APPENDIX D —WATER RESOURCE VALUE (WRV) ASSESSMENT

Pursuant to Sections 373.042 and 373.0421, F.S., SJRWMD considered the following 10 environmental values (also called water resource values [WRVs]) identified in rule 62-40.473, F.A.C..

1. Recreation in and on the water
2. Fish and wildlife habitats and the passage of fish
3. Estuarine resources
4. Transfer of detrital material
5. Maintenance of freshwater storage and supply
6. Aesthetic and scenic attributes
7. Filtration and absorption of nutrients and other pollutants
8. Sediment loads
9. Water quality
10. Navigation

These WRVs span a full range of water-related functions that provide beneficial use to humans and ecological communities. The determination of whether each relevant WRV is protected is based on whether there was a significant change, from the no-pumping condition, for specific human-use or ecological criteria evaluated for each WRV.

A significant change threshold of 15%, from the no-pumping condition, was used as the allowable reduction for each WRV. A 15% threshold for allowable reduction in exceedance of critical elevations, related to both recreation and wildlife habitat, has been used by other water management districts (e.g., SRWMD MFLs for the Lower Santa Fe and Ichetucknee rivers and priority springs; and numerous SWFWMD MFLs). This threshold has been peer reviewed numerous times and has been the basis for numerous adopted MFLs within Florida (Munson and Delfino 2007).

No-pumping and MFLs conditions exceedance curves were created to help assess whether relevant environmental values are protected by the recommended MFLs (Figure D-1). The exceedance curves were created using no-pumping and MFLs conditions daily lake stage time series respectively. The no-pumping condition time series was simulated using the Lake Butler SWMM model, with the no-pumping groundwater level time series as an input (*see Appendix B for details*). The MFL condition lake stage time series was simulated by lowering groundwater levels incrementally in the SWMM model until the model produced a lake level time series that just meets (but does not trip) the most constraining environmental criterion (i.e., the lake lobe connectivity metric).

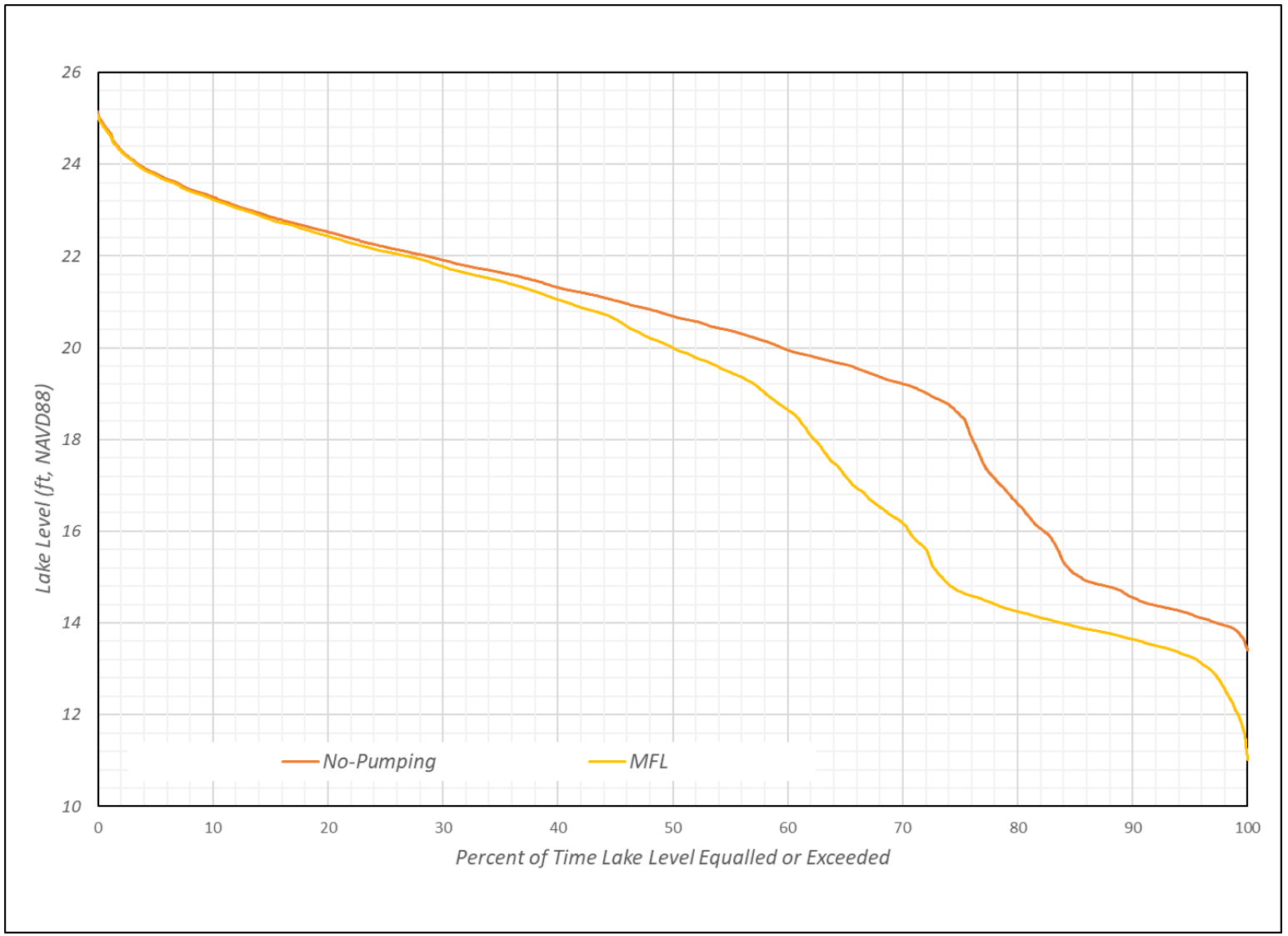

Figure D-1. No-pumping condition and MFLs condition exceedance curves for Lake Butler

The following environmental values were determined not applicable to Lake Butler and thus were not considered as part of this assessment:

- Estuarine resources (WRV3): This environmental value is not relevant because the lake is land-locked, while the overflow structure is sealed and has no surface water connection to any estuarine resources. Therefore, WRV-3 was not considered in this evaluation;

- Sediment loads (WRV8): Transport of inorganic materials as bed load is considered relevant only in flowing systems, where riverine fluvial dynamics are critical to maintenance of geomorphic features (i.e. bed forms and the floodplain) and their associated ecological communities. Lakes serve as sinks instead of sources of sediment load, and therefore WRV-8 was not considered in this evaluation;

- Water quality (WRV9): Sufficient data were not available for evaluating the relationship between lake stage and water quality. Water quality samples were collected by the district on July 22, 2003. Due to the lack of water quality data, WRV-9 was not considered in this evaluation.

1. Recreation in and on the water – WRV1

Recreation in and on the water is the use of water resources and associated natural systems for personal activity and enjoyment. The purpose of this environmental value is to protect, from significant change due to water withdrawal, the active use of water resources and associated natural systems for personal activity and enjoyment.

Lake Butler supports a variety of recreational activities, such as fishing, kayaking, canoeing and small motorcraft boating. The most popular recreational activity on Lake Butler is appears to be kayaking and canoeing (based on SJRWMD communications with residents). In addition to basing the MFL on the lake lobe connectivity metric, which is a recreation-based criterion, we also used canoeable area in the lake to evaluate whether the recommended MFLs would protect the 'Recreation in and on the water' WRV. Canoeable area is defined for this analysis as the area of the lake that is 20 inches or greater in depth. This is the minimum water depth needed to prevent damage to submerged vegetation caused by paddle gouging (FDEP 1990).

To determine whether this WRV is protected by the recommended MFLs, the average canoeable area over the model simulation period between no-pumping and MFLs conditions was compared. The average canoeable area was calculated as the mean of the daily canoeable area estimated using hydroperiod tool for the entire model simulation period for both no-pumping and MFLs conditions (*See the MFLs determination section in the main report for details about the hydroperiod tool method*).

If the average canoeable acreage, under the MFLs condition, is less than a 15% reduction from the no-pumping condition average canoeable area, then this WRV is considered protected by the recommended MFLs. The comparison indicates a 14.7% reduction in

canoeable area under the MFLs condition relative to the no pumping condition (Table D-1). Therefore, this WRV is protected under the recommended MFLs hydrologic regime.

Table D-1. Percent reduction in average canoeable area under MFL condition relative to no-pumping condition for Lake Butler.

Recreational value	Average canoeable area under no-pumping condition (acres)	Average canoeable area under MFL condition (acres)	Percent reduction in canoeable area under MFL condition, relative to no-pumping condition (%)
Area of lake deep enough to canoe or kayak	135.4	115.5	14.7

2. Fish and wildlife habitats and fish passage – WRV2

The purpose of this environmental value is to protect, from significant change due to water withdrawal, aquatic and wetland environments required by fish and wildlife. Minimum hydrologic requirements necessary to support the life cycles of aquatic, wetland and wetland-dependent species were evaluated in two ways.

The first metric evaluated was an event-based IH criterion. Because the IH was not constraining (i.e., had a large freeboard), it suggests that the hydrology necessary to prevent movement of the upland/wetland boundary is protected by the MFLs condition.

The relationship between water level decline and fish and wildlife habitat was also evaluated using the hydroperiod tool. This analysis showed that all habitats assessed were less constraining than the lake lobe connectivity metric (i.e., the MFLs condition) and are therefore protected by the latter (Table D-2). Because the fish and wildlife metrics evaluated were not as constraining as the MFLs condition, this WRV is considered protected.

Table D-2. Summary of fish and wildlife habitats percentage area reduction under MFL condition relative to No-pumping condition for Lake Butler

Nearshore Habitat	Average area of No-pumping (acres)	Average area of MFL (acres)	Reduction in area under MFL relative to No-pumping (acres)	Percent reduction in habitat under MFL relative to no-pumping (%)
Emergent Marsh	150.7	130.2	20.5	13.6
Gamefish	103.8	90.6	13.2	12.7
Small Wading Bird	15.4	13.6	1.8	11.7
Large Wading Bird	35.3	31.3	4.0	11.3
Sandhill Crane	19.7	17.3	2.4	12.2

3. Estuarine Resources -WRV3

This environmental value is not relevant and was not investigated in this assessment. The Theresa system is a land-locked chain of lakes and has no natural surface water connection to any estuarine resources. Therefore, discharge from the lake does not directly contribute to the St. Johns River flow, while the Lake Doyle emergency overflow structure is sealed. Because the Theresa system has a *de minimus* effect on the St. Johns River estuary structure and function, this WRV was not evaluated.

4. Transfer of detrital material -WRV4

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the production and movement of particulate organic matter and its associated fauna that form the base of invertebrate and fish food webs.

Detrital material is an important component of aquatic food webs (Mitsch and Gosselink 2015). For this analysis, the transport of detritus is defined as the movement by water of loose organic material and debris and associated decomposing biota. The organic particles consist of decomposing vegetation, including leaves and wood, processed by microbes (e.g., bacteria and fungus). Wetland communities, especially the emergent marsh communities, are importance sources of detrital material for the Lake Butler other than their input from the upstream water bodies of the Teresa system. Therefore, maintaining adequate amount of healthy emergent marsh habitat is essential to the supply and transport of detrital material for this lake.

To determine whether this WRV is protected by the recommended MFLs, the average acreage of emergent marsh habitat, over the long term POR, was compared under the MFLs and no-pumping conditions (Table D-3). This comparison shows an 13.6% reduction in emergent marsh area under the MFLs condition, relative to the no pumping condition. Because the MFLs condition ensures less than a 15% reduction in emergent marsh area, relative to the no-pumping condition, detrital transport at Lake Butler is considered protected under the recommended MFLs hydrologic regime.

Table D-3. Average emergent marsh habitat area over the long-term POR and percent change between the no-pumping and MFLs conditions.

Hydrologic condition	Average emergent marsh area over long-term POR (acres)	Area change between no-pumping and MFL conditions (acres)	Percent change in lake area between no-pumping and MFLs conditions (%)
No-pumping	150.7	20.5	13.6
MFL	130.2		

5. Maintenance of freshwater storage and supply -WRV5

The purpose of this environmental value is to protect, from significant change due to water withdrawal, an adequate amount of freshwater for non-consumptive uses and environmental values associated with coastal, estuarine, riverine, spring, aquatic, and wetlands ecology. This environmental value encompasses all other environmental values identified in Rule 62-40.473 F.A.C.. Because the overall purpose of the MFL is protect environmental resources, and other non-consumptive beneficial uses while also providing for consumptive uses, this environmental value is considered protected if the remaining relevant values are protected.

6. Aesthetic and scenic attributes – WRV6

The purpose of this environmental value is to protect, from significant change due to water withdrawal, those features of a waterbody typically associated with passive uses, such as bird-watching, sightseeing, hiking, photography, contemplation, painting and other forms of relaxation.

Given the lack of statutory or other guidance, this WRV was evaluated based on the change of average of open water area (acres) over the period of record between the no pumping and MFLs condition. Daily lake surface areas were calculated by translating the daily lake level using a stage-area relationship equation developed based on the data populated by the hydroperiod tool (Figure D-2). Average lake areas over the period of record were calculated based on the daily values for the no-pumping and MFLs conditions. Lake Butler surface average area over period of record (1949 -2018) is 248.3 and 216.5 acres for the no-pumping and MFLs conditions, respectively. The reduction in average lake surface area is 31.8 acres (or 13%) under the MFLs condition, relative to the no-pumping condition (Table D-4). Therefore, since the reduction of open water area is less than 15%, this WRV is considered protected by the recommended MFLs hydrologic regime.

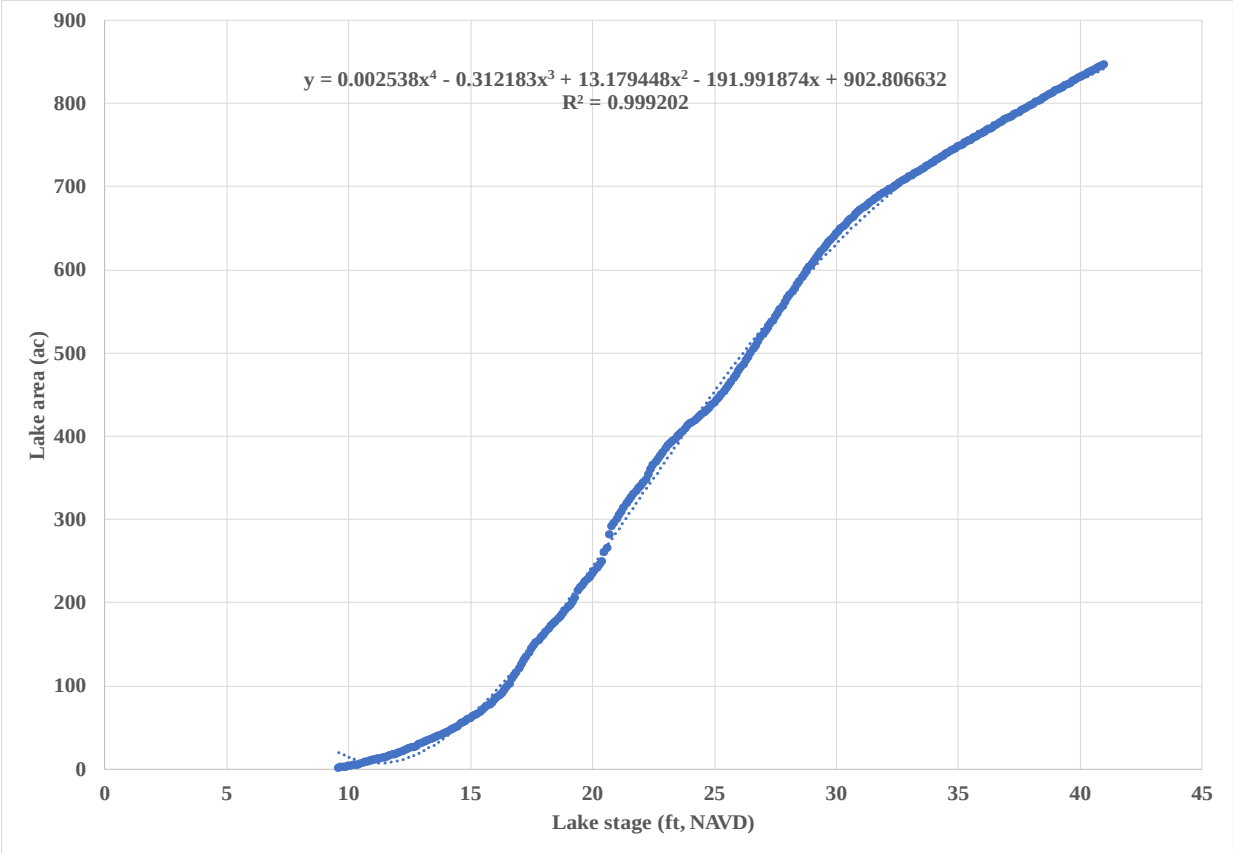

Figure D-2. Relationship between lake level and surface area at Lake Butler west

Table D-4. Average lake area over period of record (1949 -2018) and percent change between the no-pumping and MFLs conditions.

Hydrologic condition	Average lake area (acres)	Average lake area difference between no-pumping and MFLs conditions (acres)	Percent change in lake area between no-pumping and MFLs conditions (%)
No-pumping	248.3	31.8	13
MFL	216.5		

7. Filtration and absorption of nutrients and other pollutants – WRV7

The purpose of this environmental value is to protect, from significant change due to water withdrawal, the ability of a waterbody to mitigate the negative effects of elevated nutrients and other pollutants through the process of filtration and absorption (i.e., removal of suspended and dissolved materials) as these substances move through the water column, soil or substrate, and are processed by associated organisms.

Wetlands serve important ecosystem functions by filtering and absorbing nutrients and other pollutants from surface water runoff, serving as sinks for nutrients deposited from the drainage basin during periods of inundation, and allowing long-term removal through sedimentation, plant uptake, and microbial action (Adams 1997, Labaree 1992, Boudreau et al. 2004).

The main physical processes of nutrient removal are particle settling (sedimentation), volatilization (releasing as a gas into the atmosphere), and sorption. Sorption includes a nutrient adhering to a solid (adsorption) or diffusing into another liquid or solid (absorption). Chemical processes include transformations of nutrient forms and chemical precipitation, in which a solid compound is formed out of a liquid through a chemical reaction. The main biological processes are uptake (or assimilation) by plants, algae, and bacteria and transformation processes conducted by microbes. All of these processes occur throughout the different wetland compartments, which include water; biota (plants, algae, and bacteria); litter; and soil (Boudreau et al. 2004, White *et al*., 2004).

Lake Butler is surrounded by many acres of shallow and deep marsh. These wetland communities promote the key processes (discussed above) that mitigate nutrient pollution. It is assumed that if the average area of those communities is not reduced significantly (defined as a 15% reduction relative to the no-pumping condition), then the functions that maintain WRV7 will be protected from significant harm.

To determine whether this WRV is protected by the recommended MFLs, the average acreage of emergent marsh habitat, over the long term POR, was compared under the MFLs and no-pumping conditions (Table D-5). This comparison shows an 13.6% reduction in emergent marsh area under the MFLs condition, relative to the no pumping condition. Because the MFLs condition ensures less than a 15% reduction in emergent marsh area, relative to the no-pumping condition, pollutant filtration and absorption functions at Lake Butler are considered protected under the recommended MFLs hydrologic regime.

Table D-5. Average emergent marsh habitat area over the long-term POR and percent change between the no-pumping and MFLs conditions

Hydrologic condition	Average emergent marsh area over long-term POR (acres)	Area change between no-pumping and MFL conditions (acres)	Percent change in lake area between no-pumping and MFLs conditions (%)
No-pumping	150.7	20.5	13.6
MFL	130.2		

8. Sediment Loads -WRV8

Transport of inorganic materials as bed load is considered relevant only in flowing systems, where riverine fluvial dynamics are critical to maintenance of geomorphic features (i.e. bed forms and the floodplain) and their associated ecological communities. Lakes serve as sinks instead of sources of sediment load, and therefore WRV8 was not considered in this evaluation.

9. Water Quality -WRV9

Sufficient data were not available for evaluating the relationship between lake stage and water quality. Water quality samples were collected by the district on July 22, 2003. Due to the lack of water quality data, WRV9 was not considered in this evaluation.

10. Navigation – WRV10

Navigation is defined as the safe passage of watercraft (e.g., boats and ships), which is dependent upon adequate water depth and width. There is no commercial boat traffic on the Lake Butler. The primary navigation of Lake Butler is by recreational boaters, which is addressed under WRV1, “Recreation in and on the water.”

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