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Memorandum

Date: September 29, 2008
To: Christopher Hatfield
Jill Fermanich
From: Jim Bachhuber and Joseph Hanson
Subject: University of Wisconsin-Green Bay Campus Memo Report:
Stormwater Pollution Analysis Methods and Results (Revised)
Project No.: 102911

Background / Scope of Work

This report documents the stormwater pollution analysis conducted for the area of the University of Wisconsin-Green Bay (UW-GB) campus. The analysis was conducted in partial fulfillment of the UW-GB Municipal Separate Storm Sewer System (MS4) General Permit. The permit requires an estimate of the annual stormwater pollution loadings (sediment and phosphorus) for all storm sewer outfalls that meet the regulatory definition of an "MS4". This pollution loading analysis establishes the base pollution load and the pollution reduction resulting from the existing stormwater management measures on the campus.

The analysis used the Windows™ version of an urban pollution loading model "Source Loading and Management Model" (WinSLAMM) to model annual pollutant loadings under the following two scenarios:

- 1) Base Conditions: October 1, 2004, land use conditions with no Best Management Practices (BMPs) applied.
- 2) Existing Conditions: October 1, 2004, land use conditions with the existing levels of stormwater management measures applied.

If after scenario 2 was completed and the existing BMPs were not sufficient to meet the required 40% Total Suspended Solids (TSS) reduction, additional conceptual management measures would be evaluated to achieve this goal.

Summary of Methods – Base and Existing Conditions

This section summarizes the analysis conducted for UW-GB to determine the base conditions load and the amount of load reduction currently being achieved by the UW-GB's existing stormwater management practices. The policies and procedures set forth by the Wisconsin Department of Natural Resources to analyze developed urban areas were followed throughout the process.

Input Information

A GIS database was created characterizing UW-GB in terms of urban stormwater pollution generation. Information in the database includes:

- Subbasin delineations (based on the 2006 campus wide stormwater plan, campus contour data, and a field visit conducted on April 24, 2008)
- Hydrologic soil groups (based on USDA NRCS soil data)
- Land use conditions as of October 2004 (source data provided by UW-GB)
- Street Drainage type (curb & gutter or swale)*
- Existing wet detention ponds*

Area of Analysis

All of the lands within the campus boundary of UW-GB as of October 1, 2004, were analyzed with the exceptions as described below. The following list summarizes the lands excluded from the analysis in accordance with WDNR policies:

- Riparian areas (lands that drain directly to Green Bay without passing through an MS4)
- Undeveloped land greater than 5 acres
- Wisconsin DOT right-of-way (USH 57) and City of Green Bay street right-of-way (Nicolet Drive)

Stormwater Model Description

WinSLAMM version 9.3.0 was used to conduct the analysis. The following supporting parameters files were used:

- WisReg - Green Bay 1969.ran (the 1 year rainfall file was used since street cleaning was not evaluated as a management measure)
- WI_GEO01.ppd
- WI_SL06 Dec06.rsv
- WI_AVG01.psc
- WI_DLV01.prr
- WI_Res and Other Urban Dec06.std
- WI_Com Inst Indust Dec06.std

WinSLAMM “dat” files were created specifically to represent each delineated drainage basin of the campus. Each “dat” file included surface area values and descriptions for each “source area” feature in the drainage basin. Source areas in WinSLAMM consist of rooftop, parking, street, sidewalk, and landscaped areas. Each source area was further defined in the WinSLAMM “dat” file based on direct observations and discussions with UW-GB staff.

Existing Stormwater BMPs

UW-GB currently has several types of existing best management practices in place. These practices are: 1) rooftop, parking and sidewalk disconnection, 2) swale drainage, and 3) wet detention ponds. Each of these management measures was modeled for its TSS reduction capabilities. The existing practices are described below.

Disconnection: This refers to impervious surfaces, such as rooftops or parking lots, which drain directly onto pervious (vegetated) surfaces and allow for some stormwater infiltration before runoff enters the conveyance system. Directly connected source areas are those

impervious surfaces that drain into a stormwater conveyance system without passing over pervious surfaces.

Grass swale drainage: This refers to grass-lined swales along roads and parking lots, which provide drainage for the impervious surfaces. Grass swales have the ability to treat stormwater and allow for infiltration, whereas the alternative storm sewer system does not.

Wet detention ponds: These are depressions in the ground surface featuring a permanent pool of standing water. During rainfall events, stormwater enters the detention pond and is treated before being allowed to flow downstream. Wet detention ponds can be fed by both storm sewer and swale drainage systems.

UW-GB has four wet detention ponds serving developed lands. These wet detention basins service lands that were fully or partially developed prior to October 1, 2004. The pollution control effectiveness of the ponds was modeled using data provided by UW-GB and data from GIS. A summary of each wet detention pond's characteristics used for inputs to the model is found in Table 1. A summary of each wet detention pond's pollution control performance is found in Table A-3.

Table 1
Wet Detention Pond Characteristics for Modeling Purposes

Pond Name	Contributing Drainage Area (acres)	Permanent Pool Area (acres)	Permanent Pool Depth (ft)	Outlet Structure
Golf Course Pond	117.1	1.1	5	Two 50" dia. stand pipes
Teal Pond	19.8	0.3	5	10' broad-crested weir
Kress Event Center Pond	15.3	1.6	5	18" dia. culvert
Upahki Pond	16.5	1.5	5	10' broad-crested weir
Total	168.7	4.5		

The locations of the existing best management practices and their corresponding drainage areas are on Figure 2.

Results - Base and Existing Conditions

The results of the WinSLAMM modeling analysis are shown on Table 2. This table shows the annual Total Suspended Solids (TSS) and Total Phosphorus (TP) loadings under the base and existing conditions (see definitions on page one of this memo). The table shows the TSS control effectiveness for the existing BMPs since TSS is the regulated pollutant in the existing MS4 permit.

Table 2
Annual Base and Existing Conditions Pollution Loads

Scenario	Runoff Volume	Total Suspended Solids (TSS)		BMP TSS Reduction *		Total Phosphorus (TP) Campus Load
		Campus Load	BMP Reduction	Individual	Cumulative	
	(ac-ft)	(tons/yr)	(tons/yr)	%	%	(lbs/yr)
Base Conditions	188	46.7	0.0	0.0	0.0	292
Effectiveness of Existing BMPs:						
Impervious Area Disconnection	161	44.4	2.3	4.9%	4.9%	282
Road Swales	156	41.0	3.4	7.3%	12.2%	268
Wet Detention Ponds (4)	156	28.0	13.0	27.8%	40.0%	212
Existing Conditions	156	28.0	18.7	40.0%	40.0%	212

* per centages compared to entire campus pollutant load

The University's annual Base Conditions TSS base load is 46.7 tons per year. After accounting for the TSS control from the existing BMPs analyzed, the Existing Conditions TSS load is 28.0 tons per year, which represents a TSS reduction of 40.0%.

There are two figures at the end of this memo showing relevant information to the modeling effort:

Figure 1: UW – Green Bay Campus SLAMM Source Area Map. This map shows the source areas for each drainage system within the modeled campus area that was used in the SLAMM input (*.dat) files.

Figure 2: Existing Best Management Practices: This map shows the locations of the existing BMPs and their corresponding drainage areas.

Conclusions

As stated in the UW-GB MS4 Permit, the campus must provide:

“2.7.1 To the maximum extent practicable, implementation of storm water management practices necessary to achieve a 20% reduction in the annual average mass of total suspended solids discharging from the MS4 to surface waters of the state as compared to implementing no storm water management controls, by March 10, 2008. The permittee may elect to meet the 20% total suspended solids standard on a watershed or regional basis by working with other permittee(s) to provide regional treatment that collectively meets the standard.

Note: Pursuant to s. NR 151.13(2), Wis. Adm. Code, the total suspended solids reduction requirement increases to 40% by March 10, 2013.”

The stormwater pollution modeling evaluation conducted for the University of Wisconsin-Green Bay followed the guidelines provided by the WDNR for compliance with the MS4 Permit. As a result of this evaluation the following conclusions are made:

1. Accounting for all of the existing management measures, UW-GB is currently reducing its pollution load by 18.7 tons per year (40.02%). Therefore the University has met the TSS

reduction requirements of their MS4 Permit for both the 2008 goal (20%) and the 2013 goal (40%)

2. Accounting for the existing management measures, the average mass of Total Phosphorous is currently being reduced by 17.1% on an annual basis.
3. Although both 20% and 40% TSS removal goals have already been met, additional best management practices for the UW-GB campus are possible, but have not been studied at this time.

For example, there are parking lot resurfacing / expansion projects planned over the next few years. Landscaped features within or surrounding the parking lots to receive and treat stormwater runoff could be incorporated into the project.

4. The University of Wisconsin-Green Bay must review these results with the WDNR to finalize their MS4 permit compliance for the TSS reduction requirements.

**Attachment A
Supporting Documentation**

- Table A-1: Drainage Basin & Source Area Summary
- Table A-2: Base and Existing Management Pollution Load TSS and TP by Drainage Basin
- Table A-3: Wet Detention Pond Pollution Control Performance

**Table A-1
Drainage Basin & Source Area Summary**

Basin ID	Source Area (acres)					Total
	Rooftop	Landscape	Road	Parking	Sidewalk	
1	0.00	0.76	0.00	1.16	0.23	2.15
2	0.00	4.08	0.40	3.84	0.20	8.52
3	0.03	11.95	1.66	1.53	1.35	16.52
4	0.00	1.68	0.47	1.12	0.04	3.31
5	2.86	17.96	1.37	6.19	1.70	30.08
6	0.00	2.35	3.27	0.00	0.00	5.63
7	0.00	20.41	0.23	0.00	0.00	20.64
8	0.55	37.91	5.18	0.13	0.53	44.29
9	0.13	5.65	0.01	1.16	0.02	6.98
10	1.21	11.76	2.60	3.47	0.72	19.77
11	0.20	54.56	1.30	0.12	0.69	56.88
12	2.78	50.71	3.73	5.99	3.34	66.55
13	0.04	1.78	0.00	1.53	0.00	3.35
14	3.92	29.29	3.15	10.86	3.28	50.49
15	6.72	49.98	4.87	9.67	5.34	76.58
16	0.55	4.52	0.00	1.20	0.00	6.28
17	0.00	3.45	0.24	0.01	0.18	3.88
18	0.03	22.40	0.00	0.00	0.72	23.14
19	0.00	2.21	0.00	0.37	0.00	2.58
20	0.00	1.43	0.00	0.00	0.03	1.46
21	0.00	22.69	1.36	0.00	0.30	24.36
Total	19.03	357.53	29.84	48.35	18.68	473.43

* shaded basins are open space greater than 5 acres in size and are not included in modeling based on DNR guidelines

Table A-2
Base and Existing Management Pollution Load by Drainage Basin

Basin ID	Base Condition		Existing Management		Percent Control	
	TSS (tons/yr)	TP (lbs/yr)	TSS (tons/yr)	TP (lbs/yr)	TSS (%)	TP (%)
1	0.32	1.42	0.31	1.42	0.0%	0.0%
2	1.45	6.39	1.45	6.39	0.0%	0.0%
3	2.15	12.13	0.09	3.30	96.0%	72.8%
4	0.86	3.44	0.86	3.44	0.0%	0.0%
5	3.48	20.59	3.46	20.59	0.5%	0.0%
6	2.16	8.05	1.48	5.83	31.4%	27.5%
8	5.06	31.54	2.15	18.51	57.6%	41.3%
9	0.56	4.05	0.55	3.93	1.7%	3.0%
10	2.77	14.86	0.57	5.60	79.5%	62.3%
11	3.05	30.74	2.50	30.52	18.1%	0.7%
12 & 14	12.38	78.49	2.84	34.40	77.1%	56.2%
13	0.42	2.08	0.09	0.96	78.5%	53.7%
15	9.38	55.76	9.36	55.76	0.1%	0.0%
16	0.47	3.59	0.18	2.33	61.5%	35.2%
17	0.37	2.31	0.37	2.31	0.5%	0.3%
19	0.16	1.37	0.08	1.11	48.9%	19.0%
20	0.05	0.70	0.05	0.70	0.0%	0.0%
21	1.63	14.08	1.63	14.08	0.0%	0.0%
Total	46.7	291.6	28.0	211.15	40.0%	27.6%

Table A-3
Wet Detention Pond Pollution Control Performance

Pond Name	Contributing Area (acres)	Permanent Pool Area (acres)	Permanent Pool Depth (ft)	TSS Removed (tons/yr)	TSS Removed (%)*
Golf Course Pond	117.1	1.1	5	8.18	17.5%
Teal Pond	19.8	0.3	5	1.26	2.7%
Kress Event Center Pond	15.3	1.6	5	1.62	3.5%
Upahki Pond	16.5	1.5	5	1.93	4.1%
Total				12.99	27.8%

* % control compared to entire project site

**Attachment B
Supporting Figures**

- Figure-1: UWGB Campus Map showing SLAMM Source Areas, Drainage Basins, and Storm Sewer
- Figure-2: UWGB Campus Map showing Existing BMP Locations

DOCUMENT6


Legend

- Storm Sewer
- Drainage Area Boundary

Source Areas


- Landscape
- Parking
- Road
- Rooftop
- Sidewalk

0 150 300 600 Feet




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Figure 1
University of Wisconsin - Green Bay
SLAMM Source Areas and Drainage Basins
 Stormwater Management Study



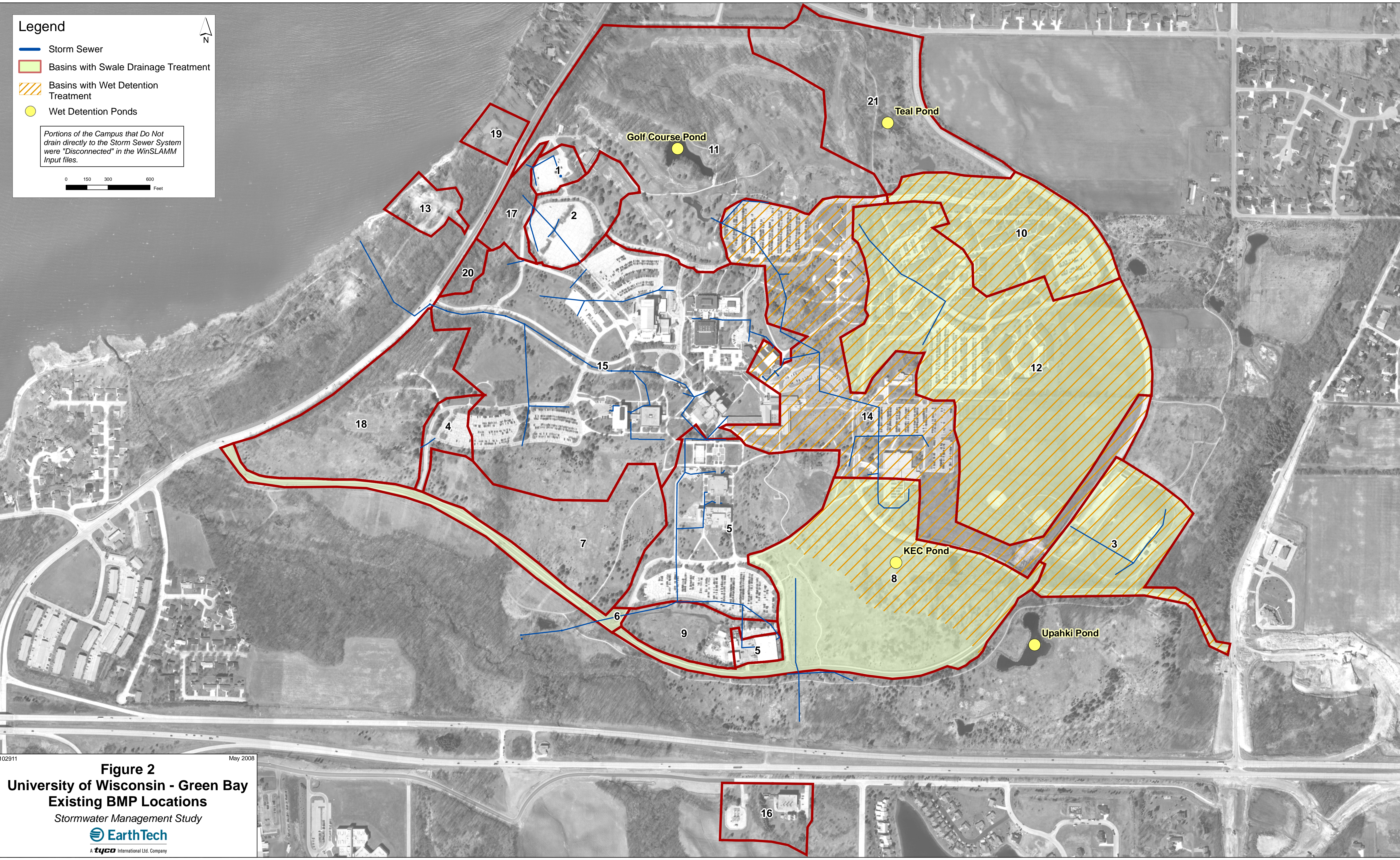
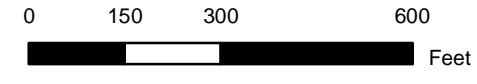
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Legend



-  Storm Sewer
-  Basins with Swale Drainage Treatment
-  Basins with Wet Detention Treatment
-  Wet Detention Ponds

Portions of the Campus that Do Not drain directly to the Storm Sewer System were "Disconnected" in the WinSLAMM Input files.



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Figure 2
University of Wisconsin - Green Bay
Existing BMP Locations
 Stormwater Management Study



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