

Lake Jesup BMAP Surface Water Load Model Modification History

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INTRODUCTION

This document was requested by the Lake Jesup, Crane Strand, Crane Strand Drain, and Long Branch BMAP Technical Working Group (TWG) to explain how the loadings in the TMDL have been modified during the BMAP process.

In response to questions and comments from the TWG over a period of two years, a series of modifications were made to the surface water loading model and the results presented to the TWG. The sequence of changes, and the magnitude and direction of changes became confused over this period. To clarify the changes that have occurred, all of the modifications have been grouped in this document into major revisions to simplify presentation and understanding. This document also compares the loading in the TMDL, allocated to responsible entities, with the loading resulting from the changes described below.

The TMDL assumed that the required 34% total phosphorus load reduction of the total loading to Lake Jesup would be achieved through reductions in surface runoff sources, septic tank loads, and loads from the St. Johns River. Reductions in loads from baseflow, springs, or atmospheric deposition were not required as part of the reduction to meet the TMDL. This document deals only with the surface load component of runoff from land areas within the Lake Jesup watershed.

Note that the TMDL document expressed surface water runoff in terms of net load, that is, the load resulting from surface runoff *after* allowing for load reductions resulting from in-place BMPs. The information in this document is expressed as a gross load, *without* allowing for load reductions from in-place BMPs. Reduction allocations will be based on gross loads, not net loads, to allow appropriate credit for BMPs that were in place at the time of TMDL completion. The load reductions from in-place BMPs will be subtracted from the gross load reduction required, equitably distributing previous activities to control loads to those entities that have implemented achieved them.

The Surface Water Load Model

The Lake Jesup TMDL was developed with a surface water load model that calculated nutrient loads based on event mean concentration (EMC) values, land use, soil types, and rainfall through the Soil Conservation Service Curve Number approach. Load reductions associated with best management practices (BMPs) were also integrated into the TMDL calculations. The loading model was developed originally by PBS&J for Seminole County, but was modified by PBS&J under contract to DEP.

The model was used during TMDL development to estimate the *net* surface water phosphorus loads entering Lake Jesup from the watershed (i.e., it included the load reductions caused by BMPs in place at the time of TMDL finalization). Subsequently, as mentioned above, the model was used to estimate the gross phosphorus loads

(ignoring BMPs in place) and the load reductions that occur as a result of in-place BMPs.

Load Model Modifications

The following sections describe the source of the model used and modifications that were made during TMDL development, TMDL finalization, and the BMAP process.

During the BMAP process, revisions were made to how land use was incorporated in the model and how BMPs were associated with individual land uses. These revisions resulted in changes in the magnitude and source of loads. The revisions are discussed according to three main categories:

1. Land Use Modifications
2. BMP Modifications
3. Base Load Allocation Modifications

LAND USES

TMDL Development

The TMDL model began with the Seminole County NPDES pollution load model generated in 2000, expanded to include the Orange County portion of the Lake Jesup watershed. During TMDL development, PBS&J met with contributing municipalities and made the following modifications:

- Used aerial imagery and local knowledge to update land uses and identify BMPs, including Orlando drainwells.
- Reconciled the difference in residential land uses between Orange and Seminole Counties.
- Modified soil type along the 17/92 corridor in Seminole County.
- Identified “impacted” and “unimpacted” wetlands, based on inspections by Seminole County biologists. Different EMCs were assigned to these two types of wetlands.

These modifications were used in the model to generate the original TMDL in 2005.

BMAP Revision 1

The following changes were made during the BMAP process, based on discussions of the TWG.

- Loads were calculated using typical average annual conditions rather than individual years. This was done to simplify model execution (one run, not one run for each year of the verified period). Runoff coefficients for specific land uses were averaged by soil type for four of the more typical average annual rainfall

over the 8 years of the verified period. This change resulted in somewhat lower loadings, but did not change the relativity of loads generated by land use.

- Transportation facilities were modified. In the land use coverage for Orange County, internal subdivision roadways were not divided out as they were in Seminole County. Since EMCs associated with subdivisions include interior roadways, Seminole County internal roads were converted primarily to residential land use types so that consideration of roadway runoff was consistent throughout the basin.
- “Agriculture” and “Golf Course” land uses were split to provide the flexibility to assign different pollutant loading characteristics. Since golf courses represent only a small portion of the “Agriculture/Golf Course” land use and no EMCs specific to golf courses were identified, the EMC associated with “Golf Course” has remained the same as “Agriculture,” but they are now listed separately.

The results of these changes are presented in the Land Use Summary Table at the end of this document. Notice that there was a substantial reduction in the acreage of “Transportation” and that mostly “Medium Density Residential” acreage increased. Similarly, there was a reduction in “Agriculture” acreage and an increase in “Golf Course” acreage. The latter two acreages do not match because of other changes affecting “Agriculture” acreage associated with the change in “Transportation”.

The effect of these changes on gross loads is presented in the Loading Summary Table at the end of this document. Although, Medium Density Residential has a larger EMC value than Transportation, the decrease in runoff rates of the two land uses resulted in a reduction in the estimated total gross loading of approximately 0.8 metric tons.

BMAP Revision 2

The following changes were made to the Revision 1 loading calculations during the BMAP process, based on further group discussions:

- Site 10 was separated out as a distinct land use category based on its multiple land uses of both agriculture and spreading of residuals from wastewater treatment processes.
- An EMC of 0.484 (Managed Pasture) was assigned to Site 10. There are three pasture studies listed in Harper and Baker’s 2007 report (Section 4.1.9.1). Based on the sampling locations described in Table B.7, all three seem applicable to Site 10 regarding soil conditions. However, the two 1987 studies measured the pasture TP concentrations after transport of effluent through an agricultural ditch. The 1977 study measured TP in runoff directly at the farm field. Predictably, the 1977 study resulted in significantly higher TP values than the 1987 studies (0.88 vs. 0.27/0.697). The 1987 studies are more representative of conditions on Site 10, since any surface runoff that makes it from the site is transported through the ponds/ditches/fringe marsh before

reaching the lake. Thus, an average of the two 1987 study EMCs appear most appropriate for the Site 10 EMC.

The results of these changes are presented in the Land Use Summary Table at the end of this document. This table indicates that the 2005 acres comprising Site 10 were originally composed of a variety of other land uses.

The effects of these changes on gross loads are presented in the Loading Summary Table at the end of this document. The recalculation of loads for Site 10 comprised the only change, resulting in an increased load of approximately 0.2 metric tons.

BMAP Revision 3

In the TMDL, loading from Site 10 was based on EMCs and land use, similar to the rest of the basin (see updates under BMAP Revision 2). This calculation accounted for basic stormwater loads from Site 10. However, the additional loading that is occurring on Site 10 due to the application of reuse water and residuals was not calculated in the TMDL. The Working Group felt it was necessary to address this "missing" load in the BMAP process. Updating of this loading value required: 1) updated land use map; 2) updated site boundary; 3) updated runoff coefficient; and 4) updated EMC. The new land use information for the site was taken from the SJRWMD 2004 land use and land cover GIS layer (<http://sjr.state.fl.us/gisdevelopment/docs/themes.html>) and included for the site a mixture of wetlands, agriculture and managed pasture. The updated site boundary was provided by CDM as part of a Site 10 analysis conducted for the City of Sanford (CDM, 2007). The new boundary resulted in a 62% decrease in the site area (1252 acres vs. 2005 acres). This change was due to elimination of the eastern portions of the site that drain to Mullet Lake, not Lake Jesup and areas adjacent to Lake Jesup back to the wetlands allocation. Based upon intermittent wet conditions present on the site as a result of the spray activities a revised runoff coefficient for the site was utilized based upon a site curve number of 90. Finally, an EMC specific to conditions on Site 10 was unavailable from the literature. An applicable EMC was calculated as follows and applied to the entire site 10 updated boundary:

- Two pasture runoff studies were evaluated: Fall, C., 1987, "Characterization of Agricultural Pump Discharge Quality in the Upper St. Johns River Basin." St. Johns River Water Management District, Contract #WM108, Palatka, FL; and Hendrickson, J., 1987, "Effect of the Willowbrook Farms Detention Basin on the Quality of Agricultural Runoff." St. Johns River Water Management District, Contract #WM108, Palatka, FL.
- Based on the EMCs (Fall = 0.27 mg/L; Hendrickson = 0.697 mg/L) and loading rates (Fall = 32-40 lbs TP/acre/year; Hendrickson = 39 lbs TP/acre/year) cited in these two studies, two potential EMCs were calculated through linear extrapolation of the EMC up to the Site 10 loading rate (175 lbs/acre/year; CDM, 2007). This resulted in potential EMCs of 1.18 mg/L based on the Fall study and

2.78 mg/L based on the Hendrickson study. Of these two, the 1.18 mg/L value was more consistent with recent data collected by Seminole County at Site 10 (2006 & 2007 sampling; ranged from 0.32 to 2.6 mg/L; average 1.405 mg/L). Thus, an EMC of 1.18 was selected for use in the updated loading calculations.

- The Fall study and Seminole County values represent an aggregate of all land cover types on the Site (hayfields and intervening wetland and forest areas). Thus, the updated EMC was applied to the full area that drains to Site 10, not just the irrigated hayfield areas.

The new site area, runoff coefficient and EMC were then used to recalculate surface runoff loads from Site 10. These changes resulted in an updated loading value of 4121 lbs TP/year from Site 10. Although, the City of Sanford will receive the full allocation for this loading as addressed in the BMAP, for the purposes of surface load allocations it was necessary to divide the load into a surface loading component and a residual application component. To remain consistent with the original TMDL surface loading into the lake the surface loading component was recalculated using the updated boundary of Site 10 and applied to the original TMDL land uses for the site, which calculated a surface loading component from Site 10 as 632 lb TP / yr, resulting in an approximation of the residual component of 3,490 lb TP / yr.

In addition to the loading changes to Site 10, Orange County requested a review of the high density residential land use designation in Orange County portion of the Bear Gulley tributary to Howell Creek. Using aerial photography and the SJRWMD 2004 land use coverage, comparisons were made between land designated as High Density Residential in Orange County and the remainder of the watershed. It was determined that for consistency with the rest of the Lake Jesup watershed, single family housing units identified as High Density Residential in Orange County would be reclassified as Medium Density Residential in the watershed.

The results of these changes are presented in the Tables at the end of this document and reflect a reduction in total watershed area of almost 700 acres and a redistribution of Land Uses towards Medium Density Residential and Wetlands and away from High Density Residential and Site 10.

The effects of these changes on gross loads are presented in the Loading Summary Table at the end of this document and show a decrease. The recalculation of loads for Site 10 comprised the only change, resulting in an increased load of 1.2 metric tons due mainly to Site 10, however when the residual is separated out there is a net reduction in gross loading of 0.4 metric tons from Revision 2.

BEST MANAGEMENT PRACTICES

BMAP Revision

The following changes were made to the BMP calculations based on group discussions:

- BMPs assumed in earlier versions of the model for Site 10 were removed. The BMPs incorporated in earlier versions were not related to runoff but to the application of sewage residuals. As such, they were not true BMPs.
- Most of the BMPs that were assigned to Wetlands were removed. In almost all cases, the treatment associated with residential BMPs is treated by a wet / dry pond prior to discharging into a wetland, whereby the wetland is not part of the wet / dry pond treatment process.

The results of these changes are presented in the BMP Summary Table at the end of this document. This table indicates that the acreage covered by BMPs declined significantly. The majority of this change was associated with removing BMPs from Wetlands and Water land use categories.

BASE LOAD ALLOCATIONS

The loads in the model are based on land use. At first, it was assumed that all of the loads generated were the responsibility of the jurisdiction from which they came. There was considerable discussion about this simplified allocation, and other responsible parties were identified: Florida Department of Transportation (FDOT), the Turnpike Authority, Orlando-Orange County Expressway Authority (OOCEA), Florida Department of Agriculture and Consumer Services (FDACS), and the City of Sanford (for Site 10). The land areas and estimated loads for which these separate entities were responsible were identified and listed; the loads from the local jurisdiction were responsibility was previously assigned were concurrently removed.

In addition, conservation areas and wetlands were determined to be naturally occurring (i.e., their loads were as low as could be achieved), and therefore these areas were not assigned load reductions.

The following changes were made during the BMAP process based on group discussions:

- The spatial extent of “Conservation Areas” was identified by working group members. This allowed staff to separate loading from conservation areas and related land uses (water and wetland) during allocation calculations.
- FDOT, OOCEA, and the Turnpike were added as stakeholders. Based on input from FDOT, a FDOT coverage was created using the Orange County and Seminole County parcel layers and roadways as identified by E-Sciences for FDOT. FDOT was further divided into OOCEA and the Turnpike. This separation changed allocations to other stakeholders, as the land uses classified

as transportation *not* associated with DOT were reallocated to the jurisdiction in which they occurred. Similarly, non Transportation land uses that fall under the FDOT coverage were allocated to FDOT; these areas comprise mostly Open land use.

- FDACS was added as a stakeholder. Using the Parcel Layer and Department of Revenue (DOR) codes, parcels receiving Agriculture tax exemptions were identified and dissolved into an allocation category called FDACS. As with the FDOT allocation, this separation changed the allocations to other stakeholders, as the land uses classified as agriculture and *not* associated with FDACS parcels were reallocated to whichever municipality they fall under. Similarly, non agriculture land uses that fall under the FDACS coverage were subsequently allocated to FDACS; these were mainly “Open” land use, with some “Commercial” land use.
- The recalculated and division of the Site 10 load into surface loading and residual components and allocated to the City of Sanford.

The results of these changes are presented in the BMP Summary Table at the end of this document. These change resulted in the reduction of the amount of land that receive BMP credits. Thus, loads associated with BMPs for wetlands and Site 10 will not be included as load reductions in the allocation tables.

SUMMARY

The changes in total loadings arose from a change in how the model was run and changes in how land uses were classified. The model was run with representative conditions, rather than as an average of individual years during the verified period. This reduced the estimated load by a modest 1.0 MT. Two modifications to the representation of land use within the model reduced the total estimated load, while the third increased the load:

1. The change of roads internal to subdivisions from “Transportation” to primarily residential land uses in Seminole County.
2. Reallocation of “High Density Residential” in Orange County to “Medium Density Residential” for consistency.
3. The change in land use and watershed boundary related to Site 10 to its surface loading and residual loading components, applied using an EMC associated with managed pasture.

The changes in BMPs increased the loadings for selected land uses and locations by about 0.2 metric tons:

1. The removal of water and wetland BMPs
2. The removal of BMPs for Site 10

The changes in allocation reduced the base load from all jurisdictions (except the City of Sanford), but increased the base load for non-political jurisdictions. In addition, the

loads associated for conservation areas and associated land uses (wetlands and water) were included as a separate category in the base load. The changes arose from four modifications:

1. The addition of an allocation for FDOT (and OOCEA and the Turnpike) for appropriate Transportation land use.
2. The addition of an allocation for FDACs for appropriate Agriculture land use.
3. The allocation of Site 10 to the City of Sanford.
4. The separation of conservation areas in the base load.

In general, the gross loads estimated by the procedures in the TMDL (but not reported in that document) have been reduced overall through the changes described in this document. The overall changes in the approach to determining how load reduction allocations are calculated are presented in a separate document.

Model Modification History

Land Use Summary						
Land Use	TMDL Report		Revision 1		Revision 2	
	Acreage	Percent	Acreage	Change	Acreage	Change
Medium-Density Residential	22,697	26.0%	25,737	3,040	25,737	(0)
Forest and Rural Open	11,505	13.2%	11,985	480	11,970	(16)
Wetlands 1 (impacted)	11,745	13.4%	11,907	162	11,122	(785)
Wetlands 2 (unimpacted)	8,355	9.6%	8,369	14	8,056	(313)
Agriculture/Golf Course	6,264	7.2%	5,963	(301)	5,597	(367)
Commercial	4,807	5.5%	4,860	53	4,860	(0)
Transportation Facilities	8,490	9.7%	4,044	(4,446)	4,044	0
Water	3,863	4.4%	3,868	5	3,868	0
High-Density Residential	2,682	3.1%	2,635	(47)	2,635	0
Low-Density Residential	2,504	2.9%	2,614	110	2,603	(11)
Institutional	2,045	2.3%	2,112	67	2,112	(0)
Site 10	0	0.0%	0	0	2,005	2,005
Industrial/Utility	2,375	2.7%	2,434	59	1,920	(515)
Golf Course	0	0.0%	546	546	546	(0)
Total	87,331	100.0%	87,076	(255)	87,076	(0)

Revision 1

Roads internal to subdivisions were converted to residential land uses because residential land use EMCs include internal roads
Separated Agriculture and Golf Course land uses

Revision 2

Based Agriculture and Transportation land use acreages on parcels, not land use coverage
Split out Site 10 as its own land use with managed pasture EMC

BMP Summary				
Land Use	TMDL Report 2006		Revision	
	Acreage	Percent	Acreage	Change
No Stormwater Facility	59,418	68.0%	62,831	3,413
Wet Detention Pond	12,187	14.0%	10,999	(1,188)
Dry Detention	11,068	12.7%	8,832	(2,236)
Lake Drainage Wells	3,081	3.5%	3,076	(5)
Swales	1,217	1.4%	1,104	(113)
Combination (Swale/Dry Pond)	311	0.4%	196	(115)
Orlando 100% On-Site Retention	33	0.0%	31	(2)
Orlando Private BMPs	6	0.0%	6	(0)
Site 10	0	0.0%	0	0
Total	87,321	100.0%	87,076	(245)

Revision

Removed Site 10 BMPs
Removed BMPs from Wetlands and Water land uses

Model Modification History

Loading Summary							
Land Use	TMDL Report 2006	TMDL Report 2006*		Revision 1		Revision 2	
		Gross Load	Percent	Gross Load	Change	Gross Load	Change
Medium-Density Residential	varies by year	7,875	23%	8,788	913	8,788	(0)
Commercial		4,072	12%	4,136	64	4,138	2
Wetlands 1 (impacted)		4,221	12%	4,285	64	4,003	(282)
					(2,959)		
Transportation Facilities		5,765	17%	2,806	)	2,806	0
High-Density Residential		2,419	7%	2,479	59	2,479	(0)
Wetlands 2 (unimpacted)		2,001	6%	2,008	7	1,933	(75)
Agriculture/Golf Course		2,031	6%	1,950	(82)	1,849	(101)
Water		1,699	5%	1,701	2	1,701	0
Industrial/Utility		1,752	5%	1,818	65	1,380	(438)
Low-Density Residential		1,209	4%	1,256	47	1,253	(3)
Managed Pasture - Site 10		0	0%	0	0	1,221	1,221
Institutional		543	2%	563	20	563	0
Forest and Rural Open		535	2%	555	20	554	(1)
Golf Course		0	0%	166	166	166	(0)
Total		34,123	100%	32,510	(1,613)	32,834	324
Metric Tons		15.5		14.7		14.9	

*Loads presented as a single number representing typical average annual conditions rather than multiple years.

Revision 1

Roads internal to subdivisions were converted to residential land uses because residential land use EMCs include internal roads
Separated Agriculture and Golf Course land uses

Revision 2

Based Agriculture and Transportation land use acreages on parcels, not land use coverage
Split out Site 10 as its own land use
Changed EMC for Site 10 to managed pasture (0.484 mg TP/L)

Base Load Allocation Summary				
Responsible Entity	TMDL Report 2006		Revision	
	Gross Load	Percent	Gross Load	Change
Altamonte Springs	131	0.4%	116	(15)
Casselberry	1,466	4.3%	1,322	(144)
Eatonville	191	0.6%	191	0
Lake Mary	922	2.7%	853	(70)
Longwood	927	2.7%	813	(114)
Maitland	606	1.8%	606	0
Orange County	1,203	3.5%	1,203	0
Orlando	1,518	4.4%	1,518	(0)
Oviedo	1,262	3.7%	1,138	(124)
Sanford	3,079	9.0%	3,305	226
Seminole County	8,533	25.0%	7,861	(672)
Winter Park	1,662	4.9%	1,662	(0)
Winter Springs	2,520	7.4%	2,274	(247)
Agriculture	1,185	3.5%	1,160	(25)
DOT District 5	690	2.0%	690	(0)
OOCEA	24	0.1%	24	(0)
Turnpike	440	1.3%	430	(10)
Water / Wetlands / Nat Lands	7,764	22.8%	7,667	(96)
Total	34,123	100.0%	32,834	(1,290)
Metric Tons per year	15.5		14.9	(0.6)

NOTE 1: The TMDL did not specifically allocate loads to jurisdiction.

NOTE 2: Base load allocation for Site 10 added to Sanford

NOTE 3: All other "new" allocations were removed from individual jurisdictions