Jordan Marsh Water Quality Treatment Park Design and Permitting
Task 5

This report presents the results of Task 5 of the scope of services in the agreement with the City of Sanibel dated February 9, 2017. The scope states that "after initial coordination with the City of Sanibel, it has been determined that the project would have a greater year-round effect on water quality if water from the stagnant Sanibel Slough was treated on a constant basis, instead of designing the project to only treat excess stormwater originating from the Periwinkle commercial corridor". Consequently, this water quality assessment examines the potential treatment of Total Nitrogen and Total Phosphorus for various flow rates.

Data Availability

The city provided water quality data for the East Slough in an Excel spreadsheet file entitled "EastBasinSlough_NPDES_MarshEng" for the period 1/22/2002 to 6/23/2016. The average of the TN and TP concentration was calculated to be 1.884 and 0.131 mg/l, respectively. These values were assumed to represent the water quality concentrations that would flow into Jordan Marsh.

Analysis

The analysis took a two-fold approach:

1. Spreadsheet Analysis including residence time analysis and typical nutrient removal efficiencies as reported in the Harper (2007) and Beaver et al., (2015)
2. A much more comprehensive analysis by using the SWMM hydraulic and water quality model.

Spreadsheet

Residence time was calculated for various assumed flow rates and geometry of the proposed filter marsh as shown below in Table 1.

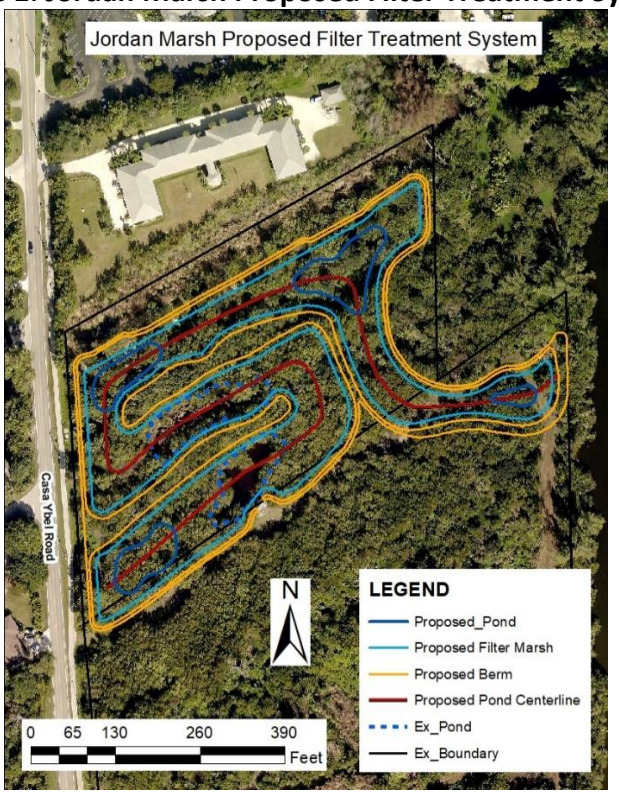
Table 1: Residence Time for Various Flow Rates

Area (ft2)	Depth (ft)	Volume (ft^3)	Q (cfs)	Q(ft/day)	Residence time (days)
160,000	3	480,000	0.5	43,200	11
			1	86,400	6
			1.5	129,600	4
			2	172,800	3
			3	259,200	2

SWMM Model

The EPA Storm Water Management Model Version 5.1 (SWMM5.1) hydraulics and water quality model was used to simulate flow conditions in the proposed marsh. The geometry of the 60% design was used to determine flow paths and cross section elevation (NAVD) every 50 feet along the pond center line shown in red on Figure 1. Cross sections commenced at the Sanibel Slough. For each model a constant flow rate was assumed to enter Jordan Marsh at this point and allowed to flow through the system over a high resistance manning's coefficient of 0.20 to reflect the vegetation in the proposed Marsh. The outfall to the western side of the basin was set to freefall at an elevation of 4 feet NAVD.

Figure 1: Jordan Marsh Proposed Filter Treatment System



The hydraulic model was coupled with the water quality routine to simulate TN and TP as first order decay processes dependent on the time each constituent spent in the marsh. The constituent changes so that the concentration is at the following rate:

Constituent concentration = Cp*(exp (-k*d))

Where Cp is the concentration on the previous day (mg/l), exp is exponential, k is decay coefficient (per day), d is current day.

Decay coefficients were selected for TN and TP to be consistent with measured BMP treatment efficiencies in the region. Harper and Baker (2007) presents equations that calculates removal efficiencies based on residence time in wet detention systems. Equations are:

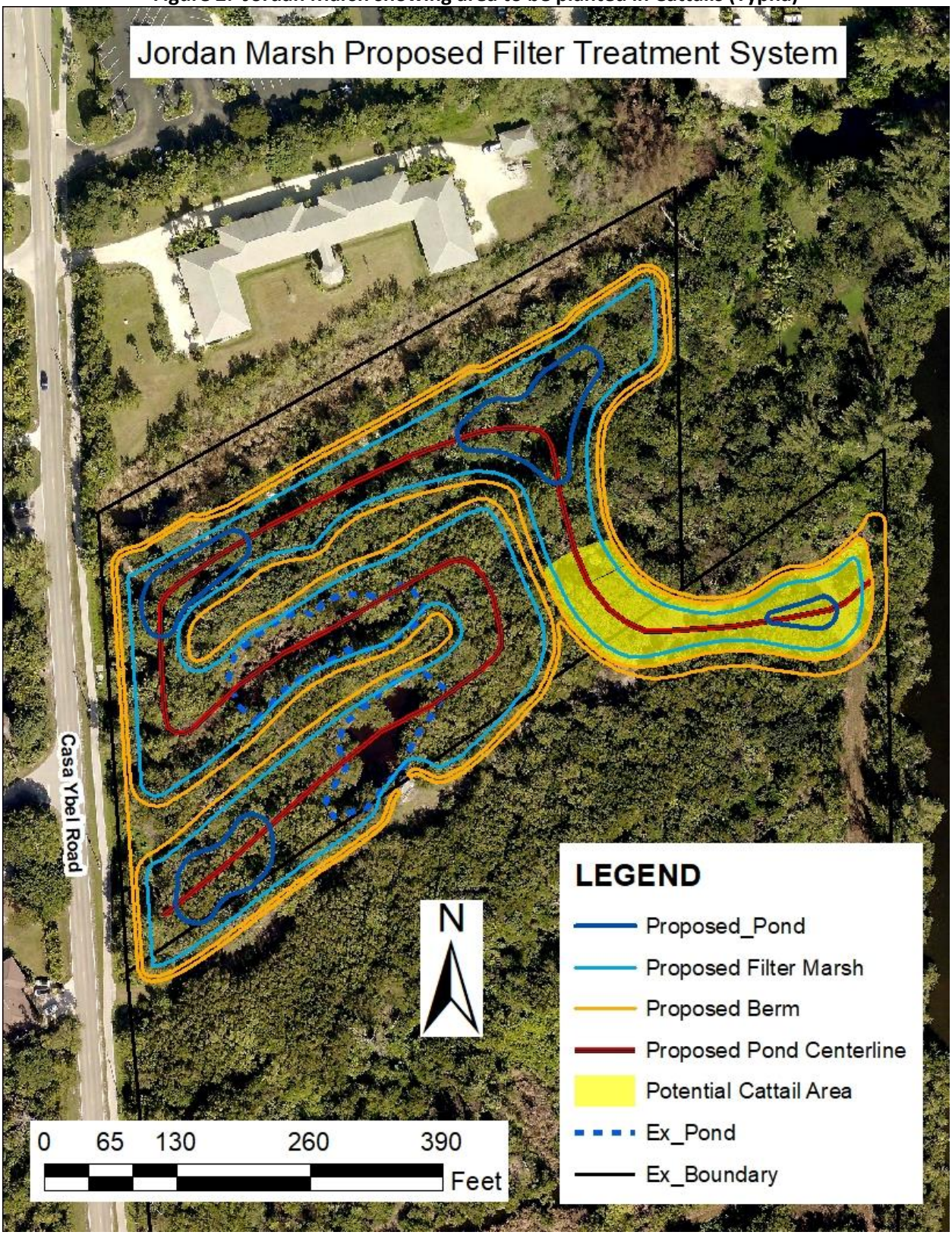
TN removed = $(43.75*t_d)/(4.38+ t_d)$
TP removed = $40.13+6.372*\ln(t_d)+0.213*(\ln(t_d))^2$

Where t_d is number of days and *ln* the natural logarithm

A flow rate of 0.5 cfs and residence time of 11 days shown in Table 1 were used to calculate TN removal of 31 percent and TP removal of 56 percent.

Fifty six (56) percent for TP was consistent with Beever et al., (2015) which showed and average TP removal of 56 percent for filter marshes in south west Florida. However, in order to maximize treatment efficiencies, the City suggested that cattails (Typha) should be included in the design. Cattails have yielded a treatment efficiency of 87 percent for phosphorus in STA-1W in South Florida (South Florida Water Management District, 2016). STA-1W is a part of the South Florida Water Management District Everglades Nutrient Removal Project (ENR) and is dominated by cattails. Fourteen (14%) percent of Jordon Marsh will be planted with cattails. This area is shown in yellow in the Figure 2 below.

Figure 2: Jordan Marsh showing area to be planted in Cattails (Typha)



As tested in the model, in order to achieve 56 % treatment efficiency for TP a decay coefficient of 0.075 per day is necessary, and to achieve 87% TP treatment efficiency a decay coefficient of 0.69 per day is necessary. Consequently, a new decay coefficient of 0.16 per day was calculated by area weighting 0.075 per day and 0.69 per day depending on the area of cattails and the remaining area of Jordan Marsh.

The 31 percent for TN appears to be low and inconsistent with measured data for filter marshes. Furthermore, the Jordan Marsh is a well-designed filter marsh which will use the appropriate technology to maximize treatment efficiencies. Consequently, the 52 percent efficiency shown in Beever et al., (2015) was considered more appropriate, so a decay coefficients 0.06 per day was selected for the model to simulate a treatment efficiency of 52 percent for TN.

The SWMM simulation was conducted for a period representing 20 days, but the results were analyzed for the last 4 days when the model had had time to stabilize from initial conditions, and water and nutrients were completely flowing and being treated in the marsh. The model summary is shown in Appendix A for the 0.5 cfs simulation. Simulation controls and statistics for the 1.0, 1.5, and 2.0 cfs simulations were similar, and not presented herewith.

The model was set up to simulate TN and TP as percentages. The initial values were 100%, so that the results can be analyzed as percentage of initial values and percentage removed. Percentage removed can then be multiplied (with relevant conversion factors) by the concentration in Sanibel Slough to determine the mass removed. Results are shown in Table 2 for the various flow rates.

Table 2: Results of Simulation

Pumped into Jordan Marsh	% of Original Concentration		% of Removed		Concentration in Sanibel Slough		Mass Removed (lbs/year)	
Q (cfs)	TN	TP	TN	TP	TN (mg/l)	TP (mg/l)	TN	TP
2	85	66	15	34	1.90	0.13	1,119	174
1.5	81	57	19	43	1.90	0.13	1,063	165
1	73	43	27	57	1.90	0.13	1,007	145
0.5	54	19	46	81	1.90	0.13	858	103

Conclusions

As expected the percentage removed for both TN and TP decreases with increasing flow rates. The highest percentage removal is for the 0.5 cfs with an 11 day residence time. Higher flow rates will obviously reduce the residence time and consequently treatment will be more inefficient. However, higher flow, although not as efficient, will remove higher mass loads as shown in Table 2.

REFERENCES

Beever, J, Cobb, D., Gray, W., Houdt, L., Walker, T., 2015. A Rapid Functional Assessment Method for Design Freshwater and Brackish Water Filter Marsh Ecosystem used for Water Quality treatment (FMFAM), Charlotte Harbor National Estuary Program

Harper, H., Baker, D., 2007. Evaluation of Current Stormwater Design Criteria within the State of Florida, Environmental Research and Design, Inc., Orlando, Florida

South Florida Water Management District, 2016. Chapter 5B: Performance and Operation of the Everglades Stormwater Treatment Areas

APPENDIX A: MODEL SUMMARY
0.5 cfs Model

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  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

WARNING 04: minimum elevation drop used for Conduit 1
WARNING 04: minimum elevation drop used for Conduit 2
WARNING 04: minimum elevation drop used for Conduit 3
WARNING 04: minimum elevation drop used for Conduit 4
WARNING 04: minimum elevation drop used for Conduit 5
WARNING 04: minimum elevation drop used for Conduit 6
WARNING 04: minimum elevation drop used for Conduit 13
WARNING 04: minimum elevation drop used for Conduit 14
WARNING 04: minimum elevation drop used for Conduit 23
WARNING 10: crest elevation raised to downstream invert for regulator Link 41

*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... YES
Flow Routing Method ...... DYNWAVE
Starting Date ............ 01/01/2000 00:00:00
Ending Date .............. 01/25/2000 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 1.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft


**************************       Volume       Volume
Flow Routing Continuity       acre-feet     10^6 gal
**************************    ---------    ---------
Dry Weather Inflow .......        0.000        0.000
Wet Weather Inflow .......        0.000        0.000
Groundwater Inflow .......        0.000        0.000
RDII Inflow ..............        0.000        0.000
External Inflow ..........       23.801        7.756
External Outflow .........       12.440        4.054
Flooding Loss ............        0.000        0.000
Evaporation Loss .........        0.000        0.000
Exfiltration Loss ........        0.000        0.000
Initial Stored Volume ....        0.000        0.000
Final Stored Volume ......       10.547        3.437
Continuity Error (%) .....        3.418
```

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**************************          TN          TP
Quality Routing Continuity          lbs         lbs
**************************   ----------  ----------
Dry Weather Inflow .......        0.000       0.000
Wet Weather Inflow .......        0.000       0.000
Groundwater Inflow .......        0.000       0.000
RDII Inflow ..............        0.000       0.000
External Inflow ..........     6467.801    6467.801
External Outflow .........     1774.581     626.240
Flooding Loss ............        0.000       0.000
Exfiltration Loss ........        0.000       0.000
Mass Reacted .............     2388.609    4325.873
Initial Stored Mass ......        0.000       0.000
Final Stored Mass ........     2101.875    1362.578
Continuity Error (%) .....        3.135       2.367


*************************
Highest Continuity Errors
*************************
Node 35 (4.37%)
Node 36 (3.81%)
Node 40 (3.44%)
Node 38 (3.37%)
Node 34 (2.47%)


****************************
Time-Step Critical Elements
****************************
None


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Highest Flow Instability Indexes
*********************************
All links are stable.


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Routing Time Step Summary
*************************
Minimum Time Step          :     0.50 sec
Average Time Step          :     0.17 sec
Maximum Time Step          :     1.00 sec
Percent in Steady State    :    83.33
Average Iterations per Step :    0.33
Percent Not Converging     :     0.00


******************
Node Depth Summary
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--------------------------------------------------------------------------------
                       Average  Maximum  Maximum  Time of Max    Reported
                         Depth    Depth      HGL   Occurrence   Max Depth
Node            Type       Feet     Feet     Feet  days hr:min        Feet
--------------------------------------------------------------------------------
1             JUNCTION     0.33     2.00     4.00   20  19:08        2.00
2             JUNCTION     0.33     2.00     4.00   21  12:00        2.00
3             JUNCTION     0.33     2.00     4.00   21  12:20        2.00
4             JUNCTION     0.33     2.00     4.00   21  12:20        2.00
5             JUNCTION     0.33     2.00     4.00   21  12:20        2.00
6             JUNCTION     0.33     2.00     4.00   21  12:21        2.00
```

7	JUNCTION	0.33	2.00	4.00	21	12:21	2.00
8	JUNCTION	0.39	2.35	4.00	21	12:05	2.35
9	JUNCTION	0.33	2.00	4.00	21	12:27	2.00
10	JUNCTION	0.48	2.86	4.00	21	12:05	2.86
11	JUNCTION	0.81	4.85	4.00	21	12:05	4.85
12	JUNCTION	1.03	6.15	4.00	20	00:00	6.15
13	JUNCTION	0.33	2.00	4.00	21	12:03	2.00
14	JUNCTION	0.33	2.00	4.00	21	12:02	2.00
15	JUNCTION	0.33	2.00	4.00	21	12:19	2.00
16	JUNCTION	0.34	2.01	4.00	21	12:02	2.01
17	JUNCTION	0.35	2.10	4.00	21	12:26	2.10
18	JUNCTION	0.36	2.18	4.00	23	17:10	2.18
19	JUNCTION	0.38	2.27	4.00	20	17:19	2.27
20	JUNCTION	0.39	2.35	4.00	20	17:19	2.35
21	JUNCTION	0.41	2.43	4.00	20	17:20	2.43
22	JUNCTION	0.42	2.50	4.00	21	12:03	2.50
23	JUNCTION	0.44	2.63	4.00	21	12:03	2.63
24	JUNCTION	0.44	2.63	4.00	22	06:25	2.63
25	JUNCTION	0.51	3.05	4.00	21	11:54	3.05
26	JUNCTION	0.52	3.12	4.00	21	11:54	3.12
27	JUNCTION	0.53	3.19	4.00	21	12:03	3.19
28	JUNCTION	0.54	3.26	4.00	22	06:25	3.26
29	JUNCTION	0.81	4.83	4.00	21	12:03	4.83
30	JUNCTION	0.57	3.41	4.00	21	12:03	3.41
31	JUNCTION	0.58	3.50	4.00	20	17:30	3.50
32	JUNCTION	0.59	3.52	4.00	21	12:03	3.52
33	JUNCTION	0.59	3.56	4.00	23	11:31	3.56
34	JUNCTION	0.60	3.59	4.00	23	11:31	3.59
35	JUNCTION	1.19	7.11	4.00	23	17:59	7.11
36	JUNCTION	1.38	8.25	4.00	23	17:59	8.25
37	JUNCTION	0.63	3.79	4.00	20	06:04	3.79
38	JUNCTION	0.91	5.43	4.00	20	06:04	5.43
39	JUNCTION	0.65	3.91	4.00	20	06:04	3.91
40	JUNCTION	0.66	3.97	4.00	20	06:04	3.97
41	JUNCTION	0.67	4.00	4.00	20	17:39	4.00
42	OUTFALL	0.00	0.00	4.00	0	00:00	0.00

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Node Inflow Summary
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Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	0.50	0.50	20	00:00	1.29	7.76	0.221
2	JUNCTION	0.00	0.50	22	02:46	0	7.74	0.575
3	JUNCTION	0.00	0.50	22	02:45	0	7.69	0.704
4	JUNCTION	0.00	0.50	22	05:21	0	7.64	0.551
5	JUNCTION	0.00	0.50	23	13:40	0	7.6	0.438
6	JUNCTION	0.00	0.50	20	09:05	0	7.57	0.570
7	JUNCTION	0.00	0.50	20	09:05	0	7.52	0.702
8	JUNCTION	0.00	0.50	20	18:56	0	7.47	0.785
9	JUNCTION	0.00	0.50	20	18:56	0	7.41	0.687
10	JUNCTION	0.00	0.50	22	04:19	0	7.36	1.293
11	JUNCTION	0.00	0.50	20	09:01	0	7.27	2.095
12	JUNCTION	0.00	0.50	20	05:07	0	7.12	1.614
13	JUNCTION	0.00	0.50	23	17:14	0	7	0.767
14	JUNCTION	0.00	0.50	23	04:40	0	6.95	2.390
15	JUNCTION	0.00	0.50	23	04:40	0	6.79	2.383
16	JUNCTION	0.00	0.50	21	08:37	0	6.63	0.970
17	JUNCTION	0.00	0.50	21	08:37	0	6.57	0.823
18	JUNCTION	0.00	0.50	21	08:37	0	6.51	0.776

19	JUNCTION	0.00	0.50	22	06:02	0	6.46	0.858
20	JUNCTION	0.00	0.50	22	06:02	0	6.41	0.885
21	JUNCTION	0.00	0.50	22	06:02	0	6.35	0.943
22	JUNCTION	0.00	0.50	23	04:41	0	6.29	1.079
23	JUNCTION	0.00	0.50	23	17:57	0	6.23	1.035
24	JUNCTION	0.00	0.50	23	17:56	0	6.16	0.928
25	JUNCTION	0.00	0.50	23	17:56	0	6.11	1.866
26	JUNCTION	0.00	0.50	20	05:06	0	5.99	2.177
27	JUNCTION	0.00	0.50	20	05:06	0	5.87	1.145
28	JUNCTION	0.00	0.50	20	22:49	0	5.8	1.168
29	JUNCTION	0.00	0.50	20	22:49	0	5.73	1.871
30	JUNCTION	0.00	0.50	22	06:03	0	5.63	1.219
31	JUNCTION	0.00	0.50	22	19:17	0	5.56	1.861
32	JUNCTION	0.00	0.50	22	06:03	0	5.46	2.121
33	JUNCTION	0.00	0.50	22	14:48	0	5.34	2.309
34	JUNCTION	0.00	0.50	23	04:28	0	5.22	2.531
35	JUNCTION	0.00	0.50	23	02:13	0	5.1	4.572
36	JUNCTION	0.00	0.50	23	04:28	0	4.87	3.960
37	JUNCTION	0.00	0.50	20	06:48	0	4.69	2.336
38	JUNCTION	0.00	0.50	22	14:42	0	4.58	3.484
39	JUNCTION	0.00	0.50	21	07:02	0	4.43	3.562
40	JUNCTION	0.00	0.50	21	07:02	0	4.27	3.568
41	JUNCTION	0.00	0.50	21	12:04	0	4.13	1.793
42	OUTFALL	0.00	0.50	20	17:39	0	4.05	0.000

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Node Surcharge Summary
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Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
1	JUNCTION	96.00	0.003	6.997
2	JUNCTION	96.00	0.003	6.997
3	JUNCTION	96.00	0.003	6.997
8	JUNCTION	96.00	0.003	6.647
10	JUNCTION	96.00	0.003	6.137
11	JUNCTION	96.00	0.003	4.147
14	JUNCTION	96.00	0.003	6.997
15	JUNCTION	96.00	0.003	6.997
16	JUNCTION	96.00	0.003	6.987
17	JUNCTION	96.00	0.003	6.897
18	JUNCTION	96.00	0.003	6.817
19	JUNCTION	96.00	0.003	6.727
20	JUNCTION	96.00	0.003	6.647
21	JUNCTION	96.00	0.003	6.567
22	JUNCTION	96.00	0.003	6.497
23	JUNCTION	96.00	0.003	6.367
24	JUNCTION	96.00	0.003	6.367
25	JUNCTION	96.00	0.003	5.947
26	JUNCTION	96.00	0.003	5.877
31	JUNCTION	96.00	0.003	5.497
32	JUNCTION	96.00	0.003	5.477
33	JUNCTION	96.00	0.003	5.437
34	JUNCTION	96.00	0.003	5.407
35	JUNCTION	96.00	0.003	1.887
36	JUNCTION	96.00	0.003	0.747
38	JUNCTION	96.00	1.583	3.567
39	JUNCTION	96.00	0.003	5.087
40	JUNCTION	96.00	0.003	5.027
41	JUNCTION	96.00	0.002	4.997

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Node Flooding Summary
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No nodes were flooded.

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Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal	Total TN lbs	Total TP lbs
42	16.67	0.50	0.50	4.054	573.772	206.059
System	16.67	0.50	0.50	4.054	573.772	206.059

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Link Flow Summary
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Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
1	CHANNEL	0.50	22	02:46	0.01	0.18	1.00
2	CHANNEL	0.50	22	02:45	0.00	0.08	1.00
3	CHANNEL	0.50	22	05:21	0.00	0.08	1.00
4	CHANNEL	0.50	23	13:40	0.01	0.12	0.89
5	CHANNEL	0.50	20	09:05	0.01	0.12	0.91
6	CHANNEL	0.50	20	09:05	0.00	0.09	1.00
7	CHANNEL	0.50	20	18:56	0.00	0.00	1.00
8	CHANNEL	0.50	20	18:56	0.00	0.00	0.93
9	CHANNEL	0.50	22	04:19	0.00	0.00	1.00
10	CHANNEL	0.50	20	09:01	0.00	0.00	1.00
11	CHANNEL	0.50	20	05:07	0.00	0.00	1.00
12	CHANNEL	0.50	23	17:14	0.00	0.00	0.51
13	CHANNEL	0.50	23	04:40	0.00	0.05	1.00
14	CHANNEL	0.50	23	04:40	0.00	0.02	1.00
15	CHANNEL	0.50	21	08:37	0.00	0.02	1.00
16	CHANNEL	0.50	21	08:37	0.00	0.01	1.00
17	CHANNEL	0.50	21	08:37	0.00	0.01	1.00
18	CHANNEL	0.50	22	06:02	0.00	0.01	1.00
19	CHANNEL	0.50	22	06:02	0.00	0.01	1.00
20	CHANNEL	0.50	22	06:02	0.00	0.01	1.00
21	CHANNEL	0.50	23	04:41	0.00	0.01	1.00
22	CHANNEL	0.50	23	17:57	0.00	0.00	1.00
23	CHANNEL	0.50	23	17:56	0.00	0.06	1.00
24	CHANNEL	0.50	23	17:56	0.00	0.00	1.00
25	CHANNEL	0.50	20	05:06	0.00	0.00	1.00
26	CHANNEL	0.50	20	05:06	0.00	0.00	1.00
27	CHANNEL	0.50	20	22:49	0.00	0.00	0.39
28	CHANNEL	0.50	20	22:49	0.00	0.00	1.00
29	CHANNEL	0.50	22	06:03	0.00	0.00	0.59
30	CHANNEL	0.50	22	19:17	0.00	0.00	1.00
31	CHANNEL	0.50	22	06:03	0.00	0.01	1.00
32	CHANNEL	0.50	22	14:48	0.00	0.00	1.00
33	CHANNEL	0.50	23	04:28	0.00	0.00	1.00
34	CHANNEL	0.50	23	02:13	0.00	0.00	1.00
35	CHANNEL	0.50	23	04:28	0.00	0.00	1.00

36	CHANNEL	0.50	20	06:48	0.00	0.00	0.73
37	CHANNEL	0.50	22	14:42	0.00	0.00	1.00
38	CHANNEL	0.50	21	07:02	0.00	0.00	1.00
39	CHANNEL	0.50	21	07:02	0.00	0.00	1.00
40	CHANNEL	0.50	21	12:04	0.00	0.00	1.00
41	DUMMY	0.50	20	17:39			

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Flow Classification Summary
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Conduit	Adjusted /Actual Length	Up Dry	Down Dry	Sub Dry	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
		---------- Fraction of Time in Flow Class ----------							
1	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
2	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
3	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
4	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
5	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
6	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
7	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
8	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
9	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
10	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
11	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
12	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
13	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
14	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
15	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
16	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
17	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
18	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
19	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
20	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
21	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
22	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
23	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
24	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
25	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
26	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
27	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
28	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
29	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
30	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
31	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
32	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
33	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
34	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
35	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
36	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
37	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
38	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
39	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
40	1.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00

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Conduit Surcharge Summary
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	--------- Hours Full --------	Hours Above Full	Hours Capacity

Conduit	Both Ends	Upstream	Dnstream	Normal Flow	Limited
1	96.00	96.00	96.00	0.01	0.01
2	96.00	96.00	96.00	0.01	0.01
3	96.00	96.00	96.00	0.01	0.01
6	96.00	96.00	96.00	0.01	0.01
7	0.01	0.01	96.00	0.01	0.01
8	0.01	0.01	96.00	0.01	0.01
9	96.00	96.00	96.00	0.01	0.01
10	96.00	96.00	96.00	0.01	0.01
11	96.00	96.00	96.00	0.01	0.01
13	96.00	96.00	96.00	0.01	0.01
14	96.00	96.00	96.00	0.01	0.01
15	96.00	96.00	96.00	0.01	0.01
16	96.00	96.00	96.00	0.01	0.01
17	96.00	96.00	96.00	0.01	0.01
18	96.00	96.00	96.00	0.01	0.01
19	96.00	96.00	96.00	0.01	0.01
20	96.00	96.00	96.00	0.01	0.01
21	96.00	96.00	96.00	0.01	0.01
22	96.00	96.00	96.00	0.01	0.01
23	96.00	96.00	96.00	0.01	0.01
24	96.00	96.00	96.00	0.01	0.01
25	96.00	96.00	96.00	0.01	0.01
26	96.00	96.00	96.00	0.01	0.01
28	96.00	96.00	96.00	0.01	0.01
30	96.00	96.00	96.00	0.01	0.01
31	96.00	96.00	96.00	0.01	0.01
32	96.00	96.00	96.00	0.01	0.01
33	96.00	96.00	96.00	0.01	0.01
34	96.00	96.00	96.00	0.01	0.01
35	96.00	96.00	96.00	0.01	0.01
36	0.01	0.01	96.00	0.01	0.01
37	96.00	96.00	96.00	0.01	0.01
38	96.00	96.00	96.00	0.01	0.01
39	96.00	96.00	96.00	0.01	0.01
40	96.00	96.00	96.00	0.01	0.01

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Link Pollutant Load Summary
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Link	TN lbs	TP lbs
1	6427.896	6385.799
2	6345.639	6230.720
3	6257.028	6073.473
4	6199.216	5980.360
5	6144.065	5883.513
6	6072.912	5759.953
7	5985.813	5609.841
8	5900.687	5475.115
9	5813.812	5326.891
10	5662.879	5076.331
11	5458.740	4769.599
12	5297.254	4551.902
13	5200.402	4395.515
14	4916.960	3965.863
15	4756.093	3777.459
16	4674.076	3669.710
17	4603.841	3577.402
18	4536.671	3489.037
19	4460.432	3388.467

20	4388.026	3296.565
21	4306.313	3191.106
22	4216.686	3078.653
23	4138.498	2984.404
24	4063.350	2892.730
25	3893.679	2679.898
26	3748.567	2518.862
27	3684.962	2452.758
28	3577.181	2322.626
29	3475.089	2217.352
30	3381.897	2112.360
31	3254.814	1975.417
32	3120.413	1836.396
33	2979.592	1694.513
34	2820.199	1534.879
35	2586.907	1311.291
36	2396.076	1140.059
37	2257.379	1016.061
38	2090.104	865.292
39	1941.017	747.407
40	1804.279	645.317
41	1774.582	626.240

Analysis begun on: Thu Aug 24 14:33:39 2017
Analysis ended on: Thu Aug 24 14:34:53 2017
Total elapsed time: 00:01:14