NORTH CREEK BASIN MASTER PLAN

FINAL

Prepared for:

Sarasota County
Stormwater Environmental Utility

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5/18/99

Bob Cross
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May 18, 1999

To: Whom it may concern

RE: North Creek Drainage Basin Study

I hereby certify that the field information dated May 7, 1996 for the above reference project was true and correct as of that date to the best of my information, knowledge and belief.

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WATER QUALITY MODEL

5.1 Model Formation

An assessment of the water quality conditions in the North Creek basin was performed by utilizing Watershed Management Model (version 3.30) developed by Camp, Dresser & McKee. The Watershed Management Model (WMM) is a spreadsheet model designed to estimate annual pollutant loads based on Event Mean Concentrations (EMC's) and stormwater runoff volumes. The model incorporates 12 major land use categories with the required data consisting of EMCs for each pollutant type, land use constituents, average annual precipitation, impervious area percentages, Best Management Practices (BMP's), and runoff coefficients.

The WMM is designed to run on Lotus 1-2-3 software, specifically Release 2.4 for DOS. The WMM will estimate annual runoff pollutant loads for oxygen demand and sediment (BOD_5, COD, total suspended solid, total dissolved solids); nutrients (total phosphorus, dissolved phosphorus, total nitrogen, ammonia plus organic nitrogen); and heavy metals (lead, copper, zinc, cadmium). The pollutant load estimates for each basin are calculated based on acreages by land use category, rainfall/runoff ratios, EMC's, and the average annual rainfall.

The model utilizes the land use and percent imperviousness data to compute non-point pollution loading factors (expressed as lbs/yr). The pollution loading factor M_L is computed for each land use L by the following equation:

$$M_L = EMC_L * R_L * K_L * A_L$$

Where:	M_L =	loading factor for land use L (lbs/yr)
	EMC_L =	Event Mean Concentration of runoff from land use L (mg/L); EMC_L varies by land use and by pollutant
	R_L=	total average annual surface runoff land use L (in/yr)
	K_L =	0.2266, a unit conversion constant
	A_L=	area of land use L (acres)

One of the required data is the EMC file. EMC values must be entered into the provided spreadsheet for each of the above mentioned constituents based on land use. Default selections are available, if local EMC's data are not obtainable. These default values are based on the pooled U.S. EPA National Urban Runoff Program (NURP). The NURP, which was conducted between 1978 and 1983, used 28 storms at each of 81 representative outfalls in 28 U.S. metropolitan areas that were monitored to determine the characteristics of urban runoff.

A BMP can consist of wet detention/retention (e.g., lake, wetlands) or dry detention/retention (e.g., swales). The term detention implies that the stormwater runoff is detained long enough to allow stormwater treatment to occur through settlement, dissolution, etc. Retention implies that the stormwater runoff is completely retained and not allowed to discharge directly to outfall surface waters.

BMP data files, land use data files and impervious area data are also required as input files to the WMM. BMP data files consist of specific types of BMP's. Default values for the pollutant removal efficiencies of these BMP's are provided in the WMM. The land use data file showing the sub-basins in the analyzed watershed is defined, according to the 12 given land use categories. Impervious area data files contain the percentage of each land use that is impervious. Default values are provided, but they may be changed.

5.2 Model Input and Assumptions

5.2.1 Sub-basins and Land Uses

The model requires input for sub-basins and land use in the form of acreages, impervious percentiles and pollutant constituent EMC's.

A total of ten sub-basins, ranging from 20 acres to 500 acres, are delineated based on the hydrologic model and land uses in the basin study. Land use acreages of existing condition for sub-basins were basically calculated from Land Use Map (1994). To be consistent with the impervious values used in the hydrologic model, few adjustments were made when the values from the land use map were slightly different from those used in the hydrologic model.

Figure 5.2.1.1 shows ten sub-basins used in the water quality model, and each contains larger areas than those in the hydrologic study. This is because water quality modeling is more concerned on the assessments of water quality conditions in the North Creek, but not on the conditions for each sub-basin; therefore, less detailed level of the sub-basins is delineated and the time for model run is saved. Table 5.2.1.1.a presents the existing land uses of sub-basins used in the water quality model.

In the existing condition of North Creek watershed approximately 34% of the land is open space or agriculture, 45% is residential area, approximately 4% is commercial or industrial, and 15% is wetlands or lakes. Sub-basin A consists more than half of vacant land and sub-basin B contains approximately 80% low density residential areas. Sub-basins C and D are newly developed areas containing high percentages of residential areas in low density. Sub-basin E is also a newly developed area with a combination of land uses, with approximately 30% covered by either lakes or wetlands. Sub-basin F is a relatively old area with very few BMP facilities. Sub-basin G is located on the east side of the study area, with approximately half residential area. Sub-basins H and I are low or medium density residential areas. Sub-basin J is a junk yard and was modeled as heavy industrial area.

In the proposed condition for the future land uses, the North Creek watershed has approximately 76% of residential area and about 7% of commercial, industrial, and major road area. Table 5.2.1.1.b shows the future land uses of sub-basins used in the WMM model.

The impervious areas file was created by obtaining existing and future land use categories and percent impervious values from the land use maps (1994) and the values used in NPDES study for Sarasota County in 1993. Table 5.2.1.2 shows the impervious percentages used in the water quality model for existing and future conditions.

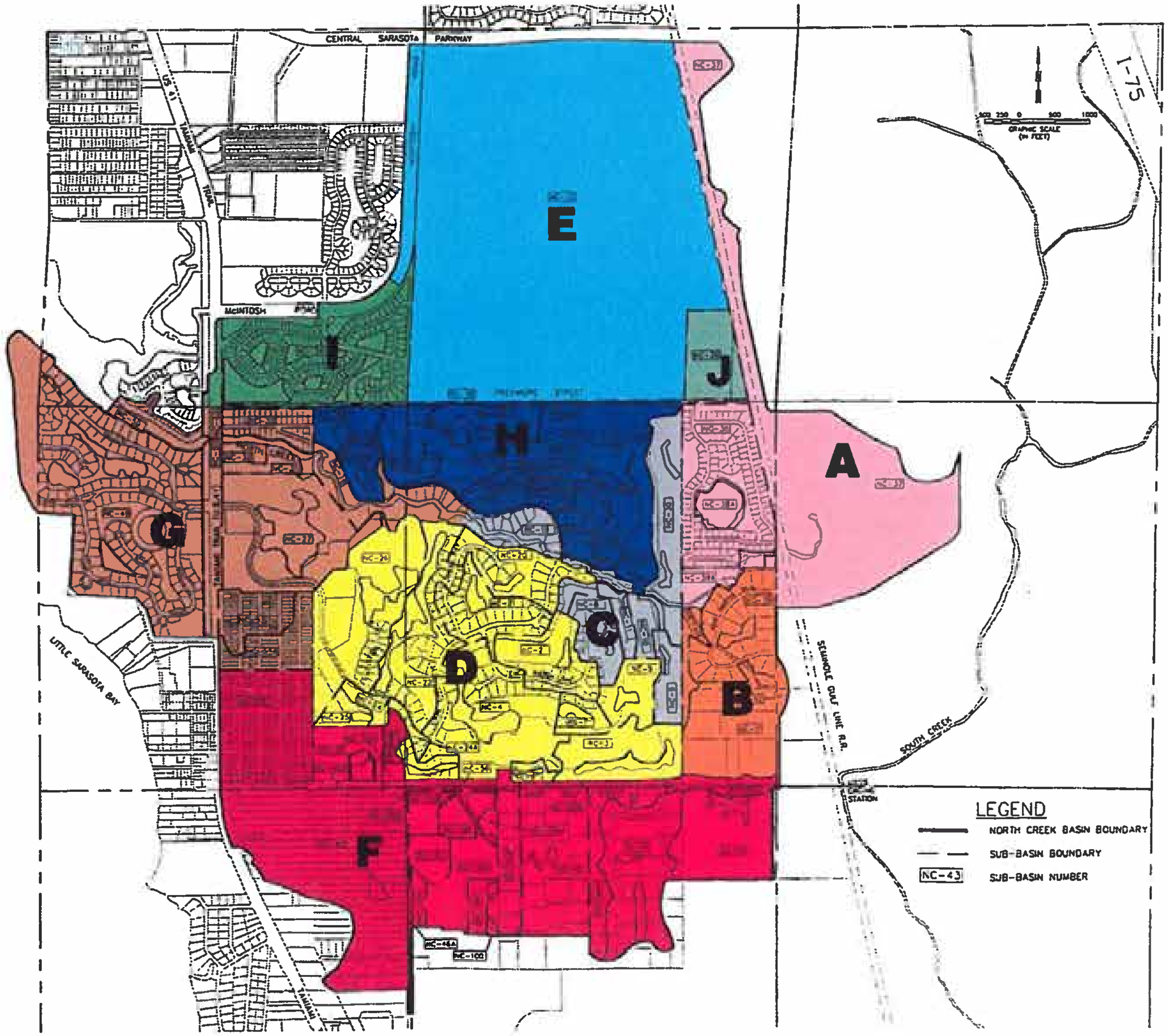

Figure 5.2.1.1

Water Quality Model Sub-Basins in the North Creek Watershed

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FIGURE 5.2.1.1

TABLE 5.2.1.1a and TABLE 5.2.1.1.b

Table 5.2.1.1a
Land Uses in North Creek Under Existing Conditions

Land Use Type (Acres)	Sub-basins										
	A	B	C	D	E	F	G	H	I	J	Total
Forest/Open	35	9	19	96	274	58	86	55	12	0	644
Agricultural/Pasture	115	0	0	0	0	36	0	0	0	0	151
Cropland	0	0	0	0	0	0	0	0	0	0	0
Low Den. Single Fam.	0	76	63	187	13	137	130	99	0	0	704
Med. Den. Single Fam.	88	4	0	0	20	70	89	0	47	0	318
High Den. Single Fam.	0	0	0	0	27	5	5	0	0	0	37
Commercial	0	0	0	0	0	19	1	0	0	0	20
Office/Light Industrial	0	0	0	0	6	65	2	0	0	0	73
Heavy Industrial	0	0	0	0	0	0	0	0	0	24	24
Water	11	3	9	35	84	16	48	12	13	0	230
Wetlands	0	0	0	0	67	26	14	0	0	0	107
Major Roads	0	0	0	0	9	4	9	0	2	0	24
Total	249	92	91	318	500	436	384	166	74	24	2333

Table 5.2.1.1b
Land Uses in North Creek Under Future Development

Land Use Type (Acres)	Sub-basins										
	A	B	C	D	E	F	G	H	I	J	Total
Forest/Open	0	0	0	0	0	0	0	0	0	0	0
Agricultural/Pasture	0	0	0	0	0	0	0	0	0	0	0
Cropland	0	0	0	0	0	0	0	0	0	0	0
Low Den. Single Fam.	0	86	80	274	13	194	167	148	12	0	974
Med. Den. Single Fam.	223	4	0	9	294	79	130	0	47	0	786
High Den. Single Fam.	0	0	0	0	27	5	5	0	0	0	37
Commercial	0	0	0	0	0	28	1	0	0	0	29
Office/Light Industrial	0	0	0	0	6	74	2	0	0	0	82
Heavy Industrial	0	0	0	0	0	0	0	0	0	24	24
Water	26	2	11	35	84	25	56	18	13	0	270
Wetlands	0	0	0	0	67	26	14	0	0	0	107
Major Roads	0	0	0	0	9	4	9	0	2	0	24
Total	249	92	91	318	500	435	384	166	74	24	2,333

Table 5.2.1.2
Impervious Percentages

Land Use	% Impervious
Forest/Open	1.0%
Agricultural/Pasture	1.0%
Cropland	1.0%
Low Density Single Family	20.0%
Med. Density Single Family	30.0%
High Density Single Family	40.0%
Commercial	85.0%
Office/Lt. Industrial	70.0%
Heavy Industrial	80.0%
Water	25.0%
Wetlands	25.0%
Major Roads	90.0%

5.2.2 Event Mean Concentrations (EMC's)

EMC's are defined as the average individual measurements of storm pollutant loads divided by the event storm runoff volumes. The default values in the WMM are based on data obtained by the EPA in association with NURP. During NURP, EMC's were measured for various land uses and pollutants during 2,000+ rainstorms across the country. Comparison of these results indicated that for a given land use, the EMC's for many pollutants did not vary appreciably from one part of the country to another. Therefore, extrapolation or even pooling of the data can be performed without introducing significant errors in the estimates. These nationally derived values were used for the key of EMC data in Table 5.2.2.1.

Several sites in Tampa, Florida were monitored during the NURP study. Additional urban runoff quality was collected at Tampa and St. Petersburg by the USGS (1984) and non-urban values were derived from the open watersheds of Tampa Bay by CDM (1984). These values were used to revise the national values obtained from the NURP study. The loading factors in Table 5.2.2.1 represent the estimates presently available and agreement with the values used recently in completion of the Sarasota Bay National Estuary Program loading assessment.

TABLE 5.2.2.1 (3 PAGES)

Table 5.2.2.1

Mean EMCs

mg/L

Land Use	Oxygen Demand & Sediment				Nutrients				Heavy Metals			
	BOD	COD	TSS	TDS	TP	DP	TKN	NO23	Pb	Cu	Zn	Cd
Forest/Open	8.0	51	216	100	0.16	0.06	0.82	0.20	0.00	0.00	0.00	0.00
Agriculture/Pasture	8.0	51	216	100	0.16	0.06	0.82	0.20	0.00	0.00	0.00	0.00
Cropland	8.0	51	216	100	1.13	0.42	2.99	0.75	0.00	0.00	0.00	0.00
Low Density Single Family	10.8	83	140	100	0.39	0.16	1.50	0.37	0.05	0.05	0.05	0.002
Medium Density Single Family	10.8	83	140	100	0.39	0.16	1.50	0.37	0.05	0.05	0.05	0.002
High Density Single Family	10.8	83	140	100	0.33	0.16	1.32	0.33	0.08	0.05	0.06	0.002
Commercial	9.7	61	91	100	0.15	0.10	1.06	0.12	0.24	0.04	0.12	0.002
Office/Light Industrial	9.7	61	91	100	0.15	0.10	1.06	0.12	0.24	0.04	0.12	0.002
Heavy Industrial	9.7	61	91	100	0.15	0.10	1.06	0.12	0.24	0.04	0.12	0.002
Water	3.1	19	91	100	0.17	0.12	0.50	0.48	0.01	0.04	0.15	0.001
Wetlands	3.1	19	91	100	0.17	0.12	0.50	0.48	0.01	0.04	0.15	0.001
Major Roads	9.7	103	142	100	0.15	0.10	1.06	0.12	0.24	0.05	0.12	0.002

Coefficient of Variation

Land Use	Oxygen Demand & Sediment				Nutrients				Heavy Metals			
	BOD CV	COD CV	TSS CV	TDS CV	TP CV	SP CV	TKN CV	NO23 CV	Pb CV	Cu CV	Zn CV	Cd CV
Forest/Open	0.5	0.5	0.5	0.5	0.7	0.7	0.5	0.5	0.0	0.0	0.0	0.0
Agriculture/Pasture	0.5	0.5	0.5	0.5	0.7	0.7	0.5	0.5	0.0	0.0	0.0	0.0
Cropland	0.5	0.5	0.5	0.5	0.7	0.7	0.5	0.5	0.0	0.0	0.0	0.0
Low Density Single Family	0.4	0.6	1.0	1.0	0.7	0.5	0.7	0.8	0.8	1.0	0.8	0.8
Medium Density Single Family	0.4	0.6	1.0	1.0	0.7	0.5	0.7	0.8	0.8	1.0	0.8	0.8
High Density Single Family	0.4	0.6	1.0	1.0	0.7	0.5	0.7	0.8	0.8	1.0	0.8	0.8
Commercial	0.3	0.4	0.9	0.9	0.7	0.7	0.4	0.5	0.7	0.8	1.1	1.1
Office/Light Industrial	0.3	0.4	0.9	0.9	0.7	0.7	0.4	0.5	0.7	0.8	1.1	1.1
Heavy Industrial	0.3	0.4	0.9	0.9	0.7	0.7	0.4	0.5	0.7	0.8	1.1	1.1
Water	0.6	0.8	0.9	0.9	0.9	1.2	1.0	1.7	1.3	0.7	0.6	0.9
Wetlands	0.6	0.8	0.9	0.9	0.9	1.2	1.0	1.7	1.3	0.7	0.6	0.9
Major Roads	0.7	0.7	1.2	1.2	1.1	1.1	0.7	0.8	2.0	0.9	1.4	1.4

Table 5.2.2.1 - Continue

High EMCs Pctle – 95%
mg/L z = 1.645

Land Use	Oxygen Demand & Sediment				Nutrients				Heavy Metals			
	BOD	COD	TSS	TDS	TP	DP	TKN	NO23	Pb	Cu	Zn	Cd
Forest/Open	15.6	99	420	195	0.37	0.14	1.60	0.39	0.00	0.00	0.00	0.000
Agriculture/Pasture	15.6	99	420	195	0.37	0.14	1.60	0.39	0.00	0.00	0.00	0.000
Cropland	15.6	99	420	195	2.62	0.97	5.82	1.46	0.00	0.00	0.00	0.000
Low Density Single Family	19.1	170	382	273	0.90	0.30	3.55	0.94	0.12	0.13	0.13	0.005
Medium Density Single Family	19.1	170	382	273	0.90	0.30	3.55	0.94	0.12	0.13	0.13	0.005
High Density Single Family	19.1	170	382	273	0.76	0.30	3.12	0.84	0.19	0.13	0.15	0.005
Commercial	15.3	106	232	256	0.34	0.23	1.92	0.23	0.55	0.09	0.34	0.006
Office/Light Industrial	15.3	106	232	256	0.34	0.23	1.92	0.23	0.55	0.09	0.34	0.006
Heavy Industrial	15.3	106	232	256	0.34	0.23	1.92	0.23	0.55	0.09	0.34	0.006
Water	6.6	47	233	256	0.45	0.36	1.39	1.66	0.03	0.09	0.32	0.003
Wetlands	6.6	47	233	256	0.45	0.36	1.39	1.66	0.03	0.09	0.32	0.003
Major Roads	22.5	240	425	298	0.44	0.29	2.40	0.30	0.87	0.13	0.38	0.006

Low EMCs Pctle = 5%
mg/L z = -1.645

Land Use	Oxygen Demand & Sediment				Nutrients				Heavy Metals			
	BOD	COD	TSS	TDS	TP	DP	TKN	NO23	Pb	Cu	Zn	Cd
Forest/Open	3.3	21	89	41	0.05	0.02	0.34	0.08	0.00	0.00	0.00	0.0000
Agriculture/Pasture	3.3	21	89	41	0.05	0.02	0.34	0.08	0.00	0.00	0.00	0.0000
Cropland	3.3	21	89	41	0.33	0.12	1.23	0.31	0.00	0.00	0.00	0.0000
Low Density Single Family	5.2	31	27	19	0.11	0.07	0.41	0.09	0.01	0.01	0.01	0.0005
Medium Density Single Family	5.2	31	27	19	0.11	0.07	0.41	0.09	0.01	0.01	0.01	0.0005
High Density Single Family	5.2	31	27	19	0.10	0.07	0.36	0.08	0.02	0.01	0.01	0.0005
Commercial	5.7	31	21	23	0.05	0.03	0.49	0.05	0.07	0.01	0.02	0.0003
Office/Light Industrial	5.7	31	21	23	0.05	0.03	0.49	0.05	0.07	0.01	0.02	0.0003
Heavy Industrial	5.7	31	21	23	0.05	0.03	0.49	0.05	0.07	0.01	0.02	0.0003
Water	1.1	5	21	23	0.04	0.02	0.09	0.04	0.00	0.01	0.05	0.0002
Wetlands	1.1	5	21	23	0.04	0.02	0.09	0.04	0.00	0.01	0.05	0.0002
Major Roads	2.8	29	20	14	0.02	0.02	0.32	0.03	0.01	0.01	0.01	0.0002

Table 5.2.2.1 Continue
Standard Normal Deviate Storage Area

High		Low	
Percentile	Deviate	Percentile	Deviate
65%	0.385	1%	-2.327
70%	0.524	5%	-1.645
75%	0.674	10%	-1.282
80%	0.842	15%	-1.037
85%	1.037	20%	-0.842
90%	1.282	25%	-0.674
95%	1.645	30%	-0.524
99%	2.327	35%	-0.385

EMC monitoring data collected by NURP were determined to be lognormally (base e) distributed. The lognormal distribution allows the EMC data to be described by two parameters: the mean or median, which is a measure of central tendency; and the standard deviation or coefficient of variation (standard deviation divided by the mean), which is a measure of the dispersion or spread of the data. The median value should be used for comparisons between EMC's for individual sites or groups of sites because it is less influenced by small number of large value which is typical of lognormally distributed data. For computations of annual mass loadings, it is more appropriate to use the mean value since large infrequent events can comprise a significant portion of the annual pollutant loads. Mean values of EMC's were used for the percent loading estimates.

Because the non-point pollution loading factors used in the WMM were derived from national statistics, the model includes the capacity to perform an uncertainty analysis with a range of literature values for each land use category. The calculated EMC's (mg/L) from the loading factors (lbs/acre/year) based on the average annual runoff estimates, are assumed to be representative of a "medium" or "most probable" estimate of the non-point pollution loading factor for each specific land use. The purpose of the uncertainty analysis is to develop estimates of the extremes, high and low values of pollutant loadings and to assess whether these estimates would result in different management decisions. Therefore, the EMC's used in the model were in tendencies of mean, high and low.

The information of areas served by septic tanks is presented in Figure 5.2.2.1 which shows that most septic tank serving areas are in sub-basins B and F. A typical annual failure rate 8% of septic tanks provided by the model, was used in the simulation for the impacts of water quality. The default EMC's of septic tank discharges were used in the simulations.

The Tri-State WWTP is located south of Bay Street and east of Highway 41. It was modeled as a "point source" to sub-basin F of the North Creek watershed. The average effluent data of Tri-State WWTP during January-July, 1996, was input into the water quality model.

FIGURE 5.2.2.1

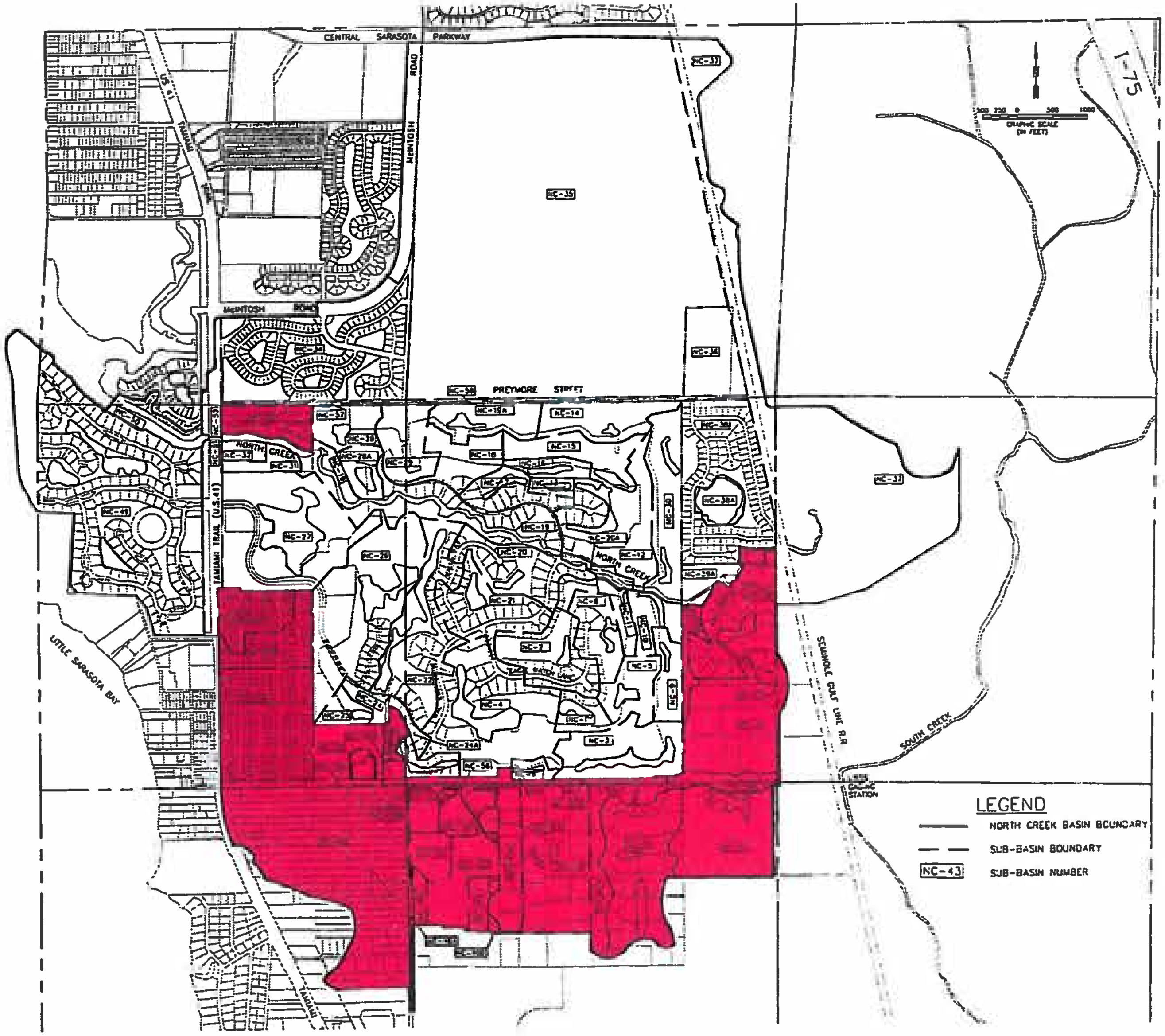

Figure 5.2.2.1

Septic Tank Areas

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5.2.3 Annual Runoff Volume

WMM calculates annual runoff volumes for the pervious/impervious areas in each land use category by multiplying the average annual rainfall volume by a runoff coefficient. A typical runoff coefficient of 0.95 is used for impervious areas while a coefficient of 0.20 is used for pervious area runoff calculation.

An average annual rainfall of 57.95 inch is used in the model, which is consistent with the value used in the previous basin study for Sarasota County. No baseflow water quality analysis is involved in the study as there is no USGS stream gage data available in the North Creek watershed.

5.2.4 BMP's

A file of BMP's was created for calculation of the pollutant loadings removed by the BMPs. Wet detention pond is the only BMP type in North Creek watershed. From the aerial photographs the percentage of each land use type served by existing BMP's in each sub-basin was estimated and input into the model. To be consistent with NPDES study done for Sarasota County in 1993, the same BMP efficiencies are used in this study, and these efficiencies are listed in Table 5.2.4.1.

Table 5.2.4.1
BMP Removal Efficiencies

Constituent	Wet Detention Pond
BOD	30%
COD	50%
TSS	70%
TDS	0%
Total-P	50%
Dissolved-P	80%
TKN	30%
NO2 +NO3	80%
Lead	80%
Copper	75%
Zinc	50%
Cadmium	50%

5.3 Model Results

5.3.1 Pollutant Loads Under Existing Condition with Existing Land Uses.

The pollutant loads under existing condition with existing land uses were determined for the North Creek watershed by using WMM spreadsheet model, with the results summarized in Tables 5.3.1.1 and 5.3.1.2. Table 5.3.1 shows the loadings of every sub-basin in tendencies of medium, high and low. The loading results are also presented for gross loadings with no BMP reductions and loadings with BMP reductions. Table 5.3.1.2 provides the total loads of the entire North Creek basin with or without BMP's.

The WMM provides annual constituent loadings and runoff volumes whereby average annual concentrations can be derived. The average annual event mean concentrations from the model are presented in Table 5.3.1.3.

Pollutant loads and unit loading rates per basin for the North Creek watershed are summarized by parameter in Table 5.3.1.4. Pollutant loads show that the larger sub-basins such as sub-basins E, F and G, contribute more loads, while the smaller sub-basins B, C, I and J produce lesser amounts of pollutant loads.

Sub-basin J has the highest pollutant unit loading rates among the ten sub-basins in the North Creek watershed, because the entire sub-basin is used as a junk yard which provides very high loading rates, especially for oxygen demand, sediment and heavy metals loads. High unit loading rates are also shown in sub-basin F as it has 19% commercial and official land uses, and approximately 58% residential area.

From the total watershed perspective, the highest unit loading rate in the North Creek watershed is associated with industrial, commercial, and residential land uses. In contrast, the lowest unit loading rates are found in the sub-basins which contain mainly open spaces or agricultural land uses. It can be concluded that the unit loading rate in North Creek watershed is dependent on the level of urbanization. Overall, the high gross pollutant loads are contributed by the large basins. Sub-basins E, F and G produce approximately 60% of the total load in the entire basin. The point source Tri-State WWTP does not show significant impacts on receiving waters as the plant has very low flow volume and the constituent concentrations of the effluent are within the permit.

TABLE 5.3.1.1

(10 PAGES)

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

							No BMP Controls Average Annual				With BMP Control Average Annual				% Reduction
Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	Surface	Baseflow	Point Sour	Total	Surface	Baseflow	Point Sour	Total	Surface NPS Loads
A	249	31	12.3%	Medium	Runoff	(ac-ft/yr	351	0	0	351	351	0	0	351	
A	249	31	12.3%	Medium	BOD	(lbs/yr)	8,748	0	0	8,748	6,301	0	0	6,301	-27.7%
A	249	31	12.3%	Medium	COD	(lbs/yr)	62,694	0	0	62,694	33,407	0	0	33,407	-46.1%
A	249	31	12.3%	Medium	TSS	(lbs/yr)	162,064	0	0	162,064	57,207	0	0	57,207	-64.5%
A	249	31	12.3%	Medium	TDS	(lbs/yr)	95,475	0	0	95,475	95,475	0	0	95,475	0.0%
A	249	31	12.3%	Medium	Total-P	(lbs/yr)	266	0	0	266	141	0	0	141	-46.1%
A	249	31	12.3%	Medium	Dissolved-P	(lbs/yr)	110	0	0	110	27	0	0	27	-73.8%
A	249	31	12.3%	Medium	TKN	(lbs/yr)	1,099	0	0	1,099	791	0	0	791	-27.7%
A	249	31	12.3%	Medium	NO2&NO3	(lbs/yr)	290	0	0	290	72	0	0	72	-73.8%
A	249	31	12.3%	Medium	Lead	(lbs/yr)	25	0	0	25	6	0	0	6	-76.4%
A	249	31	12.3%	Medium	Copper	(lbs/yr)	25	0	0	25	7	0	0	7	-71.7%
A	249	31	12.3%	Medium	Zinc	(lbs/yr)	33	0	0	33	17	0	0	17	-47.8%
A	249	31	12.3%	Medium	Cadmium	(lbs/yr)	1	0	0	1	1	0	0	1	-47.8%
A	249	31	12.3%	High	BOD	(lbs/yr)	16,117	0	0	16,117	11,614	0	0	11,614	-27.7%
A	249	31	12.3%	High	COD	(lbs/yr)	126,447	0	0	126,447	67,328	0	0	67,328	-46.1%
A	249	31	12.3%	High	TSS	(lbs/yr)	372,053	0	0	372,053	130,202	0	0	130,202	-64.5%
A	249	31	12.3%	High	TDS	(lbs/yr)	227,473	0	0	227,473	227,473	0	0	227,473	0.0%
A	249	31	12.3%	High	Total-P	(lbs/yr)	616	0	0	616	327	0	0	327	-46.1%
A	249	31	12.3%	High	Dissolved-P	(lbs/yr)	224	0	0	224	55	0	0	55	-73.8%
A	249	31	12.3%	High	TKN	(lbs/yr)	2,472	0	0	2,472	1,776	0	0	1,776	-27.7%
A	249	31	12.3%	High	NO2&NO3	(lbs/yr)	710	0	0	710	173	0	0	173	-73.8%
A	249	31	12.3%	High	Lead	(lbs/yr)	61	0	0	61	14	0	0	14	-76.4%
A	249	31	12.3%	High	Copper	(lbs/yr)	68	0	0	68	19	0	0	19	-71.7%
A	249	31	12.3%	High	Zinc	(lbs/yr)	80	0	0	80	42	0	0	42	-47.8%
A	249	31	12.3%	High	Cadmium	(lbs/yr)	3	0	0	3	1	0	0	1	-47.8%
A	249	31	12.3%	Low	BOD	(lbs/yr)	3,971	0	0	3,971	2,859	0	0	2,859	-27.7%
A	249	31	12.3%	Low	COD	(lbs/yr)	24,172	0	0	24,172	12,897	0	0	12,897	-46.1%
A	249	31	12.3%	Low	TSS	(lbs/yr)	50,571	0	0	50,571	18,173	0	0	18,173	-64.5%
A	249	31	12.3%	Low	TDS	(lbs/yr)	27,426	0	0	27,426	27,426	0	0	27,426	0.0%
A	249	31	12.3%	Low	Total-P	(lbs/yr)	77	0	0	77	41	0	0	41	-46.1%
A	249	31	12.3%	Low	Dissolved-P	(lbs/yr)	43	0	0	43	11	0	0	11	-73.8%
A	249	31	12.3%	Low	TKN	(lbs/yr)	346	0	0	346	249	0	0	249	-27.7%
A	249	31	12.3%	Low	NO2&NO3	(lbs/yr)	78	0	0	78	20	0	0	20	-73.8%
A	249	31	12.3%	Low	Lead	(lbs/yr)	7	0	0	7	2	0	0	2	-76.4%
A	249	31	12.3%	Low	Copper	(lbs/yr)	5	0	0	5	1	0	0	1	-71.7%
A	249	31	12.3%	Low	Zinc	(lbs/yr)	8	0	0	8	4	0	0	4	-47.8%
A	249	31	12.3%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-47.8%

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	Baseflow	Point Sour	Total	With BMP Control Average Annual Surface	Baseflow	Point Sour	Total	% Reduction Surface NPS Loads
B	92	17	18.8%	Medium	Runoff	(ac-ft/yr	152	0	0	152	152	0	0	152	
B	92	17	18.8%	Medium	BOD	(lbs/yr)	4,276	0	0	4,276	3,435	0	0	3,435	-20.3%
B	92	17	18.8%	Medium	COD	(lbs/yr)	32,614	0	0	32,614	21,968	0	0	21,968	-33.8%
B	92	17	18.8%	Medium	TSS	(lbs/yr)	58,948	0	0	58,948	31,251	0	0	31,251	-47.4%
B	92	17	18.8%	Medium	TDS	(lbs/yr)	41,324	0	0	41,324	41,324	0	0	41,324	0.0%
B	92	17	18.8%	Medium	Total-P	(lbs/yr)	165	0	0	165	111	0	0	111	-33.8%
B	92	17	18.8%	Medium	Dissolved-P	(lbs/yr)	68	0	0	68	32	0	0	32	-54.1%
B	92	17	18.8%	Medium	TKN	(lbs/yr)	632	0	0	632	508	0	0	508	-20.3%
B	92	17	18.8%	Medium	NO2&NO3	(lbs/yr)	162	0	0	162	76	0	0	76	-54.1%
B	92	17	18.8%	Medium	Lead	(lbs/yr)	19	0	0	19	9	0	0	9	-52.3%
B	92	17	18.8%	Medium	Copper	(lbs/yr)	18	0	0	18	9	0	0	9	-49.0%
B	92	17	18.8%	Medium	Zinc	(lbs/yr)	21	0	0	21	14	0	0	14	-32.7%
B	92	17	18.8%	Medium	Cadmium	(lbs/yr)	1	0	0	1	1	0	0	1	-32.7%
B	92	17	18.8%	High	BOD	(lbs/yr)	7,619	0	0	7,619	6,116	0	0	6,116	-20.3%
B	92	17	18.8%	High	COD	(lbs/yr)	66,585	0	0	66,585	44,842	0	0	44,842	-33.8%
B	92	17	18.8%	High	TSS	(lbs/yr)	156,330	0	0	156,330	83,563	0	0	83,563	-47.4%
B	92	17	18.8%	High	TDS	(lbs/yr)	110,482	0	0	110,482	110,482	0	0	110,482	0.0%
B	92	17	18.8%	High	Total-P	(lbs/yr)	412	0	0	412	278	0	0	278	-33.8%
B	92	17	18.8%	High	Dissolved-P	(lbs/yr)	141	0	0	141	67	0	0	67	-54.1%
B	92	17	18.8%	High	TKN	(lbs/yr)	1,597	0	0	1,597	1,285	0	0	1,285	-20.3%
B	92	17	18.8%	High	NO2&NO3	(lbs/yr)	441	0	0	441	206	0	0	206	-54.1%
B	92	17	18.8%	High	Lead	(lbs/yr)	45	0	0	45	22	0	0	22	-52.3%
B	92	17	18.8%	High	Copper	(lbs/yr)	49	0	0	49	25	0	0	25	-49.0%
B	92	17	18.8%	High	Zinc	(lbs/yr)	53	0	0	53	35	0	0	35	-32.7%
B	92	17	18.8%	High	Cadmium	(lbs/yr)	2	0	0	2	1	0	0	1	-32.7%
B	92	17	18.8%	Low	BOD	(lbs/yr)	2,047	0	0	2,047	1,647	0	0	1,647	-20.3%
B	92	17	18.8%	Low	COD	(lbs/yr)	12,272	0	0	12,272	8,268	0	0	8,268	-33.8%
B	92	17	18.8%	Low	TSS	(lbs/yr)	12,471	0	0	12,471	6,421	0	0	6,421	-47.4%
B	92	17	18.8%	Low	TDS	(lbs/yr)	8,485	0	0	8,485	8,485	0	0	8,485	0.0%
B	92	17	18.8%	Low	Total-P	(lbs/yr)	47	0	0	47	31	0	0	31	-33.8%
B	92	17	18.8%	Low	Dissolved-P	(lbs/yr)	28	0	0	28	14	0	0	14	-54.1%
B	92	17	18.8%	Low	TKN	(lbs/yr)	170	0	0	170	137	0	0	137	-20.3%
B	92	17	18.8%	Low	NO2&NO3	(lbs/yr)	36	0	0	36	17	0	0	17	-54.1%
B	92	17	18.8%	Low	Lead	(lbs/yr)	5	0	0	5	2	0	0	2	-52.3%
B	92	17	18.8%	Low	Copper	(lbs/yr)	3	0	0	3	2	0	0	2	-49.0%
B	92	17	18.8%	Low	Zinc	(lbs/yr)	5	0	0	5	3	0	0	3	-32.7%
B	92	17	18.8%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-32.7%

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Sour	No BMP Controls Average Annual Total	With BMP Control Average Annual Surface	With BMP Control Average Annual Baseflow	With BMP Control Average Annual Point Sour	With BMP Control Average Annual Total	% Reduction Surface NPS Loads
C	91	15	16.5%	Medium	Runoff	(ac-ft/yr	142	0	0	142	142	0	0	142	
C	91	15	16.5%	Medium	BOD	(lbs/yr)	3,686	0	0	3,686	2,586	0	0	2,586	-29.7%
C	91	15	16.5%	Medium	COD	(lbs/yr)	27,620	0	0	27,620	13,876	0	0	13,876	-49.5%
C	91	15	16.5%	Medium	TSS	(lbs/yr)	55,893	0	0	55,893	17,159	0	0	17,159	-69.3%
C	91	15	16.5%	Medium	TDS	(lbs/yr)	38,712	0	0	38,712	38,712	0	0	38,712	0.0%
C	91	15	16.5%	Medium	Total-P	(lbs/yr)	129	0	0	129	65	0	0	65	-49.5%
C	91	15	16.5%	Medium	Dissolved-P	(lbs/yr)	55	0	0	55	11	0	0	11	-79.2%
C	91	15	16.5%	Medium	TKN	(lbs/yr)	500	0	0	500	350	0	0	350	-29 7%
C	91	15	16.5%	Medium	NO2&NO3	(lbs/yr)	139	0	0	139	28	0	0	28	-79.2%
C	91	15	16.5%	Medium	Lead	(lbs/yr)	15	0	0	15	3	0	0	3	-80.0%
C	91	15	16.5%	Medium	Copper	(lbs/yr)	15	0	0	15	4	0	0	4	-75.0%
C	91	15	16.5%	Medium	Zinc	(lbs/yr)	21	0	0	21	11	0	0	11	-50 0%
C	91	15	16.5%	Medium	Cadmium	(lbs/yr)	1	0	0	1	0	0	0	0	-50 0%
C	91	15	16.5%	High	BOD	(lbs/yr)	6,647	0	0	6,647	4,665	0	0	4,665	-29.7%
C	91	15	16.5%	High	COD	(lbs/yr)	56,511	0	0	56,511	28,383	0	0	28,383	-49.5%
C	91	15	16.5%	High	TSS	(lbs/yr)	142,958	0	0	142,958	43,649	0	0	43,649	-69.3%
C	91	15	16.5%	High	TDS	(lbs/yr)	100,745	0	0	100,745	100,745	0	0	100,745	0.0%
C	91	15	16.5%	High	Total-P	(lbs/yr)	299	0	0	299	150	0	0	150	-49.5%
C	91	15	16.5%	High	Dissolved-P	(lbs/yr)	110	0	0	110	22	0	0	22	-79.2%
C	91	15	16.5%	High	TKN	(lbs/yr)	1,174	0	0	1,174	823	0	0	823	-29.7%
C	91	15	16.5%	High	NO2&NO3	(lbs/yr)	367	0	0	367	74	0	0	74	-79.2%
C	91	15	16.5%	High	Lead	(lbs/yr)	36	0	0	36	7	0	0	7	-80.0%
C	91	15	16.5%	High	Copper	(lbs/yr)	41	0	0	41	10	0	0	10	-75.0%
C	91	15	16.5%	High	Zinc	(lbs/yr)	52	0	0	52	26	0	0	26	-50.0%
C	91	15	16.5%	High	Cadmium	(lbs/yr)	2	0	0	2	1	0	0	1	-50.0%
C	91	15	16.5%	Low	BOD	(lbs/yr)	1,733	0	0	1,733	1,216	0	0	1,216	-29.7%
C	91	15	16.5%	Low	COD	(lbs/yr)	10,367	0	0	10,367	5,211	0	0	5,211	-49.5%
C	91	15	16.5%	Low	TSS	(lbs/yr)	13,282	0	0	13,282	4,146	0	0	4,146	-69.3%
C	91	15	16.5%	Low	TDS	(lbs/yr)	8,694	0	0	8,694	8,694	0	0	8,694	0.0%
C	91	15	16.5%	Low	Total-P	(lbs/yr)	37	0	0	37	19	0	0	19	-49.5%
C	91	15	16.5%	Low	Dissolved-P	(lbs/yr)	22	0	0	22	4	0	0	4	-79.2%
C	91	15	16.5%	Low	TKN	(lbs/yr)	141	0	0	141	99	0	0	99	-29.7%
C	91	15	16.5%	Low	NO2&NO3	(lbs/yr)	31	0	0	31	6	0	0	6	-79.2%
C	91	15	16.5%	Low	Lead	(lbs/yr)	4	0	0	4	1	0	0	1	-80.0%
C	91	15	16.5%	Low	Copper	(lbs/yr)	3	0	0	3	1	0	0	1	-75.0%
C	91	15	16.5%	Low	Zinc	(lbs/yr)	6	0	0	6	3	0	0	3	-50.0%
C	91	15	16.5%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-50.0%

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

							No BMP Controls Average Annual				With BMP Control Average Annual				% Reduction
Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	Surface	Baseflow	Point Sour	Total	Surface	Baseflow	Point Sour	Total	Surface NPS Loads
D	318	47	14.8%	Medium	Runoff	(ac-ft/yr	477	0	0	477	477	0	0	477	
D	318	47	14.8%	Medium	BOD	(lbs/yr)	11,931	0	0	11,931	8,351	0	0	8,351	-30 0%
D	318	47	14.8%	Medium	COD	(lbs/yr)	88,239	0	0	88,239	44,119	0	0	44,119	-50.0%
D	318	47	14.8%	Medium	TSS	(lbs/yr)	192,963	0	0	192,963	57,889	0	0	57,889	-70 0%
D	318	47	14.8%	Medium	TDS	(lbs/yr)	129,813	0	0	129,813	129,813	0	0	129,813	0.0%
D	318	47	14.8%	Medium	Total-P	(lbs/yr)	407	0	0	407	204	0	0	204	-50 0%
D	318	47	14.8%	Medium	Dissolved-P	(lbs/yr)	175	0	0	175	35	0	0	35	-80 0%
D	318	47	14.8%	Medium	TKN	(lbs/yr)	1,592	0	0	1,592	1,115	0	0	1,115	-30 0%
D	318	47	14.8%	Medium	NO2&NO3	(lbs/yr)	455	0	0	455	91	0	0	91	-80 0%
D	318	47	14.8%	Medium	Lead	(lbs/yr)	45	0	0	45	9	0	0	9	-80 0%
D	318	47	14.8%	Medium	Copper	(lbs/yr)	47	0	0	47	12	0	0	12	-75 0%
D	318	47	14.8%	Medium	Zinc	(lbs/yr)	70	0	0	70	35	0	0	35	-50 0%
D	318	47	14.8%	Medium	Cadmium	(lbs/yr)	2	0	0	2	1	0	0	1	-50 0%
D	318	47	14.8%	High	BOD	(lbs/yr)	21,681	0	0	21,681	15,176	0	0	15,176	-30 0%
D	318	47	14.8%	High	COD	(lbs/yr)	180,330	0	0	180,330	90,165	0	0	90,165	-50 0%
D	318	47	14.8%	High	TSS	(lbs/yr)	479,290	0	0	479,290	143,787	0	0	143,787	-70 0%
D	318	47	14.8%	High	TDS	(lbs/yr)	330,575	0	0	330,575	330,575	0	0	330,575	0 0%
D	318	47	14.8%	High	Total-P	(lbs/yr)	946	0	0	946	473	0	0	473	-50.0%
D	318	47	14.8%	High	Dissolved-P	(lbs/yr)	358	0	0	358	72	0	0	72	-80.0%
D	318	47	14.8%	High	TKN	(lbs/yr)	3,715	0	0	3,715	2,600	0	0	2,600	-30.0%
D	318	47	14.8%	High	NO2&NO3	(lbs/yr)	1,200	0	0	1,200	240	0	0	240	-80.0%
D	318	47	14.8%	High	Lead	(lbs/yr)	109	0	0	109	22	0	0	22	-80.0%
D	318	47	14.8%	High	Copper	(lbs/yr)	127	0	0	127	32	0	0	32	-75.0%
D	318	47	14.8%	High	Zinc	(lbs/yr)	166	0	0	166	83	0	0	83	-50.0%
D	318	47	14.8%	High	Cadmium	(lbs/yr)	5	0	0	5	2	0	0	2	-50.0%
D	318	47	14.8%	Low	BOD	(lbs/yr)	5,543	0	0	5,543	3,880	0	0	3,880	-30 0%
D	318	47	14.8%	Low	COD	(lbs/yr)	33,216	0	0	33,216	16,608	0	0	16,608	-50.0%
D	318	47	14.8%	Low	TSS	(lbs/yr)	49,861	0	0	49,861	14,958	0	0	14,958	-70.0%
D	318	47	14.8%	Low	TDS	(lbs/yr)	31,175	0	0	31,175	31,175	0	0	31,175	0.0%
D	318	47	14.8%	Low	Total-P	(lbs/yr)	117	0	0	117	59	0	0	59	-50.0%
D	318	47	14.8%	Low	Dissolved-P	(lbs/yr)	68	0	0	68	14	0	0	14	-80.0%
D	318	47	14.8%	Low	TKN	(lbs/yr)	459	0	0	459	322	0	0	322	-30.0%
D	318	47	14.8%	Low	NO2&NO3	(lbs/yr)	102	0	0	102	20	0	0	20	-80.0%
D	318	47	14.8%	Low	Lead	(lbs/yr)	12	0	0	12	2	0	0	2	-80.0%
D	318	47	14.8%	Low	Copper	(lbs/yr)	9	0	0	9	2	0	0	2	-75.0%
D	318	47	14.8%	Low	Zinc	(lbs/yr)	19	0	0	19	10	0	0	10	-50.0%
D	318	47	14.8%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-50.0%

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

							No BMP Controls Average Annual				With BMP Control Average Annual				% Reduction
Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	Surface	Baseflow	Point Sour	Total	Surface	Baseflow	Point Sour	Total	Surface NPS Loads
E	500	72	14.5%	Medium	Runoff	(ac-ft/yr	745	0	0	745	745	0	0	745	
E	500	72	14.5%	Medium	BOD	(lbs/yr)	13,703	0	0	13,703	9,592	0	0	9,592	-30.0%
E	500	72	14.5%	Medium	COD	(lbs/yr)	95,751	0	0	95,751	47,875	0	0	47,875	-50.0%
E	500	72	14.5%	Medium	TSS	(lbs/yr)	299,974	0	0	299,974	89,992	0	0	89,992	-70.0%
E	500	72	14.5%	Medium	TDS	(lbs/yr)	202,536	0	0	202,536	202,536	0	0	202,536	0.0%
E	500	72	14.5%	Medium	Total-P	(lbs/yr)	405	0	0	405	203	0	0	203	-50.0%
E	500	72	14.5%	Medium	Dissolved-P	(lbs/yr)	212	0	0	212	42	0	0	42	-80.0%
E	500	72	14.5%	Medium	TKN	(lbs/yr)	1,679	0	0	1,679	1,175	0	0	1,175	-30.0%
E	500	72	14.5%	Medium	NO2&NO3	(lbs/yr)	664	0	0	664	133	0	0	133	-80.0%
E	500	72	14.5%	Medium	Lead	(lbs/yr)	70	0	0	70	14	0	0	14	-80.0%
E	500	72	14.5%	Medium	Copper	(lbs/yr)	54	0	0	54	14	0	0	14	-75.0%
E	500	72	14.5%	Medium	Zinc	(lbs/yr)	154	0	0	154	77	0	0	77	-50.0%
E	500	72	14.5%	Medium	Cadmium	(lbs/yr)	2	0	0	2	1	0	0	1	-50.0%
E	500	72	14.5%	High	BOD	(lbs/yr)	26,600	0	0	26,600	18,620	0	0	18,620	-30.0%
E	500	72	14.5%	High	COD	(lbs/yr)	200,210	0	0	200,210	100,105	0	0	100,105	-50.0%
E	500	72	14.5%	High	TSS	(lbs/yr)	683,314	0	0	683,314	204,994	0	0	204,994	-70.0%
E	500	72	14.5%	High	TDS	(lbs/yr)	482,984	0	0	482,984	482,984	0	0	482,984	0.0%
E	500	72	14.5%	High	Total-P	(lbs/yr)	1,001	0	0	1,001	501	0	0	501	-50.0%
E	500	72	14.5%	High	Dissolved-P	(lbs/yr)	541	0	0	541	108	0	0	108	-80.0%
E	500	72	14.5%	High	TKN	(lbs/yr)	3,876	0	0	3,876	2,713	0	0	2,713	-30.0%
E	500	72	14.5%	High	NO2&NO3	(lbs/yr)	1,938	0	0	1,938	388	0	0	388	-80.0%
E	500	72	14.5%	High	Lead	(lbs/yr)	201	0	0	201	40	0	0	40	-80.0%
E	500	72	14.5%	High	Copper	(lbs/yr)	135	0	0	135	34	0	0	34	-75.0%
E	500	72	14.5%	High	Zinc	(lbs/yr)	355	0	0	355	178	0	0	178	-50.0%
E	500	72	14.5%	High	Cadmium	(lbs/yr)	5	0	0	5	2	0	0	2	-50.0%
E	500	72	14.5%	Low	BOD	(lbs/yr)	5,726	0	0	5,726	4,008	0	0	4,008	-30.0%
E	500	72	14.5%	Low	COD	(lbs/yr)	34,937	0	0	34,937	17,469	0	0	17,469	-50.0%
E	500	72	14.5%	Low	TSS	(lbs/yr)	94,781	0	0	94,781	28,434	0	0	28,434	-70.0%
E	500	72	14.5%	Low	TDS	(lbs/yr)	57,567	0	0	57,567	57,567	0	0	57,567	0.0%
E	500	72	14.5%	Low	Total-P	(lbs/yr)	105	0	0	105	52	0	0	52	-50.0%
E	500	72	14.5%	Low	Dissolved-P	(lbs/yr)	54	0	0	54	11	0	0	11	-80.0%
E	500	72	14.5%	Low	TKN	(lbs/yr)	522	0	0	522	365	0	0	365	-30.0%
E	500	72	14.5%	Low	NO2&NO3	(lbs/yr)	124	0	0	124	25	0	0	25	-80.0%
E	500	72	14.5%	Low	Lead	(lbs/yr)	13	0	0	13	3	0	0	3	-80.0%
E	500	72	14.5%	Low	Copper	(lbs/yr)	14	0	0	14	3	0	0	3	-75.0%
E	500	72	14.5%	Low	Zinc	(lbs/yr)	47	0	0	47	23	0	0	23	-50.0%
E	500	72	14.5%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-50.0%

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Sour	No BMP Controls Average Annual Total	With BMP Control Average Annual Surface	With BMP Control Average Annual Baseflow	With BMP Control Average Annual Point Sour	With BMP Control Average Annual Total	% Reduction Surface NPS Loads
F	436	127	29.2%	Medium	Runoff	(ac-ft/yr	881	0	5	886	881	0	5	886	
F	436	127	29.2%	Medium	BOD	(lbs/yr)	22,600	0	64	22,664	20,580	0	64	20,645	-29.0%
F	436	127	29.2%	Medium	COD	(lbs/yr)	160,166	0	0	160,166	138,973	0	0	138,973	-48.4%
F	436	127	29.2%	Medium	TSS	(lbs/yr)	303,701	0	42	303,742	250,433	0	42	250,474	-67.7%
F	436	127	29.2%	Medium	TDS	(lbs/yr)	239,625	0	0	239,625	239,625	0	0	239,625	0.0%
F	436	127	29.2%	Medium	Total-P	(lbs/yr)	652	0	0	652	587	0	0	587	-48.4%
F	436	127	29.2%	Medium	Dissolved-P	(lbs/yr)	310	0	0	310	240	0	0	240	-77.4%
F	436	127	29.2%	Medium	TKN	(lbs/yr)	2,939	0	0	2,939	2,709	0	0	2,709	-29.0%
F	436	127	29.2%	Medium	NO2&NO3	(lbs/yr)	677	0	51	728	535	0	51	586	-77.4%
F	436	127	29.2%	Medium	Lead	(lbs/yr)	265	0	0	265	144	0	0	144	-77.4%
F	436	127	29.2%	Medium	Copper	(lbs/yr)	91	0	0	91	67	0	0	67	-72.6%
F	436	127	29.2%	Medium	Zinc	(lbs/yr)	190	0	0	190	136	0	0	136	-48.4%
F	436	127	29.2%	Medium	Cadmium	(lbs/yr)	4	0	0	4	3	0	0	3	-48.4%
F	436	127	29.2%	High	BOD	(lbs/yr)	39,246	0	64	39,311	35,950	0	64	36,015	-29.0%
F	436	127	29.2%	High	COD	(lbs/yr)	313,101	0	0	313,101	274,767	0	0	274,767	-48.4%
F	436	127	29.2%	High	TSS	(lbs/yr)	771,000	0	42	771,042	634,286	0	42	634,328	-67.7%
F	436	127	29.2%	High	TDS	(lbs/yr)	617,440	0	0	617,440	617,440	0	0	617,440	0.0%
F	436	127	29.2%	High	Total-P	(lbs/yr)	1,599	0	0	1,599	1,445	0	0	1,445	-48.4%
F	436	127	29.2%	High	Dissolved-P	(lbs/yr)	687	0	0	687	511	0	0	511	-77.4%
F	436	127	29.2%	High	TKN	(lbs/yr)	6,707	0	0	6,707	6,259	0	0	6,259	-29.0%
F	436	127	29.2%	High	NO2&NO3	(lbs/yr)	1,792	0	51	1,842	1,395	0	51	1,446	-77.4%
F	436	127	29.2%	High	Lead	(lbs/yr)	628	0	0	628	349	0	0	349	-77.4%
F	436	127	29.2%	High	Copper	(lbs/yr)	238	0	0	238	180	0	0	180	-72.6%
F	436	127	29.2%	High	Zinc	(lbs/yr)	506	0	0	506	365	0	0	365	-48.4%
F	436	127	29.2%	High	Cadmium	(lbs/yr)	11	0	0	11	9	0	0	9	-48.4%
F	436	127	29.2%	Low	BOD	(lbs/yr)	11,384	0	64	11,448	10,263	0	64	10,327	-29.0%
F	436	127	29.2%	Low	COD	(lbs/yr)	66,098	0	0	66,098	56,036	0	0	56,036	-48.4%
F	436	127	29.2%	Low	TSS	(lbs/yr)	73,215	0	42	73,256	61,187	0	42	61,228	-67.7%
F	436	127	29.2%	Low	TDS	(lbs/yr)	54,874	0	0	54,874	54,874	0	0	54,874	0.0%
F	436	127	29.2%	Low	Total-P	(lbs/yr)	185	0	0	185	167	0	0	167	-48.4%
F	436	127	29.2%	Low	Dissolved-P	(lbs/yr)	110	0	0	110	93	0	0	93	-77.4%
F	436	127	29.2%	Low	TKN	(lbs/yr)	980	0	0	980	882	0	0	882	-29.0%
F	436	127	29.2%	Low	NO2&NO3	(lbs/yr)	167	0	51	217	135	0	51	186	-77.4%
F	436	127	29.2%	Low	Lead	(lbs/yr)	75	0	0	75	39	0	0	39	-77.4%
F	436	127	29.2%	Low	Copper	(lbs/yr)	19	0	0	19	13	0	0	13	-72.6%
F	436	127	29.2%	Low	Zinc	(lbs/yr)	40	0	0	40	28	0	0	28	-48.4%
F	436	127	29.2%	Low	Cadmium	(lbs/yr)	1	0	0	1	1	0	0	1	-48.4%

Table 5.3.1.1

North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Sour	No BMP Controls Average Annual Total	With BMP Control Average Annual Surface	With BMP Control Average Annual Baseflow	With BMP Control Average Annual Point Sour	With BMP Control Average Annual Total	% Reduction Surface NPS Loads
G	384	81	21.2%	Medium	Runoff	(ac-ft/yr	665	0	0	665	665	0	0	665	
G	384	81	21.2%	Medium	BOD	(lbs/yr)	16,328	0	0	16,328	13,905	0	0	13,905	-22.2%
G	384	81	21.2%	Medium	COD	(lbs/yr)	124,240	0	0	124,240	94,298	0	0	94,298	-37.1%
G	384	81	21.2%	Medium	TSS	(lbs/yr)	254,441	0	0	254,441	166,933	0	0	166,933	-51.9%
G	384	81	21.2%	Medium	TDS	(lbs/yr)	180,877	0	0	180,877	180,877	0	0	180,877	0.0%
G	384	81	21.2%	Medium	Total-P	(lbs/yr)	550	0	0	550	400	0	0	400	-37.1%
G	384	81	21.2%	Medium	Dissolved-P	(lbs/yr)	246	0	0	246	135	0	0	135	-59.3%
G	384	81	21.2%	Medium	TKN	(lbs/yr)	2,180	0	0	2,180	1,843	0	0	1,843	-22.2%
G	384	81	21.2%	Medium	NO2&NO3	(lbs/yr)	630	0	0	630	322	0	0	322	-59.3%
G	384	81	21.2%	Medium	Lead	(lbs/yr)	93	0	0	93	61	0	0	61	-78.0%
G	384	81	21.2%	Medium	Copper	(lbs/yr)	71	0	0	71	40	0	0	40	-73.1%
G	384	81	21.2%	Medium	Zinc	(lbs/yr)	120	0	0	120	80	0	0	80	-48.7%
G	384	81	21.2%	Medium	Cadmium	(lbs/yr)	3	0	0	3	2	0	0	2	-48.7%
G	384	81	21.2%	High	BOD	(lbs/yr)	30,070	0	0	30,070	25,669	0	0	25,669	-22.2%
G	384	81	21.2%	High	COD	(lbs/yr)	257,627	0	0	257,627	195,537	0	0	195,537	-37.1%
G	384	81	21.2%	High	TSS	(lbs/yr)	652,777	0	0	652,777	423,267	0	0	423,267	-51.9%
G	384	81	21.2%	High	TDS	(lbs/yr)	471,832	0	0	471,832	471,832	0	0	471,832	0.0%
G	384	81	21.2%	High	Total-P	(lbs/yr)	1,295	0	0	1,295	941	0	0	941	-37.1%
G	384	81	21.2%	High	Dissolved-P	(lbs/yr)	523	0	0	523	277	0	0	277	-59.3%
G	384	81	21.2%	High	TKN	(lbs/yr)	5,125	0	0	5,125	4,315	0	0	4,315	-22.2%
G	384	81	21.2%	High	NO2&NO3	(lbs/yr)	1,707	0	0	1,707	819	0	0	819	-59.3%
G	384	81	21.2%	High	Lead	(lbs/yr)	253	0	0	253	177	0	0	177	-78.0%
G	384	81	21.2%	High	Copper	(lbs/yr)	191	0	0	191	109	0	0	109	-73.1%
G	384	81	21.2%	High	Zinc	(lbs/yr)	295	0	0	295	202	0	0	202	-48.7%
G	384	81	21.2%	High	Cadmium	(lbs/yr)	7	0	0	7	5	0	0	5	-48.7%
G	384	81	21.2%	Low	BOD	(lbs/yr)	7,461	0	0	7,461	6,330	0	0	6,330	-22.2%
G	384	81	21.2%	Low	COD	(lbs/yr)	45,629	0	0	45,629	34,621	0	0	34,621	-37.1%
G	384	81	21.2%	Low	TSS	(lbs/yr)	60,135	0	0	60,135	41,101	0	0	41,101	-51.9%
G	384	81	21.2%	Low	TDS	(lbs/yr)	40,421	0	0	40,421	40,421	0	0	40,421	0.0%
G	384	81	21.2%	Low	Total-P	(lbs/yr)	155	0	0	155	113	0	0	113	-37.1%
G	384	81	21.2%	Low	Dissolved-P	(lbs/yr)	91	0	0	91	52	0	0	52	-59.3%
G	384	81	21.2%	Low	TKN	(lbs/yr)	620	0	0	620	529	0	0	529	-22.2%
G	384	81	21.2%	Low	NO2&NO3	(lbs/yr)	132	0	0	132	78	0	0	78	-59.3%
G	384	81	21.2%	Low	Lead	(lbs/yr)	19	0	0	19	11	0	0	11	-78.0%
G	384	81	21.2%	Low	Copper	(lbs/yr)	15	0	0	15	8	0	0	8	-73.1%
G	384	81	21.2%	Low	Zinc	(lbs/yr)	31	0	0	31	19	0	0	19	-48.7%
G	384	81	21.2%	Low	Cadmium	(lbs/yr)	1	0	0	1	0	0	0	0	-48.7%

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Sour	No BMP Controls Average Annual Total	With BMP Control Average Annual Surface	With BMP Control Average Annual Baseflow	With BMP Control Average Annual Point Sour	With BMP Control Average Annual Total	% Reduction Surface NPS Loads
H	166	23	14.1%	Medium	Runoff	(ac-ft/yr	245	0	0	245	245	0	0	245	
H	166	23	14.1%	Medium	BOD	(lbs/yr)	6,294	0	0	6,294	4,406	0	0	4,406	-30.0%
H	166	23	14.1%	Medium	COD	(lbs/yr)	46,575	0	0	46,575	23,288	0	0	23,288	-50.0%
H	166	23	14.1%	Medium	TSS	(lbs/yr)	101,540	0	0	101,540	30,462	0	0	30,462	-70.0%
H	166	23	14.1%	Medium	TDS	(lbs/yr)	66,558	0	0	66,558	66,558	0	0	66,558	0.0%
H	166	23	14.1%	Medium	Total-P	(lbs/yr)	218	0	0	218	109	0	0	109	-50.0%
H	166	23	14.1%	Medium	Dissolved-P	(lbs/yr)	92	0	0	92	18	0	0	18	-80.0%
H	166	23	14.1%	Medium	TKN	(lbs/yr)	859	0	0	859	601	0	0	601	-30.0%
H	166	23	14.1%	Medium	NO2&NO3	(lbs/yr)	234	0	0	234	47	0	0	47	-80.0%
H	166	23	14.1%	Medium	Lead	(lbs/yr)	23	0	0	23	5	0	0	5	-80.0%
H	166	23	14.1%	Medium	Copper	(lbs/yr)	24	0	0	24	6	0	0	6	-75.0%
H	166	23	14.1%	Medium	Zinc	(lbs/yr)	32	0	0	32	16	0	0	16	-50.0%
H	166	23	14.1%	Medium	Cadmium	(lbs/yr)	1	0	0	1	0	0	0	0	-50.0%
H	166	23	14.1%	High	BOD	(lbs/yr)	11,419	0	0	11,419	7,993	0	0	7,993	-30.0%
H	166	23	14.1%	High	COD	(lbs/yr)	94,863	0	0	94,863	47,432	0	0	47,432	-50.0%
H	166	23	14.1%	High	TSS	(lbs/yr)	250,613	0	0	250,613	75,184	0	0	75,184	-70.0%
H	166	23	14.1%	High	TDS	(lbs/yr)	168,732	0	0	168,732	168,732	0	0	168,732	0.0%
H	166	23	14.1%	High	Total-P	(lbs/yr)	523	0	0	523	262	0	0	262	-50.0%
H	166	23	14.1%	High	Dissolved-P	(lbs/yr)	190	0	0	190	38	0	0	38	-80.0%
H	166	23	14.1%	High	TKN	(lbs/yr)	2,052	0	0	2,052	1,436	0	0	1,436	-30.0%
H	166	23	14.1%	High	NO2&NO3	(lbs/yr)	617	0	0	617	123	0	0	123	-80.0%
H	166	23	14.1%	High	Lead	(lbs/yr)	56	0	0	56	11	0	0	11	-80.0%
H	166	23	14.1%	High	Copper	(lbs/yr)	64	0	0	64	16	0	0	16	-75.0%
H	166	23	14.1%	High	Zinc	(lbs/yr)	78	0	0	78	39	0	0	39	-50.0%
H	166	23	14.1%	High	Cadmium	(lbs/yr)	2	0	0	2	1	0	0	1	-50.0%
H	166	23	14.1%	Low	BOD	(lbs/yr)	2,931	0	0	2,931	2,052	0	0	2,052	-30.0%
H	166	23	14.1%	Low	COD	(lbs/yr)	17,631	0	0	17,631	8,816	0	0	8,816	-50.0%
H	166	23	14.1%	Low	TSS	(lbs/yr)	26,718	0	0	26,718	8,016	0	0	8,016	-70.0%
H	166	23	14.1%	Low	TDS	(lbs/yr)	16,228	0	0	16,228	16,228	0	0	16,228	0.0%
H	166	23	14.1%	Low	Total-P	(lbs/yr)	62	0	0	62	31	0	0	31	-50.0%
H	166	23	14.1%	Low	Dissolved-P	(lbs/yr)	36	0	0	36	7	0	0	7	-80.0%
H	166	23	14.1%	Low	TKN	(lbs/yr)	247	0	0	247	173	0	0	173	-30.0%
H	166	23	14.1%	Low	NO2&NO3	(lbs/yr)	55	0	0	55	11	0	0	11	-80.0%
H	166	23	14.1%	Low	Lead	(lbs/yr)	6	0	0	6	1	0	0	1	-80.0%
H	166	23	14.1%	Low	Copper	(lbs/yr)	5	0	0	5	1	0	0	1	-75.0%
H	166	23	14.1%	Low	Zinc	(lbs/yr)	8	0	0	8	4	0	0	4	-50.0%
H	166	23	14.1%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-50.0%

Table 5.3.1.1

North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

							No BMP Controls Average Annual				With BMP Control Average Annual				% Reduction
Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	Surface	Baseflow	Point Sour	Total	Surface	Baseflow	Point Sour	Total	Surface NPS Loads
1	74	19	26.0%	Medium	Runoff	(ac-ft/yr	141	0	0	141	141	0	0	141	
1	74	19	26.0%	Medium	BOD	(lbs/yr)	3,527	0	0	3,527	2,536	0	0	2,536	-0.3
1	74	19	26.0%	Medium	COD	(lbs/yr)	27,146	0	0	27,146	14,757	0	0	14,757	-0.5
1	74	19	26.0%	Medium	TSS	(lbs/yr)	53,128	0	0	53,128	18,230	0	0	18,230	-0.7
1	74	19	26.0%	Medium	TDS	(lbs/yr)	38,464	0	0	38,464	38,464	0	0	38,464	0
1	74	19	26.0%	Medium	Total-P	(lbs/yr)	122	0	0	122	63	0	0	63	-0.5
1	74	19	26.0%	Medium	Dissolved-P	(lbs/yr)	54	0	0	54	13	0	0	13	-0.8
1	74	19	26.0%	Medium	TKN	(lbs/yr)	478	0	0	478	342	0	0	342	-0.3
1	74	19	26.0%	Medium	NO2&NO3	(lbs/yr)	138	0	0	138	30	0	0	30	-0.8
1	74	19	26.0%	Medium	Lead	(lbs/yr)	19	0	0	19	8	0	0	8	-0.8
1	74	19	26.0%	Medium	Copper	(lbs/yr)	16	0	0	16	5	0	0	5	-0.75
1	74	19	26.0%	Medium	Zinc	(lbs/yr)	26	0	0	26	14	0	0	14	-0.5
1	74	19	26.0%	Medium	Cadmium	(lbs/yr)	1	0	0	1	0	0	0	0	-0.5
1	74	19	26.0%	High	BOD	(lbs/yr)	6,485	0	0	6,485	4,695	0	0	4,695	-0.3
1	74	19	26.0%	High	COD	(lbs/yr)	56,501	0	0	56,501	31,011	0	0	31,011	-0.5
1	74	19	26.0%	High	TSS	(lbs/yr)	139,167	0	0	139,167	48,583	0	0	48,583	-0.7
1	74	19	26.0%	High	TDS	(lbs/yr)	101,806	0	0	101,806	101,806	0	0	101,806	0
1	74	19	26.0%	High	Total-P	(lbs/yr)	287	0	0	287	149	0	0	149	-0.5
1	74	19	26.0%	High	Dissolved-P	(lbs/yr)	114	0	0	114	28	0	0	28	-0.8
1	74	19	26.0%	High	TKN	(lbs/yr)	1,131	0	0	1,131	808	0	0	808	-0.3
1	74	19	26.0%	High	NO2&NO3	(lbs/yr)	376	0	0	376	81	0	0	81	-0.8
1	74	19	26.0%	High	Lead	(lbs/yr)	53	0	0	53	27	0	0	27	-0.8
1	74	19	26.0%	High	Copper	(lbs/yr)	43	0	0	43	13	0	0	13	-0.75
1	74	19	26.0%	High	Zinc	(lbs/yr)	64	0	0	64	36	0	0	36	-0.5
1	74	19	26.0%	High	Cadmium	(lbs/yr)	2	0	0	2	1	0	0	1	-0.5
1	74	19	26.0%	Low	BOD	(lbs/yr)	1,615	0	0	1,615	1,150	0	0	1,150	-0.3
1	74	19	26.0%	Low	COD	(lbs/yr)	9,888	0	0	9,888	5,281	0	0	5,281	-0.5
1	74	19	26.0%	Low	TSS	(lbs/yr)	11,758	0	0	11,758	3,855	0	0	3,855	-0.7
1	74	19	26.0%	Low	TDS	(lbs/yr)	8,190	0	0	8,190	8,190	0	0	8,190	0
1	74	19	26.0%	Low	Total-P	(lbs/yr)	35	0	0	35	18	0	0	18	-0.5
1	74	19	26.0%	Low	Dissolved-P	(lbs/yr)	21	0	0	21	4	0	0	4	-0.8
1	74	19	26.0%	Low	TKN	(lbs/yr)	133	0	0	133	95	0	0	95	-0.3
1	74	19	26.0%	Low	NO2&NO3	(lbs/yr)	28	0	0	28	6	0	0	6	-0.8
1	74	19	26.0%	Low	Lead	(lbs/yr)	4	0	0	4	1	0	0	1	-0.8
1	74	19	26.0%	Low	Copper	(lbs/yr)	3	0	0	3	1	0	0	1	-0.75
1	74	19	26.0%	Low	Zinc	(lbs/yr)	7	0	0	7	4	0	0	4	-0.5
1	74	19	26.0%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	-0.5

Table 5.3.1.1
North Creek Sub-basin Pollutant Loading Summary Under Existing Conditions

Basin	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Sour	No BMP Controls Average Annual Total	With BMP Control Average Annual Surface	With BMP Control Average Annual Baseflow	With BMP Control Average Annual Point Sour	With BMP Control Average Annual Total	% Reduction Surface NPS Loads
J	24	19	80.0%	Medium	Runoff	(ac-ft/yr	92	0	0	92	92	0	0	92	
J	24	19	80.0%	Medium	BOD	(lbs/yr)	2,445	0	0	2,445	2,445	0	0	2,445	0.0%
J	24	19	80.0%	Medium	COD	(lbs/yr)	15,361	0	0	15,361	15,361	0	0	15,361	0.0%
J	24	19	80.0%	Medium	TSS	(lbs/yr)	22,737	0	0	22,737	22,737	0	0	22,737	0.0%
J	24	19	80.0%	Medium	TDS	(lbs/yr)	25,108	0	0	25,108	25,108	0	0	25,108	0.0%
J	24	19	80.0%	Medium	Total-P	(lbs/yr)	38	0	0	38	38	0	0	38	0.0%
J	24	19	80.0%	Medium	Dissolved-P	(lbs/yr)	25	0	0	25	25	0	0	25	0.0%
J	24	19	80.0%	Medium	TKN	(lbs/yr)	266	0	0	266	266	0	0	266	0.0%
J	24	19	80.0%	Medium	NO2&NO3	(lbs/yr)	30	0	0	30	30	0	0	30	0.0%
J	24	19	80.0%	Medium	Lead	(lbs/yr)	60	0	0	60	60	0	0	60	0.0%
J	24	19	80.0%	Medium	Copper	(lbs/yr)	9	0	0	9	9	0	0	9	0.0%
J	24	19	80.0%	Medium	Zinc	(lbs/yr)	30	0	0	30	30	0	0	30	0.0%
J	24	19	80.0%	Medium	Cadmium	(lbs/yr)	1	0	0	1	1	0	0	1	0.0%
J	24	19	80.0%	High	BOD	(lbs/yr)	3,843	0	0	3,843	3,843	0	0	3,843	0.0%
J	24	19	80.0%	High	COD	(lbs/yr)	26,577	0	0	26,577	26,577	0	0	26,577	0.0%
J	24	19	80.0%	High	TSS	(lbs/yr)	58,274	0	0	58,274	58,274	0	0	58,274	0.0%
J	24	19	80.0%	High	TDS	(lbs/yr)	64,350	0	0	64,350	64,350	0	0	64,350	0.0%
J	24	19	80.0%	High	Total-P	(lbs/yr)	85	0	0	85	85	0	0	85	0.0%
J	24	19	80.0%	High	Dissolved-P	(lbs/yr)	57	0	0	57	57	0	0	57	0.0%
J	24	19	80.0%	High	TKN	(lbs/yr)	481	0	0	481	481	0	0	481	0.0%
J	24	19	80.0%	High	NO2&NO3	(lbs/yr)	57	0	0	57	57	0	0	57	0.0%
J	24	19	80.0%	High	Lead	(lbs/yr)	137	0	0	137	137	0	0	137	0.0%
J	24	19	80.0%	High	Copper	(lbs/yr)	23	0	0	23	23	0	0	23	0.0%
J	24	19	80.0%	High	Zinc	(lbs/yr)	87	0	0	87	87	0	0	87	0.0%
J	24	19	80.0%	High	Cadmium	(lbs/yr)	1	0	0	1	1	0	0	1	0.0%
J	24	19	80.0%	Low	BOD	(lbs/yr)	1,419	0	0	1,419	1,419	0	0	1,419	0.0%
J	24	19	80.0%	Low	COD	(lbs/yr)	7,707	0	0	7,707	7,707	0	0	7,707	0.0%
J	24	19	80.0%	Low	TSS	(lbs/yr)	5,150	0	0	5,150	5,150	0	0	5,150	0.0%
J	24	19	80.0%	Low	TDS	(lbs/yr)	5,687	0	0	5,687	5,687	0	0	5,687	0.0%
J	24	19	80.0%	Low	Total-P	(lbs/yr)	11	0	0	11	11	0	0	11	0.0%
J	24	19	80.0%	Low	Dissolved-P	(lbs/yr)	7	0	0	7	7	0	0	7	0.0%
J	24	19	80.0%	Low	TKN	(lbs/yr)	124	0	0	124	124	0	0	124	0.0%
J	24	19	80.0%	Low	NO2&NO3	(lbs/yr)	13	0	0	13	13	0	0	13	0.0%
J	24	19	80.0%	Low	Lead	(lbs/yr)	18	0	0	18	18	0	0	18	0.0%
J	24	19	80.0%	Low	Copper	(lbs/yr)	2	0	0	2	2	0	0	2	0.0%
J	24	19	80.0%	Low	Zinc	(lbs/yr)	5	0	0	5	5	0	0	5	0.0%
J	24	19	80.0%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0	0.0%

TABLE 5.3.1.2

Table 5.3.1.2
North Creek Pollutant Loading Summary Under Existing Conditions

	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Source	No BMP Controls Average Annual Total	With BMP Controls Average Annual Surface	With BMP Controls Average Annual Baseflow	With BMP Controls Average Annual Point Source	With BMP Controls Average Annual Total
T. Watershed (Sum)	2,333	453	19.4%	Medium	Runoff	(ac-ft/yr)	3,893	0	5	3,898	3,893	0	5	3,898
T. Watershed (Sum)	2,333	453	19.4%	Medium	BOD	(lbs/yr)	93,536	0	64	93,601	74,137	0	64	74,202
T. Watershed (Sum)	2,333	453	19.4%	Medium	COD	(lbs/yr)	680,406	0	0	680,406	447,923	0	0	447,923
T. Watershed (Sum)	2,333	453	19.4%	Medium	TSS	(lbs/yr)	1,505,390	0	40	1,505,430	742,290	0	40	742,330
T. Watershed (Sum)	2,333	453	19.4%	Medium	TDS	(lbs/yr)	1,058,490	0	0	1,058,490	1,058,490	0	0	1,058,490
T. Watershed (Sum)	2,333	453	19.4%	Medium	Total-P	(lbs/yr)	2,953	0	0	2,953	1,920	0	0	1,920
T. Watershed (Sum)	2,333	453	19.4%	Medium	Dissolved-P	(lbs/yr)	1,346	0	0	1,346	579	0	0	579
T. Watershed (Sum)	2,333	453	19.4%	Medium	TKN	(lbs/yr)	12,220	0	0	12,220	9,700	0	0	9,700
T. Watershed (Sum)	2,333	453	19.4%	Medium	NO2&NO3	(lbs/yr)	3,420	0	50	3,470	1,360	0	50	1,410
T. Watershed (Sum)	2,333	453	19.4%	Medium	Lead	(lbs/yr)	634	0	0	634	320	0	0	320
T. Watershed (Sum)	2,333	453	19.4%	Medium	Copper	(lbs/yr)	371	0	0	371	173	0	0	173
T. Watershed (Sum)	2,333	453	19.4%	Medium	Zinc	(lbs/yr)	700	0	0	700	430	0	0	430
T. Watershed (Sum)	2,333	453	19.4%	Medium	Cadmium	(lbs/yr)	20	0	0	20	10	0	0	10
T. Watershed (Sum)	2,333	453	19.4%	High	BOD	(lbs/yr)	169,727	0	64	169,792	134,342	0	64	134,406
T. Watershed (Sum)	2,333	453	19.4%	High	COD	(lbs/yr)	1,378,751	0	0	1,378,751	906,146	0	0	906,146
T. Watershed (Sum)	2,333	453	19.4%	High	TSS	(lbs/yr)	3,705,780	0	40	3,705,820	1,845,790	0	40	1,845,830
T. Watershed (Sum)	2,333	453	19.4%	High	TDS	(lbs/yr)	2,676,420	0	0	2,676,420	2,676,420	0	0	2,676,420
T. Watershed (Sum)	2,333	453	19.4%	High	Total-P	(lbs/yr)	7,064	0	0	7,064	4,609	0	0	4,609
T. Watershed (Sum)	2,333	453	19.4%	High	Dissolved-P	(lbs/yr)	2,946	0	0	2,946	1,236	0	0	1,236
T. Watershed (Sum)	2,333	453	19.4%	High	TKN	(lbs/yr)	28,330	0	0	28,330	22,500	0	0	22,500
T. Watershed (Sum)	2,333	453	19.4%	High	NO2&NO3	(lbs/yr)	9,200	0	50	9,250	3,560	0	50	3,610
T. Watershed (Sum)	2,333	453	19.4%	High	Lead	(lbs/yr)	1,581	0	0	1,581	807	0	0	807
T. Watershed (Sum)	2,333	453	19.4%	High	Copper	(lbs/yr)	981	0	0	981	462	0	0	462
T. Watershed (Sum)	2,333	453	19.4%	High	Zinc	(lbs/yr)	1,730	0	0	1,730	1,090	0	0	1,090
T. Watershed (Sum)	2,333	453	19.4%	High	Cadmium	(lbs/yr)	40	0	0	40	30	0	0	30
T. Watershed (Sum)	2,333	453	19.4%	Low	BOD	(lbs/yr)	43,831	0	64	43,895	34,823	0	64	34,888
T. Watershed (Sum)	2,333	453	19.4%	Low	COD	(lbs/yr)	261,916	0	0	261,916	172,913	0	0	172,913
T. Watershed (Sum)	2,333	453	19.4%	Low	TSS	(lbs/yr)	397,940	0	40	397,980	191,440	0	40	191,480
T. Watershed (Sum)	2,333	453	19.4%	Low	TDS	(lbs/yr)	258,750	0	0	258,750	258,750	0	0	258,750
T. Watershed (Sum)	2,333	453	19.4%	Low	Total-P	(lbs/yr)	832	0	0	832	542	0	0	542
T. Watershed (Sum)	2,333	453	19.4%	Low	Dissolved-P	(lbs/yr)	481	0	0	481	217	0	0	217
T. Watershed (Sum)	2,333	453	19.4%	Low	TKN	(lbs/yr)	3,740	0	0	3,740	2,980	0	0	2,980
T. Watershed (Sum)	2,333	453	19.4%	Low	NO2&NO3	(lbs/yr)	770	0	50	820	330	0	50	380
T. Watershed (Sum)	2,333	453	19.4%	Low	Lead	(lbs/yr)	162	0	0	162	80	0	0	80
T. Watershed (Sum)	2,333	453	19.4%	Low	Copper	(lbs/yr)	78	0	0	78	35	0	0	35
T. Watershed (Sum)	2,333	453	19.4%	Low	Zinc	(lbs/yr)	180	0	0	180	100	0	0	100
T. Watershed (Sum)	2,333	453	19.4%	Low	Cadmium	(lbs/yr)	0	0	0	0	0	0	0	0

TABLE 5.3.1.3

Table 5.3.1.3
North Creek Pollutant EMC Summary Under Existing Conditions

	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Source	No BMP Controls Average Annual Total	With BMP Controls Average Annual Surface	With BMP Controls Average Annual Baseflow	With BMP Controls Average Annual Point Source	With BMP Controls Average Annual Total
T. Watershed (EMC)	2,333	453	19.4%	Medium	BOD	(mg/L)	8.84	0.00	4.50	8.83	7.00	0.00	4.50	7.00
T. Watershed (EMC)	2,333	453	19.4%	Medium	COD	(mg/L)	64.27	0.00	0.00	64.19	42.31	0.00	0.00	42.26
T. Watershed (EMC)	2,333	453	19.4%	Medium	TSS	(mg/L)	142.21	0.00	2.79	142.02	70.12	0.00	2.79	70.03
T. Watershed (EMC)	2,333	453	19.4%	Medium	TDS	(mg/L)	99.99	0.00	0.00	99.85	99.99	0.00	0.00	99.85
T. Watershed (EMC)	2,333	453	19.4%	Medium	Total-P	(mg/L)	0.28	0.00	0.00	0.28	0.18	0.00	0.00	0.18
T. Watershed (EMC)	2,333	453	19.4%	Medium	Dissolved-P	(mg/L)	0.13	0.00	0.00	0.13	0.05	0.00	0.00	0.05
T. Watershed (EMC)	2,333	453	19.4%	Medium	TKN	(mg/L)	1.15	0.00	0.00	1.15	0.92	0.00	0.00	0.92
T. Watershed (EMC)	2,333	453	19.4%	Medium	NO2&NO3	(mg/L)	0.32	0.00	3.49	0.33	0.13	0.00	3.49	0.13
T. Watershed (EMC)	2,333	453	19.4%	Medium	Lead	(mg/L)	0.06	0.00	0.00	0.06	0.03	0.00	0.00	0.03
T. Watershed (EMC)	2,333	453	19.4%	Medium	Copper	(mg/L)	0.04	0.00	0.00	0.03	0.02	0.00	0.00	0.02
T. Watershed (EMC)	2,333	453	19.4%	Medium	Zinc	(mg/L)	0.07	0.00	0.00	0.07	0.04	0.00	0.00	0.04
T. Watershed (EMC)	2,333	453	19.4%	Medium	Cadmium	(mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T. Watershed (EMC)	2,333	453	19.4%	High	BOD	(mg/L)	16.03	0.00	4.50	16.02	12.69	0.00	4.50	12.68
T. Watershed (EMC)	2,333	453	19.4%	High	COD	(mg/L)	130.24	0.00	0.00	130.07	85.60	0.00	0.00	85.48
T. Watershed (EMC)	2,333	453	19.4%	High	TSS	(mg/L)	350.06	0.00	2.79	349.59	174.36	0.00	2.79	174.13
T. Watershed (EMC)	2,333	453	19.4%	High	TDS	(mg/L)	252.83	0.00	0.00	252.48	252.83	0.00	0.00	252.48
T. Watershed (EMC)	2,333	453	19.4%	High	Total-P	(mg/L)	0.67	0.00	0.00	0.67	0.44	0.00	0.00	0.43
T. Watershed (EMC)	2,333	453	19.4%	High	Dissolved-P	(mg/L)	0.28	0.00	0.00	0.28	0.12	0.00	0.00	0.12
T. Watershed (EMC)	2,333	453	19.4%	High	TKN	(mg/L)	2.68	0.00	0.00	2.67	2.13	0.00	0.00	2.12
T. Watershed (EMC)	2,333	453	19.4%	High	NO2&NO3	(mg/L)	0.87	0.00	3.49	0.87	0.34	0.00	3.49	0.34
T. Watershed (EMC)	2,333	453	19.4%	High	Lead	(mg/L)	0.15	0.00	0.00	0.15	0.08	0.00	0.00	0.08
T. Watershed (EMC)	2,333	453	19.4%	High	Copper	(mg/L)	0.09	0.00	0.00	0.09	0.04	0.00	0.00	0.04
T. Watershed (EMC)	2,333	453	19.4%	High	Zinc	(mg/L)	0.16	0.00	0.00	0.16	0.10	0.00	0.00	0.10
T. Watershed (EMC)	2,333	453	19.4%	High	Cadmium	(mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T. Watershed (EMC)	2,333	453	19.4%	Low	BOD	(mg/L)	4.14	0.00	4.50	4.14	3.29	0.00	4.50	3.29
T. Watershed (EMC)	2,333	453	19.4%	Low	COD	(mg/L)	24.74	0.00	0.00	24.71	16.33	0.00	0.00	16.31
T. Watershed (EMC)	2,333	453	19.4%	Low	TSS	(mg/L)	37.59	0.00	2.79	37.54	18.08	0.00	2.79	18.06
T. Watershed (EMC)	2,333	453	19.4%	Low	TDS	(mg/L)	24.44	0.00	0.00	24.41	24.44	0.00	0.00	24.41
T. Watershed (EMC)	2,333	453	19.4%	Low	Total-P	(mg/L)	0.08	0.00	0.00	0.08	0.05	0.00	0.00	0.05
T. Watershed (EMC)	2,333	453	19.4%	Low	Dissolved-P	(mg/L)	0.05	0.00	0.00	0.05	0.02	0.00	0.00	0.02
T. Watershed (EMC)	2,333	453	19.4%	Low	TKN	(mg/L)	0.35	0.00	0.00	0.35	0.28	0.00	0.00	0.28
T. Watershed (EMC)	2,333	453	19.4%	Low	NO2&NO3	(mg/L)	0.07	0.00	3.49	0.08	0.03	0.00	3.49	0.04
T. Watershed (EMC)	2,333	453	19.4%	Low	Lead	(mg/L)	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.01
T. Watershed (EMC)	2,333	453	19.4%	Low	Copper	(mg/L)	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
T. Watershed (EMC)	2,333	453	19.4%	Low	Zinc	(mg/L)	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.01
T. Watershed (EMC)	2,333	453	19.4%	Low	Cadmium	(mg/L)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 5.3.1.4

Table 5.3.1.4
Pollutant Loads and Unit Loading Rates Per Basin in the North Creek Watershed Under Existing Conditions

		Sub-basins										
		A	B	C	D	E	F	G	H	I	J	Total
Area	(acres)	249	92	91	318	500	436	382	166	74	24	2333
Runoff	(ac-ft/yr)	351	152	142	477	745	887	665	245	142	92	3898
Pollutant Loads (lbs/yr)												
BOD	(lbs/yr)	6,301	3,435	2,586	8,351	9,592	20,645	13,905	4,406	2,536	2,445	74,202
COD	(lbs/yr)	33,407	21,968	13,876	44,119	47,875	138,973	94,298	23,288	14,757	15,361	447,923
TSS	(lbs/yr)	57,207	31,251	17,159	57,889	89,992	250,474	166,933	30,462	18,230	22,737	742,334
TDS	(lbs/yr)	95,475	41,324	38,712	129,813	202,536	239,625	180,877	66,558	38,464	25,108	1,058,492
Total-P	(lbs/yr)	141	111	65	204	203	587	400	109	63	38	1,920
Dissolved-P	(lbs/yr)	27	32	11	35	42	240	135	18	13	25	579
TKN	(lbs/yr)	791	508	350	1,115	1,175	2,709	1,843	601	342	266	9,700
NO2&NO3	(lbs/yr)	72	76	28	91	133	586	322	47	30	30	1,414
Lead	(lbs/yr)	6	9	3	9	14	144	61	5	8	60	320
Copper	(lbs/yr)	7	9	4	12	14	67	40	6	5	9	173
Zinc	(lbs/yr)	17	14	11	35	77	136	80	16	14	30	430
Cadmium	(lbs/yr)	1	1	0	1	1	3	2	0	0	1	10
Unit Loading Rates (lbs/yr-acre)												
BOD		25	37	28	26	19	47	36	27	34	102	32
COD		134	239	152	139	96	319	247	140	199	640	192
TSS		230	340	189	182	180	574	437	184	246	947	318
TDS		383	449	425	408	405	550	474	401	520	1046	454
Total-P		0.57	1.21	0.71	0.64	0.41	1.35	1.05	0.66	0.85	1.57	0.82
Dissolved-P		0.11	0.35	0.12	0.11	0.08	0.55	0.35	0.11	0.17	1.03	0.25
TKN		3.18	5.53	3.85	3.50	2.35	6.21	4.82	3.62	4.62	11.09	4.16
NO2&NO3		0.29	0.82	0.31	0.29	0.27	1.34	0.84	0.28	0.40	1.26	0.61
Lead		0.02	0.10	0.03	0.03	0.03	0.33	0.16	0.03	0.11	2.51	0.14
Copper		0.03	0.10	0.04	0.04	0.03	0.15	0.11	0.04	0.07	0.39	0.07
Zinc		0.07	0.15	0.12	0.11	0.15	0.31	0.21	0.10	0.19	1.26	0.18
Cadmium		0.002	0.006	0.003	0.003	0.002	0.008	0.005	0.003	0.005	0.021	0.004

As a result of numerous BMP facilities in the North Creek watershed, gross pollutant loadings are reduced prior to their introduction into the surface waters. In accordance with Level of Service (LOS) standards, drainage systems will treat the first inch of rainfall in order to minimize pollution from oil, suspended solids, and other objectionable materials. This LOS criteria is only applicable to new development. Approximately 70% of the North Creek watershed is treated through wet detention ponds in each sub-basin before the runoff flows into other sub-basins or to the North Creek, and about 30% of the basin developed without sufficient stormwater control facilities. The different LOS objectives may be appropriate to improve or maintain water quality in the basin . A number of sub-basins such as F and G contain few BMP's, but the runoffs from the sub-basins are treated by detention ponds in the neighboring sub-basins before the runoffs flow into North Creek. It would be ideal for these sub-basins to have the runoff treated locally before it flows out of the sub-basin.

Table 5.3.1.5 shows the removal of pollutants through the use of BMPs for each sub-basin under existing conditions. Table 5.3.1.6 provides the estimated total gross loads and net loads. Figures 5.3.1.1 and 5.3.1.2 graphically present the differences between the gross loads and net loads. In general, approximately 30% of the pollutant load is removed by the treatment systems presently in place in the North Creek watershed. As expected, there are approximately 50% reduction of TSS and Lead and 60% removal of Dissolved-P, NO_2 and NO_3.

Sub-basin J has no removal load as no BMP's existing in the area. Sub-basins F and G have low pollutant removal efficiencies of 11% and 21%, respectively. Removal efficiencies for the remaining sub-basins are from 29% to 44%.

Based on the available pollutant concentration results from the modeling, the water quality index value is calculated and compared with Florida Stream Water Quality Index (WQI). The WQI of the North Creek Basin, under existing conditions, falls in the same range with the index value shown in the study of Southwest Florida District Water Quality, 1994, 305(b); and the value calculated by using North Creek water quality data from NPDES permit application in 1993. The WQI values calculated by using NPDES data for other basins, such as South Creek, Hatchett Creek and Phillippi Creek also fall in the same range of water quality conditions (see Table 5.3.2.7)..

TABLE 5.3.1.5

Table 5.3.1.5

Pollutant Loading Reductions Per Basin Utilizing Existing BMP's in the North Creek Watershed

		A	B	C	D	E	F	G	H	I	J	Total
Area	(acres)	249	92	91	318	500	436	382	166	74	24	2333
Runoff	(ac-ft/yr)	351	152	142	477	745	887	665	245	142	92	3898
BOD	(lbs/yr)	2,447	841	1,099	3,579	4,111	2,019	2,423	1,888	991	0	19,399
COD	(lbs/yr)	29,287	10,646	13,744	44,119	47,875	21,193	29,942	23,288	12,389	0	232,484
TSS	(lbs/yr)	104,857	27,698	38,733	135,074	209,982	53,268	87,509	71,078	34,899	0	763,097
TDS	(lbs/yr)	0	0	0	0	0	0	0	0	0	0	0
Total-P	(lbs/yr)	125	54	64	204	203	65	150	109	59	0	1,032
Dissolved-	(lbs/yr)	83	36	44	140	169	69	111	74	42	0	768
TKN	(lbs/yr)	309	124	149	478	504	230	337	258	136	0	2,524
NO2&NO3	(lbs/yr)	218	86	111	364	531	142	309	187	108	0	2,056
Lead	(lbs/yr)	19	10	12	36	56	121	31	19	11	0	315
Copper	(lbs/yr)	18	9	11	35	41	24	31	18	11	0	198
Zinc	(lbs/yr)	16	7	11	35	77	53	40	16	12	0	266
Cadmium	(lbs/yr)	0	0	0	1	1	1	1	0	0	0	5

TABLE 5.3.1.6

Table 5.3.1.6

Estimated Total Pollutant Loading for Surface Runoff in the Noth Creek Watershed Under Existing Conditions

Parameters		Gross loads[1]	Removal[2]	Net Loads[3]
Total Drainage Area (acres) = 2,333				
Total impervious Area (acres) = 453				
Total Surface Runoff (ac-ft/yr) = 3,898				
BOD	(lbs/yr)	93,601	19,399	74,202
COD	(lbs/yr)	680,406	232,484	447,923
TSS	(lbs/yr)	1,505,431	763,097	742,334
TDS	(lbs/yr)	1,058,492	0	1,058,492
Total-P	(lbs/yr)	2,953	1,032	1,920
Dissolved-P	(lbs/yr)	1,346	768	579
TKN	(lbs/yr)	12,224	2,524	9,700
NO2&NO3	(lbs/yr)	3,470	2,056	1,414
Lead	(lbs/yr)	634	315	320
Copper	(lbs/yr)	371	198	173
Zinc	(lbs/yr)	696	266	430
Cadmium	(lbs/yr)	15	5	10

[1] Gross Laod - Total pollutant load with no best management practices

[2] Removal - Mass of pollutant removed from stormwater by BMPs.

[3] Net Laod - Total pollutant load after treatment by BMPs.

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FIGURES 5.3.1.1 and 5.3.1.2

Figure 5.3.1.1
Estimated Gross Pollutant Loads and Net Pollutant Loads of Oxygen Demand and Sediment for the North Creek Watershed Under Existing Conditions

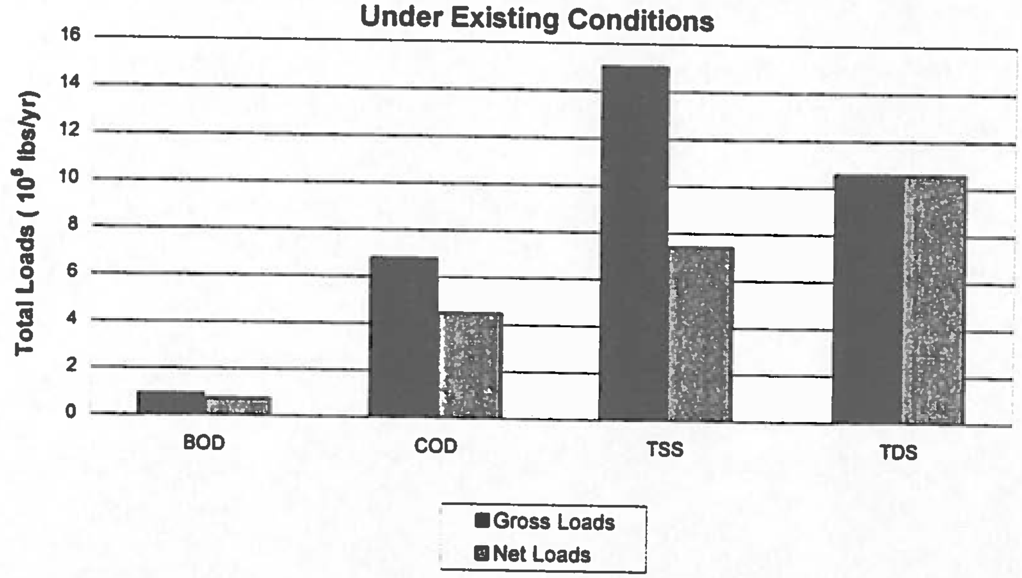
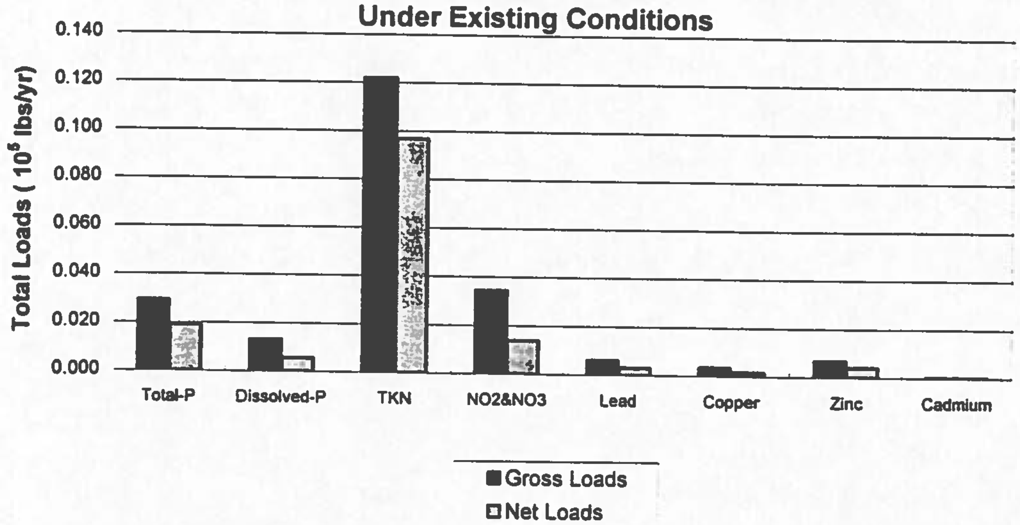


Figure 5.3.1.2
Estimated Gross Pollutant Loads and Net Pollutant Loads of Nutrients and Heavy Metals for the North Creek Watershed Under Existing Conditions



The total pollutant loads produced from North Creek basin listed in NPDES study in 1993 are higher than the loads calculated from this study, this is because the land uses and percentage coverages of BMP's in the entire basin have been significantly changed since 1993. The total forest and agricultural area is decreased from 74% in NPDES study to 34%, and the residential area is increased from 16% to 45%. The BMP coverages are also increased due to requirements for new developments.

5.3.2 Pollutant Loads under Proposed Condition with Future Land Uses.

The pollutant loads under proposed conditions with future land uses were calculated for the North Creek watershed by using WMM model. Land use data for the future development of North Creek basin is obtained from Sarasota County Future Land Use Map, 1996. The basin impervious percentages for different type of land uses and same as the values used in the existing conditions. Event Mean Concentration file is also kept same for the future development simulations. BMP's coverage data for future conditions is defined from existing BMP's and the BMP facilities planned for the future development.

Table 5.3.2.1 provides the total loads of the entire North Creek basin with or without BMP's, and Table 5.3.2.2 shows the average annual event mean concentrations calculated for the future development. Pollutant loads and unit loading rates per basin are summarized by pollutant parameter in Table 5.3.2.3. Sub-basin J has the highest pollutant unit loading rates as no BMP facility in the area. Sub-basin F shows the second highest pollutant unit loading rates as the basin has relatively low BMP coverage compared with other sub-basins.

Table 5.3.2.4 provides pollutant loading reductions by BMP's under future development. Compared with the existing condition, about 10% higher pollutant reduction have been found in sub-basins F and G due to some BMP's improvements in the future development. The pollutant loading reduction by BMP's for entire basin under the future condition is increased approximately 6%. Table 5.3.2.5 shows the total gross, removal and wet loads, and Figure 5.3.2.1 and 5.3.2.2 graphically present the differences between gross loads and wet loads for twelve pollutant parameters.

Table 5.3.2.6 lists the comparison of gross and net pollutant loads in North Creek under existing and future conditions. The removal percentages by BMP's are generally higher in the future condition than the values shown in existing condition.

The total net pollutant loads under the future land use conditions are approximately 8% higher than the loads in existing conditions. As total pollutant loads increase when impervious percentage is higher in North Creek, more residential area will be built according to the future development plan, therefore higher pollutant loads will be produced. However, several pollutant loads, such as total suspended solids, nitrate and nitrite are shown lower than existing conditions, as these parameters have higher event mean concentrations in agricultural or forest areas than urban areas.

Water Quality Index value calculated by using WMM model results simulated for future development does not show significant difference from the index value of existing condition in this study and the value calculated from NPDES study (see Table 5.3.2.7).

Table 5.3.2.1

Table 5.3.2.1
North Creek Pollutant Loading Summary Under Future Development

	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Source	No BMP Controls Average Annual Total	With BMP Controls Average Annual Surface	With BMP Controls Average Annual Baseflow	With BMP Controls Average Annual Point Source	With BMP Controls Average Annual Total
T. Watershed (Sum)	2,333	662	28.4%	Medium	Runoff	(ac-ft/yr)	4,652	0	5	4,658	4,652	0	5	4,658
T. Watershed (Sum)	2,333	662	28.4%	Medium	BOD	(lbs/yr)	120,201	0	64	120,266	89,378	0	64	89,443
T. Watershed (Sum)	2,333	662	28.4%	Medium	COD	(lbs/yr)	906,154	0	0	906,154	519,517	0	0	519,517
T. Watershed (Sum)	2,333	662	28.4%	Medium	TSS	(lbs/yr)	1,611,100	0	40	1,611,140	632,090	0	40	632,130
T. Watershed (Sum)	2,333	662	28.4%	Medium	TDS	(lbs/yr)	1,265,100	0	0	1,265,100	1,265,100	0	0	1,265,100
T. Watershed (Sum)	2,333	662	28.4%	Medium	Total-P	(lbs/yr)	4,238	0	0	4,238	2,387	0	0	2,387
T. Watershed (Sum)	2,333	662	28.4%	Medium	Dissolved-P	(lbs/yr)	1,901	0	0	1,901	576	0	0	576
T. Watershed (Sum)	2,333	662	28.4%	Medium	TKN	(lbs/yr)	16,760	0	0	16,760	12,440	0	0	12,440
T. Watershed (Sum)	2,333	662	28.4%	Medium	NO2&NO3	(lbs/yr)	4,590	0	50	4,640	1,310	0	50	1,360
T. Watershed (Sum)	2,333	662	28.4%	Medium	Lead	(lbs/yr)	872	0	0	872	338	0	0	338
T. Watershed (Sum)	2,333	662	28.4%	Medium	Copper	(lbs/yr)	564	0	0	564	197	0	0	197
T. Watershed (Sum)	2,333	662	28.4%	Medium	Zinc	(lbs/yr)	940	0	0	940	530	0	0	530
T. Watershed (Sum)	2,333	662	28.4%	Medium	Cadmium	(lbs/yr)	20	0	0	20	10	0	0	10
T. Watershed (Sum)	2,333	662	28.4%	High	BOD	(lbs/yr)	213,745	0	64	213,809	158,891	0	64	158,956
T. Watershed (Sum)	2,333	662	28.4%	High	COD	(lbs/yr)	1,848,315	0	0	1,848,315	1,057,909	0	0	1,057,909
T. Watershed (Sum)	2,333	662	28.4%	High	TSS	(lbs/yr)	4,353,660	0	40	4,353,700	1,711,150	0	40	1,711,200
T. Watershed (Sum)	2,333	662	28.4%	High	TDS	(lbs/yr)	3,402,520	0	0	3,402,520	3,402,520	0	0	3,402,520
T. Watershed (Sum)	2,333	662	28.4%	High	Total-P	(lbs/yr)	10,193	0	0	10,193	5,763	0	0	5,763
T. Watershed (Sum)	2,333	662	28.4%	High	Dissolved-P	(lbs/yr)	4,017	0	0	4,017	1,222	0	0	1,222
T. Watershed (Sum)	2,333	662	28.4%	High	TKN	(lbs/yr)	40,310	0	0	40,310	29,890	0	0	29,890
T. Watershed (Sum)	2,333	662	28.4%	High	NO2&NO3	(lbs/yr)	12,640	0	50	12,690	3,560	0	50	3,610
T. Watershed (Sum)	2,333	662	28.4%	High	Lead	(lbs/yr)	2,149	0	0	2,149	850	0	0	850
T. Watershed (Sum)	2,333	662	28.4%	High	Copper	(lbs/yr)	1,511	0	0	1,511	528	0	0	528
T. Watershed (Sum)	2,333	662	28.4%	High	Zinc	(lbs/yr)	2,350	0	0	2,350	1,350	0	0	1,350
T. Watershed (Sum)	2,333	662	28.4%	High	Cadmium	(lbs/yr)	60	0	0	60	40	0	0	40
T. Watershed (Sum)	2,333	662	28.4%	Low	BOD	(lbs/yr)	58,072	0	64	58,136	43,219	0	64	43,283
T. Watershed (Sum)	2,333	662	28.4%	Low	COD	(lbs/yr)	343,861	0	0	343,861	197,902	0	0	197,902
T. Watershed (Sum)	2,333	662	28.4%	Low	TSS	(lbs/yr)	316,240	0	40	316,280	123,510	0	40	123,550
T. Watershed (Sum)	2,333	662	28.4%	Low	TDS	(lbs/yr)	251,820	0	0	251,820	251,820	0	0	251,820
T. Watershed (Sum)	2,333	662	28.4%	Low	Total-P	(lbs/yr)	1,200	0	0	1,200	676	0	0	676
T. Watershed (Sum)	2,333	662	28.4%	Low	Dissolved-P	(lbs/yr)	730	0	0	730	221	0	0	221
T. Watershed (Sum)	2,333	662	28.4%	Low	TKN	(lbs/yr)	4,750	0	0	4,750	3,540	0	0	3,540
T. Watershed (Sum)	2,333	662	28.4%	Low	NO2&NO3	(lbs/yr)	940	0	50	1,000	290	0	50	340
T. Watershed (Sum)	2,333	662	28.4%	Low	Lead	(lbs/yr)	226	0	0	226	85	0	0	85
T. Watershed (Sum)	2,333	662	28.4%	Low	Copper	(lbs/yr)	115	0	0	115	40	0	0	40
T. Watershed (Sum)	2,333	662	28.4%	Low	Zinc	(lbs/yr)	230	0	0	230	130	0	0	130
T. Watershed (Sum)	2,333	662	28.4%	Low	Cadmium	(lbs/yr)	10	0	0	10	0	0	0	0

Table 5.3.2.2

Table 5.3.2.2
North Creek Pollutant EMC Summary Under Future Development

	Drainage Area (ac)	Imperv Area (ac)	% Imperv	Loading Factors	Constituent	(units)	No BMP Controls Average Annual Surface	No BMP Controls Average Annual Baseflow	No BMP Controls Average Annual Point Source	No BMP Controls Average Annual Total	With BMP Controls Average Annual Surface	With BMP Controls Average Annual Baseflow	With BMP Controls Average Annual Point Source	With BMP Controls Average Annual Total
T. Watershed (EMC)	2,333	662	28.4%	Medium	BOD	(mg/L)	9.50	0.00	4.50	9.49	7.06	0.00	4.50	7.06
T. Watershed (EMC)	2,333	662	28.4%	Medium	COD	(mg/L)	71.62	0.00	0.00	71.54	41.06	0.00	0.00	41.01
T. Watershed (EMC)	2,333	662	28.4%	Medium	TSS	(mg/L)	127.34	0.00	2.79	127.20	49.96	0.00	2.79	49.91
T. Watershed (EMC)	2,333	662	28.4%	Medium	TDS	(mg/L)	99.99	0.00	0.00	99.88	99.99	0.00	0.00	99.88
T. Watershed (EMC)	2,333	662	28.4%	Medium	Total-P	(mg/L)	0.33	0.00	0.00	0.33	0.19	0.00	0.00	0.19
T. Watershed (EMC)	2,333	662	28.4%	Medium	Dissolved-P	(mg/L)	0.15	0.00	0.00	0.15	0.05	0.00	0.00	0.05
T. Watershed (EMC)	2,333	662	28.4%	Medium	TKN	(mg/L)	1.32	0.00	0.00	1.32	0.98	0.00	0.00	0.98
T. Watershed (EMC)	2,333	662	28.4%	Medium	NO2&NO3	(mg/L)	0.36	0.00	3.49	0.37	0.10	0.00	3.49	0.11
T. Watershed (EMC)	2,333	662	28.4%	Medium	Lead	(mg/L)	0.07	0.00	0.00	0.07	0.03	0.00	0.00	0.03
T. Watershed (EMC)	2,333	662	28.4%	Medium	Copper	(mg/L)	0.04	0.00	0.00	0.04	0.02	0.00	0.00	0.02
T. Watershed (EMC)	2,333	662	28.4%	Medium	Zinc	(mg/L)	0.07	0.00	0.00	0.07	0.04	0.00	0.00	0.04
T. Watershed (EMC)	2,333	662	28.4%	Medium	Cadmium	(mg/L)	0.002	0.000	0.000	0.002	0.001	0.000	0.000	0.001
T. Watershed (EMC)	2,333	662	28.4%	High	BOD	(mg/L)	16.89	0.00	4.50	16.88	12.56	0.00	4.50	12.55
T. Watershed (EMC)	2,333	662	28.4%	High	COD	(mg/L)	146.09	0.00	0.00	145.92	83.61	0.00	0.00	83.52
T. Watershed (EMC)	2,333	662	28.4%	High	TSS	(mg/L)	344.10	0.00	2.79	343.71	135.24	0.00	2.79	135.10
T. Watershed (EMC)	2,333	662	28.4%	High	TDS	(mg/L)	268.93	0.00	0.00	268.62	268.93	0.00	0.00	268.62
T. Watershed (EMC)	2,333	662	28.4%	High	Total-P	(mg/L)	0.81	0.00	0.00	0.80	0.46	0.00	0.00	0.45
T. Watershed (EMC)	2,333	662	28.4%	High	Dissolved-P	(mg/L)	0.32	0.00	0.00	0.32	0.10	0.00	0.00	0.10
T. Watershed (EMC)	2,333	662	28.4%	High	TKN	(mg/L)	3.19	0.00	0.00	3.18	2.36	0.00	0.00	2.36
T. Watershed (EMC)	2,333	662	28.4%	High	NO2&NO3	(mg/L)	1.00	0.00	3.49	1.00	0.28	0.00	3.49	0.29
T. Watershed (EMC)	2,333	662	28.4%	High	Lead	(mg/L)	0.17	0.00	0.00	0.17	0.07	0.00	0.00	0.07
T. Watershed (EMC)	2,333	662	28.4%	High	Copper	(mg/L)	0.12	0.00	0.00	0.12	0.04	0.00	0.00	0.04
T. Watershed (EMC)	2,333	662	28.4%	High	Zinc	(mg/L)	0.19	0.00	0.00	0.19	0.11	0.00	0.00	0.11
T. Watershed (EMC)	2,333	662	28.4%	High	Cadmium	(mg/L)	0.005	0.000	0.000	0.005	0.003	0.000	0.000	0.003
T. Watershed (EMC)	2,333	662	28.4%	Low	BOD	(mg/L)	4.59	0.00	4.50	4.59	3.42	0.00	4.50	3.42
T. Watershed (EMC)	2,333	662	28.4%	Low	COD	(mg/L)	27.18	0.00	0.00	27.15	15.64	0.00	0.00	15.62
T. Watershed (EMC)	2,333	662	28.4%	Low	TSS	(mg/L)	24.99	0.00	2.79	24.97	9.76	0.00	2.79	9.75
T. Watershed (EMC)	2,333	662	28.4%	Low	TDS	(mg/L)	19.90	0.00	0.00	19.88	19.90	0.00	0.00	19.88
T. Watershed (EMC)	2,333	662	28.4%	Low	Total-P	(mg/L)	0.09	0.00	0.00	0.09	0.05	0.00	0.00	0.05
T. Watershed (EMC)	2,333	662	28.4%	Low	Dissolved-P	(mg/L)	0.06	0.00	0.00	0.06	0.02	0.00	0.00	0.02
T. Watershed (EMC)	2,333	662	28.4%	Low	TKN	(mg/L)	0.38	0.00	0.00	0.38	0.28	0.00	0.00	0.28
T. Watershed (EMC)	2,333	662	28.4%	Low	NO2&NO3	(mg/L)	0.07	0.00	3.49	0.08	0.02	0.00	3.49	0.03
T. Watershed (EMC)	2,333	662	28.4%	Low	Lead	(mg/L)	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.01
T. Watershed (EMC)	2,333	662	28.4%	Low	Copper	(mg/L)	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
T. Watershed (EMC)	2,333	662	28.4%	Low	Zinc	(mg/L)	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.01
T. Watershed (EMC)	2,333	662	28.4%	Low	Cadmium	(mg/L)	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000

Table 5.3.2.3

Table 5.3.2.3

Pollutant Loads and Unit Loading Rates Per Basin in the North Creek Watershed Under Future Development

		Sub-basins										
		A	B	C	D	E	F	G	H	I	J	Total
Area	(acres)	249	92	91	318	500	436	382	166	74	24	2,332
Runoff	(ac-ft/yr)	506	157	156	547	1,032	992	741	284	150	92	4,658
Pollutant Loads (lbs/yr)												
BOD	(lbs/yr)	9,703	3,181	2,903	10,294	16,968	22,306	13,529	5,345	2,769	2,445	89,443
COD	(lbs/yr)	53,100	17,492	15,848	56,243	92,597	144,930	78,520	29,206	16,220	15,361	519,517
TSS	(lbs/yr)	55,886	17,817	16,972	59,867	105,820	214,187	89,361	31,071	18,413	22,737	632,132
TDS	(lbs/yr)	137,685	42,776	42,366	148,765	280,673	268,329	201,555	77,181	40,659	25,108	1,265,097
Total-P		254	89	76	271	467	629	346	146	71	38	2,387
Dissolved-P	(lbs/yr)	43	15	13	46	87	240	68	25	14	25	576
TKN	(lbs/yr)	1,353	477	406	1,437	2,480	3,004	1,859	772	381	266	12,436
NO2&NO3	(lbs/yr)	105	34	33	114	225	567	160	61	33	30	1,362
Lead	(lbs/yr)	13	4	4	13	29	156	42	7	9	60	338
Copper	(lbs/yr)	16	5	5	17	31	72	27	9	6	9	197
Zinc	(lbs/yr)	41	11	13	46	115	159	79	24	16	30	534
Cadmium	(lbs/yr)	1	0	0	1	2	4	2	1	0	1	13
Unit Loading Rates (lbs/yr-acre)												
BOD		39	35	32	32	34	51	35	32	37	102	38
COD		213	190	174	177	185	332	206	176	219	640	223
TSS		224	194	187	188	212	491	234	187	249	947	271
TDS		553	465	466	468	561	615	528	465	549	1046	542
Total-P		1.02	0.97	0.84	0.85	0.93	1.44	0.90	0.88	0.96	1.57	1.02
Dissolved-P		0.17	0.16	0.14	0.15	0.17	0.55	0.18	0.15	0.19	1.03	0.25
TKN		5.43	5.19	4.46	4.52	4.96	6.89	4.87	4.65	5.15	11.09	5.33
NO2&NO3		0.42	0.37	0.36	0.36	0.45	1.30	0.42	0.37	0.44	1.26	0.58
Lead		0.05	0.05	0.04	0.04	0.06	0.36	0.11	0.04	0.12	2.51	0.14
Copper		0.06	0.05	0.05	0.05	0.06	0.17	0.07	0.05	0.07	0.39	0.08
Zinc		0.16	0.12	0.15	0.14	0.23	0.36	0.21	0.14	0.21	1.26	0.23
Cadmium		0.005	0.005	0.004	0.004	0.005	0.009	0.005	0.004	0.005	0.021	0.006

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Table 5.3.2.4

Table 5.3.2.4

Pollutant Loading Reductions Per Basin Utilizing BMP's in the North Creek Watershed

Under Future Development

		A	B	C	D	E	F	G	H	I	J	Total
Area	(acres)	249	92	91	318	500	436	382	166	74	24	2333
Runoff	(ac-ft/yr)	506	157	156	547	1,032	992	741	284	150	92	4658
BOD	(lbs/yr)	4,158	1,363	1,244	4,412	7,272	3,625	5,367	2,291	1,091	0	30,823
COD	(lbs/yr)	53,100	17,492	15,848	56,243	92,597	40,431	67,866	29,206	13,853	0	386,636
TSS	(lbs/yr)	130,401	41,574	39,601	139,689	246,914	98,864	174,140	72,500	35,326	0	979,009
TDS	(lbs/yr)	0	0	0	0	0	0	0	0	0	0	0
Total-P	(lbs/yr)	254	89	76	271	467	150	330	146	68	0	1,851
Dissolved-P	(lbs/yr)	172	59	52	185	346	132	232	99	47	0	1,325
TKN	(lbs/yr)	580	204	174	616	1,063	449	750	331	153	0	4,320
NO2&NO3	(lbs/yr)	419	137	130	456	901	278	592	244	119	0	3,277
Lead	(lbs/yr)	51	17	15	54	116	170	70	28	13	0	534
Copper	(lbs/yr)	47	15	14	51	94	41	65	26	13	0	367
Zinc	(lbs/yr)	41	11	13	46	115	76	67	24	13	0	406
Cadmium	(lbs/yr)	1	0	0	1	2	1	2	1	0	0	10

Tabel 5.3.2.5

Table 5.3.2.5

Estimated Total Pollutant Loading for Surface Runoff in the Noth Creek Watershed Under Future Development

Parameters		Gross loads[1]	Removal[2]	Net Loads[3]
Total Drainage Area (acres) = 2,333				
Total impervious Area (acres) = 662				
Total Surface Runoff (ac-ft/yr) = 4658				
BOD	(lbs/yr)	120,266	30,823	89,443
COD	(lbs/yr)	906,154	386,636	519,517
TSS	(lbs/yr)	1,611,141	979,009	632,132
TDS	(lbs/yr)	1,265,097	0	1,265,097
Total-P	(lbs/yr)	4,238	1,851	2,387
Dissolved-P	(lbs/yr)	1,901	1,325	576
TKN	(lbs/yr)	16,756	4,320	12,436
NO2&NO3	(lbs/yr)	4,639	3,277	1,362
Lead	(lbs/yr)	872	534	338
Copper	(lbs/yr)	564	367	197
Zinc	(lbs/yr)	941	406	534
Cadmium	(lbs/yr)	23	10	13

[1] Gross Laod - Total pollutant load with no best management practices

[2] Removal - Mass of pollutant removed from stormwater by BMPs.

[3] Net Laod - Total pollutant load after treatment by BMPs.

Figure 5.3.2.1 and 5.3.2.2

Figure 5.3.2.1
Estimated Gross Pollutant Loads and Net Pollutant Loads of Oxygen Demand and Sediment for the North Creek Watershed Under Future Development

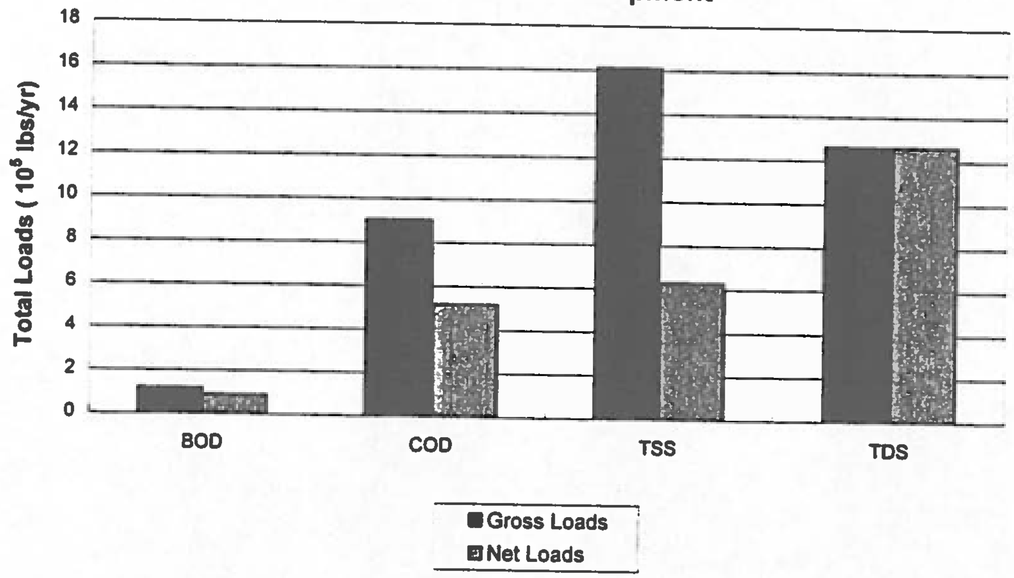

Figure 5.3.2.2
Estimated Gross Pollutant Loads and Net Pollutant Loads of Nutrients and Heavy Metals for the North Creek Watershed Under Future Development

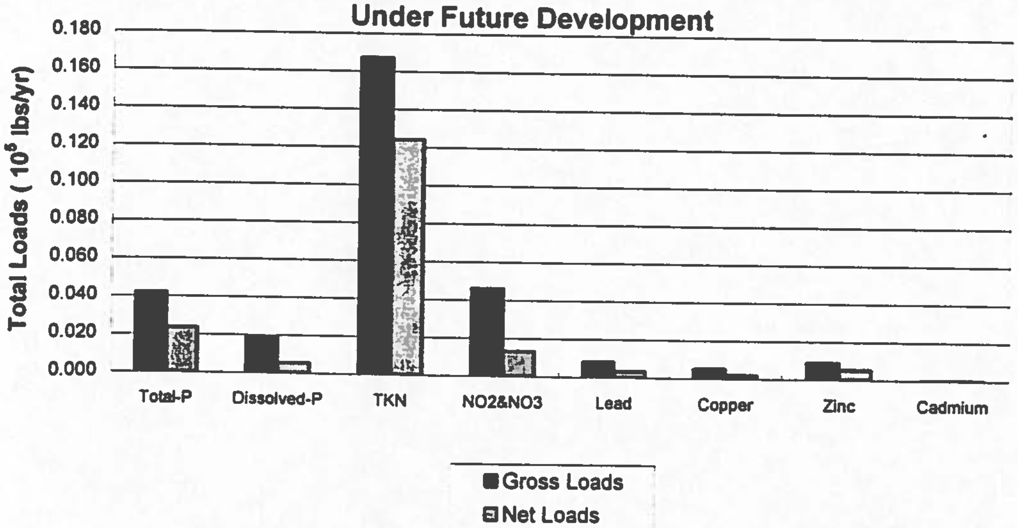

Table 5.3.2.6

Table 5.3.2.6

Estimated Total Pollutant Loading for Surface Runoff in the Noth Creek Watershed Under Existing Condition and Future Development

Parameters		Existing Conditions			Future Development		
		Gross loads[1]	Net Loads[2]	Removal %[3]	Gross loads[1]	Net Loads[2]	Removal %[3]
BOD	(lbs/yr)	93,601	74,202	21%	120,266	89,443	26%
COD	(lbs/yr)	680,406	447,923	34%	906,154	519,517	43%
TSS	(lbs/yr)	1,505,431	742,334	51%	1,611,141	632,132	61%
TDS	(lbs/yr)	1,058,492	1,058,492	0%	1,265,097	1,265,097	0%
Total-P	(lbs/yr)	2,953	1,920	35%	4,238	2,387	44%
Dissolved-P	(lbs/yr)	1,346	579	57%	1,901	576	70%
TKN	(lbs/yr)	12,224	9,700	21%	16,756	12,436	26%
NO2&NO3	(lbs/yr)	3,470	1,414	59%	4,639	1,362	71%
Lead	(lbs/yr)	634	320	50%	872	338	61%
Copper	(lbs/yr)	371	173	53%	564	197	65%
Zinc	(lbs/yr)	696	430	38%	941	534	43%
Cadmium	(lbs/yr)	15	10	34%	23	13	43%

[1] Gross Laod - Total pollutant load with no best management practices

[2] Net Laod - Total pollutant load after treatment by BMPs.

[3] Removal % - Removal percentages of pollutant load from stormwater by BMPs.

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Table 5.3.2.7
Water Quality Index Comparison with Other Streams

	NORTH CREEK Existing Con.			NORTH CREEK Future Con.			NORTH CREEK NPDES Study			SOUTH CREEK NPDES Study			PHILLIPPI CREEK NPDES Study			HATCHETT CREEK NPDES Study		
	EMC (mg/l)	Index Value	Index Average	EMC (mg/l)	Index Value	Index Average	EMC (mg/l)	Index Value	Index Average	EMC (mg/l)	Index Value	Index Average	EMC (mg/l)	Index Value	Index Average	EMC (mg/l)	Index Value	Index Average
BOD	7	100		7.1	100		8.7	100		7.7	100		10.1	100		8.8	100	
COD	42.3	45	73	41.1	43.8	72	50	53.3	77	50	53.3	77	70	68.6	84	60	61.6	81
TSS	70	100	100	50	100	100	160	100	100	160	100	100	130	100	100	130	100	100
TP	0.18	62.5	63	0.19	63.8	64	0.3	72.7	73	0.3	72.7	73	0.4	77.3	77	0.3	72.7	73
WQI*			79			79			83			83			87			85

Note: * WQI values are all calculated based on 3 water quality categaries.

SECTION 6

ALTERNATIVE SOLUTIONS TO UPGRADE THE LEVEL OF SERVICE

6.1 Conceptual Alternatives Investigated

Sixteen (16) conceptual alternatives were developed during the course of the study. The conceptual alternatives were based on the results of the existing conditions analyses, historical information, and input from local agencies and private entities knowledgeable in the basin. Plate 11 depicts the conceptual alternatives. Each conceptual alternative is briefly described as follows:

1. Detention Conveyance Ditch - this alternative calls for improvements to the existing Osprey Acres North Lateral Ditch from Washington Avenue to Glenwood Avenue. Currently, the ditch discharges into the Oaks' Lake system via a 36" circular RCP which is approximately 220' long. The improvements are expected to address the existing conveyance of the ditch and its water quality treatment capability. It is envisioned that the potential improvement option involves widening of the ditch, regular ditch maintenance activities, and a water control structure large enough to convey the flood flow. Some of the uncertainties associated with this alternative are: right-of-way availability, relocation of the existing Oaks' berm and landscape, and increase flood stage within the ditch.

2. Additional Culverts - this alternative calls for improvements to the conveyance of the existing 36" circular RCP connecting the Osprey Acres North Lateral and the Oaks' Lake 1 . The results of the existing conditions analysis indicate that during a 100 year storm event, the head losses through the 36" circular RCP are approximately 0.8'. It is envisioned that the conveyance at this location could be improved by adding additional culverts. The number and size of the additional culverts is dependent of the desirable reduction in head losses through the connection. It is anticipated that an additional 36" circular culvert could reduce the head losses to approximately 0.2' which means that the flood stage will be lowered by 0.6'.

3. Bay Street Park Ditch Improvement - this alternative calls for improvements to the existing Osprey Acres South Lateral form Glenwood Avenue to its confluence with the South Lateral. The results of the existing conditions analysis indicate that during a 100 year storm event, the Osprey Acres South Lateral is affected by backwater from the culvert crossing at MacEwen Drive over the South Lateral. It is envisioned that the improvements to the Osprey Acres South Lateral include regular maintenance activities to maintain efficient roughness coefficients and may include deepening and widening of the ditch. This alternative is recommended to be conducted in conjunction with alternative 10 (conveyance improvement at MacEwen Drive over the South Lateral).

4. Bay Street North Ditch & Three Cross-Culverts - this alternative calls for improvements to the conveyance of Bay Street from the intersection with Pine Ranch East Road to the Bay Street/Old Venice Road culverts. Currently, the conveyance in Bay Street is provided by a ditch in the south side of the road and a system of culverts. The results of the existing conditions analysis indicate that during a 100 year storm event, the Bay Street conveyance system is affected by backwater from the culvert crossing at Bay Street/Old Venice Road. It is envisioned that a ditch on the north side of Bay Street could provide additional conveyance and potentially by-pass the Bay Street/Old Venice Road culvert. This alternative requires investigation of the right-of-way availability and utility conflicts. This alternative is recommended to be conducted in conjunction with alternative 12 (conveyance improvement at Bay Street/Old Venice Road).

5. Culvert Connection to Oaks' Lake System near Shotgun Lane - this alternative calls for improvements to the conveyance of Bay Street by proposing a culvert connection, in the vicinity of Shotgun Lane, into storage area 9 (Oaks' Lake 8). It is envisioned that the culvert connection would divert flood flow from the Bay Street conveyance system into the Oaks' Lake system where tailwater elevations are lower. The culvert connection should also alleviate the head losses at the Bay Street/Old Venice Road culvert. This alternative requires an evaluation of the impacts to the internal connections within the Oaks' Lake system, right-of-way availability, and requirements to conduct work within the Oaks' property including the berm and golf course.

6. North Creek Improvement Downstream of MacEwen Bridge - this alternative calls for improvements to the North Creek from the MacEwen Bridge to the vicinity of the confluence with the South Lateral. This portion of the North Creek is densely vegetated and the channel is narrow. The roughness coefficients used in the existing conditions analysis range form 0.090 to 0.100 for the channel portion. It is envisioned that the improvements involve regular channel maintenance activities to maintain efficient roughness coefficients. At this point it is uncertain whether portions of the channel will require widening. The intent of the alternative is to achieve a lowering of the water surface profiles by improving the conveyance ability of the channel.

7. Bay Street Park Detention Lake Expansion - this alternative calls for improvements to the existing wet detention facility located north of Bay Street and west of the FPL substation. It is envisioned that the improvements will address the viability of increasing the existing water quality and quantity ability of the facility. This alternative requires an evaluation of the right-of-way availability and an environmental assessment. This alternative is recommended to be conducted in conjunction with alternative 10 (conveyance improvement at MacEwen Drive over the South Lateral).

8. Secondary Drainage Improvement - this alternative call for improvements to the entire secondary drainage system of the Osprey Acres to improve its conveyance ability. The improvements are envisioned to include regular maintenance activities to maintain the swales/grates/culverts free of debris and blockages which reduce their conveyance ability; re-grading of swales to provide positive drainage and minimize pocket areas with shallow ponding; and addition of drainage structures at depressed locations to improve their drainage ability. This alternative requires an evaluation of the right-of-way availability and utility conflicts. This alternative will be more beneficial if alternatives 2 and 10 are conducted in conjunction with it.

9. Detention/Retention Areas within Osprey Acres - this alternative calls for improvements to the water quality capacity of the Osprey Acres Area. The intent of the alternative is to locate vacant lots, preferably near the outfall points, to evaluate their potential water quality capacity. This alternative requires topographical surveys and land acquisition

procedures. Some of the uncertainties associated with this alternative are utility conflicts and increase in tailwater elevations.

10. Conveyance Improvement at MacEwen Drive - this alternative calls for improvements to the conveyance of the existing double 29" H x 45" W RCP under MacEwen Drive. The results of the existing conditions analysis indicate that during a 100 year storm event, the head losses through the double 29" H x 45" W RCP are approximately 1.9'. It is envisioned that the conveyance at this location could be improved by adding additional culverts. The number and size of the additional culverts is dependent of the desirable reduction in head losses through the connection. It is anticipated that two additional 29" H x 45" W RCP could reduce the head losses to approximately 1.3'. This alternative requires an evaluation of the impacts to the Oaks' system, right-of-way availability, utility conflicts, and requirements to conduct work within the Oaks' property.

11. Lychee Lane Detention/Retention Area - this alternative calls for an evaluation of a ±3.5 acre parcel south of Bay Street and west of Old Venice Road for use as a detention/retention area. This alternative requires topographical surveys and land acquisition procedures. Some of the uncertainties associated with this alternative are utility conflicts, legal access, and potential increase in tailwater elevations.

12. Conveyance Improvements at Bay Street/Old Venice Road - this alternative calls for improvements to the conveyance of the existing culverts at Bay Street/Old Venice Road. Currently, the culverts consist of a double 24" H x 38" W ERCP under Bay Street, a single 38" H x 60" W ERCP on the north side of Bay Street, and a single 38" H x 60" W ERCP discharging into the South Lateral north of Bay Street and west of the FPL substation. The results of the existing conditions analysis indicate that during a 100 year storm event, the head losses through the culverts are approximately 2.2'. It is envisioned that the conveyance at this location could be improved by adding additional culverts, diverting stormwater from this location, and improving the conveyance of the MacEwen Drive culverts. The number and size of the additional culverts is dependent of the desirable reduction in head losses though the connection, the diversion of

stormwater, and the improvements at the MacEwen Drive culverts. This alternative requires an evaluation of the right-of-way availability and utility conflicts.

13. Conveyance Improvements of culverts South of Preymore Street - this alternative calls for improvements to the conveyance of the existing culverts downstream of Preymore Street. The results of the existing conditions analysis indicate that during a 100 year storm event, the head losses through the golf course and MacEwen Drive culverts (immediately downstream of Preymore Street) are approximately 1.9', 1.9', and 2.8' respectively. It is envisioned that the conveyance at these locations could be improved by adding additional culverts. The number and size of the additional culverts is dependent of the desirable reduction in head losses through the connections. This alternative requires an evaluation of the impacts to the Oaks' system, right-of-way availability, utility conflicts, and requirements to conduct work within the Oaks' property including the golf course area. It is anticipated that one additional 36" circular RCP at each location could reduce the head losses to approximately 1.6', 1.2', and 2.2' respectively which results in a lowering of the stage upstream of Preymore Street, from approximately 14.3' to 13.4'.

14. Raise Weir Elevation at Storage Area 17 (Oaks' Lake 1) - this alternative calls for an adjustment to the weir elevation of the water control structure at storage area 17. The intent of the alternative is to increase the water quality treatment ability of the lake. The surface area of the lake is estimated to be approximately 12.91 acres. It is estimated that approximately 33.8 acres of land from Osprey Acres discharge into this lake. If the weir elevation is raised one tenth of a foot, the resulting water quality treatment volume is increased approximately 1.3 ac-ft. which is approximately the equivalent of a half inch of treatment over the 33.8 acres of land from Osprey Acres. This alternative requires an evaluation of the impacts to the Oaks' system and requirements to conduct work within the Oaks' property.

15. Raise Spillway Weir Elevation on South Lateral - this alternative calls for an adjustment to the weir elevation of the spillway structure on the South Lateral upstream of its confluence with the North Creek. The intent of the alternative is to increase the water

quality treatment ability of the spillway. The surface area of the Oaks' Lakes 3 and 5 is estimated to be approximately 6.15 acres. It is estimated that approximately 47.7 acres of land from Osprey Acres discharge into these lakes. If the weir elevation is raised two tenth of a foot, the resulting water quality treatment volume is increased approximately 1.23 ac-ft. which is approximately the equivalent of a third of an inch of treatment over the 47.7 acres of land from Osprey Acres. This alternative requires an evaluation of the impacts to the Oaks' system, in conjunction with alternative 10 (conveyance improvement at MacEwen Drive), and requirements to conduct work within the Oaks' property.

16. Additional Storage at Stoneybrook's Parcel R-East - this alternative calls for additional attenuation of the peak flows discharged from Stoneybrook (Parcel R-East) into the North Lateral. The results of the existing conditions analysis indicate that during a 100 year storm event, the peak discharge from Parcel R-East is approximately 205 CFS. The intent of this alternative is to increase the storage capacity of Parcel R-East to reduce the peak flows into the North Lateral which should be influential in the reduction of head losses through the culverts on the North Lateral. The reduction in peak flow is dependent on the desirable reduction in head losses through the culverts and the ability of Parcel R-East to provide additional storage without significant impacts to the existing system within Parcel R-East. This alternative requires an evaluation of the impacts to Parcel R-East system and requirements to conduct work within Parcel R-East. This alternative will be more beneficial is conducted in conjunction with alternative 13 (conveyance improvements of culverts south of Preymore Street).

The conceptual alternatives can be generally categorized as follows:

Category I - Alternatives which potentially could improve the water quality and/or reduce the flooding conditions in Osprey Acres:

- Alternatives 1, 2, 3, 7, 8, 9, 10, 14, & 15

Category II - Alternatives which potentially could improve the water quality and/or reduce the flooding conditions in Bay Street and vicinity:

- Alternatives 4, 5, 10, 11, 12, & 15

Category III - Alternatives which potentially could improve the water quality and/or reduce the flooding conditions in Preymore Street:

- Alternative 13
- Alternative 16

Category IV - Alternatives which potentially could reduce the flooding conditions in the Oaks:

- Alternatives 6, 10, 13, & 16

The aforementioned categories are not listed in any order of priority. In addition, all the alternatives listed under each category need not be conducted to achieve an improvement in the existing water quality and/or a reduction in the flooding conditions.

The conceptual alternatives which should be assigned the highest priority were grouped under Priority A Group. Priority B Group contains the conceptual alternatives which should be assigned the next highest priority level.

Priority A Group includes Alternatives 2, 5, 6, 8, 10, 13, 14, and 15.

Priority B Group includes Alternatives 1, 3, 4, 7, 9, 11, 12, and 16.

Table 6.1 summarizes the rough construction cost estimates developed for the conceptual alternatives. Appendix D contains additional detailed information pertaining to the rough construction cost estimates.

TABLE 6.1
SUMMARY OF ROUGH CONSTRUCTION COST ESTIMATES FOR THE CONCEPTUAL ALTERNATIVES

Conceptual Alternative	Rough Construction Cost Estimate ($)
1. Detention Conveyance Ditch	43,800.00
2. Additional Culvert	41,300.00
3. Bay St. Park Ditch Improvement	27,800.00
4. Bay St. North Ditch and Three Cross-Culverts	119,200.00
5. Culvert Connection to Oaks' Lake System Near Shotgun Lane	246,700.00
6. North Creek Improvement Downstream of MacEwen Drive	31,400.00
7. Bay Street Park Detention Lake Expansion	N/A [a]
8. Secondary Drainage Improvement	N/A [b]
9. Detention/Retention Areas Within Osprey Acres	N/A [c]
10. Conveyance Improvement at MacEwen Drive	74,700.00
11. Lychee Lane Detention/Retention Area	N/A [d]
12. Conveyance Improvement at Bay Street/Old Venice Road	N/A [e]
13. Conveyance Improvement of Culverts South of Preymore Street	69,100.00
14. Raise Weir Elevation at Storage Area 17 (Oaks' Lake 1)	20,700.00
15. Raise Spillway Weir Elevation on South Lateral	32,700.00
16. Additional Storage at Stoneybrook's Parcel R-East	N/A [f]

[a] The construction cost will vary widely, depending upon the size of the detention area. Since this alternative is not recommended, an estimate is not provided.

[b] This alternative is currently being designed by Hole, Montes & Associates, Inc. as part of Sarasota County's Capital Improvements Program.

[c] The construction cost will vary widely, depending upon the size of the detention/retention areas and the cost of the properties. Since this alternative is not recommended, an estimate is not provided.

[d] The construction cost will vary widely, depending upon the size of the detention/retention areas and the cost of the property. Since this alternative is not recommended, an estimate is not provided.

[e] Preliminary calculations indicated that the addition of additional culverts reduced the water surface elevation in the vicinity of the culverts, but it did not significantly reduce the water surface elevation upstream of the culverts. Since this alternative is not recommended, an estimate is not provided.

[f] The construction cost will vary widely, depending upon the magnitude of the modifications to Stoneybrook's Water Management System. Since this alternative is not recommended, an estimate is not provided.

6.2 Alternatives Selected for Detailed Hydrologic and Hydraulic Investigation

The sixteen conceptual alternatives described in Section 6.1 were presented to Sarasota County. Sarasota County selected conceptual alternatives 2, 3, 5, 6, 10, 13, 14, and 15 for detailed evaluation. It is noted that conceptual alternative 8 is currently being designed by Hole, Montes & Associates, Inc. and it is not included in the detailed evaluation of this Stormwater Master Plan. The detailed evaluation consisted of detailed hydrologic and hydraulic calculations for both the existing and future land uses. The proposed improvements for each of the recommended alternatives are summarized as follows:

- **Alternative 2** – install an additional 36" circular RCP (approximately 220' long) under the Oaks' berm to improve the conveyance of the existing 36" circular RCP connecting the Osprey Acres North Lateral to the Oaks Lake 1 (UNET's storage cell 17).
- **Alternative 3** – conduct regular maintenance activities on the Osprey Acres South Lateral, from Glenwood Avenue to its confluence with the South Lateral, to maintain efficient roughness coefficients in overbanks and channel areas. As a minimum, overbanks should be maintained in a condition that simulates a roughness coefficient of 0.060. Similarly, the channel should be maintained in a condition that simulates a roughness coefficient of 0.030.
- **Alternative 5** – install a 24" circular RCP (approximately 200' long) under Bay Street, in the vicinity of Shotgun Lane, to connect the South Lateral to the Oaks Lake 8 (UNET's storage cell 9). This alternative also requires modifications to the following existing connections within the Oaks Development:
  - install one additional 42" circular RCP (approximately 1,140' long) from the control structure of the Oaks Lake 8 (UNET's storage cell 46) to the Oaks Lake 6 (UNET's storage cell 5).
  - install one additional 54" circular RCP (approximately 600' long) from the control structure of the Oaks Lake 6 (UNET's storage cell 45) to the East Lateral.
- **Alternative 6** – conduct regular maintenance activities on the North Creek, from the MacEwen Bridge to the confluence with the North Lateral, to maintain efficient roughness coefficients in the overbanks and channel areas. As a minimum, the overbanks and channel should be maintained in a condition which simulates roughness coefficients of 0.070 and 0.035, respectively.

- **Alternative 8** – conduct improvements to the entire secondary drainage systems of Osprey Acres to improve its conveyance ability. The improvements are envisioned to include re-grading of swales to provide positive drainage and minimize pocket areas with shallow ponding, addition of drainage structures at depressed locations to improve their drainage ability, and regular maintenance to maintain the swales/grates/culverts free of debris and blockages. This alternative is currently being designed by Hole, Montes & Associates, Inc., under Sarasota County's Capital Improvements Program.
- **Alternative 10** – install two additional 29"H x 45"W RCP (approximately 70' long) under MacEwen Drive to improve the conveyance of the existing double 29"H x 45"W RCP on the South Lateral.
- **Alternative 13** – install one additional 36" circular RCP at the following locations, over the North Lateral, downstream of Preymore Street:
  - Oaks Golf Course (approximately 215' long)
  - MacEwen Drive (approximately 103' long)
  - Oaks Golf Course (approximately 250' long)
- **Alternative 14** – raise the control elevation of the Oaks Lake 1 (UNET's storage cell 17) one tenth of a foot to increase the water quality treatment ability of the lake.
- **Alternative 15** – raise the control elevation of the spillway on the South Lateral two tenths of a foot to increase its water quality treatment ability and enlarge the spillway's weir length by approximately 5.0'.

Table 6.2 summarizes the water quantity LOS for the proposed conditions at selected locations. The selected locations are crossings over the North Creek and its laterals where a detailed hydraulic analysis was conducted. The results presented in Table 6.2 assumed that the proposed improvements for alternatives 2, 3, 5, 6, 10, 13, 14, and 15 are in place. Appendix A contains HEC-1 computer model excerpts for the 2-, 5-, 10-, 25-, and 100-year storm events. Appendix C contains UNET computer model excerpts for the 2-, 5-, 10-, 25-, and 100-year storm events.

TABLE 6.2
LOS DEFICIENCIES FOR PROPOSED CONDITIONS

				Top # = Proposed Conditions w/Existing Land Use *Bottom # = Proposed Conditions w/Future Land Use* **Computed Peak Stage (Ft. NGVD)**				
Location	**Reach No./ X-Section**	**LOS Category**	**Elevation (Ft.NGVD)**	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**100 Year**
Seminole Gulf Line RR over North Creek	1 / 2.421	Neighborhood	18.61[8]	13.83 13.82	14.31 14.36	14.73 14.79	15.20 15.23	15.73 15.76
Pine Ranch East Road over North Creek	1 / 2.400	"	16.02[20]	13.76 13.76	14.26 14.31	14.67 14.73	15.12 15.15	15.64 15.66
Pine Ranch East Road over Tributary to North Creek	2 / 0.350	"	16.02[21]	12.83 13.08	13.05 13.48	13.26 13.78	13.47 14.05	13.95 14.53
Pine Ranch Trail over Tributary to North Creek	2 / 0.235	"	15.0	12.76 13.02	12.97 13.39	13.16 13.67	13.36 13.92	13.79 14.39
Pine Ranch Trail over Tributary to North Creek	2 / 0.151	"	14.5	12.13 12.56	12.51 12.96	12.68 13.27	12.89 13.56	13.33 14.08
Golf Course Timber Footbridge over North Creek	3 / 2.092	"	10.7	9.87 10.28	10.30 10.73	10.67 11.04	10.95 11.27	11.40 11.62
Mac Ewen Drive over North Creek	3 / 1.746	"	13.90	7.06 7.46	7.49 7.83	7.77 8.10	8.02 8.29	8.42 8.62
Golf Course Concrete Footbridge over North Creek	3 / 1.667	"	12.55	6.50 6.82	6.84 7.12	7.07 7.34	7.26 7.50	7.60 7.78
Golf Course Bridge/Spillway over South Lateral	4 / 0.053	"	10.29	8.94 9.23	9.26 9.58	9.53 9.89	9.79 10.17	10.20 10.59
Mac Ewen Drive over South Lateral	6 / 0.578	"	12.14	9.19 9.76	9.60 10.29	9.95 10.88	10.30 11.45	11.01 12.27
Golf Course Bridge over South Lateral	6 / 0.477	"	11.9	8.99 9.29	9.32 9.66	9.60 9.98	9.87 10.27	10.30 10.71
Golf Course Concrete Bridge over South Lateral	6 / 0.397	"	11.37	8.99 9.28	9.32 9.66	9.60 9.98	9.87 10.27	10.30 10.70
Golf Course Concrete Bridge over South Lateral	6 / 0.314	"	12.55	8.98 9.28	9.31 9.65	9.60 9.97	9.87 10.26	10.29 10.69

				Top # = Proposed Conditions w/Existing Land Use *Bottom # = Proposed Conditions w/Future Land Use* **Computed Peak Stage (Ft. NGVD)**				
Location	**Reach No./ X-Section**	**LOS Category**	**Elevation (Ft.NGVD)**	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**100 Year**
Bay Oaks Estates, Unit II, Driveway Culvert over South Lateral	7 / 1.679	Neighborhood	15.28[1]	14.71 14.47	15.29 14.90	15.47 15.25	15.53 15.46	15.65 15.63
Longbow Trail Driveway Culvert over South Lateral	7 / 1.607	"	15.61[1]	14.68 14.47	15.28 14.88	15.46 15.24	15.52 15.45	15.65 15.63
Shotgun Lane Driveway Culvert over South Lateral	7 / 1.394	"	15.37[1]	13.55 13.95	14.00 14.31	14.28 14.51	14.50 14.68	14.83 14.99
Trinity Acres Driveway Culvert over South Lateral	7 / 1.290	"	14.92[1]	13.41 13.89	13.89 14.24	14.17 14.43	14.39 14.58	14.65 14.88
Faith Avenue Driveway Culvert over South Lateral	7 / 1.207	"	14.72[1]	13.43 13.98	13.95 14.39	14.27 14.57	14.49 14.73	14.75 14.98
School Board Facility Driveway Culvert over South Lateral	7 / 1.165	"	14.58[1]	13.20 13.71	13.71 14.26	14.13 14.49	14.40 14.65	14.68 14.93
School Board Facility Driveway Culvert over South Lateral	7 / 1.057	"	14.71[1]	12.59 13.09	13.12 13.74	13.58 14.27	14.17 14.48	14.53 14.80
School Board Facility Driveway Culvert over South Lateral	7 / 0.977	"	14.49[1]	11.71 12.06	12.23 12.87	12.77 13.48	13.37 14.10	14.18 14.61
Bay Street/Old Venice Road Culvert over South Lateral	7 / 0.898	Collector	14.58[1]	10.37 10.95	10.88 11.62	11.41 12.32	12.05 13.02	12.96 14.27
Bay Street/Old Venice Road Culvert over South Lateral	7 / 0.8848	"	14.38[2]	10.17 10.67	10.59 11.21	11.00 11.81	11.50 12.45	12.26 13.49
Bay Street/Old Venice Road Culvert over South Lateral	7 / 0.8078	"	14.21[2]	9.90 10.32	10.21 10.79	10.58 11.28	10.92 11.87	11.52 12.78
Preymore Street over North Lateral	10 / 0.264	Neighborhood	12.63[3]	8.99 8.99	9.79 9.89	10.57 10.57	11.22 11.22	13.39 13.40
Golf Course Over North Lateral	10 / 0.235	"	14.0[4]	7.86 7.86	8.49 8.49	8.97 8.97	9.61 9.62	12.34 12.59
Mac Ewen Drive over North Lateral	10 / 0.160	"	13.5[4]	6.95 6.99	7.65 7.65	8.09 8.09	8.59 8.61	10.70 10.96
Golf Course Over North Lateral	10 / 0.096	"	11.7[4]	6.09 6.09	6.70 6.70	7.10 7.10	7.52 7.56	9.41 9.68

				Top # = Proposed Conditions w/Existing Land Use *Bottom # = Proposed Conditions w/Future Land Use* **Computed Peak Stage (Ft. NGVD)**				
Location	**Reach No./ X-Section**	**LOS Category**	**Elevation (Ft.NGVD)**	**2 Year**	**5 Year**	**10 Year**	**25 Year**	**100 Year**
Mac Ewen Drive Over North Lateral	10 / 0.0478	Neighborhood	11.6[4]	4.25 4.44	4.86 5.07	5.40 5.68	6.08 6.38	7.69 7.94
Golf Course Concrete Bridge over North Creek	11 / 1.174	"	10.19	3.17 3.43	3.65 3.92	4.00 4.29	4.36 4.65	4.98 5.30
Oaks Development Berm Over Osprey Acres North Lateral	13 / 0.044	"	14.5[5]	10.32 10.37	10.54 10.54	10.82 10.86	11.23 11.26	11.94 11.95
Utility Crossing over North Creek	14 / 0.627	"	8.04[6]	2.50 2.66	2.82 3.02	3.10 3.34	3.41 3.68	3.99 4.29
Northbound U.S. Hwy. 41 Bridge over North Creek	14 / 0.620	Evacuation	8.96[7]	2.41 2.54	2.67 2.83	2.90 3.09	3.15 3.37	3.64 3.88
Southbound U.S. Hwy. 41 Bridge over North Creek	14 / 0.609	"	8.96[7]	2.31 2.40	2.50 2.62	2.67 2.83	2.88 3.06	3.29 3.51
Glenwood Avenue south of Church Street	8 / SA-39	Neighborhood	12.89[9]	12.30 12.40	12.42 12.43	12.44 12.45	12.45 12.47	12.48 12.74
Glenwood Avenue north of Church Street	13 / SA-38	"	12.61[10]	12.10 12.23	13.02 13.06	13.36 13.41	13.73 13.78	14.22 14.19
Patterson Avenue south of Church Street	8 / SA-39	"	14.04[11]	12.30 12.40	12.42 12.43	12.44 12.45	12.45 12.47	12.48 12.74
Patterson Avenue north of Church Street	13 / SA-38	"	14.02[12]	12.10 12.23	13.02 13.06	13.36 13.41	13.73 13.78	14.22 14.19
Pennsylvania Avenue south of Church Street	8 / SA-39	"	13.80[13]	12.30 12.40	12.42 12.43	12.44 12.45	12.45 12.47	12.48 12.74
Pennsylvania Avenue north of Church Street	13 / SA-38	"	14.35[14]	12.10 12.23	13.02 13.06	13.36 13.41	13.73 13.78	14.22 14.19
Washington Avenue south of Church Street	8 / SA-39	"	13.07[15]	12.30 12.40	12.42 12.43	12.44 12.45	12.45 12.47	12.48 12.74
Washington Avenue north of Church Street	13 / SA-37	"	14.24[16]	13.56 13.61	13.98 13.98	14.16 14.17	14.23 14.23	14.27 14.26
Ogburn Street	8 / SA-39	"	12.42[17]	12.30 12.40	12.42 12.43	12.44 12.45	12.45 12.47	12.48 12.74

				Top # = Proposed Conditions w/Existing Land Use Bottom # = Proposed Conditions w/Future Land Use Computed Peak Stage (Ft. NGVD)				
Location	Reach No./ X-Section	LOS Category	Elevation (Ft.NGVD)	2 Year	5 Year	10 Year	25 Year	100 Year
Oak Street	8 / SA-39	Neighborhood	14.30[18]	12.30 12.40	12.42 12.43	12.44 12.45	12.45 12.47	12.48 12.74
Church Street	13 / SA-38	"	12.61[10]	12.10 12.23	13.02 13.06	13.36 13.41	13.73 13.78	14.22 14.19
Green Street	13 / SA-38	"	13.31[19]	12.10 12.23	13.02 13.06	13.36 13.41	13.73 13.78	14.22 14.19

[1]Edge of pavement on south side of Bay Street
[2]Edge of pavement on north side of Bay Street
[3]Edge of pavement on north side of Preymore Street
[4]From Construction Plans for "Oaks II Off-Site Stormwater Conveyance Preymore Road to North Creek; Post, Buckley, Schuh & Jernigan, Inc., May 9, 1990, Sheets 1, 2, and 3 of 3"
[5]Ground elevation at the extension of Glenwood Avenue. The Oaks Development berm is estimated to be higher than elevation 14.5' at this location (estimate is based on visual inspection)
[6]Bottom of beam supporting utility pipe
[7]Roadway elevation on northbound U.S. 41 on north side of bridge
[8]Top of trestle
[9]Curb inlet throat at southwest corner of intersection of Glenwood Avenue with Church Street
[10]Curb inlet throat at northwest corner of intersection of Glenwood Avenue with Church Street
[11]Edge of pavement at southeast corner of intersection of Patterson Avenue with Church Street
[12]Edge of pavement at northwest corner of intersection of Patterson Avenue with Church Street
[13]Edge of pavement at west side of Pennsylvania Avenue, approximately 200' north of intersection of Pennsylvania Avenue with Oak Street
[14]Edge of pavement at northeast corner of intersection of Pennsylvania Avenue with Church Street
[15]Edge of pavement at west side of Washington Avenue, approximately 370' south of intersection of Washington Avenue with Church Street
[16]Edge of pavement at east side of Washington Avenue, approximately 400' south of intersection of Washington Avenue with U.S. 41
[17]Top of grate on inlet at northwest corner of intersection of Ogburn Street with Glenwood Avenue
[18]Edge of pavement at north side of Oak Street, approximately 150' west of intersection of Oak Street with Pennsylvania Avenue
[19]Edge of pavement at south side of Green Street, approximately 60' west of intersection of Green Street with Glenwood Avenue
[20]Edge of pavement – provided by Sarasota County, based on a survey of Pine Ranch East Road
[21]Edge of pavement – provided by Sarasota County, based on a survey of Pine Ranch East Road

6.3 Recommended Alternative for Preliminary Design

Based on results of the analyses and the evaluations of the alternatives, Alternatives 2, 3, 5, 6, 8, 10, 13, 14, and 15 are recommended for preliminary design. Alternative 8 is currently being designed by Hole, Montes & Associates, Inc., under Sarasota County's Capital Improvements Program.

The aforementioned alternatives are primarily intended to address the LOS deficiencies of crossings over North Creek and its Laterals where a detailed hydraulic analysis was conducted.

In addition, the following recommendations are offered:

- Regular mowing and cleaning of the ditches/canals to remove nuisance vegetation before it becomes established. Once established, it could reduce the conveyance ability of the facilities.
- Regular mowing, cleaning, and debris removal of detention/retention areas.
- Regular inspection, cleaning, repair or replacement of storm sewer pipes, catch basins/inlets, and water control structures. Particular emphasis should be given during periods of expected heavy rainfall.
- Installation of baffle, skimmer, grease trap or other suitable mechanism at outlet structures which receive stormwater runoff from highly impervious areas or from potential sources of oil and grease.
- Installation of rainfall gages and gaging stations to develop site specific information for future projects.

6.4 Supplemental Freshwater Supply Assessment

The conceptual stormwater improvement recommendations have been evaluated. Alternative 14 is recommended for raising the control elevation of the Oaks Lake 1 one-tenth of a foot, and Alternative 15 is recommended for raising the control elevation of the spillway on the South Lateral two-tenths of a foot. These two alternatives will have approximate storage increases of 1.3 and 1.23 ac.ft., respectively. In terms of providing supplemental freshwater supply source, the storage volume increases in Alternatives 14 and 15 are insignificant. Other recommended improvements are primarily limited to replacement of existing culverts. In the selected Alternatives, no stormwater retention storage areas are recommended which could potentially provide a supplemental freshwater supply source. Potential supplies could provide a freshwater supply for irrigation water, process water, and other potential uses in conjunction with the County's wastewater reuse program. However, the County Utility Department has not identified a viable need for providing a supplemental freshwater supply in the North Creek Basin.

SECTION 7

CONCLUSIONS

Results of the existing conditions water quantity analyses revealed that LOS deficiencies exist at the following three locations:

- Golf Course Timber Footbridge over North Creek
- Preymore Street over North Lateral
- Intersection of Glenwood Avenue with Church Street

Results of the proposed conditions water quantity analyses revealed that the LOS deficiencies could be reduced if the recommended alternatives (2, 3, 5, 6, 8, 10, 13, 14 and 15) and recommendations contained in Section 6.3 of this report are implemented.

Additionally, numerous cases of flooding had been reported to Sarasota County's Initial Response Team and Stormwater Environmental Utility by local residents. During the June 1992 and July 1995 storms, severe flooding was reported throughout the basin. It is worth noting that during the July 1995 storm, overflow from the South Creek Basin was reported at the following three locations:

- Pine Ranch East Road over North Creek
- Pine Ranch East Road over the Tributary to North Creek
- Vicinity of intersection of Bay Street with Pine Ranch East Road

The aforementioned results are based on overflow from the South Creek Basin at Pine Ranch East Road over the North Creek location only. The overflow quantities were provided by Parsons Engineering Science, based on their study of the South Creek Basin. The aforementioned results were also based on unobstructed flow and assuming that the hydraulic structures remain unobstructed, operate properly, and do not fail.

In summary, it is recommended that Sarasota County implement Alternatives 2, 3, 5, 6, 8, 10, 13, 14, and 15, as well as the recommendations contained in Section 6.3 of this report.

SECTION 8

PUBLIC MEETING

A public meeting was held on October 20, 1997 at Twin Lakes Park. Fifty-two people signed the register. Public discussion included verbal and written comments. Some citizens wanted an overview presentation and specific assessment information. Comment forms were handed out to all interested parties. Twelve North Creek residents filled out comment forms.

The comment forms were reviewed and revealed the following information:

North Creek – 12 Respondents:

Roadway and yard flooding was experienced in Pine Ranch, Bay Oaks, and Osprey Acres/Park Subdivisions. Structure flooding was reported in Osprey Acres. Yard flooding was reported in all residential areas – 1 to 4 feet deep for 2 to 10 days. In Osprey Acres, standing water was observed for as long as two months in depressional areas. No water quality problems were reported in North Creek Basin. Most of the North Creek respondents observed overflows from South Creek to North Creek during the 1995 storm event. Long-term payment of capital improvement projects was preferred 7 to 0 over short-term payment. Four North Creek respondents were in favor and four were against a levelized assessment for capital improvement projects in North and South Creeks. According to verbal and written comments, funding through assessments for the Flood Plain Restoration Project was opposed. Comments were not received from The Oaks and Stoneybrook subdivisions.

SUMMARY OF COMMENTS:

North Creek – 12 Respondents:

North Creek comments are summarized as follows:

- **Pine Ranch Subdivision – 4 Respondents:**

Roadway and yard flooding was experienced by all four respondents. No structure flooding was reported. During July 1995 and June 1992 storm events, yard flooding was observed to be 1.5-2.5 feet deep. According to residents, water remained in the yards for 10 days.

Three Respondents observed overflow from South Creek into the North Creek Basin during these storm events. The respondents believe that for acceptable flooding criteria – no structure flooding, and street flooding – 6 inches for 24 hours.

General Comments included the following:

- Two respondents observed flow from the east under the Seminole-Gulf Railroad into North Creek.
- Two respondents indicated that water in South Creek did not flow freely into the State Park area and railroad ditches were observed to be full of debris.
- Respondents feel that Seminole-Gulf Railroad ditches and culverts are not satisfactorily maintained. They feel the County, SWFWMD or other State agencies should force the railroad to properly maintain stormwater conveyance systems.

Bay Oaks – 2 Respondents:

During the July 1995 storm event, yard flooding was experienced by the respondents. No structure flooding was reported. Respondents did not observe overflow from South Creek to North Creek. Respondents believe that for acceptable flooding criteria —no building flooding, and street flooding – 12 inches for 24 hours. They were not aware of any water quality problems.

The two respondents were against a levelized assessment rate for North and South Creeks and against any C.I.P. assessment.

Osprey Acres & Park – 6 Respondents:

Building, roadway and yard flooding was observed by all respondents. During the July 1995 and June 1992 storm events, yard flooding was observed to be 1-4 feet deep. According to residents, water remained in the yards for 2-4 days, and depressional areas had standing water for two months.

Four Respondents observed overflow from South Creek into North Creek basin during these storm events. Bay Street was observed to be under water and flow from South Creek was observed at the FPL bridge. Two of the questionnaires had no response to South Creek overflow. Respondents believe that for acceptable flooding criteria – no building flooding, and street flooding – 12 inches for 24 hours.

Three respondents indicated they preferred longer term payment with lower assessment. Three did not respond to the question. Two respondents were against the levelized assessment rate with South Creek, and four did not respond.

General comments included the following:

- One respondent was against expansion of the Bay Street Detention Pond. They felt the flooding problem in Osprey Acres was increased by development of The Oaks subdivision.

SECTION 9

REFERENCES

1. Hydrologic Engineering Center, U.S. Army Corps of Engineers, 609 Second Street, Davis, CA 95616-4687, UNET One-Dimensional Unsteady Flow Through a Full Network of Open Channels, User's Manual, September 1995, Version 3.0.

2. Hydrologic Engineering Center, U.S. Army Corps of Engineers, 609 Second Street, Davis, CA 95616-4687, HEC-DSS User's Guide and Utility Manuals, March 1995.

3. Hydrologic Engineering Center, U.S. Army Corps of Engineers, 609 Second Street, Davis, CA 95616-4687, HEC-1 Flood Hydrograph Package, User's Manual, September 1981.

4. Gee & Jenson E-A-P, Inc., One Harvard Circle, West Palm Beach, FL 33409, Modification of HEC-1 to Include the Santa Barbara Urban Hydrographs and Constant's Unit Hydrographs Procedures, November 4, 1989.

5. Soil Conservation Service, Engineering Division, U.S. Department of Agriculture, Technical Release 55 - Urban Hydrology for Small Watersheds, June 1986.

6. Environmental Resource Permitting Information Manual, Southwest Florida Water Management District, February 1996.

7. Watershed Management Model Version 3.30 User's Manual, Camp Dresser & McKee.

8. Southwest Florida District Water Quality 1994 305(b) Technical Appendix.

9. Sarasota County MS4, NPDES Permit Application Part 2, Storm Sewer System, June 1993.

10. Florida Department of Environmental Protection, STORET Water Quality Monitoring Data (1972-1992), North Creek U.S. 41 Bridge.