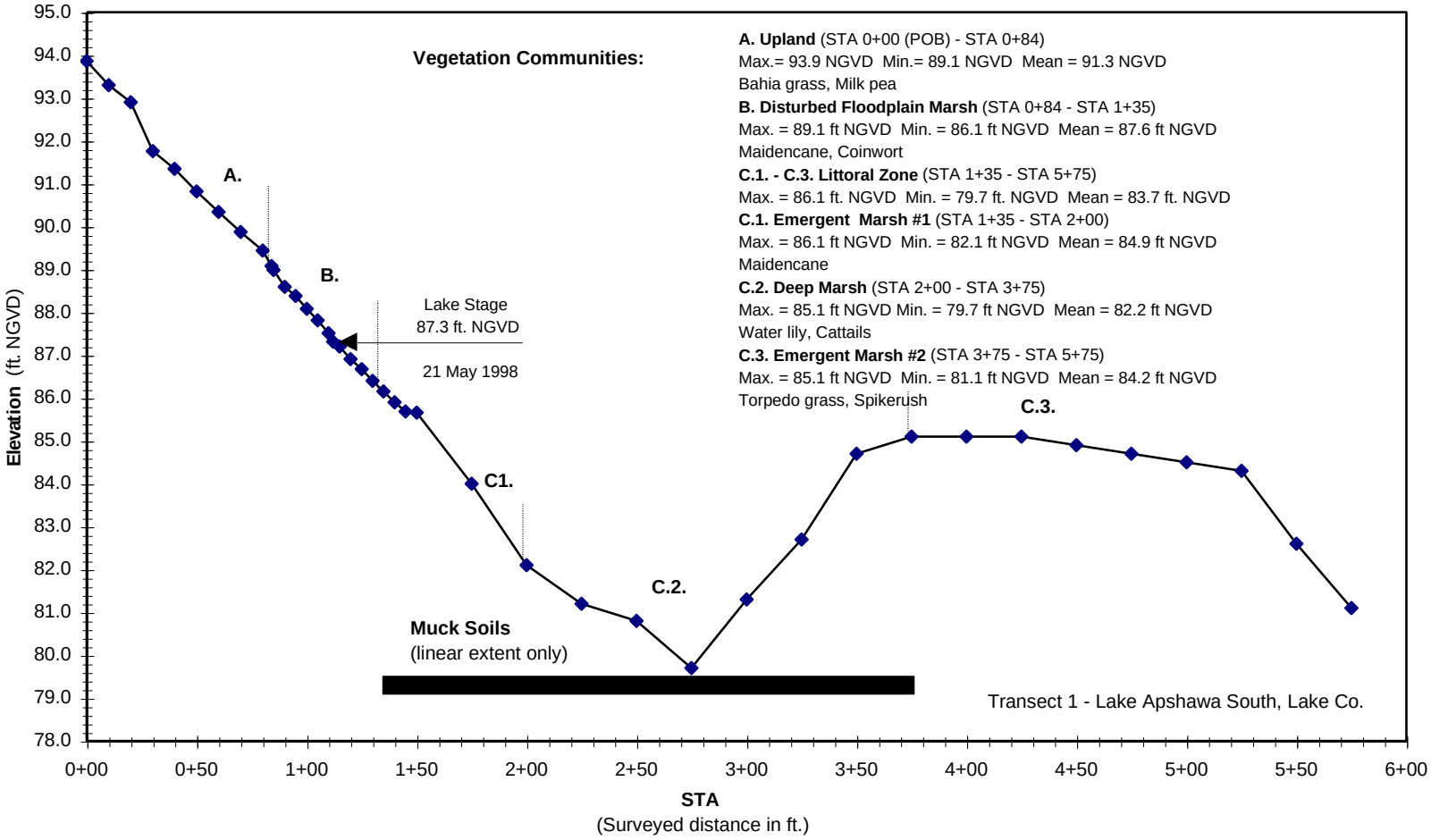

Figure 10. Transect 1 – Lake Apshawa South, Lake Co.

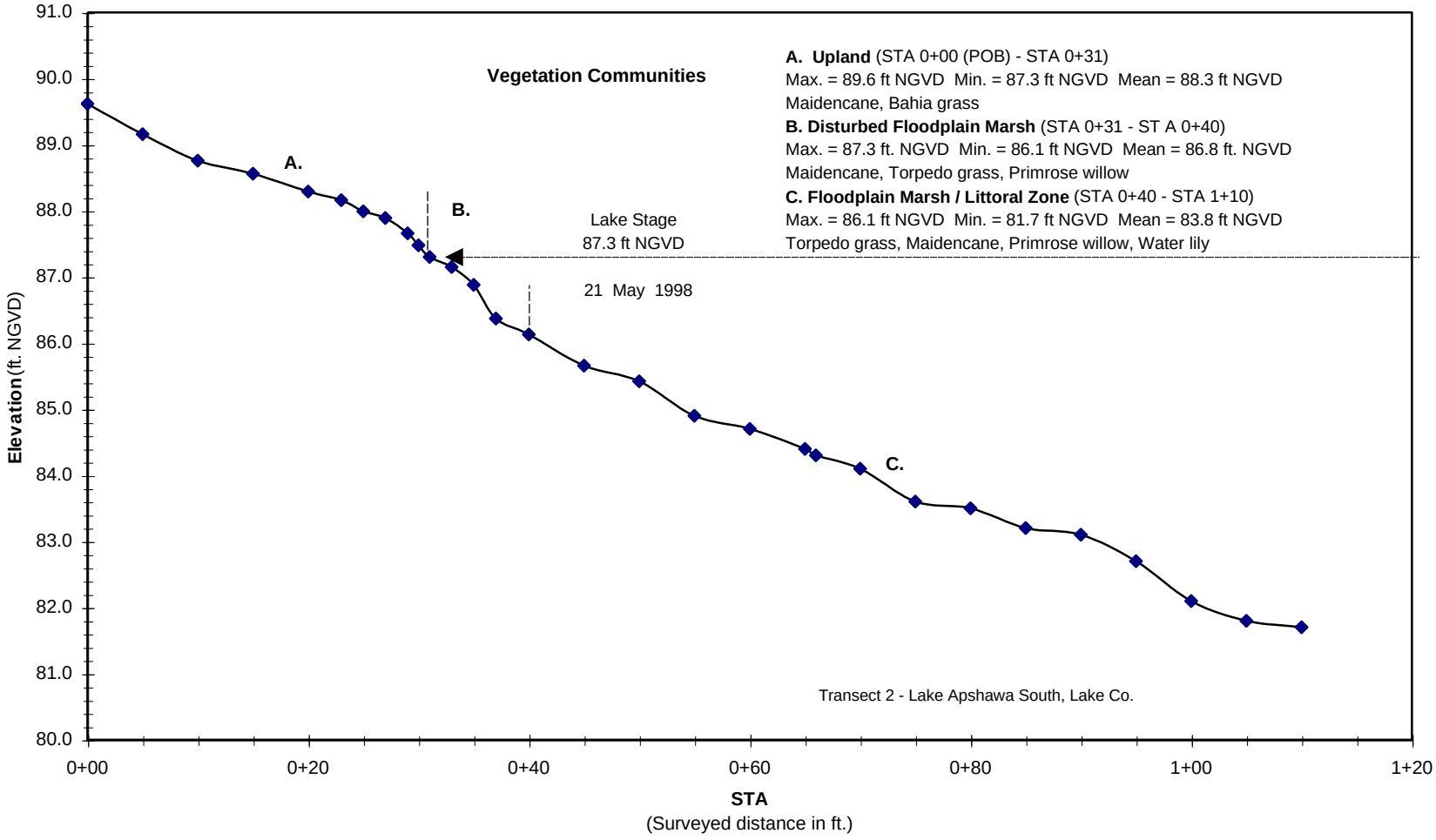

Figure 11. Transect 2 - Lake Apshawa South, Lake Co.

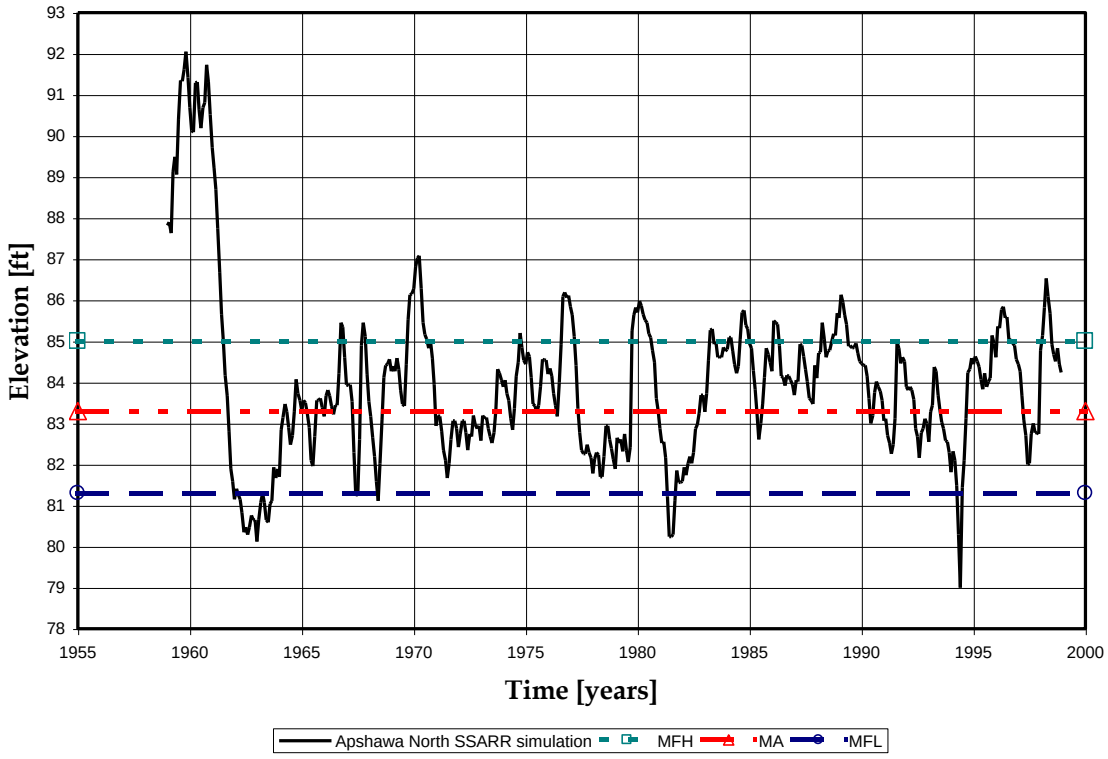

Figure 12. Hydrograph for the Streamflow Synthesis and Reservoir Regulation (SSARR) Model - Lake Apshawa North, Lake Co.

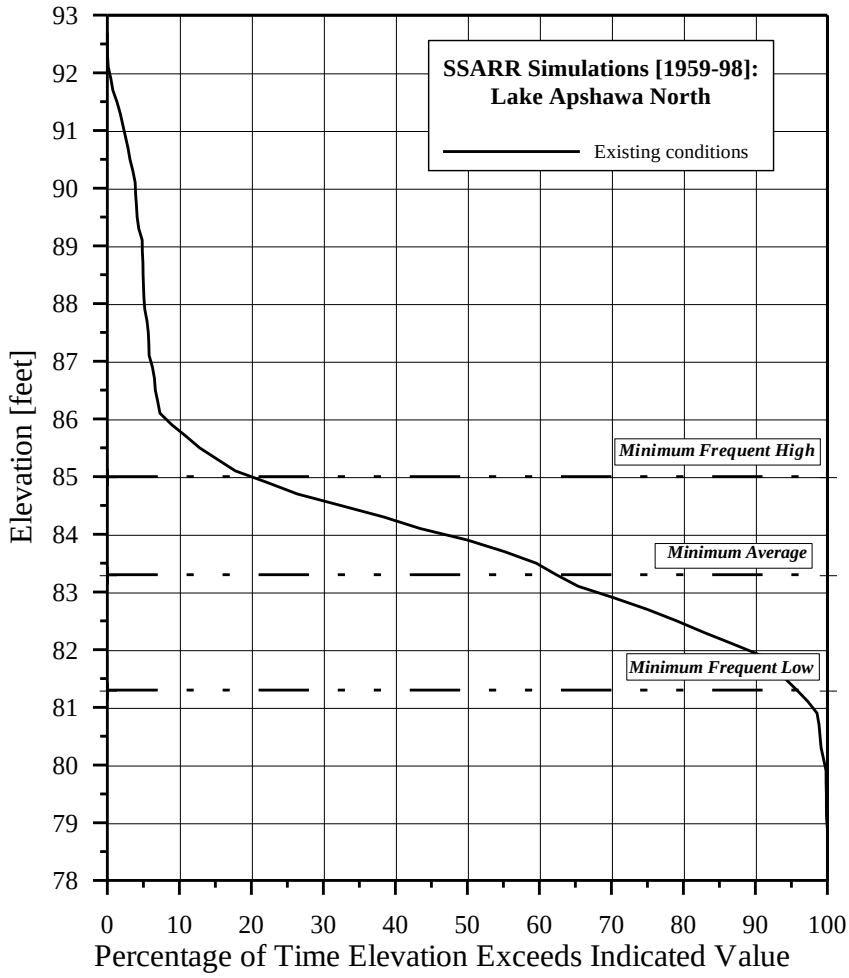

Figure 13. – Elevation duration curve of Streamflow Synthesis and Reservoir Regulation (SSARR) simulation; existing conditions (circa 1998) with MFLs superimposed - Lake Apshawa North, Lake Co.

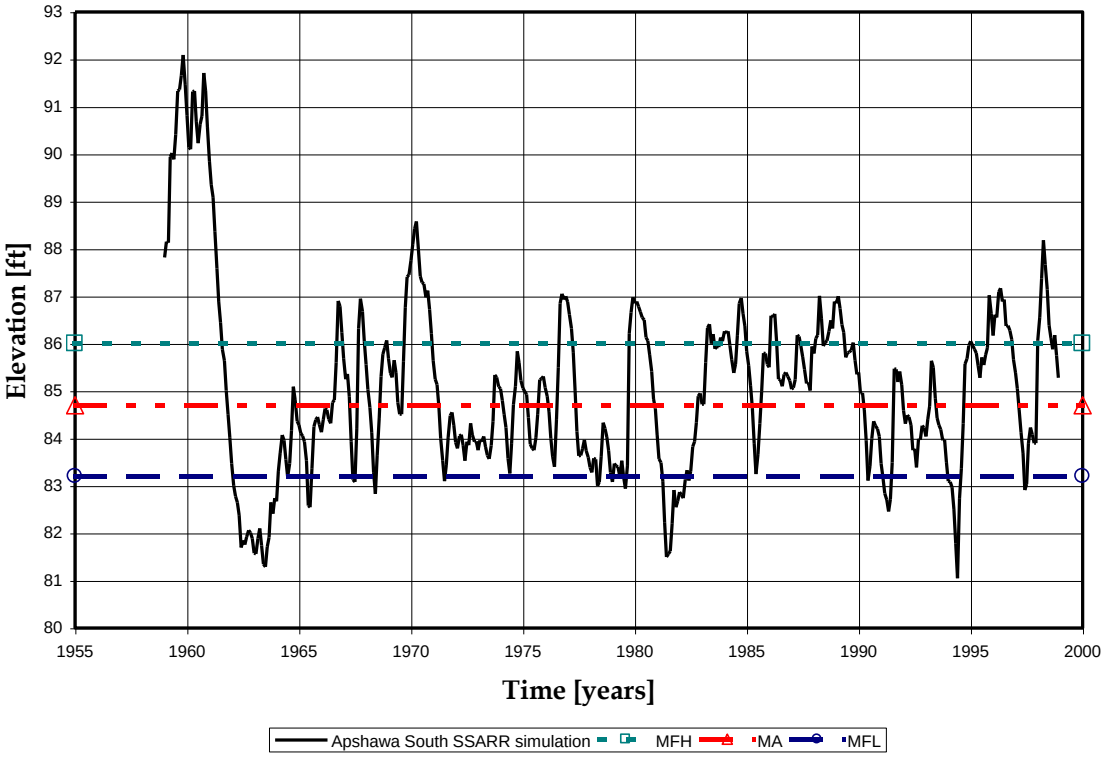

Figure 14. Elevation duration curve of the Streamflow Synthesis and Reservoir Regulation (SSARR) simulation; existing conditions circa 1998 - Lake Apshawa South, Lake Co.

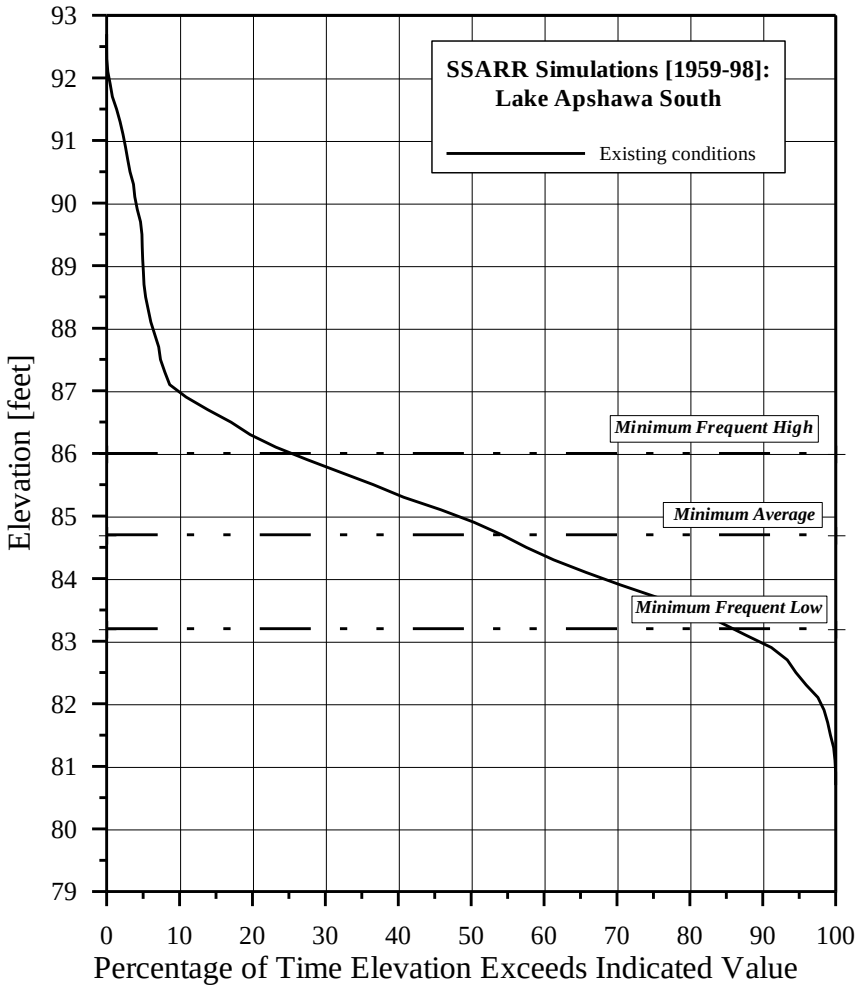

Figure 15. Elevation duration curve of the Streamflow Synthesis and Reservoir Regulation (SSARR) simulation; existing conditions circa 1996 - Lake Apshawa South, Lake Co.