CITY OF EDEN PRAIRIE, MN POND INVENTORY AND MAINTENANCE ASSESSMENT

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Abstract. The City of Eden Prairie, MN (population 62,409) is a suburb of Minneapolis with an area of approximately 12 square miles. The City's stormwater system consists of approximately 950 water bodies; including constructed stormwater ponds, wetlands, lakes, infiltration BMPs and creek segments. The next step in the City's stormwater program is to ensure adequate maintenance of the constructed ponds, infiltration BMPs and wetlands that are either City-owned, under a drainage easement, receive public drainage or are within City right-of-way.

The City selected Wenck Associates, Inc. (Wenck) to evaluate 180 water bodies in a portion of the Staring Lake watershed. (The remaining water bodies will be evaluated in subsequent phases.) Wenck spent 2010 reviewing construction records and conducting visual inspections and sedimentation surveys.

Wenck collected data using a survey-grade sub-centimeter GPS unit to complete bathymetric surveys of the basins; estimate accumulated sediment depth and percent coverage by aquatic vegetation; determine the water surface elevation; and establish basin outlet/overflow data.

Data from the survey is being used to determine sedimentation, pollutant removal effectiveness, and, ultimately, which basins need sediment removal. The load-based removal efficiency will be calculated and compared to NURP design standards. Maintenance will be prioritized by degree of sedimentation, proximity to public waters, potential water quality benefits and budget available.

The final phase of the project will include a watershed-wide P8 model and a lake-response model for Staring Lake. The removal efficiency analysis may show that maintenance of individual water bodies is necessary; however, the P8 and lake-response models may show that the system adequately protects Staring Lake even though maintenance is needed.

The final report (March 2011) will document methodology, analysis, results, and cost considerations for the recommended maintenance activities.

INTRODUCTION

The City of Eden Prairie, MN (population 62,409; Figure 1) is a suburb of Minneapolis with an area of approximately 12 square miles. The City's stormwater system consists of approximately 950 water bodies; including constructed stormwater ponds, wetlands, lakes, infiltration BMPs and creek segments. Following NPDES requirements, the City inspects 20% of their system annually. The Minnesota Pollution Control Agency (MPCA), however, has asked the City to take the next step to ensure adequate maintenance of the basins (constructed ponds, infiltration BMPs and wetlands) that are either City-owned, under a drainage easement, receive public drainage or are within City right-of-way. The City selected Wenck Associates (Wenck) to assist with basin assessment and performance analysis to satisfy MPCA requirements.

Figure 1. Eden Prairie, MN – a western suburb of Minneapolis.

BASIN INVENTORY & ASSESSMENT

Evaluating over 950 basins is a daunting task – where is the best place to start? The City chose to begin the study in the Staring Lake watershed because the local watershed district expects to undertake a water quality capital project in 2012. The City expects the outcome from this study will help prioritize the location of the watershed district project. (The remaining water bodies in the city will be evaluated in subsequent phases.)

The basin inventory completed by the City identified over 180 basins within the Staring Lake watershed. Wenck began the study by working with City staff to determine which of the 180 basins were considered "public": located on City property; within City right-of-way; under a drainage and utility easement; or private but receiving runoff from public right-of-way.

Wenck spent 2010 reviewing design and record drawings to determine easements, using GIS-based parcel information to determine ownership, and delineating subwatersheds using 1-foot contours. In the end, a total of 124 basins (Figure 2) were identified by Wenck as "public" in the Staring Lake watershed.

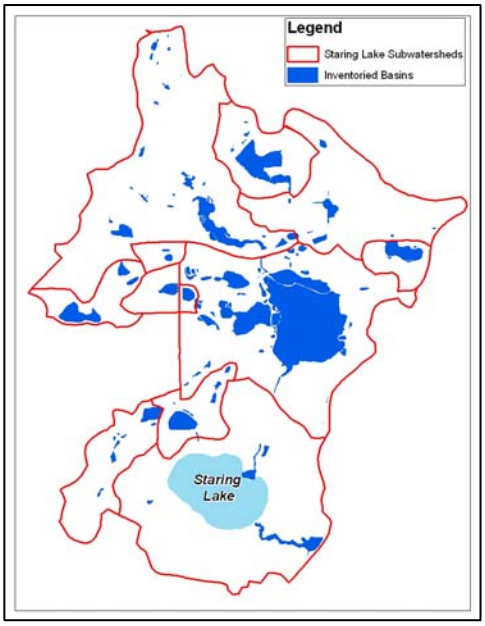

Figure 2. Basins and major subwatersheds in the Staring Lake watershed.

SEDIMENTATION SURVEY

Wenck spent the summer of 2010 conducting visual inspections and sedimentation surveys for each of the 124 basins. Wenck used a survey-grade sub-centimeter GPS unit to complete bathymetric surveys of the basins; estimate accumulated sediment depth and percent coverage by aquatic vegetation; determine the water surface elevation; and establish basin outlet/overflow data.

Wenck reviewed or collected the following by visual inspection:

- Storm sewer, grading, and utility plans available for each basin prior to field evaluation. These plans were taken into the field with the inspector to allow for easy comparison between the proposed and constructed facilities.
- Photograph basin features.
- Identify and report plain-sight maintenance needs (i.e., erosion, accumulation of debris on trash racks, repairs to damaged structures) using the City's "Stormwater System Follow-Up Checklist."
- Estimate the percentage of the pond's permanent pool surface regularly covered by aquatic vegetation.
- Measure the basin length and width.

The bathymetric survey was conducted using cross-sections surveyed throughout each basin (Figure 3). At each survey point in the cross-section, Wenck determined the basin bottom elevation and the top of accumulated sediment. Sediment depth was determined by advancing a rod into the basin muck until resistance is felt (the original basin bottom).

BASIN ANALYSIS

Data collected from the sedimentation survey was used to determine sedimentation amounts, pollutant removal effectiveness, and, ultimately, which basins need sediment removal. The load-based removal efficiency was calculated and compared to Nationwide Urban Runoff Program (NURP) design standards. Maintenance will be prioritized by degree of sedimentation, proximity to public waters, potential water quality benefits, and budget available.

Figure 3. Survey points collected for four basins.

Wenck used ArcMap software to import the GPS data from the sedimentation survey to determine the degree of sediment deposition in each basin. The ArcMap software allowed Wenck to calculate the basin surface area, permanent pool volume, and live storage volume. Wenck also used ArcMap to determine the amount of sedimentation in each basin using the sediment depth measured in the field at each survey point. When available, Wenck compared the sedimentation survey results to the design or record drawings.

Using the subwatershed area and impervious amount from the "Basin Inventory & Assessment," Wenck calculated the water quality volume draining to the basin (the "required" volume according to NURP guidelines). Wenck then estimated the load-based removal efficiency of each basin using a numerical relationship developed from the computer model P8.

Wenck executed the P8 model with a "dummy" subwatershed and variety of pond permanent pool volumes to determine the total suspended solids (TSS) and total phosphorus (TP) removal efficiencies. (A smaller permanent pool generally results in lower TSS and TP removal efficiencies.) These removal efficiencies will then be compared to those for a basin designed to NURP standards. This gave us a simple relationship with which to compare each of the 124 basins evaluated in the field.

Wenck is currently in the process of prioritizing basin maintenance based on the degree of sedimentation found in each pond, its hydrologic proximity to public waters, and the potential water quality benefits of increasing permanent pool volumes. The plain-sight maintenance needs identified during the sedimentation survey have been forwarded to the public works department and will be incorporated into the ongoing maintenance programs.

WATER QUALIY AND LAKE-RESPONSE MODELS

The tasks and aalysis discussed above will provide the City with an assessment of individual pond performance throughout much of the Staring Lake watershed. It will not, however, indicate whether this is an adequate level of pollutant removal for Staring Lake. Therefore, the final phase of the project includes a watershed-wide P8 model and a lake-response model for Staring Lake. Model results will be validated using water quality monitoring data where available.

P8 is an industry-standard model developed to assess pollutant loading and removal in urban watersheds. P8 will be used to calculate watershed runoff loads for TSS and TP. Inserting basin data obtained from sedimentation survey will allow us to calculate the approximate amount of TSS and TP removed by the basins. These values, in turn, will serve as input for the BATHTUB analysis.

BATHTUB is a widely-used model used to assess in-lake pollutant concentrations as a result of external and internal loads. To assess the role of watershed loads in affecting Staring Lake water quality, it is important to know the level of internal loading in the lake. To assess the internal load, Wenck will collect sediment cores from the deepest part of the lake and measure the anoxic release of phosphorus from the sediments. These results will be combined with dissolved oxygen and temperature profiles from Staring Lake to develop annualized phosphorus loads from the sediments of Staring Lake.

Once the watershed load and internal load has been determined, Wenck will use a spreadsheet version of BATHTUB to assess in-lake water quality response. This model will be executed for up to 10 years depending on the availability of the data. The lake response model will then be used to determine the required level of effort in pond maintenance to meet established lake water quality goals such as state eutrophication standards.

FINAL REPORT

Upon completion of the analysis, Wenck will complete a final report to summarize the methods and results of the study. The report will detail the methods of the inventory and assessment, the sedimentation survey, the basin analysis, and highlight critical maintenance activities including individual basin sediment volumes. Plain-sight maintenance activities will be summarized

using tables and figures rather than a detailed explanation for each individual basin visited during the field evaluation.

The report will present cost considerations for the recommended maintenance activities. Among these, dredging and disposal of sediment is likely the most costly. Therefore, our planning-level cost estimates will include costs for sediment characterization, mobilization, site preparation, dredging, sediment disposal, minor storm sewer work, site restoration, and erosion control. PAH-contamination is a developing concern in Minnesota basins; we will discuss the cost impacts if contamination is identified in any dredged material.