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# Memorandum

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| Date: | January 20, 2009 |
| To: | Peter Nemmetz – Assistant Director of Facilities Management, UW-Platteville |
| From: | Caroline Burger, P.E. and Theran P. Jacobson, E.I.T. |
| Subject: | **University of Wisconsin – Platteville Urban Pollution Loading Analysis Platteville, WI AECOM Project No. 106805** |
| Distribution: | Peter Davis – Interim Director of Facilities Management, UW-Platteville<br>Doug Stephens – Director Campus Planning, UW-Platteville<br>Howard Crofoot - Director of Public Works, C. of Platteville |

## Background / Scope of Work

The analysis described in this memorandum was conducted in partial fulfillment of the University of Wisconsin-Platteville (UWP) Campus Municipal Separate Storm Sewer System (MS4) General Permit. This report documents the stormwater pollution analysis conducted for the area of the UWP Campus regulated under the MS4 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 best management practices (BMPs) on the campus.

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

1. Base Conditions: October 1, 2004, land use conditions with no BMPs applied.

2. Existing Conditions: October 1, 2004, land use conditions with the BMPs as of January 2009 applied. The existing BMPs are described later in this memorandum.

If under scenario 2, the existing BMPs were not sufficient to meet the required 20 percent and 40 percent Total Suspended Solids (TSS) reduction requirements, additional BMPs would be evaluated to achieve this goal. Analysis to achieve a TSS

reduction goal of 60 percent was also evaluated.

**Summary of Methods for Pollution Loading Model – Base and Existing Conditions**

This section summarizes the analysis conducted for UWP to determine the base conditions pollution load and the amount of pollution load reduction currently being achieved by UWP's existing BMPs. The pollution loads are established using the policies and procedures set forth by the Wisconsin Department of Natural Resources (WDNR) to analyze pollution loading in developed urban areas were followed throughout the process. These policies can be found at the WDNR website: http://www.dnr.state.wi.us/runoff/stormwater/muni.htm

Pollution Loading Model Input Information

A GIS database was created characterizing the UWP Campus in terms of urban stormwater pollution generation. Information in the database includes:

- Subbasin delineations (based on the 2004 City wide stormwater plan, contour data, and storm sewer mapping)
- Hydrologic soil groups (based on USDA NRCS soil data)
- Land use conditions as of October 2004
- Street drainage type (curb & gutter or swale)
- Catch basins
- Pond locations
- Biofilter locations
- Connected or disconnected impervious surfaces

The data used to create the GIS database was provided by UWP, unless noted above.

Area of Analysis

All of the lands within the campus boundary of UWP 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 Roundtree Branch or tributaries of the Roundtree Branch without passing through an MS4)
- Undeveloped land greater than 5 acres
- City owned right of way for Greenwood Avenue
- City owned right of way for University Plaza for section up to western most parking lot to north of right of way boundary.

Stormwater Model Description

WinSLAMM version 9.3.1 was used to conduct the analysis. The following supporting parameters files were used:

- WisReg – Madison Five year Rainfall.ran 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 data files were created specifically to represent each delineated drainage basin of the campus. Each data file included surface area values and descriptions for each "source area" feature within the drainage basin. Source areas in WinSLAMM consist of rooftop, parking, driveway, sidewalk, and landscaped areas. Each source area was further defined in the WinSLAMM data file based on direct observations and discussions with UWP staff.

Existing Stormwater BMPs

UWP currently has four types of existing BMPs in place. These practices are:

1) Biofilters
2) Catch basins with sumps
3) Wet detention ponds
4) Dry detention ponds

The existing BMPs are described below.

1) Biofilters: Biofilters are specially constructed landscaped depressions in the ground surface. During rain events, stormwater enters the biofilter and soaks into an area with a mixture of sand, compost and top soil before being allowed to either infiltrate into the ground or exit through one or more under drain pipes. Biofilters also feature landscaping of various plant species which contribute with aesthetic value and enhance the infiltration rate of the soil.

UWP has constructed biofilters during renovations in recent years. In addition to the newly constructed facilities, some of these treatment devices service lands that were fully or partially developed prior to October 1, 2004. The pollution control from these existing developed lands was applied to the equivalent land area as of October 1, 2004. The pollution control effectiveness of the biofilters was modeled using data provided by UWP. A summary of the biofilter characteristics used for input into the WinSLAMM model is found in Table 1.

**Table 1: Biofilter Characteristics for Modeling Purposes**

| BMP | Contributing Drainage Area (acres) | BMP Surface Area (sq ft) | Total Depth (feet) | Outlet Structure |
|---|---|---|---|---|
| Hickory Street Northern Biofilter | 0.22 | 270 | 4.3 | 4" dia underdrain & 5' broad-crested weir |
| Hickory Street Southern Biofilter | 0.11 | 175 | 4.3 | 4" dia underdrain & 5' broad-crested weir |

Note: Based on plans provided by UWP, and for modeling purposes, the biofilters were assumed to have a total depth of 4.3 feet. Also, it was assumed that each biofilter has a high-flow outlet represented by a 5 foot broad-crested weir. This information was referenced from the plans provided by UWP.

2) Catch basins with sumps: These are structures located under the ground surface where storm water is intercepted and directed to underground storm sewer pipes. Catch basins are typically found in curb and gutter along streets and along the perimeter of parking lots. Catch basins can be rectangular or circular structures with a storage depth below the discharge pipe of the structures which allow sediment to accumulate.

UWP has constructed catch basins with sumps during renovations in recent years. In addition to the newly constructed facilities, some of these treatment devices service lands that were fully or partially developed prior to October 1, 2004. The pollution control from these existing developed lands was applied to the equivalent land area as of October 1, 2004.

3) Wet Detention Pond: 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/or swale drainage systems.

UWP has one wet detention pond serving developed lands. This wet detention pond services lands that were fully or partially developed prior to October 1, 2004. The pollution control effectiveness of the pond was modeled using data provided by UWP. A summary of the wet detention pond's characteristics used for inputs to the model is found in Table 2.

4) Dry Detention Ponds: These are depressions in the ground surface with an outlet at or near the bottom of the pond. During rainfall events, stormwater enters the detention pond and is treated before being allowed to flow downstream. Dry detention ponds can be fed by both storm sewer and/or swale drainage systems.

UWP has two dry detention ponds serving developed lands. These dry detention ponds service lands that were fully or partially developed prior to October 1, 2004. The pollution control effectiveness of the pond was modeled using data provided by UWP. A summary of the dry detention ponds characteristics used for inputs to the model is found in Table 2.

Both dry ponds were analyzed in WinSLAMM as detention ponds to determine the TSS removal efficiency. Ponds with an outlet less than three feet above the pond bottom have a reduced pollution trapping due to scour. Therefore low treatment efficiencies, if any are anticipated from the two wet detention ponds.

The BMPs on campus was modeled for the TSS reduction capabilities.

The approximate locations of the existing BMPs are shown on Figure 2. The BMPs were modeled to determine the pollution reduction of the load generated by present day (January 2009) land use conditions. The reduction was then applied to pollution load generated by the same contributing drainage areas under the October 1, 2004 land use conditions

**Table 2: BMP Descriptions and Drainage Area Characteristics**

| Location | BMP Type | Site Description | Subbasin Name | Subbasin Area | BMP Drainage Area | Total BMP Drainage Area | BMP Surface Area | Treatment Efficiency |
|---|---|---|---|---|---|---|---|---|
| | | | | (acres) | (acres) | (acres) | | (%) |
| Hickory Street | Biofilter | Northern Most BMP | RB2B.2 | 0.15 | 0.03 | 0.22 | 270 sq. ft. | 62 |
| | | | RB3J.6 | 0.2 | 0.14 | | | |
| | | | RB3J.5 | 0.13 | 0.05 | | | |
| Hickory Street | Biofilter | Middle BMP | RB3J.5 | 0.13 | 0.04 | 0.11 | 175 sq. ft. | 69 |
| | | | RB3J.4 | 0.13 | 0.07 | | | |
| Southwest Dorm | Wet Pond | ---- | RB3C.1 | 16.57 | 4.21 | 6.07 | 0.08 ac* | 61 |
| | | | RB3D.1 | 22.27 | 1.44 | | | |
| | | | RB3J.1 | 58.92 | 0.42 | | | |
| Engineering Building | Dry Pond | South Pond | RB3C.1 | 16.57 | 1.39 | 3.05 | 0.14 ac** | 0 |
| | | | RB3J.1 | 58.92 | 1.66 | | | |
| Engineering Building | Dry Pond | North Pond | RB3J.1 | 58.92 | 56.85 | 102.98 | 0.22 ac** | 25 |
| | | | RB3J.3 | 1.25 | 1.11 | | | |
| | | | RB3J.7 | 10.94 | 10.94 | | | |
| | | | City Owned | 34.08 | 34.08 | | | |

* Wet pond permanent pool size
** Top berm is modeled as outer limits of BMP

**Results - Base and Existing Conditions**

The results of the WinSLAMM modeling analysis are shown in Table 3. 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).

**Table 3: Annual Base and Existing Conditions Pollution Loads**

| Scenario | TSS Load | BMP Reduction | | | TP Load |
|---|---|---|---|---|---|
| | | Individual | Individual | Cumulative | |
| | (tons/yr) | (tons/yr) | (%) | (%) | (lbs/yr) |
| **Base Conditions** | **24.3** | **0.0** | **0.0** | **0.0** | **149** |
| adding catchbasins | 23.8 | 0.5 | 1.9 | 1.9 | 146 |
| adding biofilters | 23.8 | 0.0 | 0.1 | 2.0 | 146 |
| adding ponds | 21.7 | 2.2 | 9.2 | 10.7 | 135 |
| **Sum of Existing Conditions** | **21.7** | **2.6*** | **----** | **10.7** | **135** |

* rounding in calculations

The University's annual base conditions TSS load is 24.3 tons per year. After accounting for the TSS control from the existing BMPs analyzed, the existing conditions TSS load is 21.7 tons per year, which represents a TSS reduction of 10.7%.

Two figures showing information relevant to the modeling effort can be found at the end of this memo:

- Figure 1: UW – Platteville Campus WinSLAMM Source Area Map. This map shows the source areas for each drainage system within the modeled campus area that was used in the WinSLAMM input (data) files.
- Figure 2: Existing Best Management Practices: This map shows the approximate locations of the existing BMPs and the current campus parcel boundaries.

**<<End of Base and Existing Conditions Analysis>>**

## Proposed Management

Since the existing BMPs do not achieve the 20 percent or 40 percent TSS control required under the MS4 permit, additional stormwater BMPs were investigated. The campus needs to reduce its TSS loading by an additional 2.2 tons per year to achieve a 20 percent reduction, 7.1 tons per year to achieve a 40 percent reduction, and 12.0 tons per year to achieve a 60 percent reduction.

Load per Source Area

The first step in determining the location and size of the proposed BMPs is to conduct an analysis that characterizes the project area based on relative pollution load generation. BMPs that are applied to areas with a relatively large pollution load are generally more cost effective.

The pollution loading for each impervious source area identified on the UWP campus was calculated. The cumulative load for each impervious source area is listed in Table 4. Note, there are other source areas not shown on Table 4 which account for the base loading difference between 24.9 and 12.9 tons/yr.

**Table 4: Sediment (TSS) Loading by Source Area**

| Source Area | Area (acres) | TSS Load (tons / yr) |
|---|---|---|
| Roof | 17.2 | 1.4 |
| Parking Lot | 22.0 | 6.6 |
| Street | 2.6 | 2.2 |
| Sidewalk | 13.2 | 2.7 |

As shown in the table, parking lots account for the highest sediment loading for impervious surfaces on campus. Sidewalks account for the next highest sediment loading on campus. 100 percent of the sediment from the streets would need to be treated to reach the 20 percent reduction goal (reduce the sediment load by 2.2 tons/yr). In addition to that, almost all of the parking lots would need to be treated to reach the 40 percent reduction goal.

Wet Detention
Bio Filter
Proprietary Device

Retrofitting Existing BMPs

Proposed BMPs

## Conclusions

## Figures

**Supporting Documentation**