MINNEHAHA CREEK WATERSHED DISTRICT
QUALITY OF WATER QUALITY OF LIFE

Monitoring Department – Ecosystem Evaluation Program Update

Introduction

This report will provide an update on the Monitoring Department's Ecosystem Evaluation Program activities through the end of September 2014. The next update will occur in December 2014. If there are questions regarding any elements of this report, please contact Yvette Christianson at 952-641-4514 / ychristianson@minnehahacreek.org or Kelly Dooley at 952-641-4515 / kdooley@minnehahacreek.org.

Timeline and Program Status

Task	**Subtask**	**Timeframe**	**Status**
Introductory Meeting with Partners (e.g., CAC and Technical Advisory Committee (TAC))	• Deep & Shallow Lakes • Streams & Wetlands	July 2014 (Pushed back to September to accommodate TAC member's field schedules)	**Completed:** Met with CAC on September 24, 2014; Met with TAC on September 25, 2014
Identify key features of health and ecosystem services		July – October 2014	**In Progress:** Ecosystem Services and functions have been identified; redefining the list with TAC's input
Identify appropriate metrics and indices (data collection/analysis)		October – December 2014	**In Progress:** Identified potential metrics/ indices; meet one on one with agencies on the TAC and internal staff to get more information

Task	Subtask	Timeframe	Status
Update datasets and fill data gaps	• Deep & Shallow Lakes • Streams & Wetlands	Spring - Summer 2015	**TBD:** Wenck is reviewing the data and determining the data gaps for collection in Summer 2015
Follow up meeting: Partners & Consultant (e.g., CAC, TAC, and Board of Managers)		Winter 2014 – 2015	**In Progress:** Setting up the next TAC for a date in October/November 2014; Provide 2nd update to the Board in December 2014
Literature research & stressor response		July – October 2014	**In Progress:** The research and stressor response information is being incorporated into generating the list of ecosystem services, functions and potential metrics/indices

Enclosed Documents

- Technical Memorandum on the Approach for the Ecosystem Evaluation Program with attachment
    - Provided to the TAC members for the September 25, 2014 meeting
    - Table 1 was the focus of the TAC meeting discussion

- September 25, 2014 TAC meeting minutes

Wenck Associates, Inc.
1800 Pioneer Creek Center
P.O. Box 249
Maple Plain, MN 55359-0249

(800) 472-2232
(763) 479-4200
Fax (763) 479-4242
wenckmp@wenck.com
www.wenck.com

TECHNICAL MEMORANDUM

TO: Kelly Dooley, Minnehaha Creek Watershed District
Yvette Christianson, Minnehaha Creek Watershed District

FROM: Joe Bischoff, Wenck Associates, Inc.
Diane Spector, Wenck Associates, Inc.

DATE: September 18, 2014

SUBJECT: Approach for the Ecosystem Evaluation Program

The purpose of this technical memorandum is to outline the overall approach for developing the Ecosystem Evaluation Program for the Minnehaha Creek Watershed District (MCWD).

Purpose

The purpose of the Minnehaha Creek Ecosystem Evaluation Program (EEP) is to develop and implement a watershed wide ecosystem evaluation/grading tool to assess watershed condition, inform monitoring and other data collection, identify target areas that need improvement or that may be impacted by potential stressors, and ensure that the District's management strategies effectively protect and improve water resources. EEP will be designed to more effectively communicate the watershed's condition to the public and stakeholders. The Program will assess and report watershed health through the use of environmental indicators or metrics that will serve as the basis for project and program targeting and as the measures of environmental change.

The goals of the program are:

1. Provide a tool to deliver a wide variety of highly technical information in an understandable form for local citizens, municipalities, and other agencies.
2. Provide a tool for targeting programs to address watershed deficiencies and measuring environmental change.

Approach

The guiding principle of the District's 2007 Comprehensive Water Resources Management Plan was Integrated Resource Management. Integrated Resource Management is an interdisciplinary approach to water resources management that focuses on specific water resource, subwatershed, or watershed *outcomes* rather than on *processes* such as wetland regulation, runoff rate control, or BMP selection. This approach recognizes that water resources are complex, dynamic systems that require integrated decisions about water quality, water quantity, ecologic integrity, and land use and regulation to achieve

complex and multi-dimensional end goals. The Plan established a number of goals in each of the 11 subwatersheds and defined associated metrics to evaluate progress. Among these indicators were:

- In-lake nutrient concentrations
- Watershed nutrient loading goals
- Acres of land conserved in Key Conservation Area
- Acres of restored/created wetlands
- Surficial groundwater levels
- Stream Visual Assessment Protocol scores
- Macroinvertebrate Index of Biotic Integrity

The Ecosystem Evaluation tool builds off that approach and expands it by defining the health of the watershed and its features in the context of key ecosystem services. To accomplish this, we must first determine the key ecosystem services provided in the watershed and what features or components of the watershed are critical in providing these ecosystem services. Once the key ecosystem services and critical watershed components are defined, the current health or condition of the watershed will be determined through the use of indicators or metrics. Following that, potential stressors that could negatively impact those services or value will be identified. Management and implementation activities can then be developed to address those stressors with protection or improvement actions.

The process will follow the 6 steps below:

1. Identify the key components that describe the health of the watershed feature (lake, stream, wetland, upland).
    a. Identify the key ecosystem services to be protected
2. Identify the metrics or indices required to evaluate health of each of the identified components
    a. Collect and analyze data associated with each of these metrics
3. Develop scales for each of the metrics or indices using statistical analyses, reference sites, and literature values
    a. Statistical analysis of the data
    b. Literature review of index values at different scales (metro, ecoregion, state, region)
4. Develop grades for each of the resource features and watershed as a whole
    a. Develop scales combining metrics
5. Develop lists of poor scoring metrics or data gaps
6. Develop programmatic approaches to addressing scored resources
    a. Developing monitoring approach to fill data gaps (Hydrodata)
    b. Develop management actions focused on improving resources and areas with low scoring metrics (Planning)
    c. Develop outreach programs to communicate grades (Communications)
    d. Develop protection strategies for resources and areas with high scoring metrics (Planning)

Following is description of the current status in developing key ecosystem services, critical watershed components, and appropriate metrics to evaluate watershed conditions.

Technical Memo
Approach for the Ecosystem Evaluation Program
Minnehaha Creek Watershed District
September 16, 2014

Ecosystem Services

Ecosystem services are simply defined as the benefits people get from ecosystems. These benefits include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth. The Millennium Ecosystem Assessment group (MA) defines the different types of Ecosystem Services as:

Provisioning services: The products obtained from ecosystems, including, for example, genetic resources, food and fiber, and fresh water.

Regulating services: The benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, and some human diseases.

Cultural services: The non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, e.g., knowledge systems, social relations, and aesthetic values.

Supporting services: Ecosystem services that are necessary for the production of all other ecosystem services. Some examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

The MA is an international work program designed to meet the needs of decision makers and the public for scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes.

Using this framework, there are number of ecosystem services that can be identified for watersheds as well as the key watershed components supporting the ecosystem services (attached figure). Determining a watersheds ability to provide all of these services at this level of detail is quite challenging and very labor intensive. In an attempt to simplify the approach and improve understandability, the ecosystem services were reduced to six primary categories for this assessment including:

1. Flood Control
2. Nutrient Cycling
3. Biodiversity
4. Habitat Diversity
5. Recreation
6. Drinking Water Supply

Key Watershed Features

To develop an understanding of the health of the watershed, the watershed was broken into its key components that support or deliver identified ecosystem services. These key components were selected based on scientific understanding of these areas to deliver ecosystem services as well as focus areas for the Minnehaha Creek Watershed District. These are not intended to be all inclusive, rather to focus on

the primary management areas for the district and to encompass the majority of critical ecosystem services that are provided by the Minnehaha Creek watershed.

The following key watershed components will be included in the study:

- Deep Lakes
- Shallow Lakes
- Streams
- Wetlands
- Terrestrial Habitat
- Groundwater
- Precipitation/Hydrology

Shallow and deep lakes were separated due to their functional differences as well as differences in ecosystem services provided. For example, deep lakes sustain a different suite of recreational services than shallow lakes. Precipitation and hydrology are a unique watershed "feature" in that it is dependent on other components such as wetlands, uplands, and streams. However, the hydrologic functioning of a watershed is critical for supporting almost all of the identified ecosystem services, so it was broken out into its own category for evaluation.

Indicators

Watershed health indicators or metrics will be used for each watershed component to measure the health of that component and its ability to provide key watershed ecosystem services. The goal for this project is to use metrics and indices already developed by other agencies and to build off of those wherever possible. Table 1 lists a number of potential metrics and indices that have been applied in Minnesota. Several of these indices provide an assessment across a number of ecosystem functions. For example, the Floristic Quality Index can be used as an index for the health of the plant community and also its habitat conditions for supporting waterfowl.

Table 1. Watershed features, functions and potential metrics for the MCWD Ecosystem Evaluation Program.

Watershed Feature	Ecosystem Service	Functions	Potential Indicators/Metrics
Deep Lakes	Flood Control	Watershed storage	TBD - Hydrology
	Nutrient Cycling	Nutrient sink, source, transformer	Water quality parameters
	Biodiversity	Resilient biological community Recreational use (hunting and fishing)	Fish IBI Floristic Quality Index Invasive Species (presence/absence; abundance) Land use change? Imperviousness?
	Habitat Diversity	Fish, macroinvertebrate, and wildlife habitat	Floristic Quality Index Shoreline Development Index Connectivity (# of culverts, dams, etc.) Fragmentation
	Recreation	Access	Public access
		Aesthetics	Water quality parameters
	Drinking Water Supply	Groundwater recharge	TBD – Groundwater Lake level trends Monitoring well elevations
Shallow Lakes	Flood Control	Watershed storage	TBD - Hydrology
	Nutrient Cycling	Nutrient sink, source, transformer	Water quality parameters
	Biodiversity	Resilient biological community Recreational use (hunting and fishing)	Fish IBI Floristic Quality Index Invasive Species (presence/absence; abundance) Wildlife surveys (waterfowl, birds, etc.) Land use change? Imperviousness?
	Habitat Diversity	Fish, macroinvertebrate, and wildlife habitat	Floristic Quality Index Shoreline Development Index Connectivity (# of culverts, dams, etc.) Fragmentation
	Recreation	Access	Public access
		Aesthetics	Water quality parameters
	Drinking Water Supply	Groundwater recharge	TBD – Groundwater Lake level trends Monitoring well elevations

Watershed Feature	Ecosystem Service	Functions	Potential Indicators/Metrics
Streams	Flood Control	Conveyance	TBD - Hydrology
	Nutrient Cycling	Nutrient sink, source, transformer	Water quality parameters
	Biodiversity	Resilient biological community Recreational use (hunting and fishing)	Macroinvertebrate IBI Fish IBI
	Habitat Diversity	Fish, macroinvertebrate, and wildlife habitat	Stream Visual Assessment Rapid Bioassessment Protocol MPCA protocol Fluvial geomorphology assessments
	Recreation	Access	Public Access Fish IBI
		Aesthetics	Stream Visual Assessment Rapid Bioassessment Protocol
	Drinking Water Supply	Groundwater recharge	TBD - Groundwater
Wetlands	Flood Control	Watershed storage	TBD - Hydrology
	Nutrient Cycling	Nutrient sink, source, transformer	Water quality parameters
	Drinking Water Supply	Groundwater recharge	TBD - Groundwater
	Biodiversity	Habitat diversity	Invasive Species (presence/absence; abundance) Wetland Health Evaluation Program protocol Land use change? Imperviousness? Functions and values assessments
	Habitat diversity	Vegetative diversity	MPCA Wetland IBI Functions and values assessments
Terrestrial Habitat	TBD	TBD	TBD
Groundwater	TBD	TBD	TBD
Precipitation/Hydrology	TBD	TBD	TBD

Following is a brief description of some of the key indicators that will be explored for this project. Note that at this stage in the project, the indicator list is not exhaustive and new indicators may be added or subtracted as the project progresses. Rather, this list is a preliminary list of indicators already developed or utilized in Minnesota. Further literature review is needed prior to finalizing the list of indicators and metrics.

*MPCA's Index of Biotic Integrity for Streams. T*he MPCA recently developed a macroinvertebrate and fish community-based Index of Biological Integrity (M-IBI) for Minnesota's streams and rivers. The primary intended use for this tool is the assessment of aquatic life use support.

Development of the M-IBI utilized a standardized protocol developed by researchers from the United States Environmental Protection Agency and elsewhere (Whittier et al. 2007). Minnesota's streams and rivers were first partitioned into five distinct classes, and a unique IBI was developed for each. Within each stream class, biological metrics were sequentially ranked and eliminated by a series of tests, and selected for inclusion in each IBI. Among the most important tests was an evaluation of each metric's ability to distinguish most-disturbed sites from least-disturbed sites. More information can be found at http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/biological-monitoring/index-of-biological-integrity.html.

MNDNR Index of Biotic Integrity for Fish in Lakes. Excerpt from http://www.legacy.leg.mn/projects/lake-index-biological-integrity-assessments-0.

The Minnesota Pollution Control Agency currently uses IBIs for fish and macroinvertebrates (stream-dwelling insects and other critters) to help determine whether streams and rivers are impacted by water pollution. DNR is developing similar tools, using fish and aquatic plants, to identify lakes that may be impacted to support Legacy Amendment assessment efforts. The development of an IBI involves sampling a wide range of lakes, from high-quality systems to those with significant water quality impacts, plus detailed statistical analysis. The DNR's current effort is focused on collecting information about the entire fish community including non-game fish that have not been traditionally sampled by fishery managers and are often more sensitive to watershed and shoreline disturbance. In addition, DNR is beginning work on development of a plant IBI, especially important for assessing shallower wildlife lakes.

In FY14, DNR biologists will complete approximately 135 fish IBI surveys, which include near-shore fish communities and game and nongame fish surveys in the shallow and deep water zones. IBI survey information will be used as part of MPCA's watershed assessments. Using the data collected to date, DNR Biologists will work with MPCA to finalize a fish IBI tool for most lake types and develop a Biological Condition Gradient (BCG) Model for Minnesota lakes. We expect to finalize the IBI and BCG models by early 2015. Biologists will also begin work on developing IBI tools for aquatic plants in FY14.

Floristic Quality Index. The Floristic Quality Assessment (FQA) is a vegetation-based ecological assessment approach that can be used for shallow lake vegetation quality monitoring and assessment. FQA is based on the Coefficient of Conservatism (*C*), which is a numerical rating (0 –10) of an individual plant species' fidelity to specific habitats and tolerance of disturbance. Plant species that have narrow habitat requirements and/or little tolerance to disturbance have high *C*-values and vice versa. FQA metrics derived from on-site vegetation data and the *C*-values have been found to be effective indicators of wetland quality–similar to Indices of Biological Integrity (IBIs).

MPCA Wetland Floristic Quality Assessment. Excerpt from http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/wetlands/floristic-quality-assessment-for-minnesota-wetlands.html.

The MPCA has fully developed the FQA (see Floristic Quality Index description above) for use in Minnesota's wetlands. This includes: assigning *C*-values to Minnesota's wetland plant species; developing data-driven benchmarks to translate FQA results into assessments; and developing a 'Rapid FQA' geared towards broader usage. The MPCA is currently utilizing the FQA approach to monitor all wetland types in Minnesota through our wetland quality status and trends monitoring.

Wetlands Functions and Values Assessment. In 2001-2003 the District undertook a *Functional Assessment of Wetlands* (FAW) on all wetlands greater than one-quarter acre in size. This assessment used a variant of the Minnesota Routine Assessment Method. Wetlands that were evaluated as Exceptional or High on certain ecological or hydrologic values were assigned to the Preserve category. The balance of evaluated wetlands were assigned to a category based on this assessment of current functions and values, with Manage 1 wetlands exhibiting higher values and Manage 2 and 3 moderate or lower values.

Invasive Species Indicators. The presence or absence of invasive species can be used to assess the health of a plant community beyond the use of Floristic Quality Assessments, especially in lakes. Lakes can be scored separately based on the presence or absence of key invasive species and assigned grading based on their abundance and overall impact on the system. An index for the presence and impacts for invasive species has not been identified yet, but may be developed during the project.

Shoreline Development Index. The amount of development along a lake's shoreline can impact ecosystem functions and lake health. To date, no indexes for the impacts of shoreline development on the lake have been identified. However, research is being compiled to determine appropriate metrics. For the purpose of regulating shoreline stabilization projects, the District has developed an erosion susceptibility classification system.

Connectivity and Fragmentation. Connectivity of habitat features and habitat fragmentation are critical areas that need to be assessed. Indices to assess upland patch cohesion, connectance, and traversability have been developed, but there are few indices have been identified to date, but a literature review is underway to identify appropriate metrics. Metrics may include number of dams, culverts and water control structures, habitat fragmentation measures, and other easily obtained information.

Water Quality Parameters. There are numerous water quality standards that will be applied to measure health of the watershed from a nutrient cycling perspective.

Recreational Access. Recreational access can be assessed simply by identify those waterbodies with or without public access.

Stream Assessments. In 2003 the District assessed the physical and biological condition of Minnehaha Creek and five principle upper watershed streams. The Minnehaha Creek stream assessment included a

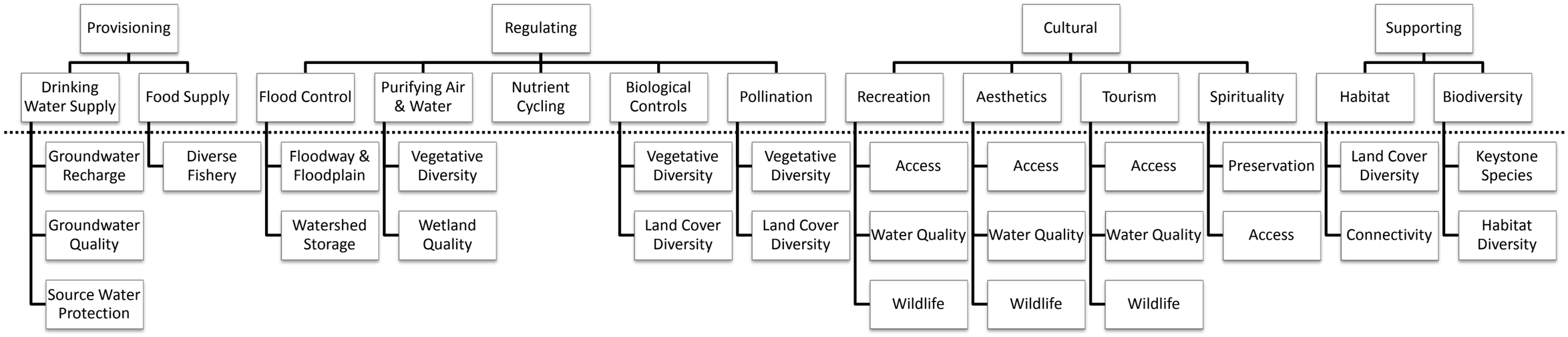
fluvial geomorphic investigation to evaluate the stability of the creek as well as evaluation of creek conditions using the standard assessment tools Stream Visual Assessment Protocol and Pfankuch Channel Stability. Additional indices to evaluate streams might include Rosgen's Bank Erosion Hazard Index (BEHI) or the Rapid Bioassessment Protocol.

Next Steps

Using the above described framework, the next step is to further explore the identified indicators and metrics and their application in scoring system. The MCWD team will be reaching out to Agency leads on many of these metrics to explore their application in the Ecosystem Evaluation Program and how MCWD may be able to partner with Agency.

MCWD also identified three test subwatersheds to apply the scoring systems to evaluate their efficacy. The MCWD team are currently compiling data for these subwatersheds to assess application scale, data quality and data gaps.

Watershed Wide Ecosystems Services



Ecosystem Service | Key Components

Ecosystem Evaluation Program's Technical Advisory Committee
September 25, 2014

TAC Members:

Joe Bischoff (Wenck), Diane Spector (Wenck), Peter Sorenson (U of MN), Justine Koch (U of MN), Emily Deering (U of MN), Kim Laing (MPCA), Chris Zadak (MPCA), Will Bouchard (MPCA), Richard Kiesling (USGS), Brian Vlach (TRPD), Rich Brasch (TRPD), Kate Drewry (MnDNR), Nick Proulx (MnDNR), Tony Brough (Hennepin Co), Adam Arvidson (MPRB), Jen Kostrzewski (MCES), Brian Johnson (MCES), Cassie Champion (MCES), Yvette Christianson (MCWD), Craig Dawson (MCWD), Kelly Dooley (MCWD) and *Conference Called in:* Jacquelyn Bacigalupi (MnDNR) and Taylor Polomis (MnDNR)

TAC Minutes:

After Introductions, Joe Bischoff started off by stating this TAC should function more like a work group with interaction and collaboration among all members. He then presented the powerpoint on the Ecosystem Evaluation Program to the TAC members. The objectives for the meeting were to discuss if the list of the Ecosystem Services and functions on the table on page 6 of the Technical Memo were appropriate and to discuss the next steps for the second TAC meeting.

The following questions/comments were addressed:

- We should consider grouping Biodiversity and Habitat Diversity as one ecosystem service instead of separating them out.
- Plankton, especially the zooplankton, are important. They are missing from the list of metrics. Plankton drive the fish community.
    - Minneapolis Chain of Lakes has a plankton data set

- DNR does not manage shallow lakes for fish but for waterfowl, another metric to consider.
    - DNR makes a good point, how do we break out the uses for deep/shallow lakes and wetlands?
    - It's really important that we define the different uses between shallow lakes and wetlands not only for management action but also to set expectations for the public.
    - Fishless shallow lakes have importance for amphibians, but their presence is more tied to hydrology – could be another metric.
    - DNR suggests using the Fisheries Lake Class System to define lakes vs wetlands.
    - Fish are not a good indicator/metric for shallow lakes due to winterkills. Plants may be a better indicator.
        - However, the presence/absence of carp could be used as an indicator in shallow lakes
    - Lakes that winterkill still provide valuable information, so fish should still be used as an indicator for shallow lakes
        - Shallow lakes have winter kills
        - Wetlands do not have winter kills
    - Consider adding oxygen dynamics to shallow lakes indicators, can help detect flip
- How do recreational uses fit into the program?
- The cultural/recreation/aesthetics piece is important, but will be difficult to devise metrics/scales all can agree upon
- The recreation metric would seem to undermine the ecological metrics and lower the overall E-grade. Recreation is very important, especially in an urban watershed.

    - The plan was not to average the grades of the metrics similar to the Humber River Report Card
    - Recreation could be a recommendation rather than a metric (ex: list the types of recreation supported for each waterbody)
- A topic for future discussions is resolving conflicting metrics (e.g., providing public access may negatively impact fish community)
- The focus/goal should be more towards sustainability because everything has been altered
- Considering grading or assessing based on current ability to meet its 'best attainable condition' for its function rather than a reference condition
- Essentially a functional assessment on all waterbodies should be done
    - Is the grading scale the main objective? Functional assessment would be ideal.
    - The District wants the grades as public communication tool
    - Expanded grading system that encompasses more ecosystem parameters, rather than just water quality which is the current MCES grading system that the District uses
- The Shallow Lakes Example flow chart in the presentation – Stressors – then Opportunities – then Management Actions. What opportunities are present in the subwatershed to develop/carry out management actions?
    - Opportunities such as all the lakeshore in Minneapolis being owned by the MPRB. Lakeshore owned by homeowners around Lake Minnetonka limits the opportunities for action.
- For the management action part – need more data otherwise we should not be making any decisions/plans for action on how to manage the stressor without data
    - If there is a lack of data, then that metric will be incomplete until data is available
- What scale idea does Wenck/MCWD have in mind?
    - Basin (lakes)/ Reach (streams) scale that works with the Index of Biological Integrity (IBIs).

Next Steps:

- Email ideas on ecosystem services via Dropbox
- Smaller meetings with individual agencies to get more detailed information on metrics and the available data
- Next TAC meeting (October/November) 3 short presentations from the following experts:
    - Tired Aquatic Life Uses (TALU), Wetland IBIs and Stream IBIs – Will Bouchard (MPCA)
    - Lake Fish and Plant IBIs – Jacquelyn Bacigalupi and colleague (MnDNR)
    - Current Lake Grading system and Trophic Status Index – Brian Johnson (MCES)