2013

Ft. Sheridan Ravine & Coastal Restoration

Appendix H – Monitoring Plan

Alternative Formulation Briefing Document

Chicago District
US Army Corps of Engineers
05/13/2013

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Introduction

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure, that when conducting a feasibility study for a project (or component of a project) under the Corps ecosystem restoration mission, that the recommended project includes a monitoring plan to measure the success of the ecosystem restoration and to dictate the direction adaptive management should proceed, if needed. This monitoring and adaptive management plan shall include a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring as well as specify that monitoring will continue until such time as the Secretary determines that the success criteria have been met.

Section 2039 of WRDA 2007 also directs the Corps to develop an adaptive management plan for all ecosystem restoration projects. The adaptive management plan must be appropriately scoped to the scale of the project. The information generated by the monitoring plan will be used by the District in consultation with the Federal and State resource agencies and the MSC to guide decisions on operational or structural changes that may be needed to ensure that the ecosystem restoration project meets the success criteria.

An effective monitoring program is necessary to assess the status and trends of ecological health and biota richness and abundance on a per project basis, as well as to report on regional program success within the United States. Assessing status and trends includes both spatial and temporal variations. Gathered information under this monitoring plan will provide insights into the effectiveness of current restoration projects and adaptive management strategies, and indicate where goals have been met, if actions should continue, and/or whether more aggressive management is warranted.

Monitoring the changes at a project site is not always a simple task. Ecosystems, by their very nature, are dynamic systems where populations of macroinvertebrates, fish, birds, and other organisms fluctuate with natural cycles. Water quality also varies, particularly as seasonal and annual weather patterns change. The task of tracking environmental changes can be difficult, and distinguishing the changes caused by human actions from natural variations can be even more difficult. This is why a focused monitoring protocol tied directly to the planning objectives needs to be followed.

This Monitoring and Adaptive Management Plan describes the existing habitats and monitoring methods that could be utilized to assess projects. By reporting on environmental changes, the results from this monitoring effort will be able to evaluate whether measurable results have been achieved and whether the intent of Section 506 Great Lakes Fishery and Ecosystem Restoration is being met.

Guidance

The following documents provide distinct Corps policy and guidance that are pertinent to developing this monitoring and adaptive management plan:

a. Section 2039 of WRDA 2007 Monitoring Ecosystem Restoration

(a) In General - In conducting a feasibility study for a project (or a component of a project) for ecosystem restoration, the Secretary shall ensure that the recommended project includes, as an integral part of the project, a plan for monitoring the success of the ecosystem restoration.

(b) Monitoring Plan - The monitoring plan shall--

(1) include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration success, and the estimated cost and duration of the monitoring; and

(2) specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met.

(c) Cost Share - For a period of 10 years from completion of construction of a project (or a component of a project) for ecosystem restoration, the Secretary shall consider the cost of carrying out the monitoring as a project cost. If the monitoring plan under subsection (b) requires monitoring beyond the 10-year period, the cost of monitoring shall be a non-Federal responsibility.

b. USACE. 2009. Planning Memorandum. Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) - Monitoring Ecosystem Restoration

c. USACE. 2000. ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies. Washington D.C.

d. USACE. 2003a. ER 1105-2-404. Planning Civil Work Projects under the Environmental Operating Principles. Washington, D.C.

General Monitoring Objectives

As presented in "Guidance on Monitoring Ecosystem Restoration Project" on 12 January 2010, the following are general project monitoring objectives:

- To determine and prioritize needs for ecosystem restoration
- To support adaptive management of implemented projects
- To assess and justify adaptive management expenditures
- To minimize costs and maximize benefits of future restoration projects
- To determine "ecological success", document, and communicate it
- To advance the state of ecosystem restoration practice

Project Area Description

The Ft. Sheridan Restoration area is located between the City of Lake Forest to the North and Highland Park to the South (Plate 01). The area includes lake, dune, bluff, and ravine habitat. The general study area includes eight (8) ravine watersheds and about 2-miles of shoreline. Topography of the site is a direct result of surficial drainage over highly erodible lacustrine clays deposited by the Wisconsinan glacial retreat and is termed the Highland Moraine. The area has been primarily impacted by the affects of urbanization including influx of storm runoff due to increased impermeable surfaces, in-lake structures, reduced aquatic species richness due to ravine and stream degradation and fragmentation, and vegetation loss through the invasion of exotic and adventive plant species.

Habitat Trends Triggering Restoration

This project aims to remedy problems of:

- Altered hydraulics and littoral drift from manmade infrastructure
- Altered coastal geomorphology from manmade infrastructure and land use
- Altered coastal geomorphology from non-native plant species colonization (buckthorn, lyme grass)
- Altered stream hydraulics from increased rainwater runoff
- Altered fluvialgeomorphic processes from urbanized watershed
    - Channel widening & incision

    - Bank mass wasting
- Altered hydrology, hydraulics and geomorphology from manmade dams at mouths of ravines
- Altered geomorphology from invasive plant and tree species
    - Large amounts of unnatural woody debris
    - Channel destabilizing buckthorn and honeysuckles

Restoration Design Overview (NER Plan)

The preferred plan will greatly increase the ecological integrity and complexity of ~2- miles of shoreline and five (5) ravines. In general, the habitat restoration is targeted at:

- Naturalizing ravine stream hydraulics, in stream complexity, and connectivity
- Providing stability for coastal lake, dune and bluff natural communities
- Eradicating/reducing invasive species
- Reestablishing floral and faunal species richness and abundance in support of higher organism habitat structure and food production

Monitoring Components

Monitoring Plan Goals & Objectives

The goal of the project is to increase habitat complexity and biodiversity within select areas of the Ft. Sheridan natural area. The following specific objectives were established for monitoring the effectiveness of this project:

- Restore ravine stream and riparian corridor habitat as measured by the presence of naturalized stream hydraulics (observation during and shortly after large storm events)
- Improve native stream & lake fish species richness as measured by Fish Species Richness: Target R Score for Ravine Stream **≥8**
- Improve native plant species richness and assemblage structure as measured by coefficient of conservatism of the Chicago Region Floristic Quality Index: Target Overall Mean C Score **≥ 5**
- Eradicate/reduce the presence of non-native and invasive species: Target Invasive Species Eradication Percentage **<1% Areal Coverage**

Fish communities, lake habitat, ravine habitat, ravine hydraulics, and dune, bluff and riparian vegetation will be monitored to determine the effectiveness of the restoration plan. All components will be monitored as discussed below, once prior to the project and over the course of five years following completion of the project. Once the project is under construction and habitat restoration areas finalized, the monitoring plan would be revised with more detail on monitoring locations and protocol.

Ravine Stream Hydraulics

Hydraulic parameters will monitored at each riffle/pool complex within the ravine stream. In order for the created cobble riffles to provide conditions for lotic macroinvertebrates and fishes, induced flow velocities must be apparent; otherwise they are just a pile of rocks in a stream. These flow patterns will be monitored through observation in the field. Velocity, stream morphology, and substrate count data will be collected at certain cross-sections within the stream to determine how the channel is developing after restoration.

Ravine Stream Habitat

Habitat parameters for the restoration reach will be evaluated using the Qualitative Habitat Evaluation Index, or QHEI (Ranking 1989). The QHEI consists of eight sections with a maximum total of 100 points:

1. Characterization of substrate types and effects of siltation
2. Characterization of in-stream cover
3. Characterization of channel morphology
4. Characterization of the riparian zone and bank erosion
5. Assessment of the pool/glide & riffle/run
6. Gradient
7. Shade
8. Channel incision

One raw data sheet consisting of one to five transects will be completed for each site. The sites will be assessed from a river right descending perspective. The transects are dependent and based on the area sampled for fishes and will begin some distance up or downstream from evident bridge disturbance to the stream; however, the impacts from these structures should be taken into consideration when implementing restoration measures since this study recommends remedies to anthropogenic disturbance to stream morphology and function.

Fish Community

This portion of the assessment uses fish species richness (R), which is the total number of native fish species. An assessment was done utilizing the Fishes of the Chicago Region database, which is primarily comprised of fish collection vouchers stowed at the Field Museum on Natural History and the Illinois Natural History Survey from 1895 – 2007. One hundred and fifty six (156) fish collections were queried from the whole coast line of Lake County, IL and from two similar streams just north of the study in Kenosha County, WI. It was determined from these historic collections that 32 native species have in the past utilized ravine stream and lake shoreline habitat. Several species that formerly used ravines were listed but not counted, such as blacknose shiner, since the chance of these rare and sensitive species recolonization is not likely.

Plant Communities

Evaluation of vegetation will be done using the Floristic Quality Assessment Index (FQA) and native plant richness, as described in the Feasibility Report. In short, the FQA is a measure of overall environmental quality based on the presence or absence of certain plant species. Plant species that are assigned a coefficient of conservatism of 5 to 10 are considered to be indicative of less human mediated disturbance and a higher level of functionality. As the area stabilizes after restoration measures are complete, the number of higher conservative plant species that become established will increase. Communities that have an average mean coefficient of conservatism of between 3 and 5 are considered to be fair quality. This is a good estimate of the future quality of the area based on the current plant community and ‘good’ quality natural sites in the surrounding areas. The overall number of native plant species is expected to increase dramatically as well, helping to increase the overall biodiversity of the area.

Sampling Stations

Stream and lake fishes would be sampled within restored reaches/segments. Locations and protocols would be detailed once the project is in construction. Monitoring locations would be surveyed before restoration activities to establish the monitoring baseline condition. Vegetation will be surveyed and analyzed by both a roaming and stratified random transect survey. Each habitat type will be analyzed separately and then discussed as a whole in a final monitoring results report.

Reference Site Discussion

No reference site is deemed necessary; improvements will be judged from current site conditions.

Sampling/Survey Frequency

Fish Communities

Monitoring will occur twice per year, once in the spring during freshets and once in late summer. The overall monitoring period would be 5-years.

Plant Communities

Plant monitoring would occur between June and August of each year of monitoring activities. Sampling would occur once a year. The total monitoring period will be 5 years.

Stream Hydraulics and Habitat

Observations will be conducted concurrently with fish sampling periods.

Data Analysis

Stream Hydraulics, Habitat, and Fish Communities

Fish parameters calculated will be displayed graphically to show trends through time. The repaired hydraulics and habitat structure of the ravine system should allow for an increase in fish species richness (R) scores. If the trends in the data indicate a decrease in condition, adaptive management actions may be taken.

Plant Communities

The information generated through sampling the plant community would be used to indicate the trend in overall condition of the area. If the FQA analysis indicates a decrease in condition, adaptive management actions may be taken to increase the score for the following sampling year.

Monitoring Responsibilities

Currently, the US Army Corps of Engineers, Chicago District will be responsible for monitoring stream hydraulics, habitat, fish, and plants. Future discussion to have the non-Federal sponsor undertake some or all of these activities is planned.

Monitoring Costs & Funding Schedule

Table 1 - Monitoring Costs

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Hydraulics & Fish	$10,000	$10,000	$10,000	$10,000	$10,000	$ 50,000
Plant Communities	$ 7,500	$ 7,500	$ 7,500	$ 7,500	$ 7,500	$ 37,500
Final Report	$ -	$ -	$ -	$ -	$10,000	$ 10,000
Total						**$97,500**

Reporting Results

A yearly monitoring summary report would be drafted by the USACE that briefly summarizes the data collected and determines if adaptive management is needed. A final monitoring report would be drafted that details the outcomes of the restoration project.

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Adaptive Management Planning

Adaptive management needs for this project are minimal and currently not foreseen needs are apparent. However, changes would be planned, approved and implemented if expectations are not being met.

ALLIANCE FOR THE GREAT LAKES

ENSURING A LIVING RESOURCE FOR ALL GENERATIONS

Stresses and Opportunities in Illinois Lake Michigan Watersheds

Strategic Sub-Watershed Identification Process (SSIP) Report for the Lake Michigan Watershed Ecosystem Partnership

October 2009

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Cover Photo Collage (Counterclockwise from upper left): Water lily in bloom in a wetland (by Kate Rehmus); Stormwater sewer drain which discharges into McCormick/Janes Ravine; Bank surface erosion along the bottom of Ravine 10L; Iris in a wetland (by Jason Rehmus); Stormwater sewer outlet in Ravine 10L; Restored prairie along the top of Hutchins Ravine north of Fort Sheridan; A stretch of severely eroding bank in Ravine 10L; Sunlight reflecting off Lake Michigan (unidentified); A very stable stretch of restored Hutchins Ravine.
Photos by Brian Weiland except where otherwise credited.

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About the Alliance

The Alliance for the Great Lakes serves as the voice of the 40 million people who rely on Great Lakes water for drinking, recreation and commerce. Formed in 1970, it is the oldest independent Great Lakes protection organization in North America. Its mission is to conserve and restore the world's largest freshwater resource using policy, education and local efforts, ensuring a healthy Great Lakes and clean water for generations of people and wildlife. Its headquarters are in Chicago, with offices in Cleveland , Grand Haven, and Milwaukee.

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About LMWEP

The Lake Michigan Watershed Ecosystem Partnership (LMWEP) is a coalition of public, private and not-for-profit entities created to promote, preserve, protect and enhance the natural, cultural, recreational and sustainable economic resources of Lake Michigan and its watershed in Illinois. LMWEP is one of 40 partnerships in Illinois that work in conjunction with the Department of Natural Resources and others to facilitate environmental stewardship in the local landscape.

www.greatlakes.org/lmwep

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Impetus for the Study

In 2007, the Illinois Department of Natural Resources (IDNR), through the Conservation 2000 program, awarded funds to the Alliance for the Great Lakes to carry out a Strategic Sub-Watershed Identification Process on behalf of the Lake Michigan Watershed Ecosystem Partnership (LMWEP), of which it is a part. This report details the results of the study, led by Jeff Boeckler of IDNR. The C2000 program is a "comprehensive, six year, $100 million initiative, designed to take a holistic, long-term approach to protecting and managing Illinois' natural resources."[1] This SSIP aims to fulfill the C2000 mission by examining the state of eight sub-watersheds within the larger Lake Michigan watershed in Illinois in terms of three issue areas of top concern for LMWEP: water quality, habitat and ravine erosion.

This report is organized around three aspects of the Lake Michigan land and water ecology: the water quality of Lake Michigan and the streams and rivers feeding into it, the level of erosion in ravines along the coast of the lake, and the range and quality of habitat in the region. Water quality and habitat were analyzed in terms of sub-watershed boundaries, whereas ravine erosion was analyzed ravine-by-ravine. The immediate goals of the study are to 1) prioritize sub-watersheds based on their potential to negatively impact water quality or 2) the quality and extent of habitat within their boundaries; and 3) to rank ravines based on their potential for erosion. The larger goal of the study is to serve as a tool for LMWEP, municipalities and other interested groups, such as private landowners, to make informed decisions about where to focus restoration efforts and resources in order to improve the ecology of the Lake Michigan region.

Organization of the Report

This report is organized into three chapters for the three areas of the study: water quality, habitat and ravines. Each chapter begins with a short **Introduction** outlining the primary concerns, followed by a **Background** section which explores them in greater detail. The sections also highlight the major factors which affect the sub-watersheds or ravines either positively or negatively and which serve as the basis of the scoring analysis at the heart of this study. The **Indicators** section following the Background then lists these factors – referred to throughout this report as *indicators* – which were used to analyze the sub-watersheds in terms of water quality and habitat and the ravines in terms of erosion. Each chapter concludes with a **Results Summary**, which gives the final, overall scores and rankings for each area and a brief discussion of the results.

[1] *Conservation 2000*. Illinois Department of Natural Resources. http://dnr.state.il.us/OREP/pfc/ as of October 20, 2009.

Indicators Data Tables

The raw indicator data for each issue area is available in tables after the Results Summary section of each chapter. These data were analyzed using common statistical techniques to arrive at overall scores, and certain relevant intermediate calculations in this analysis are also given in the tables. The Scoring Methodology chapter explains the meanings of these calculations.

Maps

In addition to the water quality, habitat and ravines scores and the indicator data tables, this study also contains GIS maps of select data. In the water quality and habitat chapters, these maps are given for each of the eight sub-watersheds in the study. In the ravines chapter, maps are given for each individual ravine. These maps can be found at the end of each chapter (refer to the Table of Contents), with the exception of the ravines maps, which are provided as a separate set of appendices on account of their large file size.

Scoring Methodology

This report is organized around three aspects of the Lake Michigan land and water ecology: the water quality of Lake Michigan and the streams and rivers feeding into it, the level of erosion in ravines along the coast of the lake, and the range and quality of habitat in the region. Water quality and habitat were analyzed in terms of sub-watershed boundaries, whereas ravine erosion was analyzed ravine-by-ravine. The immediate goals of the study are to 1) prioritize sub-watersheds based on their potential to negatively impact water quality or 2) the quality and extent of habitat within their boundaries; and 3) to rank ravines based on their potential for erosion. The larger goal of the study is to serve as a tool for LMWEP, municipalities and other interested groups, such as private landowners, to make informed decisions about where to focus restoration efforts and resources in order to improve the ecology of the Lake Michigan region.

Indicators

Many factors, both natural and man-made, determine the impact of a given sub-watershed on water quality or habitat or the level of erosion within a given ravine. This study looks at data for the most relevant factors and uses the data to calculate a numerical score for each issue area. These factors – referred to throughout this report as *indicators* – typically vary by subject area, although there is a significant amount of overlap. For example, one of the major factors that negatively affects water quality is the number of stormwater outlets within a sub-watershed. This has a very large impact on levels of erosion in ravines as well and thus is included as a ravine erosion indicator. To take a second example, the total amount of protected forests and wetlands is an important indicator for evaluating both habitat and water quality within a sub-watershed. Finally, the length of severely eroding banks in a ravine is an important metric for ravine erosion and also has relevance for water quality, as sediment deposition can negatively impact the ecology of receiving surface waters. Explanations of the indicators used for each issue area can be found in the Background and the Indicators sections of each area chapter.

Quantitative data was gathered for each indicator, and these data were then analyzed using statistical formulas in order to come up with scores for each subject area. Water quality scores express the overall *threat* posed by a given sub-watershed. The scoring is similar for ravines, in which case the scores express the potential for erosion. Habitat scores, in contrast, are expressed as a *positive measure* of the quantity and quality of habitat within a given sub-watershed. The rest of this section will explain in detail how data for each indicator was analyzed in order to calculate overall scores.

Explanation of the Statistical Analysis Used to Calculate Scores

One of the primary challenges in coming up with overall numerical scores involves translating the raw indicator data into scores which are both immediately comprehensible and readily comparable to other indicators. To illustrate the first problem, consider the potential significance of 50 stormwater outlets within a typical size sub-watershed in terms of their impact on water quality. Without an understanding of the range of stormwater outlets across sub-watersheds, this number is essentially meaningless. Now compare this number to the actual

number of stormwater outlets within each of the eight sub-watersheds in Table 1. The number of stormwater outlets ranges from a minimum of 12 in the Pettibone Creek sub-watershed to a maximum of 212 in Dead River, with an average of around 83 per sub-watershed. Looking at the range of values and the average, one begins to gain a sense of how a given measurement compares to the entire set. The values are mostly clustered just below the average, with a couple of outliers. Dead River sub-watershed, for example, contains the greatest number of outlets, and we can intuit that this number is significantly larger than the rest. The challenge is how to *quantify* that significance as an indicator rank or score.

Sub-watershed	Stormwater Outlets
Dead River	212
Bluff Ravine South	181
Evanston-Chicago North	28
Chicago South	27
Bluff Ravine North	57
Pettibone Creek	12
Waukegan River	63
Kellogg Creek	82
Average	**82.75**
Standard Deviation	**74.18**

Table 1: Data for the number of stormwater outlets within the eight sub-watersheds in this study.

An analogous example helps to clarify the problem. Imagine for a moment 100 people plucked randomly off the street and lined up in order from shortest to tallest. Most people will be of or within a couple inches of average height (for a given sex). Some will be below or above the average by more than a few inches, and perhaps a couple rare individuals will either be exceptionally short or tall. If the chance of a random person being a given height is illustrated graphically, the result will be a normal distribution, commonly known as a bell-curve (see Figure 1). Natural phenomena that are determined by a large number of independent factors, such as human height, often follow such a distribution, as do complex social phenomena. In this study, it is assumed that the distributions of indicator data (e.g. the number of stormwater outlets) behave similarly, and thus they can be approximated by a normal distribution.

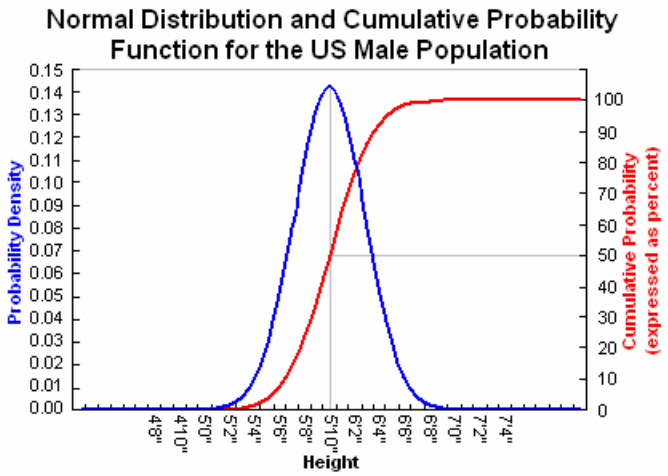

Figure 1: The distribution of human height for a given sex can be described by a normal distribution (blue), such that the chance of an individual being of a given height peaks around the average of 5'10" (for a US male) and quickly decreases in either direction. The cumulative probability curve (red) gives the percent of the population that a given height is greater or equal to. Notice that a person of exactly average height is as tall or taller than 50 percent of the entire population.

So back to the question at hand: how to express the range of data in complex natural or social systems – human height, stormwater outlets within a given sub-watershed, etc. – in a meaningful, intuitive way. Looking at a normal distribution (blue line), one immediately notices the horizontal symmetry around the peak, which corresponds to the average. Essentially, this means that 50 percent of the "population" (e.g. humans or sub-watersheds) will be at or below the average. To use the human height example, an individual who is exactly average height will be taller than 50 percent of the population. Similarly, a sub-watershed with an average number

of stormwater outlets will have as many or more outlets than 50 percent of all sub-watersheds. Below the average this number obviously decreases as it approaches 0 percent, and above the average it increases as it approaches 100 percent. A statistical formula known as the normal distribution cumulative probability function (red line) makes it possible to calculate this percent for any value for a given normal distribution.

Thus, it becomes possible to calculate a readily obvious score from 0 to 100 which expresses the relative position of a given "individual" (e.g. person or sub-watershed) relative to all others. Intuitively we know that a man who is 7"2' is tall indeed, but we can express that intuition quantitatively by saying this person is taller than 99.9999994 percent of the male population[1]. In the case of the stormwater outlets, it is not as readily apparent how great 212 stormwater outlets is, but it becomes quite clear when expressed as being greater than 95.93 percent of all stormwater outlets (see Figure 2). A careful reader will protest, however, that 212 outlets is in fact 100 percent greater than all others since it is the largest number in the set. Of course this is true, and the reason for this discrepancy is that the 95.93 percent score is simply a mathematical calculation based on an ideal normal distribution for that indicator. The calculation introduces a certain amount of error since the actual range of scores is not perfectly normal, but its usefulness as a tool for evaluating the data far outweighs the small amount of error introduced[2]. Thus, the cumulative probability function was used to calculate a rank for each indicator.

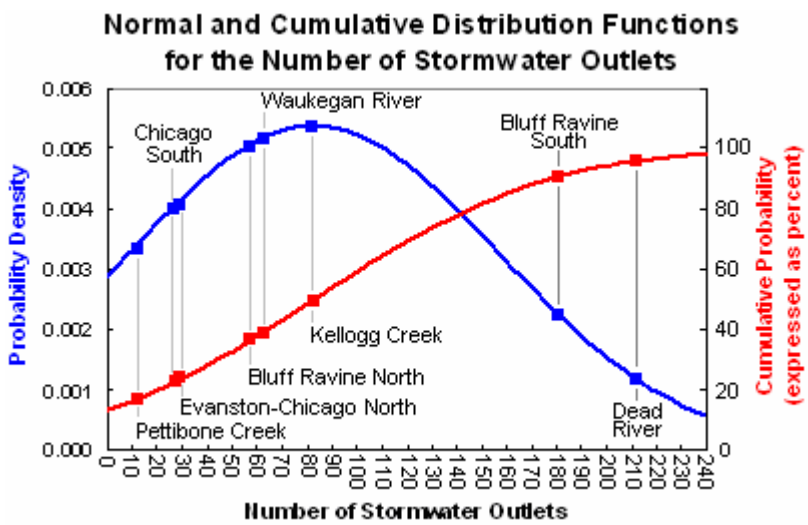

Figure 2: The number of stormwater outlets within the eight sub-watersheds are plotted on a normal distribution (blue) and cumulative probability function (red) for the average and standard deviation of the data. Notice that the sub-watersheds tend to be clustered to the left of the average (i.e. blue peak), indicating that the normal distribution is probably not a very good approximation in this case.

The second major challenge involves comparing different indicators to one another. The various indicators are obviously not of the same type, making a direct comparison impossible. How does one compare, say, the negative potential impact of a given number of stormwater outlets within a sub-watershed on water quality and the distance of those same outlets to receiving surface waters? Clearly the greater the number of outlets the greater the impact, and

[1] This calculation, as well as those used to generate the height distribution graph, was based on an average US male height of 5'10" and a standard deviation of 2.8".

[2] For the truly discriminating reader, it should be noted that the approximate score based on the cumulative probability function would never actually reach 100 percent even if the distribution of data was perfectly normal. The CPF approaches asymptotes at 0 and 100, which is a consequence of the mathematical modeling and should not be taken literally; there are maximums and minimums in nature.

the closer those outlets are to Lake Michigan the more significant the effect on water quality. But are 20 outlets within 20 ft of the lake more significant than 100 outlets each 100 ft from the lake?

Here again, the cumulative probability function proves useful. The Evanston-Chicago North sub-watershed, for example, has 28 stormwater outlets within its boundaries, which ranks low at 23.03 percent. The average nearest distance of those same outlets from surface waters (e.g. streams, ravines, Lake Michigan) is just 91.05 ft, which ranks high at 78.89 percent. In other words, there are relatively few stormwater outlets in the Evanston-Chicago North sub-watershed, but those outlets tend to discharge very close to surface waters. But which indicator is a greater threat: the total number of stormwater outlets or their proximity to surface waters? Generally speaking, how is it possible to account for differences in the relative significance of indicators?

Weighting Factors

The answer to the second question involves the use of *weighting factors* for each indicator to account for the greater relevance of some over others. Weighting factors are simply one-digit numbers from 1 to 8 used to quantify how much more important one indicator is relative to another. So for example, the number of stormwater outlets is assigned a weighting factor of 7, whereas the average nearest distance of stormwater outlets from surface waters is given only a 4. The weighting factors, along with their corresponding indicators, are based on the best professional judgment of a technical advisory committee comprised of the following:

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Weighting factors were applied simply by multiplying the rank of an indicator by the corresponding weighting factor to arrive at a *weighted indicator rank/score*. Thus, in the Evanston-Chicago North stormwater outlet example, the un-weighted indicator rank/score first given above for the number of stormwater outlets is 0.2303 (expressed now as a decimal rather than a percent), and the un-weighted indicator rank for the proximity of those outlets to surface water is 0.7889. After taking into account the weighting factors, the *weighted* indicator rank/score for the number of stormwater outlets is 1.6121 (0.2303 x 7) and the *weighted* indicator rank/score for the proximity of those outlets to surface waters is 3.1556 (0.7889 x 4). So in this example, the close proximity of the stormwater outlets in the sub-watershed is estimated to contribute twice as much as the small number of outlets to the potential of the sub-watershed to negatively impact water quality.

Summing the individual weighted indicator scores gives the *total weighted indicators score* for a sub-watershed or ravine:

Total Weighted Indicators Score for Sub-watershed$_i$ =
Cumulative Probability (i.e. rank) (*Number of Stormwater Outlets$_i$*) * Weighting Factor$_a$+
Cumulative Probability (*Density of Stormwater Outlets$_i$*) * Weighting Factor$_b$ + …
Cumulative Probability (*Agriculture Coverage$_i$*) * Weighting Factor$_n$

Finally, one last step was used to generate the overall water quality, habitat or ravine erosion scores. After calculating total weighted indicators scores, the situation is similar to that first encountered when trying to evaluate the meaning of indicator raw data. The significance of the total weighted indicators scores are, like the raw indicator data, not intuitively obvious. But because their distribution approximates a normal distribution, the cumulative probability function is once again employed to calculate overall ranks or scores. Figure 3 uses the total weighted indicators scores for water quality to illustrate this final calculation.

Figure 3 (Top): A histogram of the eight sub-watershed total weighted indicators score for water quality is compared with a normal distribution (blue) based on the average and standard deviation of the scores. **(Bottom):** The same histogram of total weighted indicators scores, this time compared with the cumulative probability function (red) used to generate the *overall* water quality risk scores in Table 2.

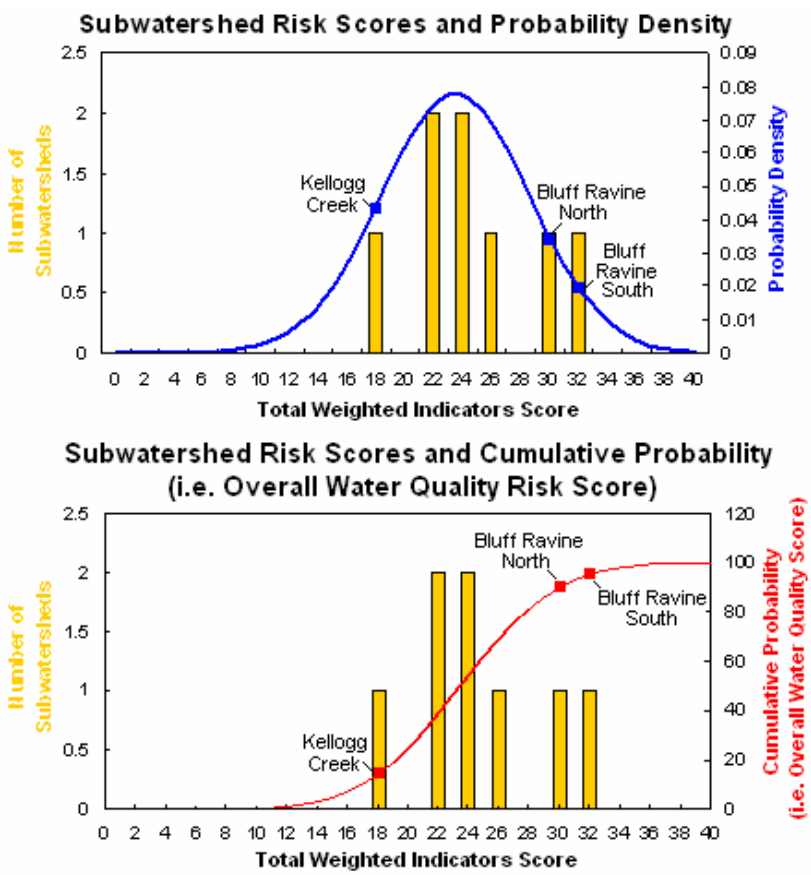

Table 2 (Below): Overall water quality risk scores, calculated from the total weighted indicators as illustrated in the bottom graph of Figure 3.

Sub-watershed Name	Water Quality Risk Score (0-100, 100=highest)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69

Water Quality

Prior to the transformations of the landscape that occurred with the development of Chicago and the communities of the North Shore, the fate of rainwater falling on the land was far different. Shingled roofs of residential houses now occupy the space formerly filled by dense forest canopies. Concrete roads and sidewalks now cover the land where open prairies and wetlands once stretched, and turfgrasses have conquered nearly every remaining gap where hundreds of different species of native grasses, flowers and shrubs once flourished. Because of these and other changes to the land, far less rainwater percolates into the ground or slowly flows into wetlands on its way to Lake Michigan. This is not much of a problem for the roofs, roads and sidewalks, nor for the turfgrasses for that matter, but it is a problem for the water quality of Lake Michigan and the rivers and streams which empty their waters into it.

Rainwater falling on urban communities picks up a variety of man-made pollutants. In certain areas, this water is mixed with sanitary wastewater and is processed before being released. But in other areas, it flows into stormwater sewers where it is then discharged, untreated, into the streams and rivers which feed into the lake, or even directly into the lake itself. These pollutants, from heavy metals to synthetic chemicals to sediment, negatively impact the waters and local ecology of Lake Michigan. The situation is worse in the case of sewers which discharge into the ravines along the North Shore, for in addition to the pollutants swept up prior to entering the sewer system, stormwater moving through the ravines tears into their banks, driving sediment into Lake Michigan and badly damaging the ravines in the process.

This section of the report looks at eight Lake Michigan sub-watersheds, starting from the Chicago South sub-watershed at the southern end of Chicago and finishing up north at the Kellogg Creek sub-watershed near the Illinois-Wisconsin border. Taking into account a variety of factors affecting water quality, each sub-watershed is scored in order to identify those which pose the greatest threat and thus represent the highest priority for remediation efforts.

Background

Centuries of development, first rural and then urban, have thoroughly changed the greater Chicago landscape, and with it the fate of rainwater falling on the land. Among the earliest European expeditions into the region was that of Father Jacques Marquette and Louis Joliet in 1673. Forests of oak and hickory trees would have loomed tall over their canoes as they made their way up the Illinois River to the Des Plaines River. A short distance from the river they would have come upon the open prairie, where thin shoots of big and little bluestem formed a sea of tall grasses, punctuated by the bright yellow flowers of fringed puccoon and purple silky aster. Further off, they may have seen patches of bur oak savannah, capable of withstanding the fires set by North American indigenous tribes or ignited by lightning. Should they have ventured out further, they inevitably would have come across whooping cranes and trumpeter swans nesting in the marshes and wet grasslands that formed in the low lying areas. Such was the mosaic of habitats before the transformation in the land wrought by Europeans, and later Americans, first into farms and homesteads and later into modern cities.

As a result of this transformation, in cities today only traces of forests and prairie remain – small oases in an urban sea. A drive through any community along the North Shore is a study in historical contrasts. In residential areas, houses face one another across streets and sidewalks paved with concrete. Turfgrasses, cut to exacting standards and maintained in pristine condition by the application of chemical treatments, comprise a monochromatic matte where prairie grass once stood tall. Asphalt driveways slope gently toward streets, which sit just a few inches below the rest of the ground, framed on either side by curbs to channel stormwater in place of rivers. In downtown districts, the situation is even more pronounced. Only the occasional tree remains amidst the concrete roads, sidewalks and parking lots and the brick of mortar of commercial buildings. This is not to disparage modern cities and suburbs in support of a Romantic retreat to nature, but simply to bring into stark relief the difference between pre-European and contemporary landscapes[1].

In the past, most rainwater would have slowly made its way into the ground and taken up by the dense mat of prairie grass roots and forest tree roots. Under the steady pull of gravity, groundwater that was not absorbed would have gradually seeped out into steams and wetlands. Aboveground, rain remaining on the leaves of plants or on the saturated soil would either have

[1] Many environmental narratives portray the vast transformations in the landscape over the past several hundred years as a decline from a pristine wilderness, untouched by the destructive techno-scientific forces of modernity to our contemporary urban and rural environments, often with Marquette and Joliet's expedition serving as the beginning of the Fall (at least for the American West). This narrative is problematic, not least of all because it ignores the presence of indigenous tribes and their effect on the environment, choosing to view them either as benevolent stewards of the Earth or as insignificant and powerless to affect Nature. Neither of these views is wholly correct nor wholly incorrect. The landscape European settlers would have encountered had already been modified over time, but the scale and scope of the transformation that followed (and continues today) was far greater than that caused by indigenous tribes. Choosing to paint this transformation as a Fall from environmental grace, as do many environmentalists, or as mostly positive, as in many narratives about human "progress," is to ignore the complications and mixed legacy of this change. The environmental changes described in this section are included simply to illustrate the historical bases for the problem of urban stormwater runoff.

evaporated back into the atmosphere or made its way across the land as runoff to rivers and wetlands[2]. These processes are still at work in cities today, albeit greatly attenuated due to the steady advance of impervious surfaces, which shed water where the land once absorbed it.

Often these surfaces are impervious by design. The shingles on roofs intentionally shed water to gutters and downspouts. Streets are paved in order to prevent the formation of rutted, muddy thoroughfares. The slight bulge in the middle funnels rainwater off the street and along curbs to stormwater drains. Paved driveways are designed to similar effect. All of which essentially leaves areas of trees and the ubiquitous turfgrasses as the sole remaining permeable land[3], and turfgrasses, it turns out, are not nearly as efficient as the native prairie grasses they replaced at absorbing rainwater[4]. The roots of most prairie grasses extend three to ten feet into the ground, with some reaching as far as fifteen feet[5]. In contrast, the roots of typical turfgrasses extend down just a few inches. Consequently, far less rainwater infiltrates into the ground in urban areas compared with undeveloped habitat. Rather than flowing *into* the ground, as it once did, rainwater now flows *across* the ground.

Image 1: Stormwater drains in cities with separated storm sewer systems drain directly into surface waters, such as ravines, streams or Lake Michigan.

Which begs the question, where does it all go? Aside from the fraction of rainwater which is still held by the land, stormwater runoff - as it is technically referred to – flows either directly into nearby surface waters or, as is the case in urban environments, into a nearby storm sewer drain. From there, its fate is largely determined by the type of sewer system created by the community in which it finds itself. Some municipalities have what are known as combined sewer systems, in which sanitary wastewater and stormwater are carried by the same network of pipes to a central wastewater treatment plant, where it is treated to remove debris, solids, heavy metals and other pollutants. The water is then pumped out to a receiving water body.

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[2] Perhaps somewhat surprisingly to us today, relatively little water actually left the region via the Des Plaines River or made its way into Lake Michigan via the Chicago River. Incredibly, in 1680 the Chicago River was, in fact, just "a stream, 'ten to fifteen yards wide, and only a few inches deep.'" Even with the steady transformation of the land by the growth of agriculture, at the close of the nineteenth century the Des Plaines river was either dry or close to dry more than half the year. But by the second half of the twentieth century, as the scope and pace of transformation increased, the median amount of water in the Des Plaines had increased four hundred times over. Source: Greenberg, Joel, *A Natural History of the Chicago Region*, pgs. 178-179.

[3] Excluding from consideration protected and restored habitat (e.g. forest preserves, prairie) and unprotected wetlands, the extent of which ranges from just 3 percent in the Bluff Ravine North sub-watershed to over 31 percent in the Dead River sub-watershed (see Habitat section, specifically the Indicators Data Table).

[4] City of Chicago. http://egov.cityofchicago.org/city/webportal/portalDeptCategoryAction.do?BV_SessionID=@@@@1912852465.1250600960@@@@&BV_EngineID=cccfadeidimhddecefecelldffhdfif.0&deptCategoryOID=-536889943&contentType=COC_EDITORIAL&topChannelName=SubAgency&entityName=Conserve+Chicago+Together&deptMainCategoryOID=-536889943&topChannelName=SubAgency

[5] Greenberg, *A Natural History of the Chicago Region,* pg. 20.

Wastewater from many such sewer systems in the Chicago region, especially in Cook County, is processed by the Metropolitan Water Reclamation District of Chicago, which discharges treated wastewater into the Mississippi River watershed. Other communities along the North Shore process their own wastewater or send it to other cities which have the capacity to do so or to county-run treatment plants.

However, some communities have separate sanitary and stormwater sewers. In these cases, only sanitary wastewater is routed to the treatment plant. Stormwater is instead released to nearby streams, rivers, ravines and even the lake without any sort of treatment. Whether that stormwater eventually ends up in Lake Michigan or the Mississippi River depends on precisely where in a given city it enters the storm sewer system. Sewers in the western portions of cities typically[6] discharge within the Skokie River watershed or the Chicago River North Branch watershed, both of which flow into the Chicago River, which goes on to the Illinois River and finally to the Mississippi (and ultimately into the Gulf of Mexico). Stormwater sewers in the eastern portions of cities are within the Lake Michigan watershed and discharge into streams or ravines which flow towards Lake Michigan or directly into the lake itself.

What makes stormwater runoff so problematic today is what it picks up along the way, and in the case of outfalls in the ravines, the speed at which it is discharged. On its journey through the atmosphere and across urban terrain, stormwater picks up a variety of pollutants, which are then ultimately deposited into the lake. Sediment is typically the greatest pollutant in terms of weight and negatively impacts fish and many organisms of the lower trophic levels[7,8]. Oil, grease and toxic chemicals from cars and trucks are carried by stormwater as it flows across streets. Nitrogen and phosphorus compounds and pesticides and herbicides[9] are picked up as stormwater flows across lawns that have been chemically treated. While these nutrients do much to keep the grass green and lush, the quantities that now wash into surface waters can cause blooms of algae and weeds and poison aquatic ecosystems[10]. When these plants die they are decomposed by bacteria which utilize oxygen in the water, thereby suffocating fish and other

[6] This study assumes that all rainwater falling within the sub-watershed boundaries ends up in Lake Michigan. In reality, stormwater sewers physically located inside the boundaries of a sub-watershed may route stormwater out of the sub-watershed toward the Mississippi River, while sewers outside the boundary may route stormwater into the sub-watershed.

[7] North Carolina Division of Water Quality, *Pollutants Commonly Found in Stormwater and Their Impacts*. Available at http://h2o.enr.state.nc.us/su/what_is_stormwater.htm#pollutants as of September 15, 2009.

[8] Brammeier, Joel; Polls, Irwin; Mackey, Scudder; *Preliminary Feasibility of Ecological Separation of the Mississippi River and the Great Lakes to Prevent the Transfer of Aquatic Invasive Species*. Available at http://www.greatlakes.org/invasives/ecosep as of October 22, 2009.

[9] Data from the US EPA shows that between 10 and 13 percent of all herbicide, pesticide and fungicide use nationwide (*including* agriculture) are applied to lawns and gardens, totaling nearly 80 *million* pounds of active ingredients. The US Fish and Wildlife Service estimates that homeowners use up to 10 times as much per acre than is typically used in agriculture. To further compound the problem, the toxins (and they are toxins, after all) used on lawns are more dangerous and much less regulated than those used on food. Environment and Health, Inc., *Risks from Lawn Care Pesticides*. Available at http://www.ehhi.org/reports/lcpesticides/ as of September 15, 2009.

[10] US EPA. *Protecting Water Quality from Urban Runoff*. Available at http://www.epa.gov/owow/nps/toolbox/other/epa_nps_urban_facts.pdf as of September 15, 2009.

organisms[11]. Pathogenic viruses and bacteria such as certain strains of *E. coli* associated with pet waste and garbage can also affect water quality. Road salt is yet another common pollutant that can have a significant impact on the salinity of local waters and can kill many aquatic organisms. Heavy metals such as copper, lead, zinc, arsenic and chromium are common pollutants in stormwater and persist for years in sediment at the bottom of streams and the lake and in the tissues of fishes and organisms tied to the aquatic environment. Unlike some pollutants which are degraded in the environment over time, these chemicals will persist in the environment until the slow geologic forces responsible for their initial deposition have time once again to bury them deep in the earth.

[11] US EPA, *2000 National Water Quality Report to Congress, Chapter 3: Lakes Reservoirs and Ponds*. Available at http://www.epa.gov/305b/2000report/chp3.pdf, as of September 15, 2009. Full Report at http://www.epa.gov/305b.

Indicators

The following chart presents the various criteria, or indicators, by which the water quality risk score for each sub-watershed was determined. Next to each indicator are the units of measure, a brief explanation, a one-word description of how it impacts water quality (i.e. positively or negatively), and a one-digit weighting factor. Since not all criteria are expected to have the same impact on water quality, weighting factors are used to take into account the greater relevance or importance of certain indicators over others.

Indicator	Unit of Measure	Explanation/Comments	**Positive** impact/***low*** risk score or **Negative** impact/***high*** risk score	W.F.
Number of Stormwater Outlets	total number	The total number of stormwater outlets within a given sub-watershed.	negative	7
Density of Stormwater Outlets	outlets/ acre	The total number of stormwater outlets divided by watershed area.	negative	7
Impervious Surface Coverage	percent	The percentage of land within a given sub-watershed covered by surfaces which do not absorb water, e.g. roads and buildings.	negative	7
Distance of Buildings and Roads from Streams and Ravines	ft	The average distance of both buildings and roads from streams and ravines. Greater distances translate into less stormwater runoff impact.	positive	5
Distance of Stormwater Outlets from Streams and Ravines	ft	The average distance of stormwater outlets from streams and ravines.	positive	4
Existing Wetland Coverage	percent	The percentage of existing wetlands within a given sub-watershed.	positive	3
Average Watershed Slope	slope %	An average measure of the steepness of the landscape. The steeper the land the faster stormwater runoff will flow.	negative	3
Number of Landfills	total number	Number of permitted landfills from statewide data set	negative	3
Watershed Plan-in-Place	yes/no	Indicates whether or not a US EPA sub-watershed plan has been drafted.	positive	3
Number of Water Quality Monitoring Sites	total number	The total number of permanent or known water quality monitoring stations.	positive	1
Watershed Drainage	ft^{-1}	A measure of the capacity of the land to drain water: the total length of all streams and/or ravines divided by the area of the sub-watershed.	negative	1
Erodible Soils Coverage	percent	The percentage of exposed, erodible soils (B slopes and greater).	negative	1
Partner Sites	total number	The total number of locations provided by LMWEP partnership members based on goal areas (e.g. water quality, habitat, ravines).	positive	1
Agriculture Coverage	acre	The percentage of 100 year floodplain land within a sub-watershed that has been converted to agricultural use.	negative	1

Data Gaps

Stormwater runoff is an important factor affecting water quality, and the indicators above reflect this concern. The five highest ranked indicators are all directly related to stormwater, either in connection with stormwater moving through sewers or with surface flows. These five indicators, however, are proxy measures of actual data on stormwater volumes, the lack of which constitutes the primary gap in this section. For example, equal weight is given to every stormwater outlet across sub-watersheds, based on the assumption that each carries the same quantity of water. Since the study is concerned with the *relative* impact of stormwater runoff *across* sub-watersheds, the number of stormwater outlets is an appropriate substitute for the actual volume of water so long as the assumption holds true. This is a good first approximation, but one can imagine that in reality stormwater sewers discharge varying volumes of water. A more robust approach would be to measure the quantities of stormwater discharged during a typical storm event from a representative sample of outlets within a sub-watershed, and then extrapolate the data to arrive at estimates of the volume of stormwater discharged into surface waters within each sub-watershed.

One additional data gap in this section is the lack of real-world data on the types and quantities of pollutants in stormwater. Again, the assumption is made that the profile of pollutants in stormwater is the same across sub-watersheds in order to allow the comparison of sub-watersheds based on the chosen indicators. This assumption ignores the possibility that pollutants may differ based on land use. For example, stormwater runoff from beach that is highly populated with wildlife, such as birds, will likely contain higher levels of bacteria than that from less populated beaches, or from an entirely different type of land, such as residential sidewalks. Again, a more robust approach would be to combine representative sampling of stormwater runoff across land-use types and stormwater sewers with the GIS land cover analysis used in this study.

Results Summary

The overall water quality scores are given in Table 2. The possible range of scores is zero to 100, in order of least to greatest risk. Interested readers can consult the Scoring Methodology section for an in-depth explanation on how these scores were calculated from the indicators data. That raw data, as well as the intermediate un-weighted and weighted indicators scores, are provided in the Water Quality Indicators Data Table following this section. For the individual sub-watershed discussions in this section, the table may prove useful for those readers who prefer or simply wish to refer to the data and calculations behind the scores.

Sub-watershed Name	Water Quality Risk Score (0-100, 100=highest)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69

Table 2: Water Quality Risk Scores for the eight sub-watersheds in this study.

Figures 1 and 2 (below) illustrate the distribution of total weighted indicators scores (yellow bars) overlaid with either the normal distribution (blue) or the overall risk score curve (red). Figure 1 shows that the distribution of total weighted indicators scores can be fairly approximated by a normal distribution. Compared to one another, this means that most of the sub-watersheds pose only a moderate risk to the water quality of the streams, ravines and the lake. Some, like Kellogg Creek, pose very little threat, while others, like Bluff Ravine South and Bluff Ravine North pose a much more significant threat. Again, one should keep in mind that these score are *relative*. Kellogg Creek, while it has the lowest water quality risk score, will nevertheless negatively affect water quality to a certain extent, but *compared* to Bluff Ravine South, for example, this contribution is relatively small.

Bluff Ravine South and Bluff Ravine North sub-watersheds have the highest and second highest water quality risk scores, respectively. Table 2 (above) and Figures 1 and 2 clearly show that these two sub-watersheds are well separated from the rest, indicating that they represent a much greater threat than the others. The primary indicators driving the scores of these sub-watersheds are the high number and density of stormwater outlets and their close proximity to surface waters, the relatively steep slope of the terrain, the close proximity of roads and buildings to surfaces waters, and the high level of impervious surface coverage. These were the main factors earlier identified as posing the greatest threat to the water quality of streams, ravines and Lake Michigan (and they are therefore the most heavily weighted) so it is not surprising that the two highest ranked sub-watersheds would also tend to rank highly in these categories.

In the middle of the pack are the Evanston-Chicago North, Pettibone and Waukegan sub-watersheds. These sub-watersheds tended to rank in the middle for every indicator, although occasionally they rank towards the top. For example, all three ranked highly in terms of their close proximity of stormwater outlets to surface waters and also in their level of impervious surface coverage. Waukegan also ranked highly in terms of the number of landfills within the sub-watershed. Chicago South, Dead River and Kellogg Creek tended to rank toward the middle

and low end of each indicator. Detailed individual summaries of each sub-watershed can be found later in this chapter.

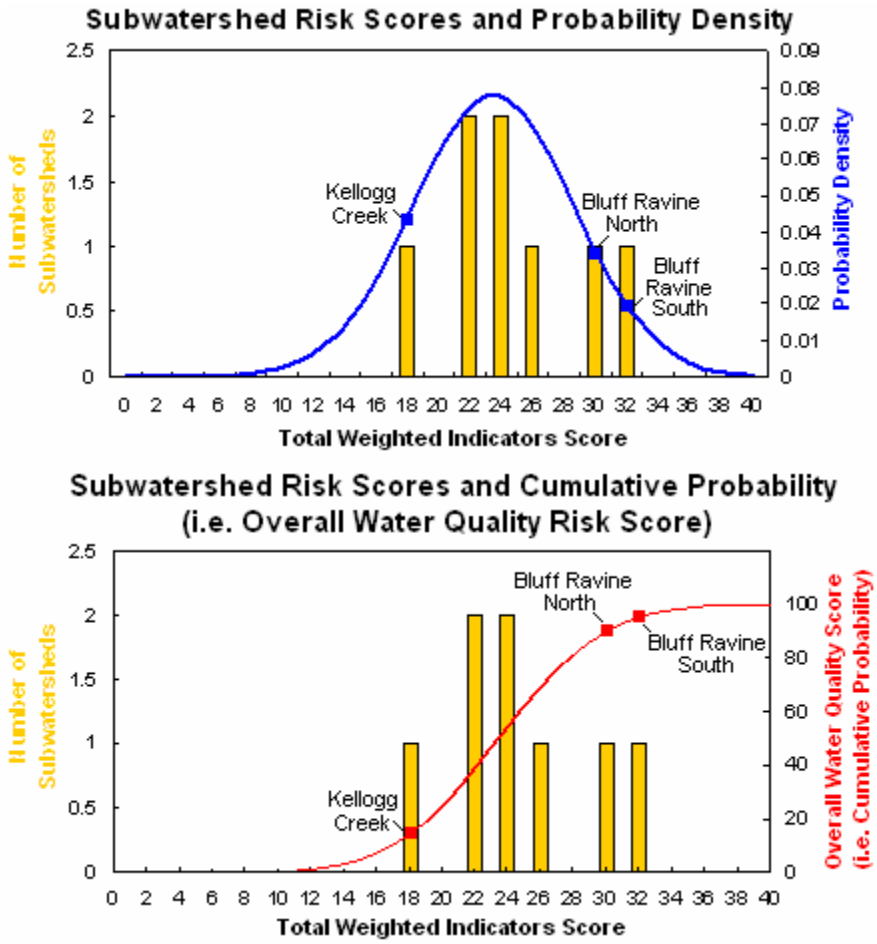


Figure 1 (top): The total weighted indicators scores for each sub-watershed are plotted as a histogram (yellow) and compared to a normal distribution based on the average and standard deviation of the scores. **Figure 2 (bottom):** The total weighted indicators scores once again, this time compared to the normal distribution cumulative probability function, which was used to calculate Water Quality Risk Scores from the total indicators scores.

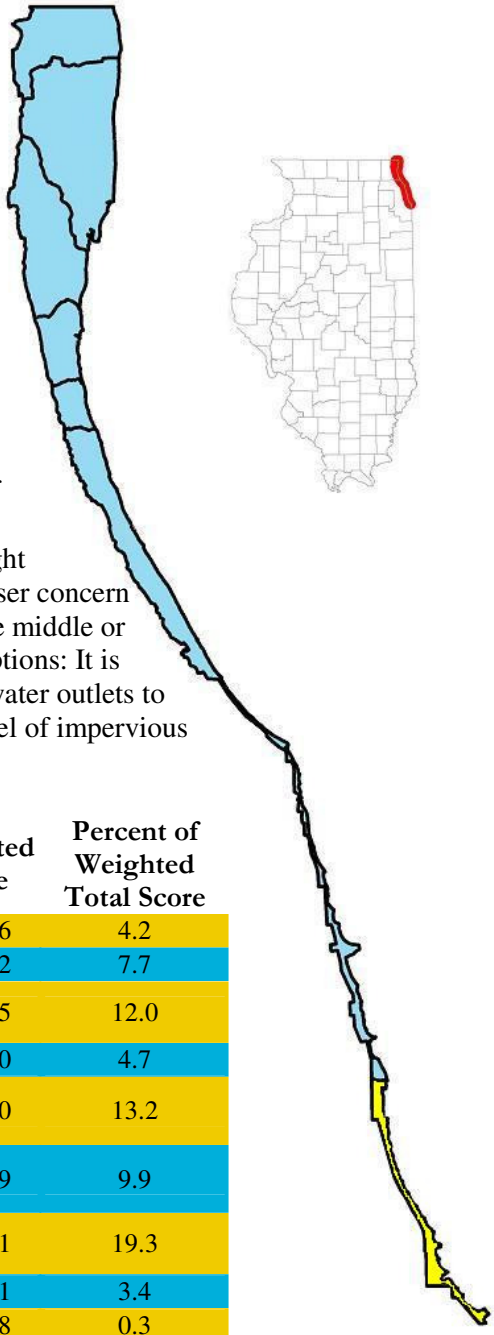
	Kellogg Creek	Dead River	Chicago South	Waukegan River	Pettibone Creek	Evanston-Chicago North	Bluff Ravine North	Bluff Ravine South
Total Acreage	5740	11778	2058	7531	2661	2142	1372	6406
Total Square Feet	250017412	513054036	89636026	328035985	115931891	93302906	59747332	279060170
Number of Monitoring Sites	2	1	0	1	0	0	1	1
Rank (0.0 – 1.0)	0.0385	0.3618	0.8556	0.3618	0.8556	0.8556	0.3618	0.3618
Weighted Rank (=Rank*Weighting Factor)	0.0385	0.3618	0.8556	0.3618	0.8556	0.8556	0.3618	0.3618
Number of Stormwater Outlets	82	212	27	63	12	28	57	181
Rank	0.4960	0.9593	0.2262	0.3950	0.1701	0.2303	0.3643	0.9073
Weighted Rank	3.4718	6.7149	1.5832	2.7652	1.1908	1.6118	2.5498	6.3512
Density of Stormwater Outlets (#/acre)	1.43E-02	1.80E-02	1.31E-02	8.37E-03	4.51E-03	1.31E-02	4.16E-02	2.83E-02
Rank	0.3891	0.5118	0.3522	0.2183	0.1354	0.3507	0.9775	0.8131
Weighted Rank	2.7238	3.5829	2.4655	1.5279	0.9475	2.4549	6.8426	5.6917
Average % Slope	4.82	4.59	4.86	4.35	6.25	3.92	7.87	8.96
Rank	0.3147	0.2705	0.3220	0.2294	0.6175	0.1650	0.8826	0.9628
Weighted Rank	0.9441	0.8115	0.9660	0.6882	1.8526	0.4951	2.6477	2.8883
Average Dist Stormwater Outlets to Streams (ft)	534.96	408.41	252.75	907.08	1457.65	91.05	70.84	119.45
Rank	0.4551	0.5589	0.6805	0.1894	0.0219	0.7889	0.8007	0.7715
Weighted Rank	1.8205	2.2356	2.7220	0.7577	0.0878	3.1555	3.2028	3.0862
Average Dist Roads/Buildings to Streams (ft)	191.18	573.67	230.27	133.73	100.91	150.08	69.1	80.6
Rank	0.5000	0.0098	0.4058	0.6370	0.7091	0.5990	0.7718	0.7501
Weighted Rank	2.5002	0.0491	2.0289	3.1852	3.5455	2.9951	3.8590	3.7503
Impervious Surface Coverage (percent)	10.22%	15.78%	21.63%	27.50%	26.54%	26.06%	17.35%	19.54%
Rank	0.0435	0.2141	0.5689	0.8736	0.8379	0.8175	0.2967	0.4320
Weighted Rank	0.3048	1.4984	3.9821	6.1154	5.8650	5.7223	2.0772	3.0238
Drainage Density (ft/acre)	4.76E-04	4.39E-04	5.28E-04	1.58E-04	2.20E-04	9.05E-04	1.09E-04	3.34E-04
Rank	0.6225	0.5668	0.6971	0.1764	0.2449	0.9766	0.1310	0.4043
Weighted Rank	0.6225	0.5668	0.6971	0.1764	0.2449	0.9766	0.1310	0.4043
Erodible Soils Coverage (percent)	47.57%	48.19%	0.00%	40.83%	47.67%	0.00%	65.42%	63.36%
Rank	0.6294	0.6385	0.0628	0.5265	0.6310	0.0628	0.8482	0.8285
Weighted Rank	0.6294	0.6385	0.0628	0.5265	0.6310	0.0628	0.8482	0.8285
Wetlands Coverage (percent)	15.31%	17.07%	4.52%	1.72%	0.44%	4.39%	0.25%	0.92%
Rank	0.0752	0.0448	0.5624	0.7156	0.7760	0.5696	0.7843	0.7544
Weighted Rank	0.2255	0.1343	1.6871	2.1467	2.3281	1.7087	2.3529	2.2633
Number of Landfills	3	14	0	9	4	5	0	1
Rank	0.3790	0.9745	0.1777	0.8223	0.4591	0.5409	0.1777	0.2362

Weighted Rank	1.1371	2.9234	0.5332	2.4668	1.3773	1.6227	0.5332	0.7085
Number of Partner Locations	4	7	7	0	0	5	0	7
Rank	0.4697	0.1612	0.1612	0.8732	0.8732	0.3517	0.8732	0.1612
Weighted Rank	0.4697	0.1612	0.1612	0.8732	0.8732	0.3517	0.8732	0.1612
Agricultural Floodplain Coverage (percent)	0.4319%	0.0083%	0.1943%	0.0229%	0.2254%	0.1400%	0.3645%	0.0000%
Rank	0.9428	0.1565	0.5509	0.1790	0.6246	0.4192	0.8785	0.1447
Weighted Rank	0.9428	0.1565	0.5509	0.1790	0.6246	0.4192	0.8785	0.1447
Plan-in-Place (1=yes, 0=no)	1	1	0	1	0	0	0	0
Rank	0.1136	0.1136	0.7656	0.1136	0.7656	0.7656	0.7656	0.7656
Weighted Rank	0.3408	0.3408	2.2969	0.3408	2.2969	2.2969	2.2969	2.2969
Total ***Weighted*** Indicators Score	16.17	20.17	20.59	22.11	22.72	24.72	29.45	31.96
Overall Water Quality Score (0-100)	**7.69**	**25.92**	**28.62**	**39.41**	**44.05**	**59.54**	**87.75**	**95.06**
Rank (Out of 8; 1 = Highest)	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**

CHICAGO SOUTH

Water Quality Summary

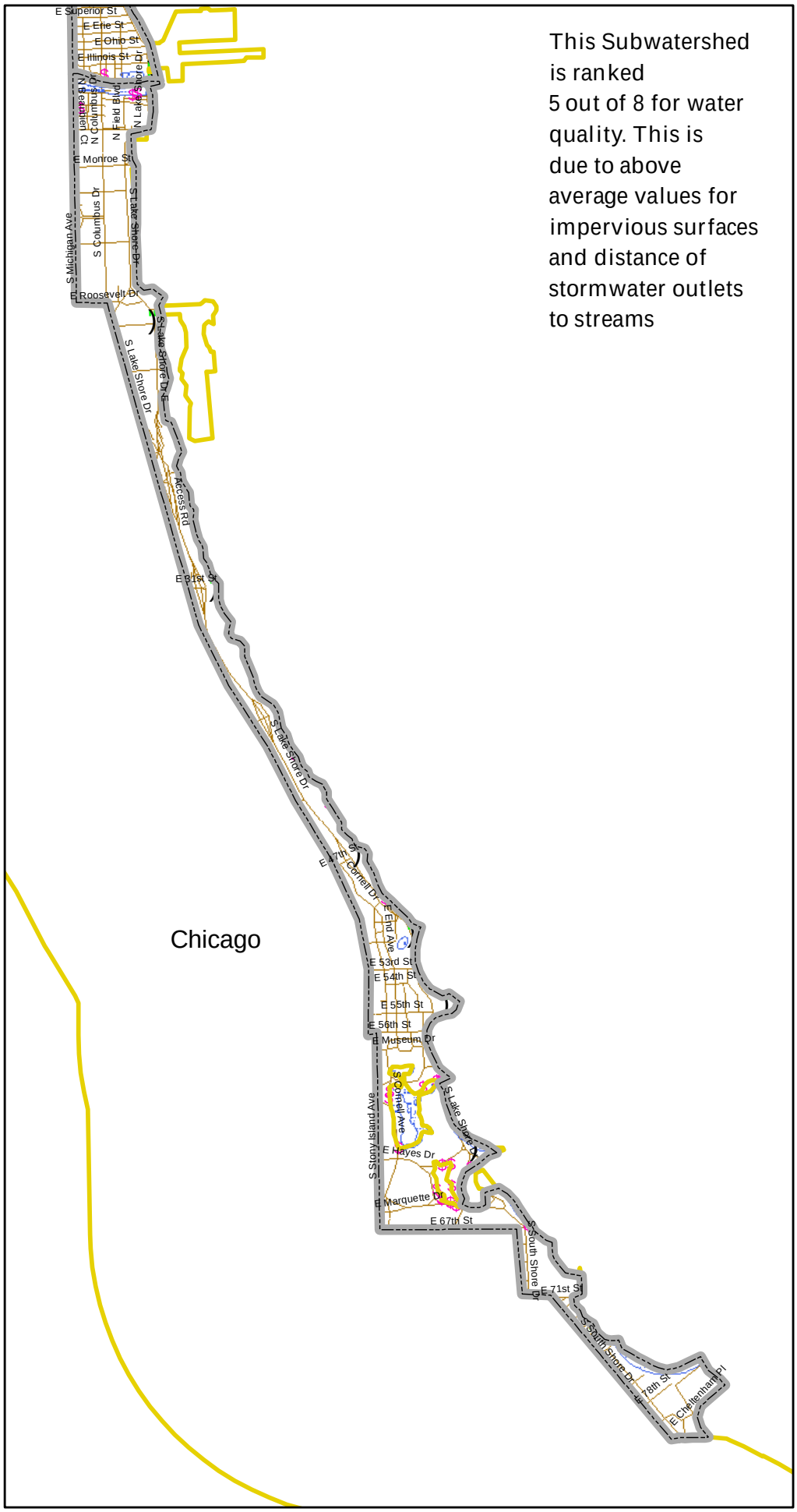
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



The Chicago South sub-watershed comprises a thin strip of land stretching from the Chicago River at the northern end to 79th street at the southern end. The sub-watershed ranks sixth out of eight with a water quality risk score of 28.62 out of 100, making it of lesser concern compared with the other eight sub-watersheds. It ranks towards the middle or bottom for most indicators, with only a couple of noteworthy exceptions: It is somewhat highly ranked in terms of the average distance of stormwater outlets to streams and ravines, and it is moderately ranked in terms of the level of impervious surface coverage.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	0	0.8556	1	0.8556	4.2
# Stormwater Outlets	27	0.2262	7	1.5832	7.7
Density Stormwater Outlets (outlets/acre)	1.31E-02	0.3522	7	2.4655	12.0
Average % Slope	4.86	0.3220	3	0.9660	4.7
Average Dist Stormwater Outlets to Streams (ft)	252.75	0.6805	4	2.7220	13.2
Average Dist Roads and Buildings to Streams (ft)	230.27	0.4058	5	2.0289	9.9
Impervious Surface Coverage	21.63%	0.5689	7	3.9821	19.3
Drainage Density (ft-1)	5.28E-04	0.6971	1	0.6971	3.4
Erodible Soils Coverage	0.00%	0.0628	1	0.0628	0.3
Wetlands Coverage	4.5210%	0.5624	3	1.6871	8.2
# Landfills	0	0.1777	3	0.5332	2.6
# Partner Locations	7	0.1612	1	0.1612	0.8
Agricultural Floodplain Coverage	0.19439%	0.5509	1	0.5509	2.7
Plan-in-Place (1=yes, 0=no)	0	0.7656	3	2.2969	11.2

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked 5 out of 8 for water quality. This is due to above average values for impervious surfaces and distance of stormwater outlets to streams

Chicago South Watershed

Water Quality Priority Area

Ranked 5 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- # Landfills
- Partner Project Locations
- $ Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:65,305

0 0.15 0.3 0.6 0.9 1.2 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

Date: 02/2009

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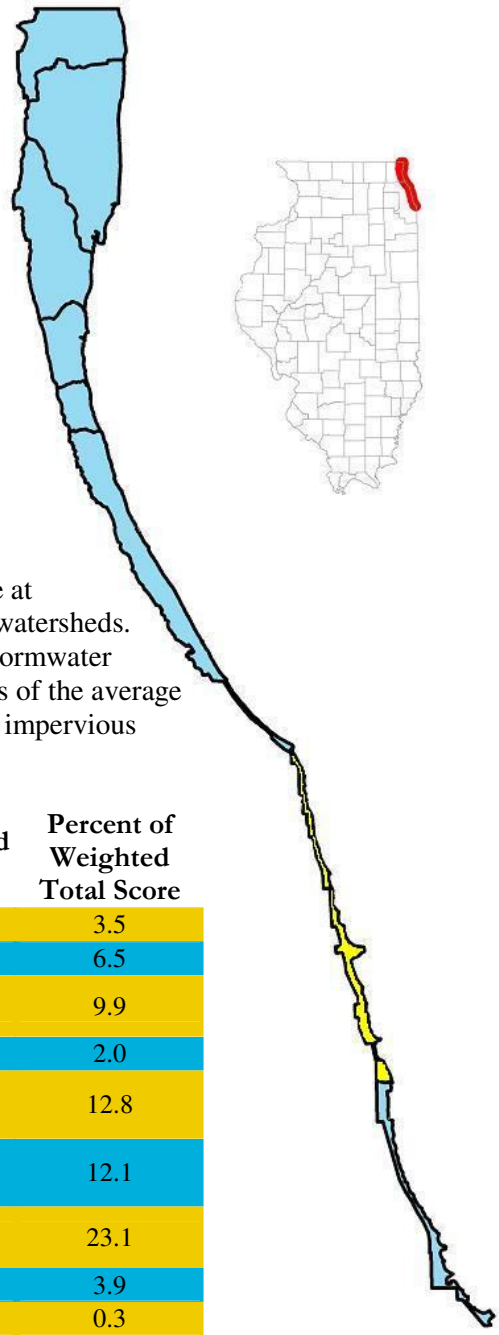
EVANSTON-CHICAGO NORTH

Water Quality Summary

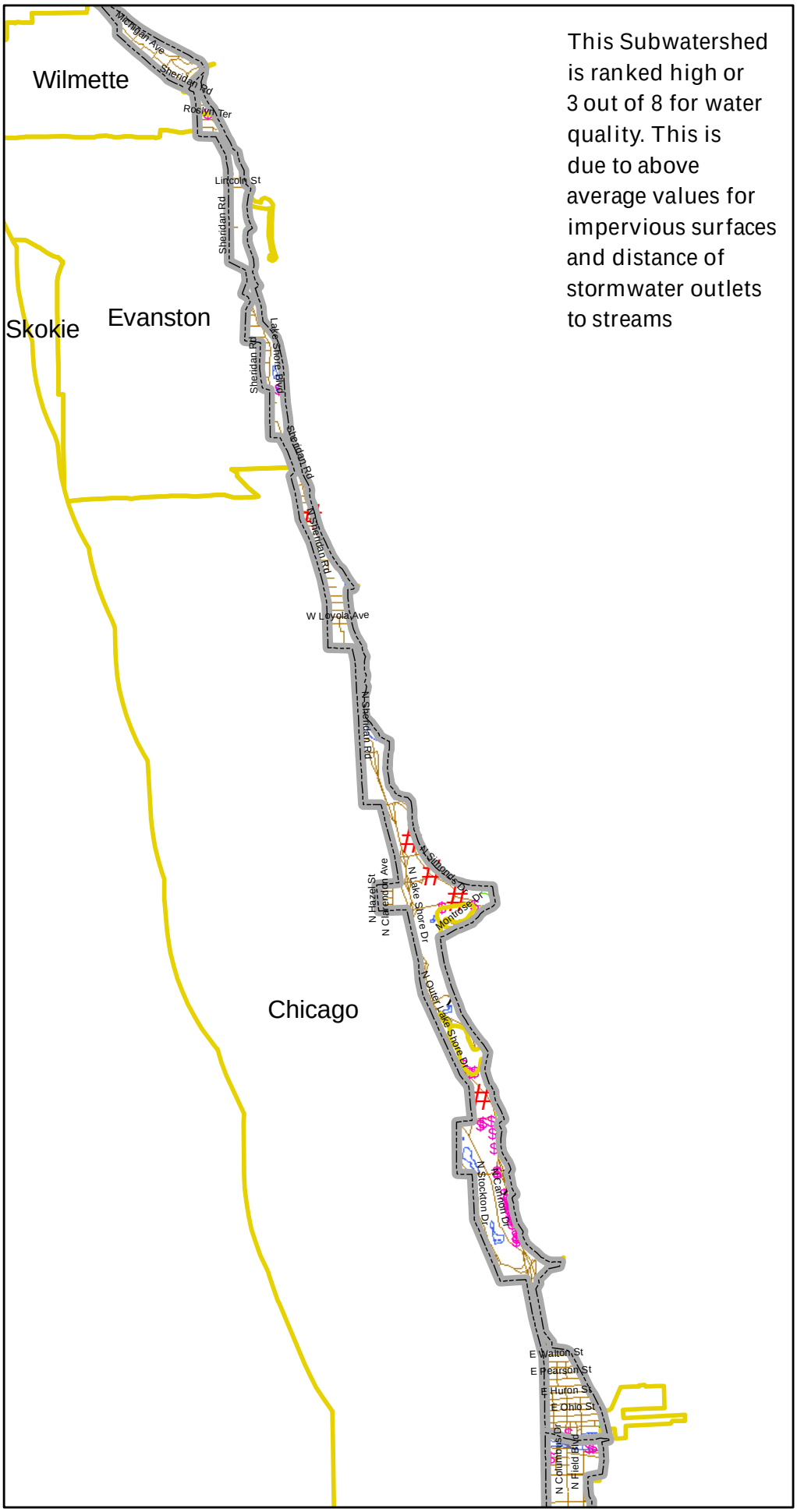
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



The Evanston-Chicago North sub-watershed consists of a thin strip of coastline extending from the southern end of Wilmette down through Evanston and northern Chicago to the Chicago River. Evanston-Chicago North has the third highest water quality risk score at 59.54 and is of moderate concern compared with the eight other sub-watersheds. The sub-watershed ranks highly in terms of the average distance of stormwater outlets to streams and ravines. It also ranks somewhat highly in terms of the average distance of roads and buildings to ravines and streams. The extent of impervious surface coverage is also relatively high.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	0	0.8556	1	0.8556	3.5
# Stormwater Outlets	28	0.2303	7	1.6118	6.5
Density Stormwater Outlets (outlets/acre)	1.31E-02	0.3507	7	2.4549	9.9
Average % Slope	3.92	0.1650	3	0.4951	2.0
Average Dist Stormwater Outlets to Streams (ft)	91.05	0.7889	4	3.1555	12.8
Average Dist Roads and Buildings to Streams (ft)	150.08	0.5990	5	2.9951	12.1
Impervious Surface Coverage	26.06%	0.8175	7	5.7223	23.1
Drainage Density (ft-1)	9.05E-04	0.9766	1	0.9766	3.9
Erodible Soils Coverage	0.00%	0.0628	1	0.0628	0.3
Wetlands Coverage	4.3968%	0.5696	3	1.7087	6.9
# Landfills	5	0.5409	3	1.6227	6.6
# Partner Locations	5	0.3517	1	0.3517	1.4
Agricultural Floodplain Coverage	0.14006%	0.4192	1	0.4192	1.7
Plan-in-Place (1=yes, 0=no)	0	0.7656	3	2.2969	9.3

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked high or 3 out of 8 for water quality. This is due to above average values for impervious surfaces and distance of stormwater outlets to streams

Evanston Chicago North Watershed

Water Quality Priority Area

Ranked 3 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- # Landfills
- Partner Project Locations
- $ Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:89,264

0 0.2 0.4 0.8 1.2 1.6 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

Date: 02/2009

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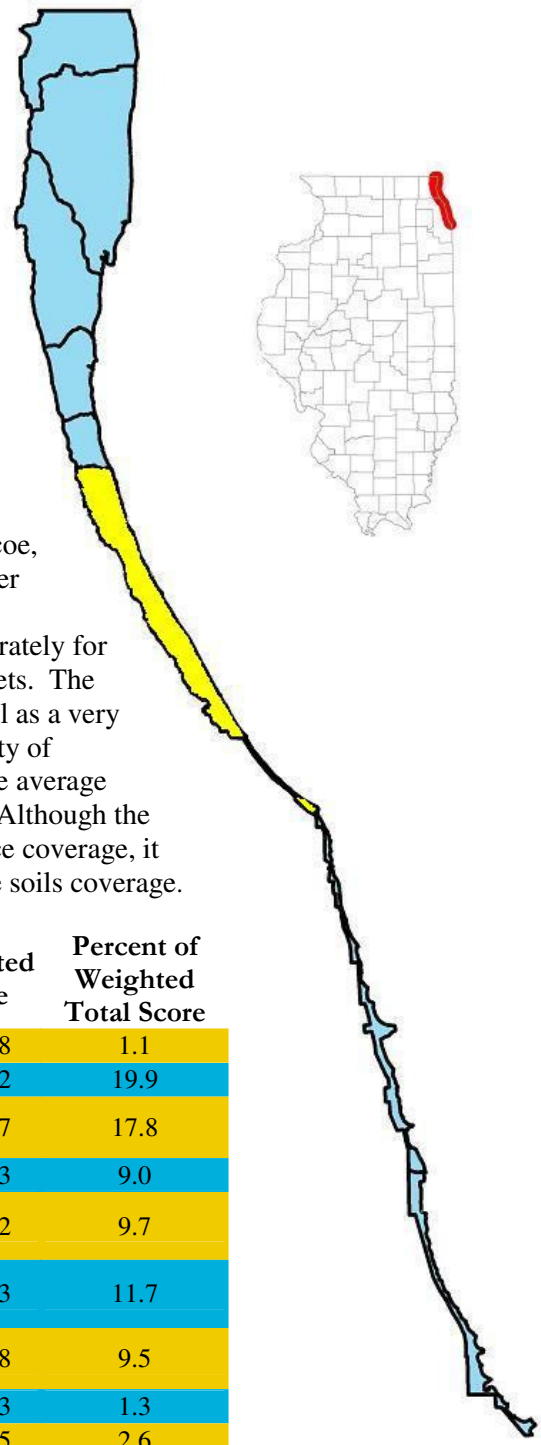
BLUFF RAVINE SOUTH

Water Quality Summary

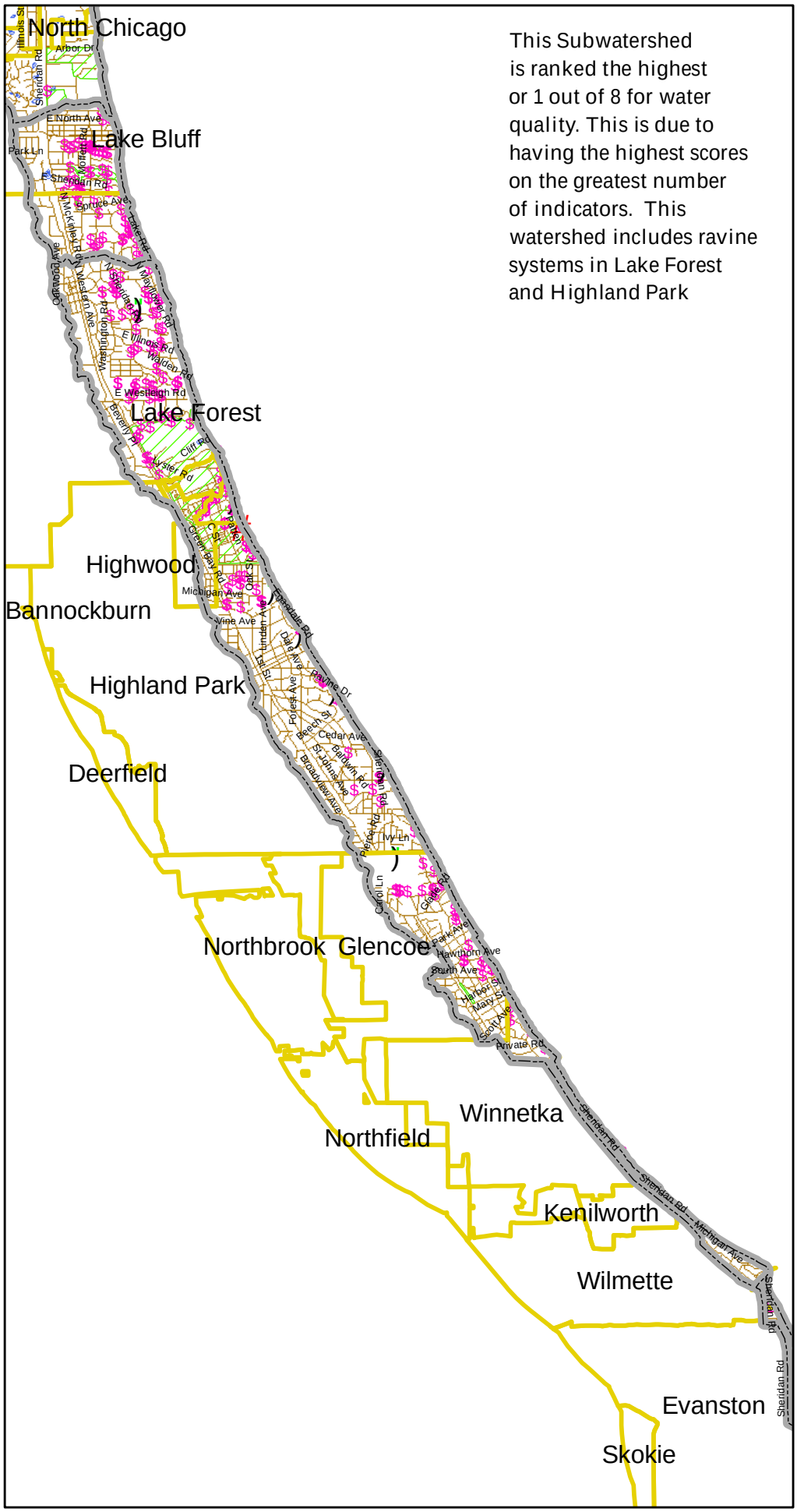
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



The Bluff Ravine South sub-watershed extends from the northern end of Lake Forest down through the southern end of Wilmette, and includes portions of Highland, Highland Park, Glencoe, Winnetka and Kenilworth. Bluff Ravine South has the highest water quality risk score of all eight sub-watersheds at 95.06, making it of greatest concern overall. This sub-watershed ranks highly or moderately for several key indicators, particularly those related to stormwater outlets. The sub-watershed has a very high number of stormwater outlets as well as a very high density of outlets. It also ranks highly in terms of the proximity of stormwater outlets, roads and buildings to streams and ravines. The average slope of the land within the sub-watershed also ranks very highly. Although the sub-watershed only ranks moderately in terms of impervious surface coverage, it ranks highly in terms of the limited wetlands coverage and erodible soils coverage.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	1	0.3618	1	0.3618	1.1
# Stormwater Outlets	181	0.9073	7	6.3512	19.9
Density Stormwater Outlets (outlets/acre)	2.83E-02	0.8131	7	5.6917	17.8
Average % Slope	8.96	0.9628	3	2.8883	9.0
Average Dist Stormwater Outlets to Streams (ft)	119.45	0.7715	4	3.0862	9.7
Average Dist Roads and Buildings to Streams (ft)	80.6	0.7501	5	3.7503	11.7
Impervious Surface Coverage	19.54%	0.4320	7	3.0238	9.5
Drainage Density (ft-1)	3.34E-04	0.4043	1	0.4043	1.3
Erodible Soils Coverage	63.36%	0.8285	1	0.8285	2.6
Wetlands Coverage	0.9235%	0.7544	3	2.2633	7.1
# Landfills	1	0.2362	3	0.7085	2.2
# Partner Locations	7	0.1612	1	0.1612	0.5
Agricultural Floodplain Coverage	0.00000%	0.1447	1	0.1447	0.5
Plan-in-Place (1=yes, 0=no)	0	0.7656	3	2.2969	7.2

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked the highest or 1 out of 8 for water quality. This is due to having the highest scores on the greatest number of indicators. This watershed includes ravine systems in Lake Forest and Highland Park

Bluff Ravine South Watershed

Water Quality Priority Area

Ranked 1 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- # Landfills
- Partner Project Locations
- $ Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:113,921

0 0.3 0.6 1.2 1.8 2.4 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

Date: 02/2009

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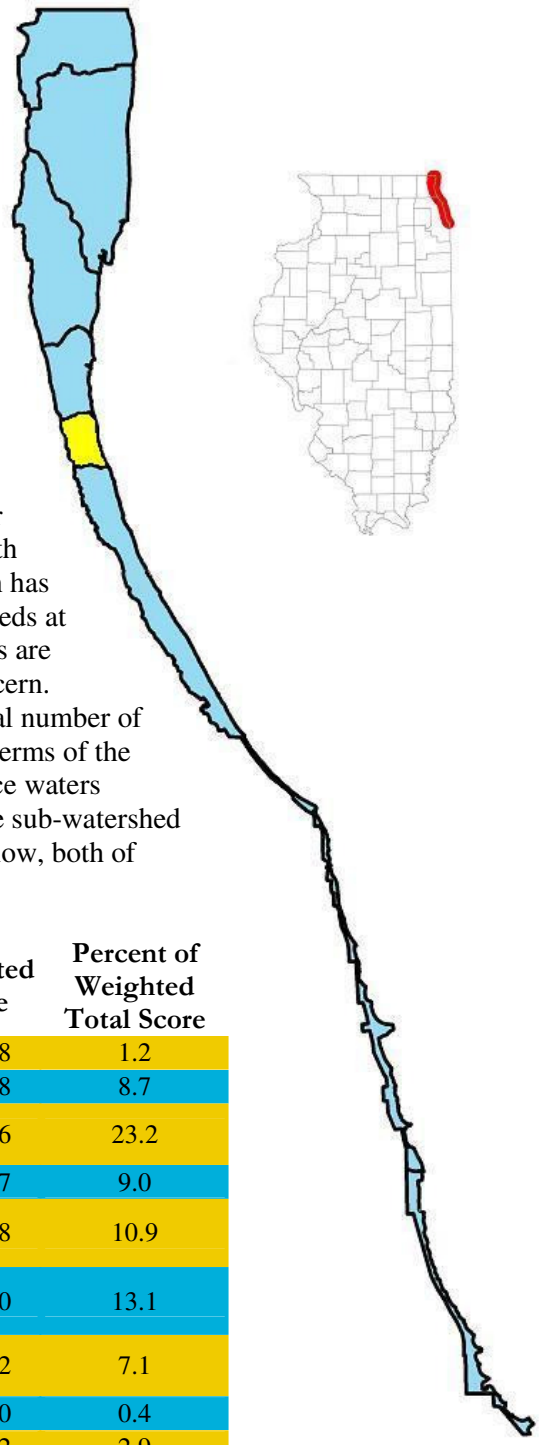
BLUFF RAVINE NORTH

Water Quality Summary

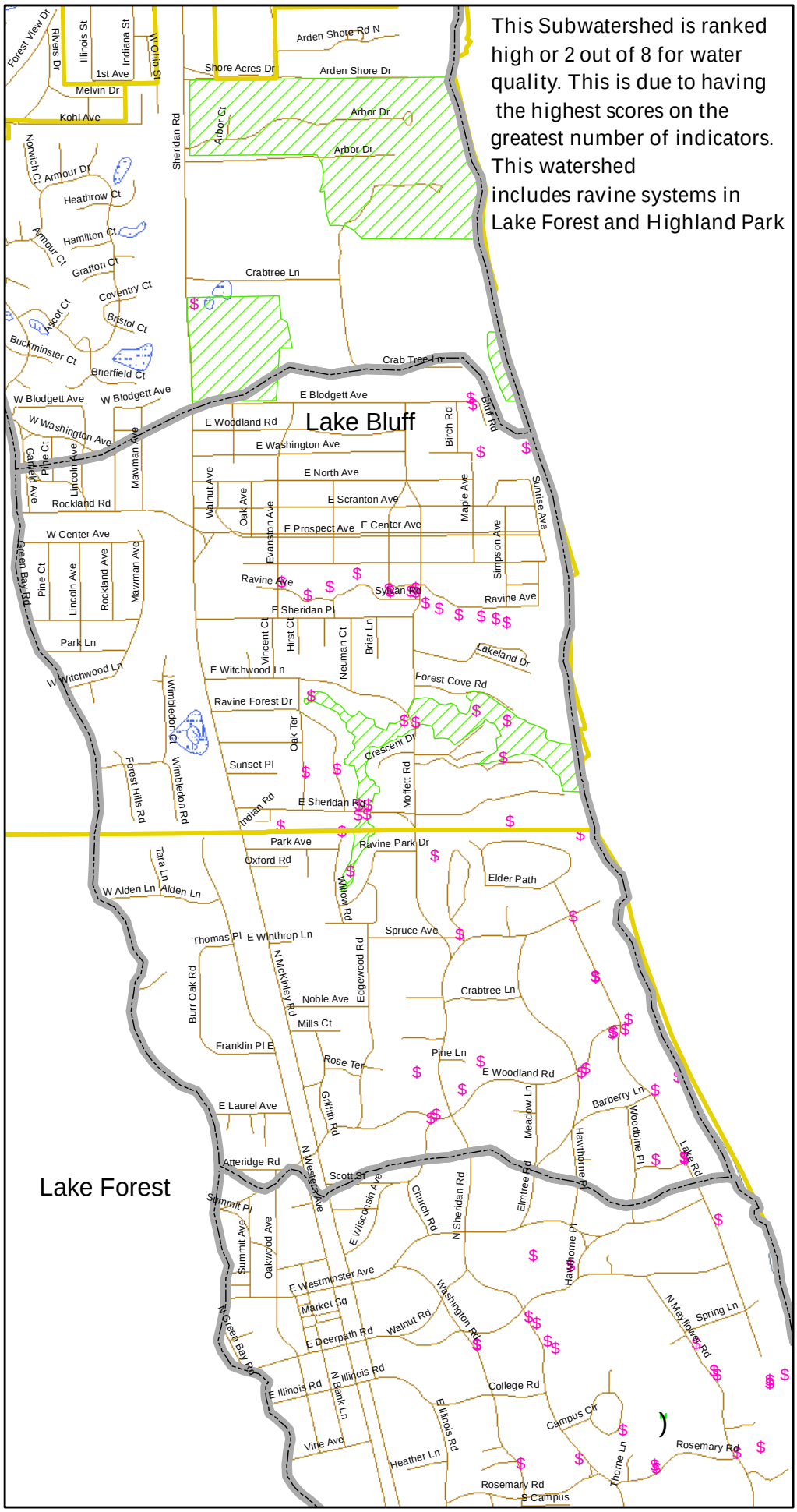
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



The Bluff Ravine North sub-watershed straddles the border between Lake Forest and Lake Bluff, extending roughly a mile north of the border and a little less than a mile south. Bluff Ravine North has the second highest water quality risk score of the eight sub-watersheds at 87.75, making it a high priority. Several highly weighted indicators are primarily responsible for the score and represent areas of most concern. The density of stormwater outlets is the very high, although the total number of outlets is relatively low. The sub-watershed also ranked highly in terms of the close proximity of buildings, roads and stormwater outlets to surface waters (e.g. streams and ravines). The average slope of the land within the sub-watershed is also relatively steep and the percentage of wetlands is relatively low, both of which also contributed to the overall risk score.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	1	0.3618	1	0.3618	1.2
# Stormwater Outlets	57	0.3643	7	2.5498	8.7
Density Stormwater Outlets (outlets/acre)	4.16E-02	0.9775	7	6.8426	23.2
Average % Slope	7.87	0.8826	3	2.6477	9.0
Average Dist Stormwater Outlets to Streams (ft)	70.84	0.8007	4	3.2028	10.9
Average Dist Roads and Buildings to Streams (ft)	69.1	0.7718	5	3.8590	13.1
Impervious Surface Coverage	17.35%	0.2967	7	2.0772	7.1
Drainage Density (ft-1)	1.09E-04	0.1310	1	0.1310	0.4
Erodible Soils Coverage	65.42%	0.8482	1	0.8482	2.9
Wetlands Coverage	0.2584%	0.7843	3	2.3529	8.0
# Landfills	0	0.1777	3	0.5332	1.8
# Partner Locations	0	0.8732	1	0.8732	3.0
Agricultural Floodplain Coverage	0.36454%	0.8785	1	0.8785	3.0
Plan-in-Place (1=yes, 0=no)	0	0.7656	3	2.2969	7.8

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked high or 2 out of 8 for water quality. This is due to having the highest scores on the greatest number of indicators. This watershed includes ravine systems in Lake Forest and Highland Park

Bluff Ravine North Watershed

Water Quality Priority Area

Ranked 2 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- # Landfills
- Partner Project Locations
- $ Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:22,028

0 0.05 0.1 0.2 0.3 0.4 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

Date: 02/2009

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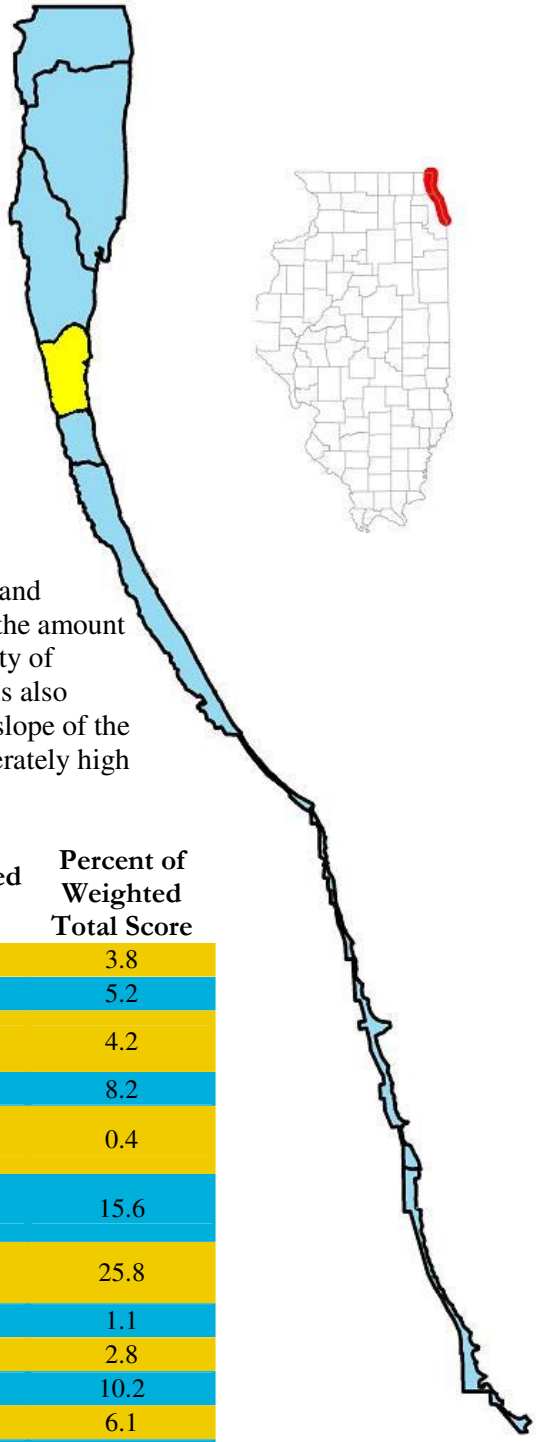
PETTIBONE CREEK

Water Quality Summary

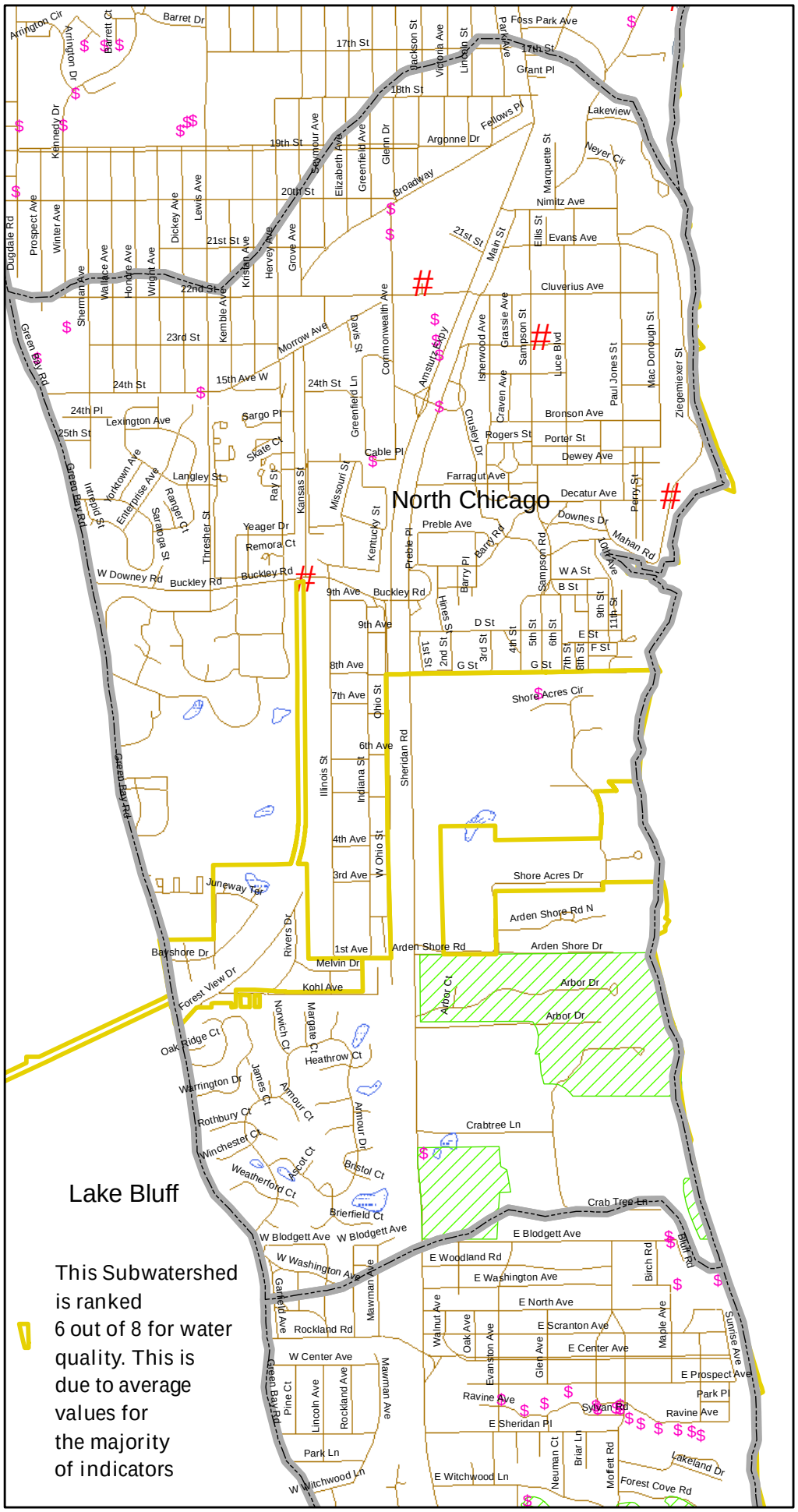
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



Pettibone Creek sub-watershed is the fourth highly ranked sub-watershed, with a water quality risk score of 44.05. This score means that Pettibone Creek poses only a relatively moderate threat to the water quality of the streams and ravines within its boundaries and to Lake Michigan. The sub-watershed does rank highly in terms of the amount of land covered by impervious surfaces, as well as the close proximity of roads and buildings to streams and ravines. The extent of wetlands is also somewhat less compared to the other sub-watersheds. The average slope of the land is the third highest as well, all of which contributed to the moderately high water quality score.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	0	0.8556	1	0.8556	3.8
# Stormwater Outlets	12	0.1701	7	1.1908	5.2
Density Stormwater Outlets (outlets/acre)	4.51E-03	0.1354	7	0.9475	4.2
Average % Slope	6.25	0.6175	3	1.8526	8.2
Average Dist Stormwater Outlets to Streams (ft)	1457.65	0.0219	4	0.0878	0.4
Average Dist Roads and Buildings to Streams (ft)	100.91	0.7091	5	3.5455	15.6
Impervious Surface Coverage	26.54%	0.8379	7	5.8650	25.8
Drainage Density (ft-1)	2.20E-04	0.2449	1	0.2449	1.1
Erodible Soils Coverage	47.67%	0.6310	1	0.6310	2.8
Wetlands Coverage	0.4478%	0.7760	3	2.3281	10.2
# Landfills	4	0.4591	3	1.3773	6.1
# Partner Locations	0	0.8732	1	0.8732	3.8
Agricultural Floodplain Coverage	0.22544%	0.6246	1	0.6246	2.7
Plan-in-Place (1=yes, 0=no)	0	0.7656	3	2.2969	10.1

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked 6 out of 8 for water quality. This is due to average values for the majority of indicators

Pettibone Creek Watershed

Water Quality Priority Area

Ranked 6 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- # Landfills
- Partner Project Locations
- $ Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:24,865

0 0.05 0.1 0.2 0.3 0.4 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
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Chicago, IL 60602

312-939-0838

Date: 02/2009

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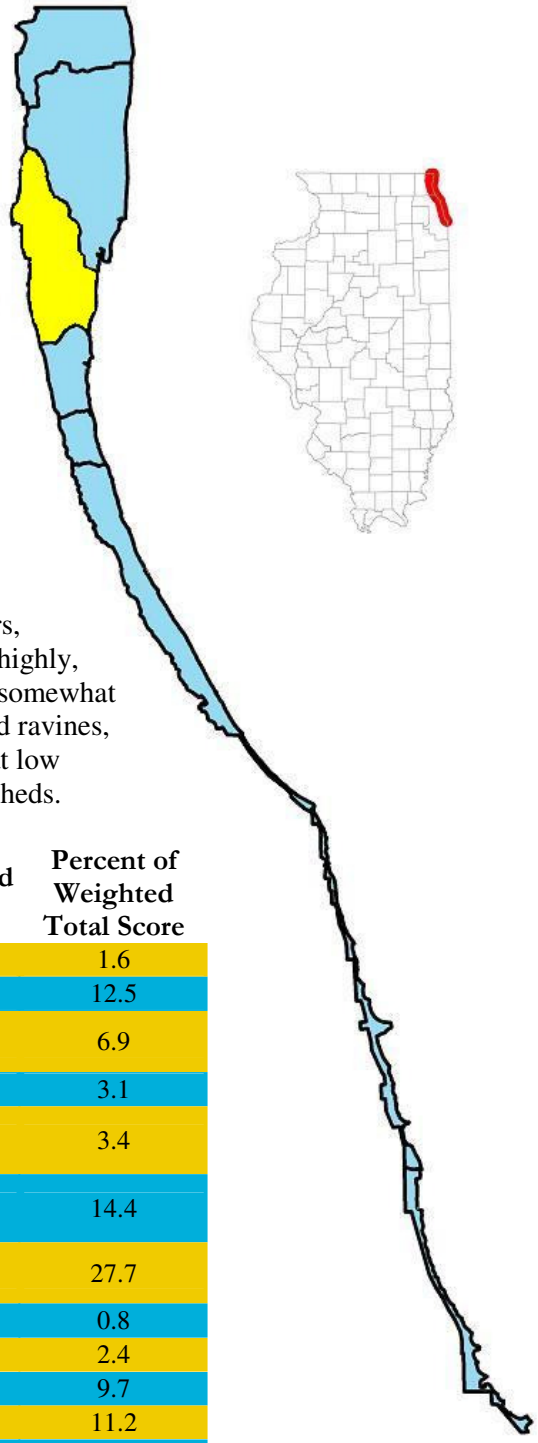
WAUKEGAN RIVER

Water Quality Summary

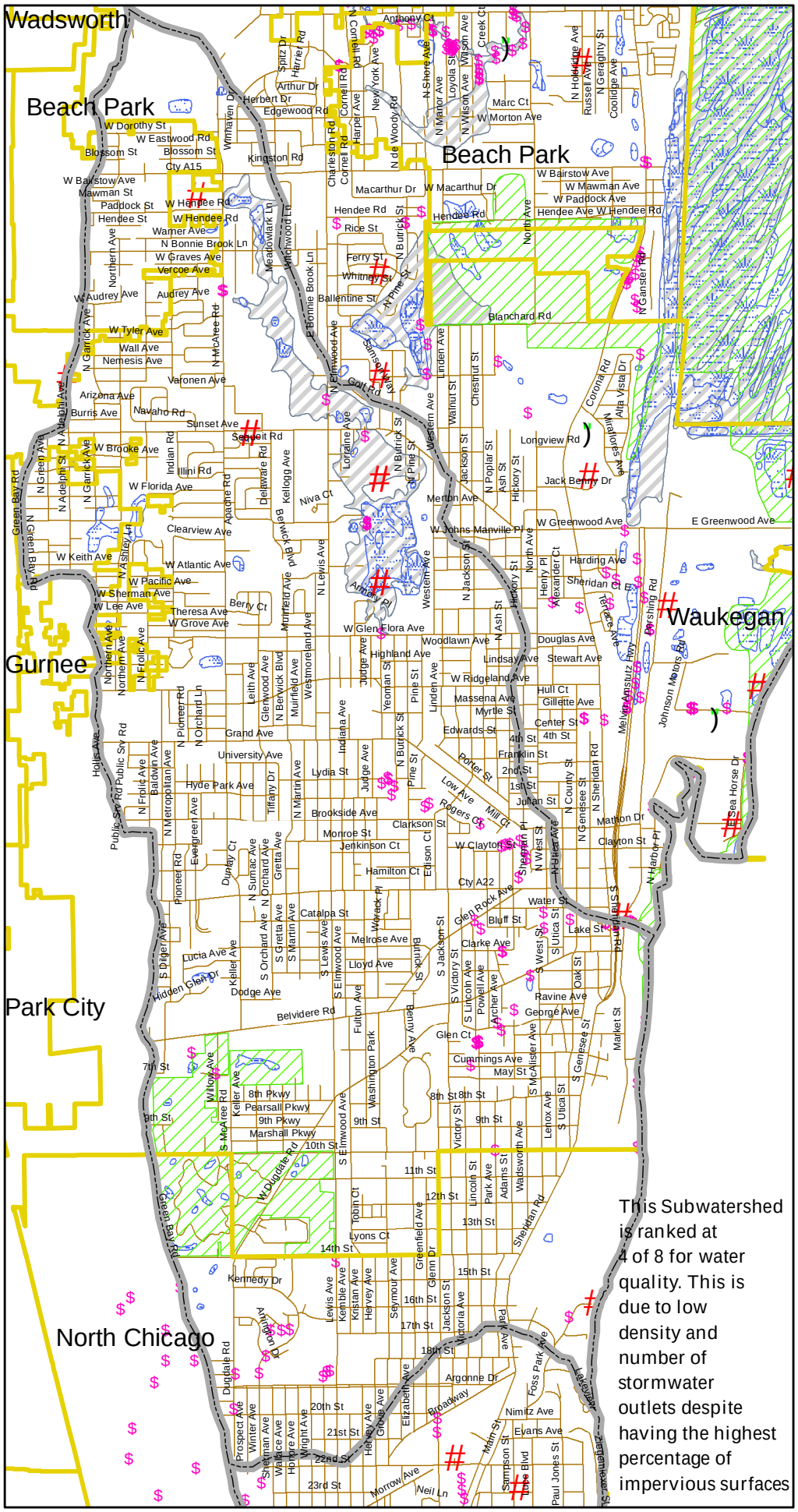
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



Waukegan River sub-watershed is ranked fifth out of eight sub-watersheds with a score of 39.41 out of 100, meaning that it is of moderate-low concern relative to the other sub-watersheds. The sub-watershed ranks towards the middle or bottom for most indicators, including those which were the most heavily weighted. It does rank highly, however, in terms of coverage by impervious surfaces. It also ranks somewhat highly in terms of the proximity of roads and buildings to streams and ravines, in the number of landfills within the sub-watershed and the somewhat low percentage of wetlands coverage compared with the other sub-watersheds.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	1	0.3618	1	0.3618	1.6
# Stormwater Outlets	63	0.3950	7	2.7652	12.5
Density Stormwater Outlets (outlets/acre)	8.37E-03	0.2183	7	1.5279	6.9
Average % Slope	4.35	0.2294	3	0.6882	3.1
Average Dist Stormwater Outlets to Streams (ft)	907.08	0.1894	4	0.7577	3.4
Average Dist Roads and Buildings to Streams (ft)	133.73	0.6370	5	3.1852	14.4
Impervious Surface Coverage	27.50%	0.8736	7	6.1154	27.7
Drainage Density (ft-1)	1.58E-04	0.1764	1	0.1764	0.8
Erodible Soils Coverage	40.83%	0.5265	1	0.5265	2.4
Wetlands Coverage	1.7277%	0.7156	3	2.1467	9.7
# Landfills	9	0.8223	3	2.4668	11.2
# Partner Locations	0	0.8732	1	0.8732	3.9
Agricultural Floodplain Coverage	0.02297%	0.1790	1	0.1790	0.8
Plan-in-Place (1=yes, 0=no)	1	0.1136	3	0.3408	1.5

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



Waukegan River Watershed

Water Quality Priority Area

Ranked 4 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- Landfills
- Partner Project Locations
- Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:45,640

0 0.05 0.1 0.2 0.3 0.4 Miles

This Subwatershed is ranked at 4 of 8 for water quality. This is due to low density and number of stormwater outlets despite having the highest percentage of impervious surfaces

Lake Michigan Watershed Ecosystem Partnership
Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

Date: 02/2009

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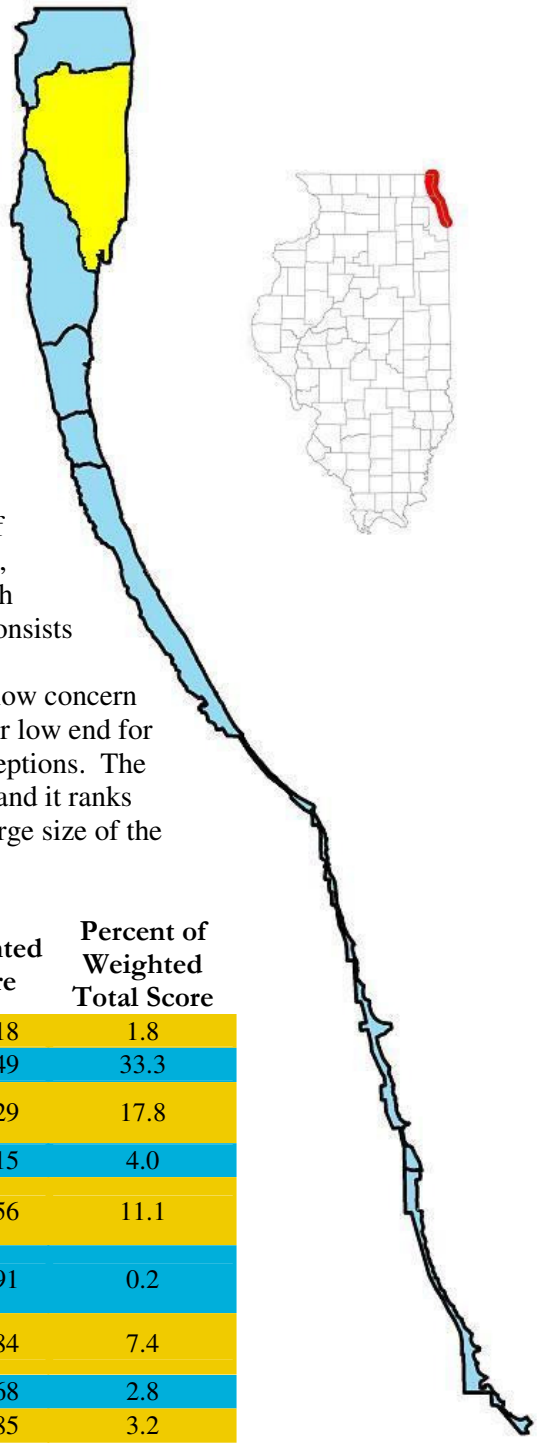
DEAD RIVER

Water Quality Summary

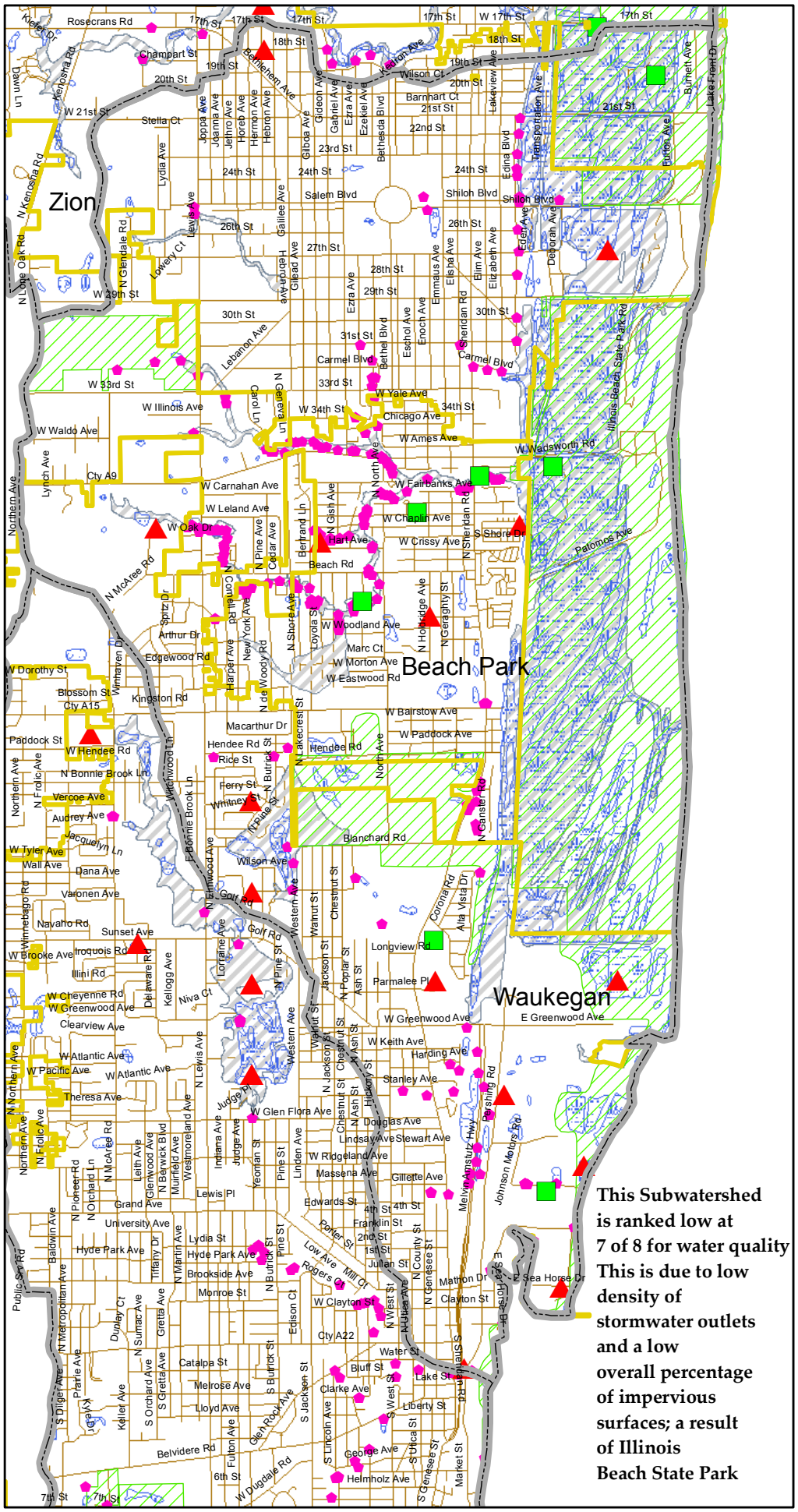
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



The Dead River sub-watershed stretches from just north of the retired Zion Nuclear Power Station down to Waukegan Harbor, and includes portions of the cities of Winthrop Harbor, Zion, Beach Park and Waukegan. A significant portion of the sub-watershed consists of part of Illinois State Beach Park. Dead River ranks seventh out of eight with an overall water quality score of 25.92, making it of low concern relative to the other sub-watersheds. It ranks towards the middle or low end for nearly every indicator, although there are several very notable exceptions. The sub-watershed contains the greatest number of stormwater outlets and it ranks moderately in terms of stormwater outlet density even given the large size of the sub-watershed. It also has the greatest number of landfills at 14.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	1	0.3618	1	0.3618	1.8
# Stormwater Outlets	212	0.9593	7	6.7149	33.3
Density Stormwater Outlets (outlets/acre)	1.80E-02	0.5118	7	3.5829	17.8
Average % Slope	4.59	0.2705	3	0.8115	4.0
Average Dist Stormwater Outlets to Streams (ft)	408.41	0.5589	4	2.2356	11.1
Average Dist Roads and Buildings to Streams (ft)	573.67	0.0098	5	0.0491	0.2
Impervious Surface Coverage	15.78%	0.2141	7	1.4984	7.4
Drainage Density (ft-1)	4.39E-04	0.5668	1	0.5668	2.8
Erodible Soils Coverage	48.19%	0.6385	1	0.6385	3.2
Wetlands Coverage	17.0727%	0.0448	3	0.1343	0.7
# Landfills	14	0.9745	3	2.9234	14.5
# Partner Locations	7	0.1612	1	0.1612	0.8
Agricultural Floodplain Coverage	0.00832%	0.1565	1	0.1565	0.8
Plan-in-Place (1=yes, 0=no)	1	0.1136	3	0.3408	1.7

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



Dead River Watershed

Water Quality Priority Area

Ranked 7 of 8

Legend

- Watershed Boundaries
- Municipal Boundaries
- Landfills
- Partner Project Locations
- Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

N
W E
S

1:51,887

0 0.10.2 0.4 0.6 0.8 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

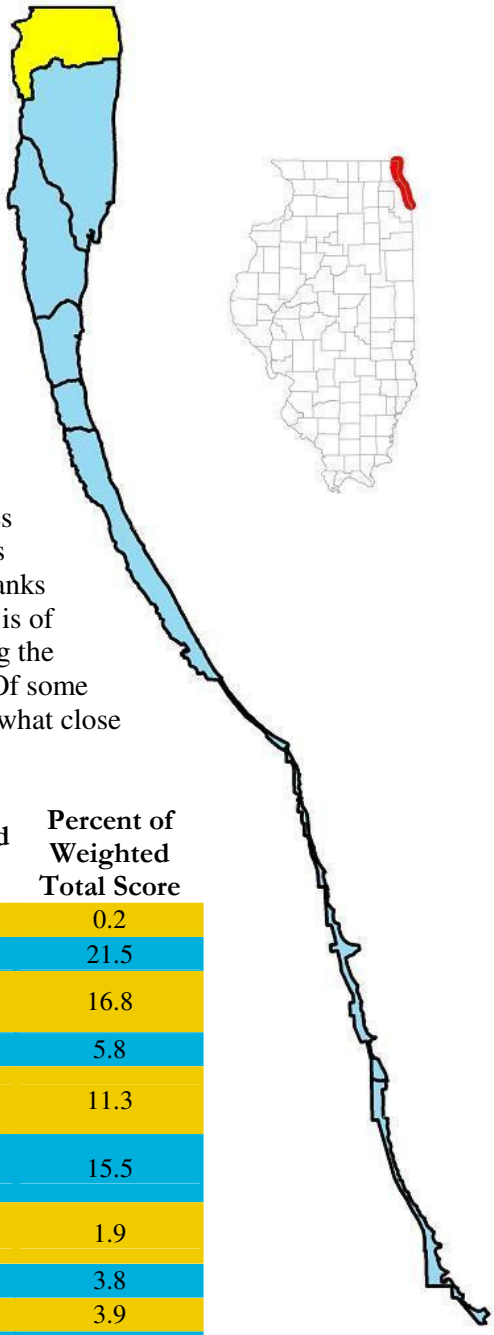
Date: 02/2009

Disclaimer: This map is for general information purposes only. A Registered Land Surveyor should be consulted to determine the precise location of features on the ground. This map does not constitute a regulatory determination and is not a base for engineering design. This map is intended to be viewed and printed in color.

KELLOGG CREEK

Water Quality Summary

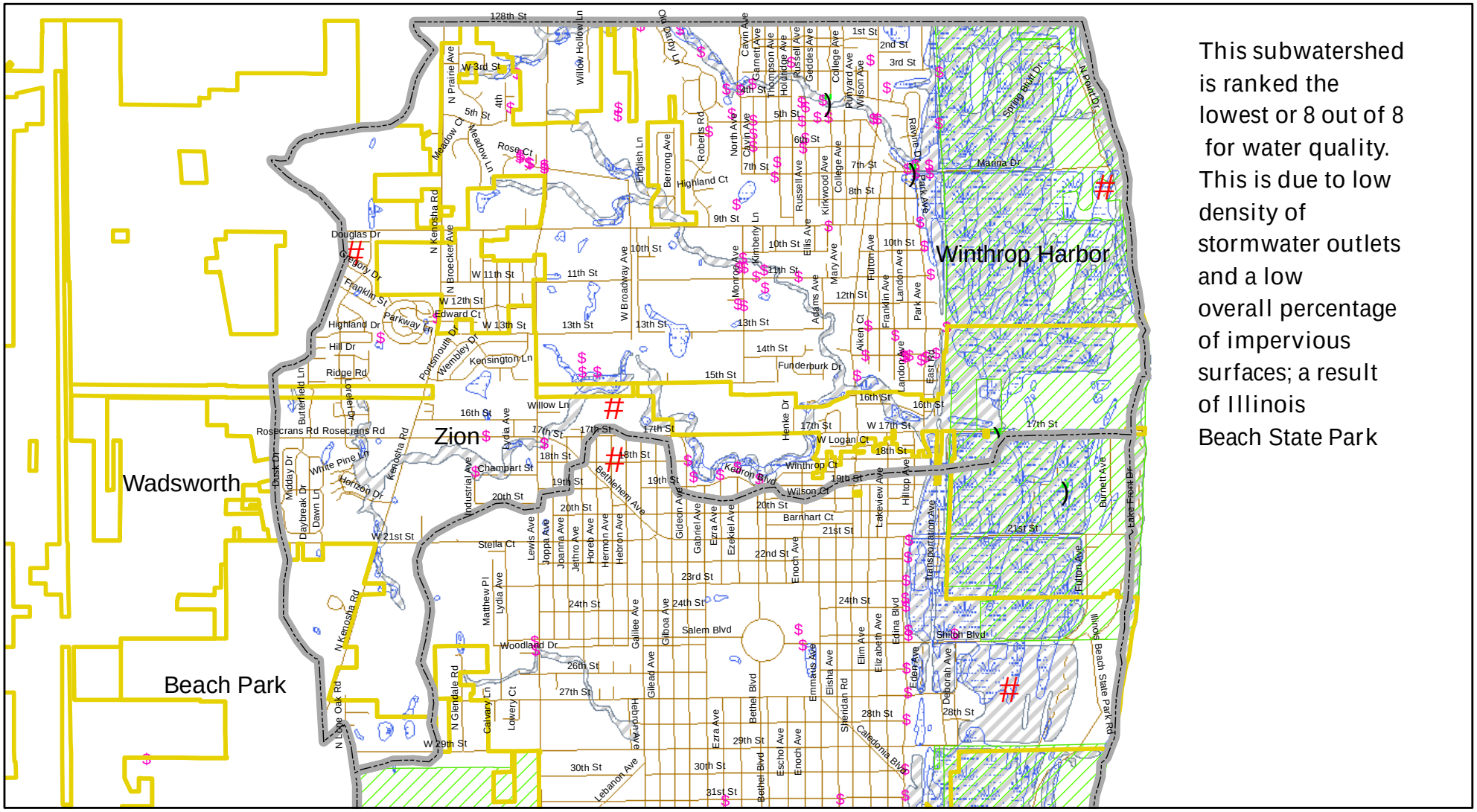
Sub-watershed Name	Water Quality Risk Score (out of 100)
Bluff Ravine South	95.06
Bluff Ravine North	87.75
Evanston-Chicago North	59.54
Pettibone Creek	44.05
Waukegan River	39.41
Chicago South	28.62
Dead River	25.92
Kellogg Creek	7.69



The Kellogg Creek sub-watershed stretches from 128th street in the city of Winthrop Harbor down to around 17th street and includes portions of Zion and Beach Park as well. The eastern section consists of the northern portion of Illinois Beach State Park. Kellogg Creek ranks last out of the eight sub-watersheds with a score of 7.69, indicating it is of very low concern relative to the other sub-watersheds. It ranks among the middle and low end for all of the most heavily weighted indicators. Of some concern are the moderate number of stormwater outlets and the somewhat close proximity of roads and buildings to streams and ravines.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
# Monitoring Sites	2	0.0385	1	0.0385	0.2
# Stormwater Outlets	82	0.4960	7	3.4718	21.5
Density Stormwater Outlets (outlets/acre)	1.43E-02	0.3891	7	2.7238	16.8
Average % Slope	4.82	0.3147	3	0.9441	5.8
Average Dist Stormwater Outlets to Streams (ft)	534.96	0.4551	4	1.8205	11.3
Average Dist Roads and Buildings to Streams (ft)	191.18	0.5000	5	2.5002	15.5
Impervious Surface Coverage	10.22%	0.0435	7	0.3048	1.9
Drainage Density (ft-1)	4.76E-04	0.6225	1	0.6225	3.8
Erodible Soils Coverage	47.57%	0.6294	1	0.6294	3.9
Wetlands Coverage	15.3169%	0.0752	3	0.2255	1.4
# Landfills	3	0.3790	3	1.1371	7.0
# Partner Locations	4	0.4697	1	0.4697	2.9
Agricultural Floodplain Coverage	0.43191%	0.9428	1	0.9428	5.8
Plan-in-Place (1=yes, 0=no)	1	0.1136	3	0.3408	2.1

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This subwatershed is ranked the lowest or 8 out of 8 for water quality. This is due to low density of stormwater outlets and a low overall percentage of impervious surfaces; a result of Illinois Beach State Park

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Watershed Boundaries
- Municipal Boundaries
- # Landfills
- Partner Project Locations
- $ Stormwater Outlets
- Protected Areas
- Wetlands
- Floodzone
- Roads

2

1:43,153

0 0.1 0.2 0.4 0.6 0.8 Miles

Kellogg Creek Watershed

Water Quality Priority Area

Ranked 8 of 8

Disclaimer: This map is for general information purposes only. A Registered Land Surveyor should be consulted to determine the precise location of features on the ground. This map does not constitute a regulatory determination and is not a base for engineering design. This map is intended to be viewed and printed in color.

Habitat

Restored prairie along the top of Hutchins Ravine in Fort Sheridan, Lake County.

Prior to the arrival of European and later, American, settlers, the Chicago region was a mosaic of distinct habitats. Forests predominated along the banks of rivers and streams that helped to protect the trees from the prairie fires which raced across the land. Wetlands proliferated across the poorly drained lands, advancing with the rains in the spring and fall and receding during the dry summer months. Savannahs and shrublands could be found in between where the forests gave way to the tall grasses of the open prairie. And along the coast of Lake Michigan were sandy beaches and dunes, and ravines traversing the bluffs which rose high over the lake.

The situation today is far different. The vast stretches of habitat started to disappear when European colonists made their way into the region and promptly drained and cleared the land to make it suitable for agricultural crops. As settlements and rural homesteads grew into cities, and cities effectively combined into the thriving greater Chicago metropolitan area of today, only a small fraction of habitat remained. Many of the plants and animals which co-evolved with the landscape disappeared along with their habitat. But some can still be found in protected areas, and others could be potentially reintroduced into restored habitats under our stewardship. This chapter is concerned with the habitat that remains scattered throughout the eight subwatersheds and the possibility of reestablishing even more.

Background

The Chicago region once was home to a diverse array of ecosystems, primarily forests, prairies and wetlands[1]. Much of region was covered either by forest or prairie, depending on the complex interplay of climate, topography and history. The existence of prairie at all is a curious fact given that historical and current climate patterns favor the growth of forests over prairie. Around eight thousand years ago, however, the climate was thought to have shifted to drier, warmer conditions which allowed prairie species indigenous to the dry lands of the west to move into the region[2]. Then around five thousand years ago the climate shifted back towards wetter, cooler conditions, which favored the growth of forests. The prairies continued to dominate the land, however, as a result of the fires which raged across the dry prairies in the summer and early autumn, ignited either by lightning or indigenous North American tribes. Most forest trees were incapable of surviving the fires, and in those regions with the most intense fires the prairie reigned supreme. In areas where the fires were less intense, however, certain species of fire-resistant trees such as bur and white oak were able to take root, thus giving rise to the savannah. And where moisture and the topography of the land kept the prairie fires at bay, forests grew tall and lush.

The Chicago region today has been greatly transformed over the past few centuries. Although North American tribes altered the landscape in significant ways, including but not limited to the setting of prairie fires, European and American ultimately had a far greater impact on the land as they displaced native habitat with agricultural crops. Wetlands and wet prairie were some of the first habitats to disappear as early settlers engineered ditches and canals to drain the water from the land. (We have continued this legacy of controlling rainwater with our network of sanitary and stormwater sewers, which carry off impressive volumes of water that would otherwise flood basements, streets, yards and fields.) Forests were cut down for timber and to clear the land for farms and homesteads. In time, these fields would themselves give way to the expansion of Chicago and its attendant suburbs, a pattern which continues today (albeit at a slower rate due to the global economic recession) on the outskirts of the city where new housing developments push against fields of corn and soy.

In some places, the downtown districts of cities being the most striking example, the displacement of habitat is nearly total in scope. It is entirely possible to walk around certain parts of cities and not see a single native plant or animal aside from the occasional tree. Residential areas, especially in the suburbs, are still quite well forested, comparatively at least; some of the trees perhaps even predate the communities themselves. Still, many of the species of plants, flowers, insects and animals that once constituted a healthy forest ecosystem are gone. Turfgrasses now reign supreme over nearly every space where native plants and wildflowers once grew along the forest floor. Prairies have all but become extinct, the deep, fertile soil (a gift from the prairies themselves) having long since been converted to agricultural crops. In the place of fields of big bluestem and little bluestem we now find an entirely different species of

[1] Greenberg, Joel, *A Natural History of the Chicago Region*, pg. 7.
[2] *Ibid*, pg. 237.

grass: corn. (And just corn – weeds don't stand a chance against the battery of chemical weapons we deploy on corn's behalf.)

Myriad species of insects, reptiles, amphibians, birds and mammals have long since disappeared from the region or are now threatened or endangered. "By the early years of the twentieth century, thirteen mammals had either virtually or entirely disappeared from the region: smoky shrew (*Sorex fumeus*), beaver, porcupine (*Erethizon dorsatum*), gray wolf (*Canis lupus*), black bear (*Ursus americanus*), river otter (*Lutra canadensis*), marten (*Martes americana*), fisher (*Martes pennanti*), mountain lion (*puma concolor*), bobcat *(Lynx rufus*), white-tailed deer, wapiti (*Cervus elephus*), and bison (*Bison bison*).[3]" Some of these species, such as the bison, have not been found in the region for centuries. Others vanished only recently, and some, like the white-tailed deer and the beaver, have been reintroduced.

Whether these species can survive reintroduction and whether those that are not yet extinct can one day return depends both on the quantity and the quality of the habitat that remains. Much of the remaining habitat is highly fragmented and isolated from other areas of habitat, which makes it difficult for animals to reestablish themselves, particularly the larger mammals. One important measure of the quality of habitat then is the distance between remaining habitat areas, whether they are protected, unprotected or restored. Fragmented neighboring areas can potentially be connected with wildlife corridors, which would allow animals to move freely from area to area. Through conserving remaining native habitats, restoring degraded ones, and enlarging the effective area available to larger animals through wildlife corridors, many of the plants and animals now gone may one day return.

[3] Greenberg, Joel, *A Natural History of the Chicago Region*, pg. 416.

Habitat Indicators

The following chart presents the various criteria, or indicators, by which the habitat score for each subwatershed was determined. The Background section of this chapter served to introduce the major factors affecting habitat which appear now as indicators. Next to each indicator are the units of measure, a brief explanation, a one-word description of how it impacts erosion potential (i.e. positively or negatively), and a one-digit weighting factor. Since not all criteria are expected to have the same impact, weighting factors are used to take into account the greater relevance or importance of certain indicators over others.

Indicator	Unit of Measure	Indicator Explanation	**Positive** impact/high quality score or **Negative** impact/low quality score	Weighting Factor
Average Nearest Distance Between Habitat/Pervious Surfaces	ft	The average nearest-neighbor distance between habitat or pervious surfaces (i.e. surfaces capable of absorbing water)	negative	7
Unprotected Wetlands	acre	Wetlands not currently under some type of federal, state or local protection	positive	7
Protected Habitat Coverage	percent	Habitat under local, state or federal protection, including forest preserves	positive	6
Total Edge-to-Area Ratio	ft/acre	Ratio of the total perimeter of all pervious surfaces to the area of the subwatershed – a measure of habitat contiguity	negative	4
Average Nearest Distance Between Partner Sites	ft	Average nearest distance between partners sites; a max distance of 99999999 was used for those subwatersheds where no partner sites were identified	negative	4
Pervious Surface Coverage	percent	Any greenspace, including pervious surfaces from lawns, state property, forest preserves, and parks	positive	3
Total Number of Threatened or Endangered Species	#	Total number of documented Threatened or Endangered species	positive	3
Watershed Plan-in-Place	yes/no	Indicates whether or not a US EPA subwatershed plan has been drafted.	positive	3
Number of Partner Projects	#	Locations provided by LMWEP partnership based on goals	positive	2
Number of Sites Monitored	#	Number of habitat sites where plant community surveys were completed (includes forest preserves, Fort Sheridan, and Highland Park)	positive	1
Hydric Soils Coverage	percent	Area soils that meet local hydric soil criteria; those not already developed or wetland. These sites could potentially be restored as wetlands.	positive	1

Data Gaps

There are two primary data gaps related to the habitat indicators. The first gap concerns a lack of data regarding different habitat types. This data gap is mostly an issue when it comes to assessing the average nearest distance between habitats and habitat contiguity. In the case of these two indicators, a green residential lawn is given the same weight as an equal size patch of protected forest, since habitat in these cases is defined as all pervious surfaces. The second gap is simply a lack of data on species diversity within a sub-watershed and an accounting of invasive species. These data would help to clarify the quality of habitat within the sub-watersheds.

Results Summary

The overall ravine habitat scores are given in the Table 1. The range of possible scores is zero to 100, from worst to best in terms of habitat extent and quality. The overall scores were calculated by evaluating the sum of the weighted indicators scores with the cumulative probability distribution function using the average and standard deviation of the total weighted indicator ranks for all 8 subwatersheds. In other words, the arbitrarily scaled total weighted indicators scores were converted to a more intuitive, meaningful scale from 0 to 100 based on where they would fall on a normal distribution, or bell-curve. For those who are interested, the Scoring Methodology section provides an in-depth explanation on how these scores were calculated from the indicators data. That raw data, as well as the intermediate un-weighted and weighted indicators scores are provided in the Habitat Indicators Data Table after this section. For the individual subwatershed discussions in this section, the table may prove useful for those readers who prefer or simply wish to refer to the data and calculations behind the largely qualitative descriptions.

Subwatershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44

Table 1: Overall habitat scores for the eight sub-watersheds in the study.

Figure 1 (below) illustrates the distribution of the raw *total weighted indicators scores* (yellow bars) for the 8 subwatersheds and the cumulative probability curve (red line) used to determine the overall habitat scores. (The blue curve is a scaled normal distribution curve based on the average and standard deviation of the total weighted indicators scores). The distribution of scores generally approximates a normal distribution (blue curve), such that most scores tend to cluster around the average (19.19) and fewer are distributed far from the average in either direction. The red curve in the graph represents the overall habitat score for the corresponding total weighted indicators score. Notice that the *average* total weighted indicator score corresponds to an overall score of *exactly* 50 out of 100.

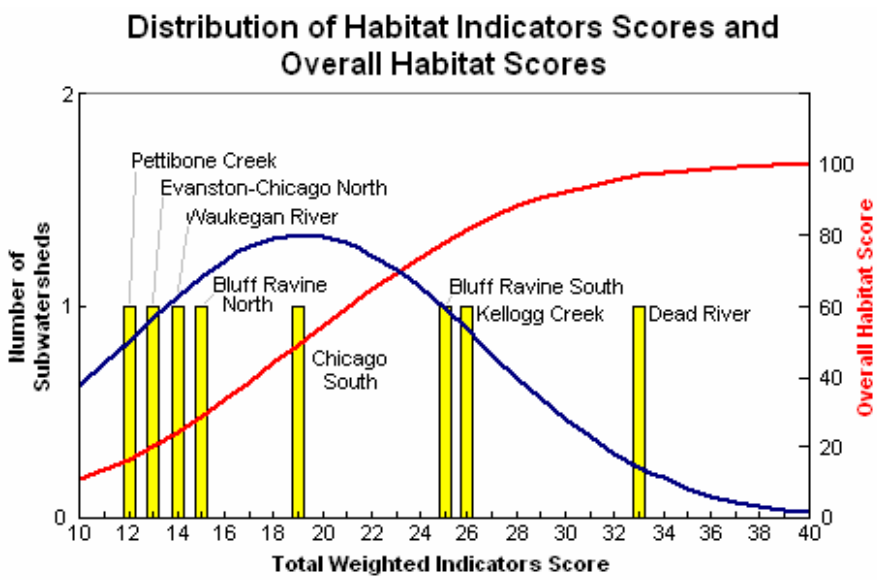


Figure 1: A histogram of the total weighted indicators scores for habitat with a normal distribution (blue) based on the average and standard deviation of the scores. The cumulative probability function (red) illustrates how the total indicators scores were converted to overall habitat scores.

The distribution of total weighted indicators scores shows that four sub-watersheds – Bluff Ravine North, Waukegan River, Evanston-Chicago North and Pettibone Creek – form a cluster well below the average. These four sub-watersheds have the poorest or least amount of habitat relative to all eight. Their corresponding overall habitat scores are likewise very poor, the highest of which is only 25.36 out of 100.

Chicago South comes in well above this cluster with a score of 47.28, which is perhaps surprisingly at first given that the heart of downtown Chicago comprises a significant portion of the sub-watershed. It does, however, contain a significant portion of continuous parks, which helps to offset the poor scores associated with the downtown fraction.

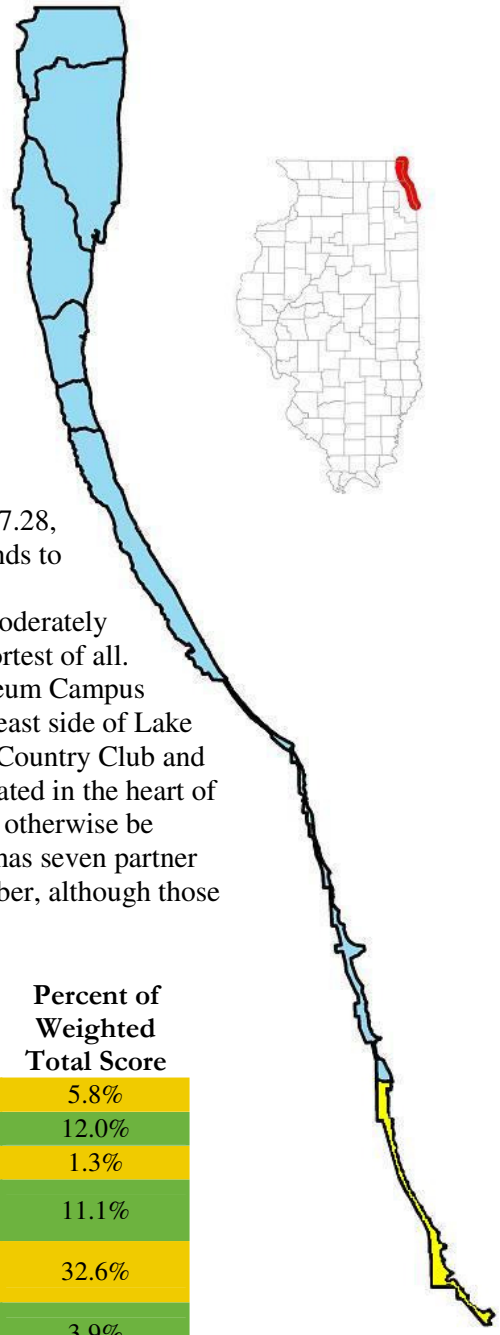
Bluff Ravine South, Kellogg Creek and Dead River are the three most highly ranked sub-watersheds in terms of habitat. The scores in Table 1 and the distribution in Figure 1 clearly show that these three sub-watersheds are well-separated from the other five. In the case of Kellogg Creek and Dead River, this is not surprising, given that Illinois Beach State Park is split between these two sub-watersheds.

	Bluff Ravine North	Bluff Ravine South	Chicago South	Dead River	Evanston-Chicago North	Kellogg Creek	Pettibone Creek	Waukegan River
Acres	1372	6406	2058	11778	2142	5740	2661	7531
Protected Area Coverage (percent)	2.62%	12.94%	0.00%	27.75%	0.23%	18.50%	5.67%	4.93%
Rank (0.0 – 1.0)	0.2567	0.6519	0.1791	0.9706	0.1853	0.8298	0.3651	0.3371
Weighted Rank (=Rank*Weighting Factor)	1.5405	3.9113	1.0743	5.8235	1.1118	4.9786	2.1905	2.0224
Pervious Surface Coverage (percent)	66.25%	61.66%	59.51%	49.01%	52.86%	51.65%	31.28%	23.28%
Rank	0.8696	0.7932	0.7497	0.4886	0.5906	0.5589	0.1122	0.0401
Weighted Rank	2.6089	2.3797	2.2492	1.4659	1.7717	1.6766	0.3366	0.1203
Number of Sites Monitored	0	10	0	3	0	2	2	1
Rank	0.2495	0.9901	0.2495	0.5892	0.2495	0.4701	0.4701	0.3536
Weighted Rank/Score	0.2495	0.9901	0.2495	0.5892	0.2495	0.4701	0.4701	0.3536
Total Edge to Area Ratio (ft/acre)	173.8	167.9	117.6	86.5	126.1	115.2	91.0	76.5
Rank	0.0656	0.0890	0.5193	0.8185	0.4251	0.5452	0.7840	0.8826
Weighted Rank	0.2623	0.3562	2.0770	3.2741	1.7005	2.1806	3.1358	3.5304
Average Nearest Distance Between Habitat/P.S. (ft)	0.53	1.23	0.5	2.6	5.74	2.67	4.61	5.7
Rank	0.8668	0.7851	0.8697	0.5635	0.0996	0.5508	0.2223	0.1029
Weighted Rank	6.0676	5.4958	6.0882	3.9442	0.6973	3.8553	1.5564	0.7200
Total # Threatened and Endangered Species	8	41	5	83	9	30	12	3
Rank	0.2807	0.7345	0.2450	0.9847	0.2932	0.5886	0.3320	0.2226
Weighted Rank	0.8422	2.2034	0.7350	2.9541	0.8796	1.7659	0.9961	0.6678
Number of Partner Projects	0	7	7	7	5	4	0	0
Rank	0.1268	0.8388	0.8388	0.8388	0.6483	0.5303	0.1268	0.1268
Weighted Rank	0.2535	1.6776	1.6776	1.6776	1.2965	1.0607	0.2535	0.2535
Hydric Soils Coverage (percent)	3.46%	7.30%	0.00%	11.00%	0.00%	13.89%	4.35%	9.81%
Rank	0.2949	0.5829	0.1124	0.8238	0.1124	0.9324	0.3572	0.7579
Weighted Rank	0.2949	0.5829	0.1124	0.8238	0.1124	0.9324	0.3572	0.7579
Unprotected Wetlands (acres)	0.75	48	93	417	82	194	12	72
Rank	0.2003	0.3112	0.4361	0.9870	0.4044	0.7201	0.2244	0.3762
Weighted Rank	1.4024	2.1786	3.0526	6.9089	2.8309	5.0405	1.5706	2.6331
Watershed Plan-in-Place (1=yes, 0=no)	0	0	0	1	0	1	0	1
Rank	0.2343	0.2343	0.2343	0.8864	0.2343	0.8864	0.2343	0.8864
Weighted Rank	0.7030	0.7030	0.7030	2.6593	0.7030	2.6593	0.7030	2.6593
Average Nearest Distance to Partner Sites (ft)	9999999	54694	138348	104498	115313	123653	9999999	9999999
Rank	0.0000	0.9504	0.1652	0.5350	0.4009	0.3041	0.0000	0.0000
Weighted Rank	0.0000	3.8017	0.6609	2.1400	1.6034	1.2165	0.0000	0.0000
Total ***Weighted*** Indicators Score	14.2247	24.2802	18.6797	32.2606	12.9566	25.8364	11.5698	13.7183
Overall Habitat Score (0-100)	**25.37**	**75.16**	**47.28**	**95.95**	**20.26**	**81.25**	**15.45**	**23.25**
Rank (Out of 8, 1 = Highest)	**5**	**3**	**4**	**1**	**7**	**2**	**8**	**6**

CHICAGO SOUTH

Habitat Summary

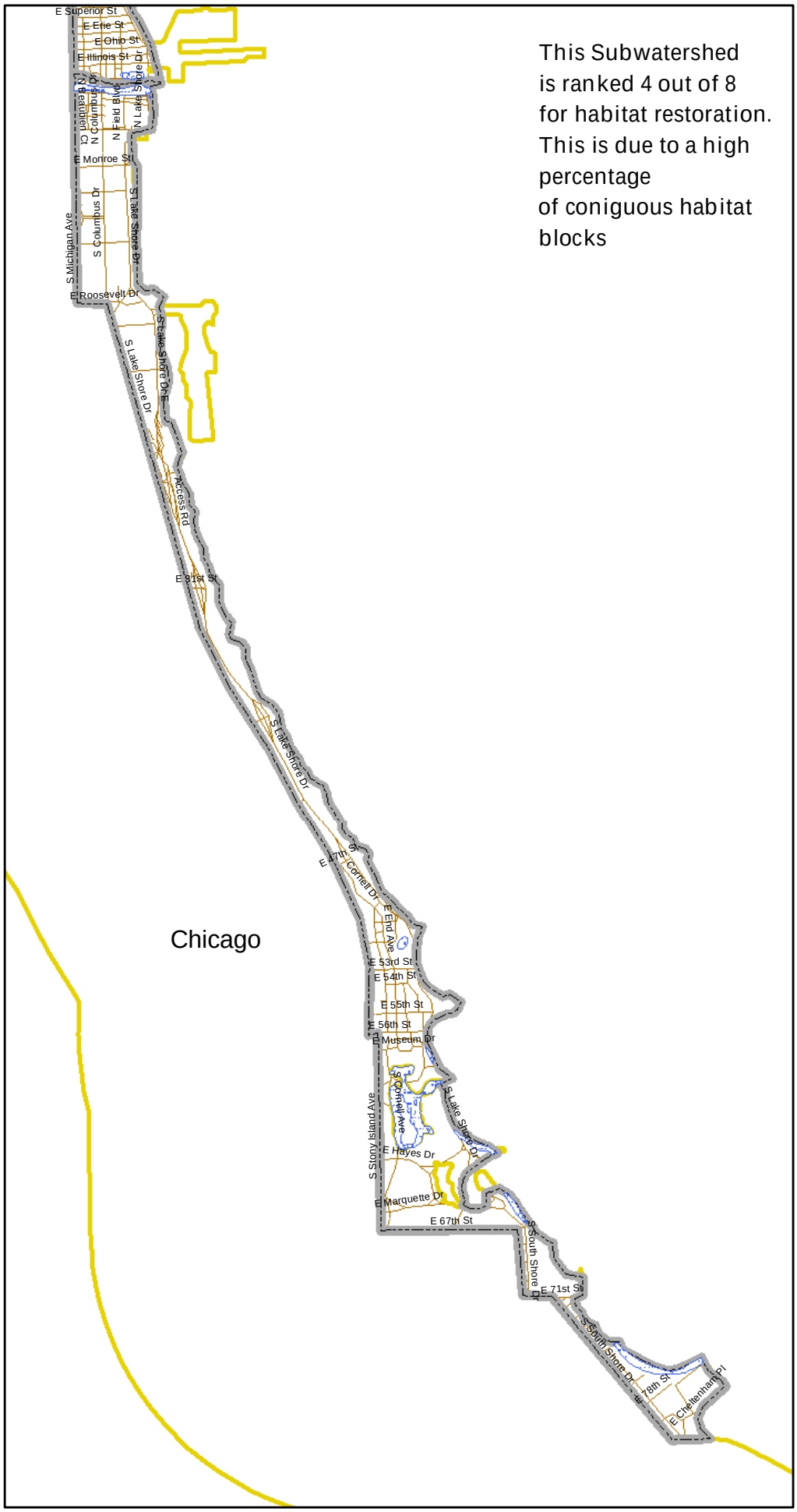
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



Chicago South sub-watershed has the fourth highest score at 47.28, just below the average for all eight sub-watersheds. Chicago South tends to rank toward the middle or bottom for every indicator, with a couple of noteworthy exceptions. First, the percentage of pervious surfaces is moderately large. Second, the average nearest distance between habitats is the shortest of all. These scores are likely due to the presence of Grant Park and the Museum Campus in the northern section of the sub-watershed; Burnham Park along the east side of Lake Shore Drive in the middle section; and Jackson Park, the South Shore Country Club and Rainbow Park and Beach in the southern section. These parks are situated in the heart of Chicago, in what is a highly developed urban setting and which would otherwise be expected to score very poorly for every indicator. Chicago South also has seven partner project sites, which ties two other sub-watersheds for the greatest number, although those sites are comparatively far from one another.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	0.00%	0.1791	6	1.0743	5.8%
Pervious Surface Coverage	59.51%	0.7497	3	2.2492	12.0%
# Sites Monitored	0	0.2495	1	0.2495	1.3%
Total Edge to Area Ratio (ft/acre)	117.6	0.5193	4	2.0770	11.1%
Avg Nearest Distance Between Habitats (meters)	0.5	0.8697	7	6.0882	32.6%
Total # Threatened and Endangered Species	5	0.2450	3	0.7350	3.9%
# Partner Projects	7	0.8388	2	1.6776	9.0%
Hydric Soils Coverage	0.00%	0.1124	1	0.1124	0.6%
Unprotected Wetlands (acres)	93	0.4361	7	3.0526	16.3%
Watershed Plan-in-Place (1=yes, 0=no)	0	0.2343	3	0.7030	3.8%
Average Nearest Distance Between Partner Sites (ft)	138348	0.1652	4	0.6609	3.5%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked 4 out of 8 for habitat restoration. This is due to a high percentage of coniguous habitat blocks

Chicago South Watershed

Habitat Priority Area

Ranked 4 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

2

1:65,305

0 0.15 0.3 0.6 0.9 1.2 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602

312-939-0838

Date: 02/2009

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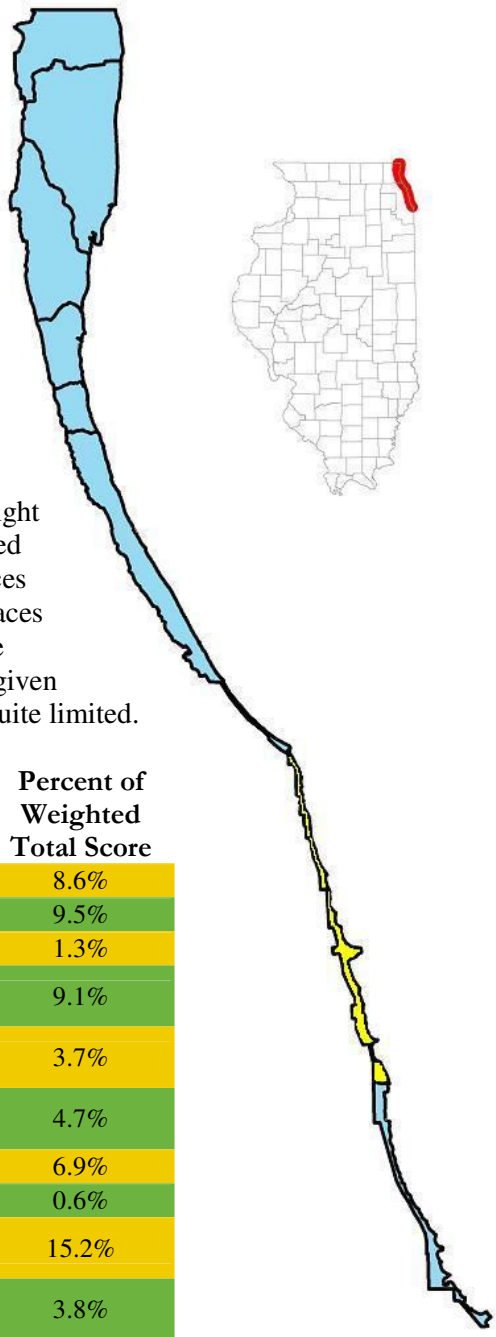
EVANSTON-CHICAGO NORTH

Habitat Summary

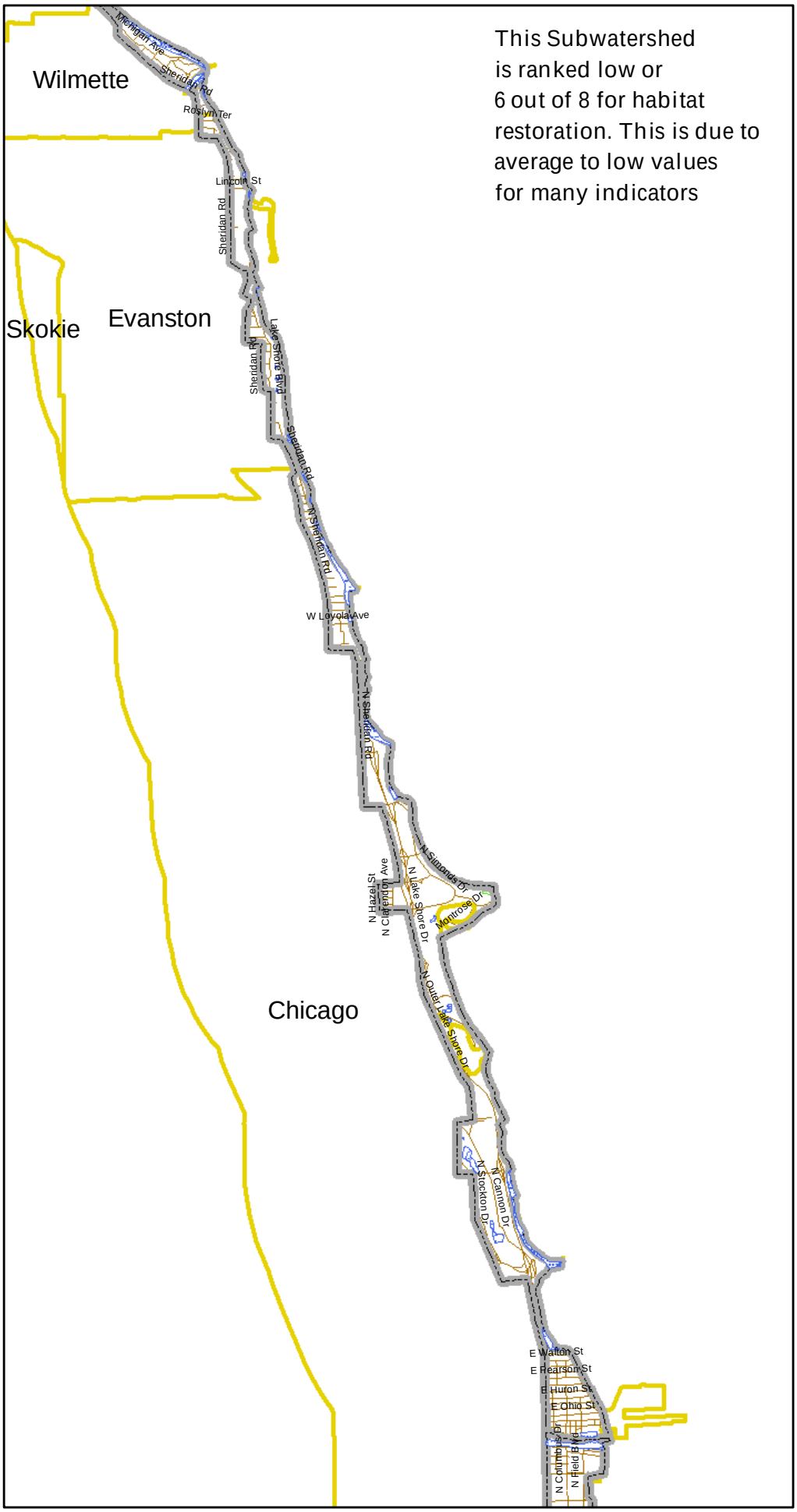
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



The Evanston-Chicago North sub-watershed ranks seventh of eight and has a poor habitat score of just 20.26. It contains almost no protected areas, although it does contain a moderate percentage of pervious surfaces and unprotected wetlands. The distance between habitats/pervious surfaces is the farthest of all. There are, however, five partner project sites in the sub-watershed, and those sites are fairly close to one another, although given that the area is well developed, the potential to link these sites may be quite limited.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	0.23%	0.1853	6	1.1118	8.6%
Pervious Surface Coverage	52.86%	0.5906	3	1.7717	9.5%
# Sites Monitored	0	0.2495	1	0.2495	1.3%
Total Edge to Area Ratio (ft/acre)	126.1	0.4251	4	1.7005	9.1%
Avg Nearest Distance Between Habitats (meters)	5.74	0.0996	7	0.6973	3.7%
Total # Threatened and Endangered Species	9	0.2932	3	0.8796	4.7%
# Partner Projects	5	0.6483	2	1.2965	6.9%
Hydric Soils Coverage	0.00%	0.1124	1	0.1124	0.6%
Unprotected Wetlands (acres)	82	0.4044	7	2.8309	15.2%
Watershed Plan-in-Place (1=yes, 0=no)	0	0.2343	3	0.7030	3.8%
Average Nearest Distance Between Partner Sites (ft)	115313	0.4009	4	1.6034	8.6%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked low or 6 out of 8 for habitat restoration. This is due to average to low values for many indicators

Evanston Chicago North Watershed

Habitat Priority Area

Ranked 6 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

2

1:89,264

0 0.25 0.5 1 1.5 2 Miles

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

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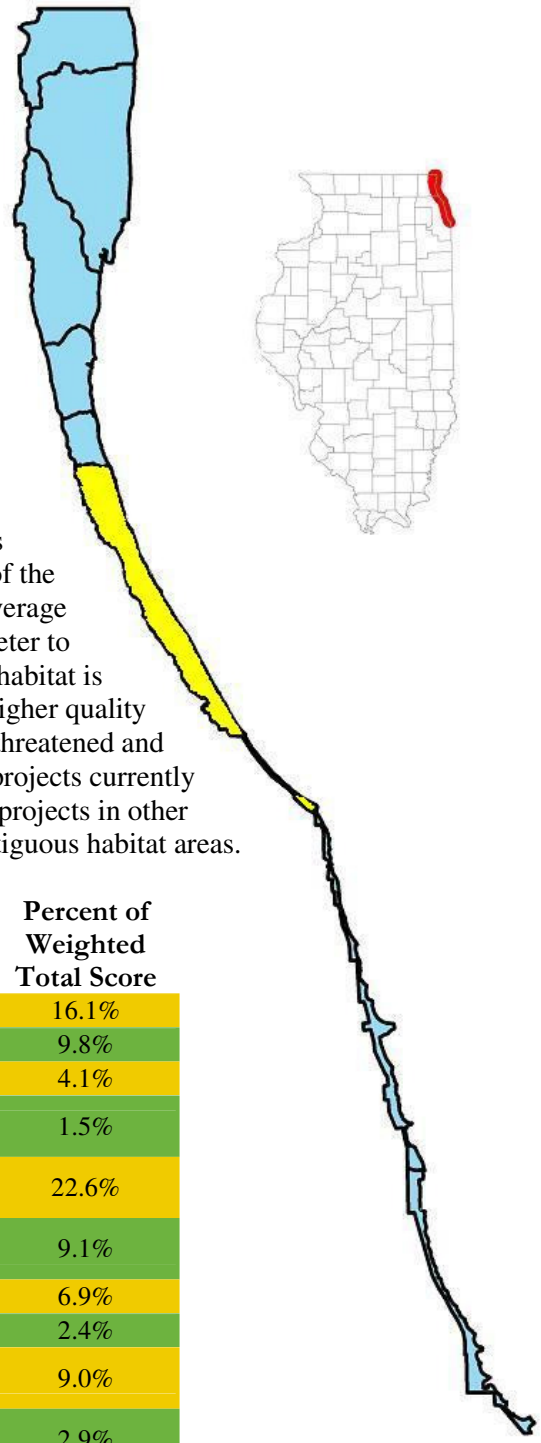
BLUFF RAVINE SOUTH

Habitat Summary

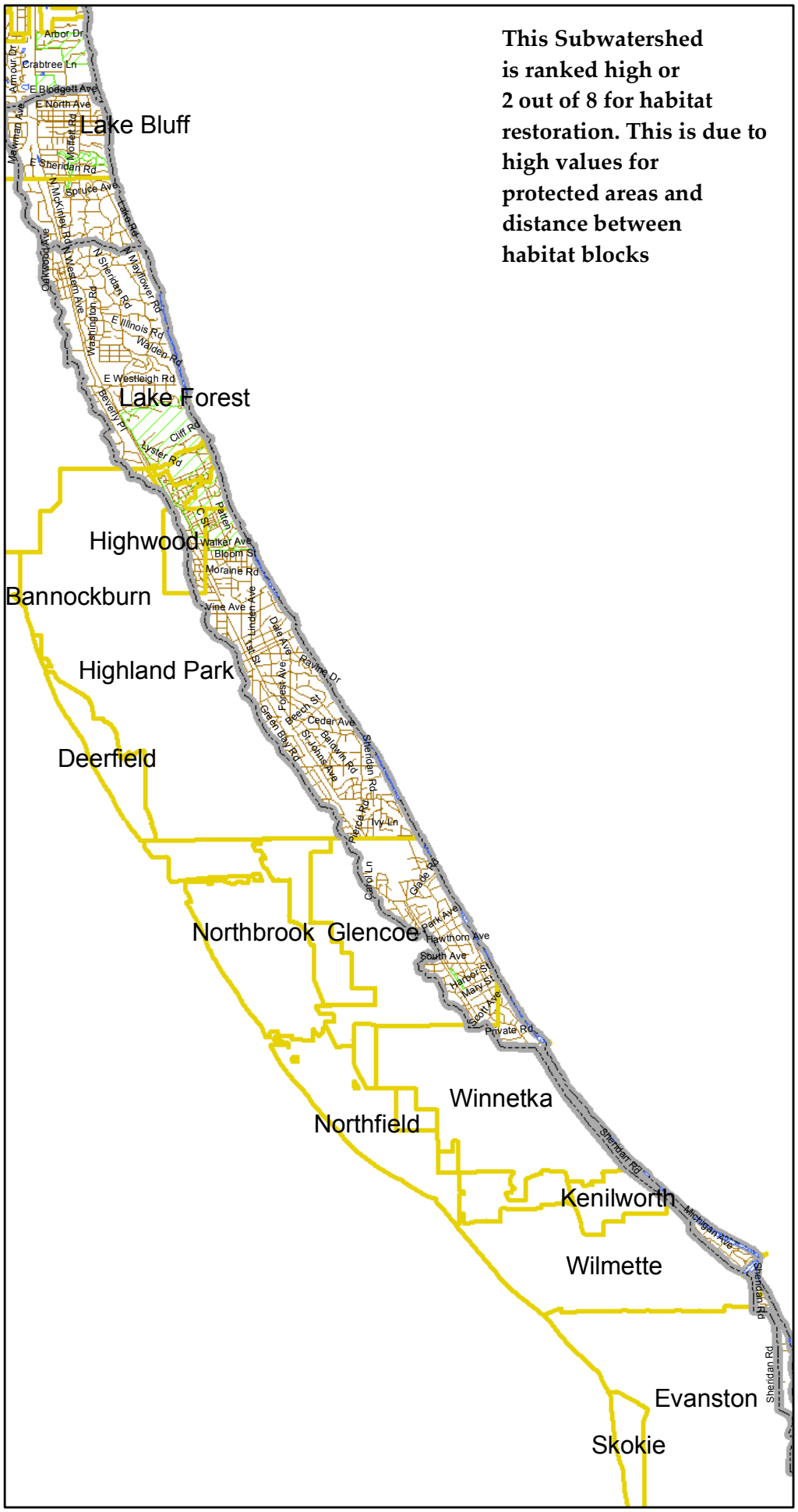
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



Bluff Ravine South sub-watershed has the third highest habitat score at 75.15, just behind Kellogg Creek. Bluff Ravine South contains the third largest percentage of protected habitat, and nearly two-thirds of the entire sub-watershed is covered by pervious surfaces. Moreover, the average distance between pervious surfaces is fairly short, but the habitat perimeter to area ratio is comparatively low. In essence, these data suggest that the habitat is not very contiguous but has the potential to be combined into greater, higher quality areas. The sub-watershed also contains the second greatest number of threatened and endangered species, behind only Dead River. There are seven partner projects currently in Bluff Ravine South, and they are very close together compared with projects in other sub-watersheds, again indicating the potential to form larger, more contiguous habitat areas.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	12.94%	0.6519	6	3.9113	16.1%
Pervious Surface Coverage	61.66%	0.7932	3	2.3797	9.8%
# Sites Monitored	10	0.9901	1	0.9901	4.1%
Total Edge to Area Ratio (ft/acre)	167.9	0.0890	4	0.3562	1.5%
Avg Nearest Distance Between Habitats (meters)	1.23	0.7851	7	5.4958	22.6%
Total # Threatened and Endangered Species	41	0.7345	3	2.2034	9.1%
# Partner Projects	7	0.8388	2	1.6776	6.9%
Hydric Soils Coverage	7.30%	0.5829	1	0.5829	2.4%
Unprotected Wetlands (acres)	48	0.3112	7	2.1786	9.0%
Watershed Plan-in-Place (1=yes, 0=no)	0	0.2343	3	0.7030	2.9%
Average Nearest Distance Between Partner Sites (ft)	54694	0.9504	4	3.8017	15.7%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked high or 2 out of 8 for habitat restoration. This is due to high values for protected areas and distance between habitat blocks

Bluff Ravine South Watershed

Habitat Priority Area

Ranked 2 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

N
W E
S

1:113,921

0 0.20.4 0.8 1.2 1.6 Miles

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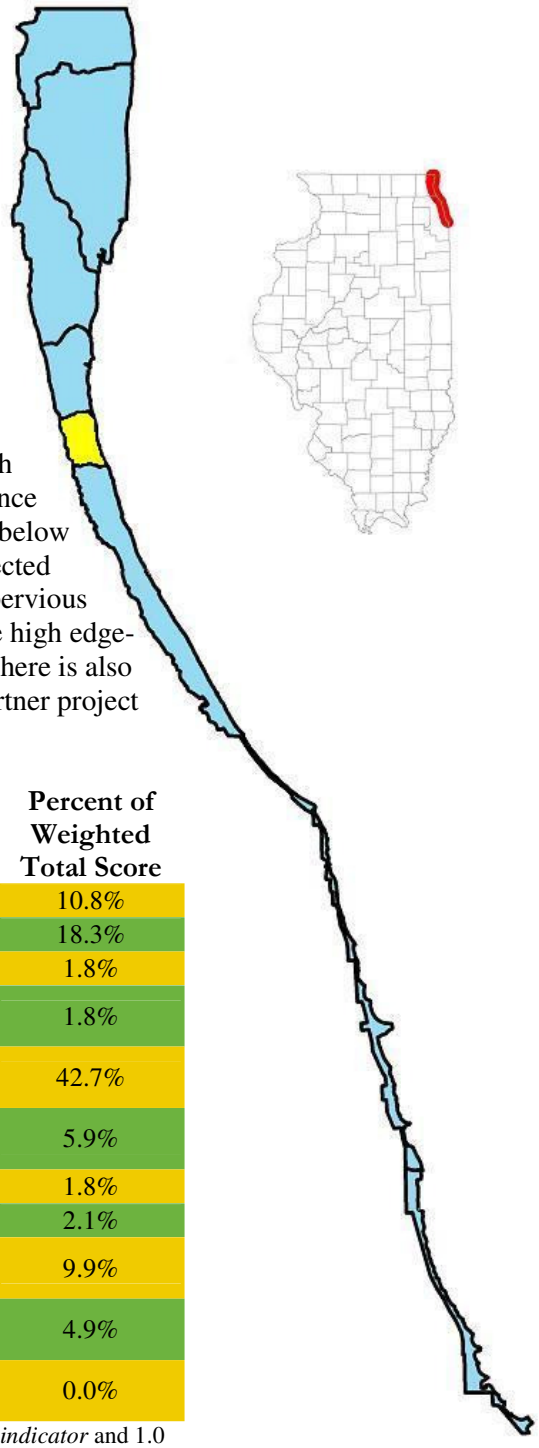
BLUFF RAVINE NORTH

Habitat Summary

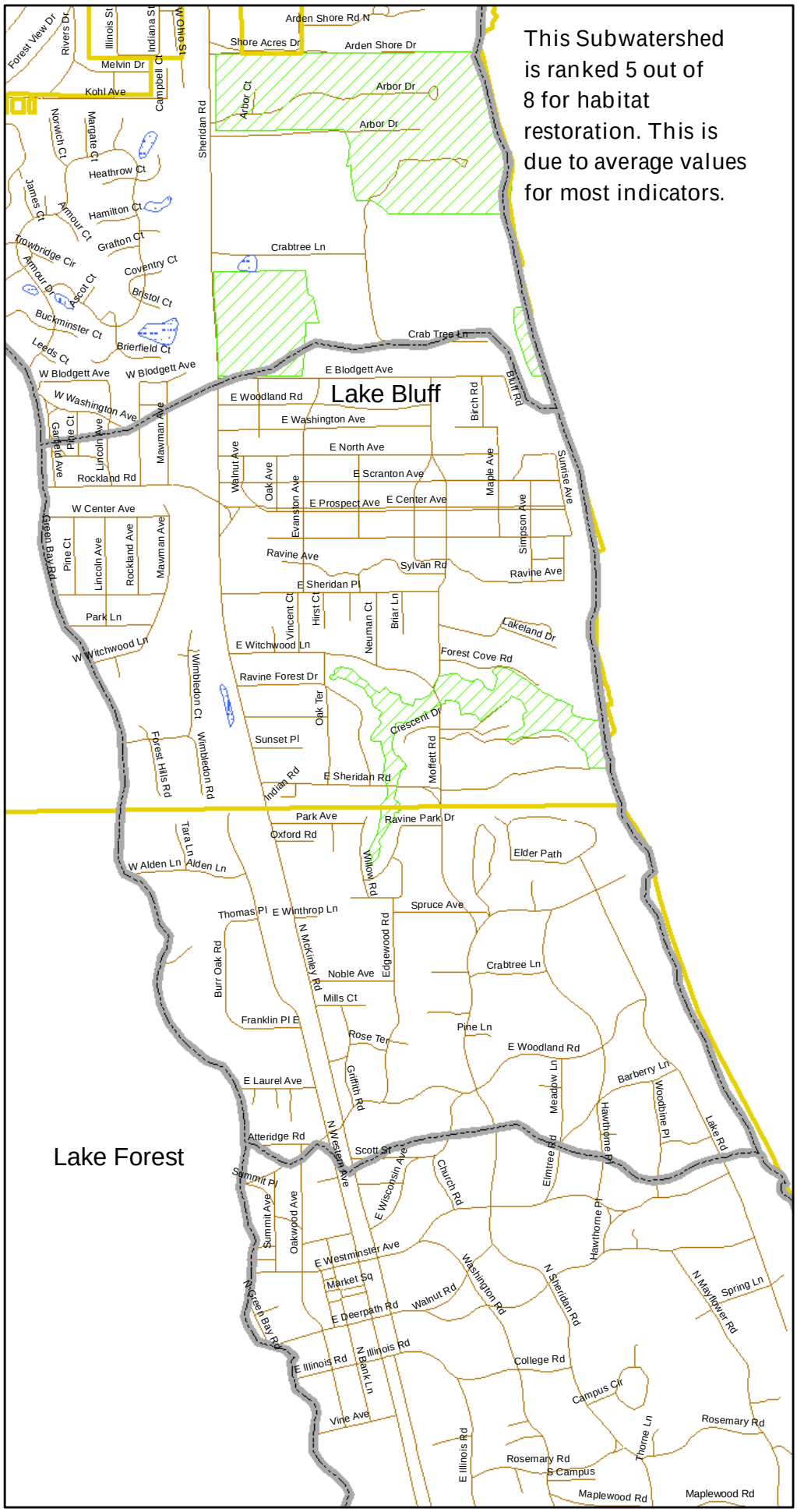
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



Bluff Ravine North has a poor habitat score of 25.36. Although it has the highest percentage of pervious surfaces and the average distance between those surfaces is very short, Bluff Ravine North tends to rank below average for every other indicator. It has a very low percentage of protected habitat and almost no unprotected wetlands to speak of. The existing pervious surfaces/habitat is very discontinuous or convoluted as indicated by the high edge-to-area ratio, and this habitat very likely consists primarily of lawns. There is also a relatively low number of threatened or endangered species and no partner project sites in the sub-watershed.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	2.62%	0.2567	6	1.5405	10.8%
Pervious Surface Coverage	66.25%	0.8696	3	2.6089	18.3%
# Sites Monitored	0	0.2495	1	0.2495	1.8%
Total Edge to Area Ratio (ft/acre)	173.8	0.0656	4	0.2623	1.8%
Avg Nearest Distance Between Habitats (meters)	0.53	0.8668	7	6.0676	42.7%
Total # Threatened and Endangered Species	8	0.2807	3	0.8422	5.9%
# Partner Projects	0	0.1268	2	0.2535	1.8%
Hydric Soils Coverage	3.46%	0.2949	1	0.2949	2.1%
Unprotected Wetlands (acres)	0.75	0.2003	7	1.4024	9.9%
Watershed Plan-in-Place (1=yes, 0=no)	0	0.2343	3	0.7030	4.9%
Average Nearest Distance Between Partner Sites (ft)	9999999	0.0000	4	0.0000	0.0%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked 5 out of 8 for habitat restoration. This is due to average values for most indicators.

Bluff Ravine North Watershed

Habitat Priority Area

Ranked 5 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed rankings

2

1:22,028

0 0.05 0.1 0.2 0.3 0.4 Miles

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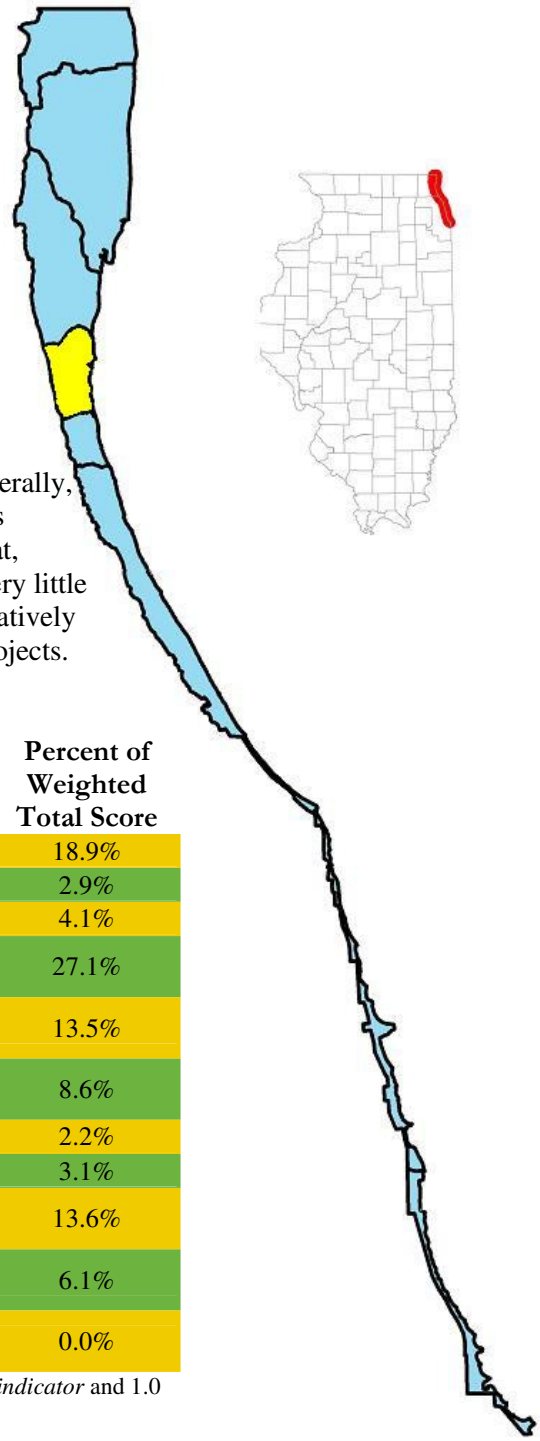
PETTIBONE CREEK

Habitat Summary

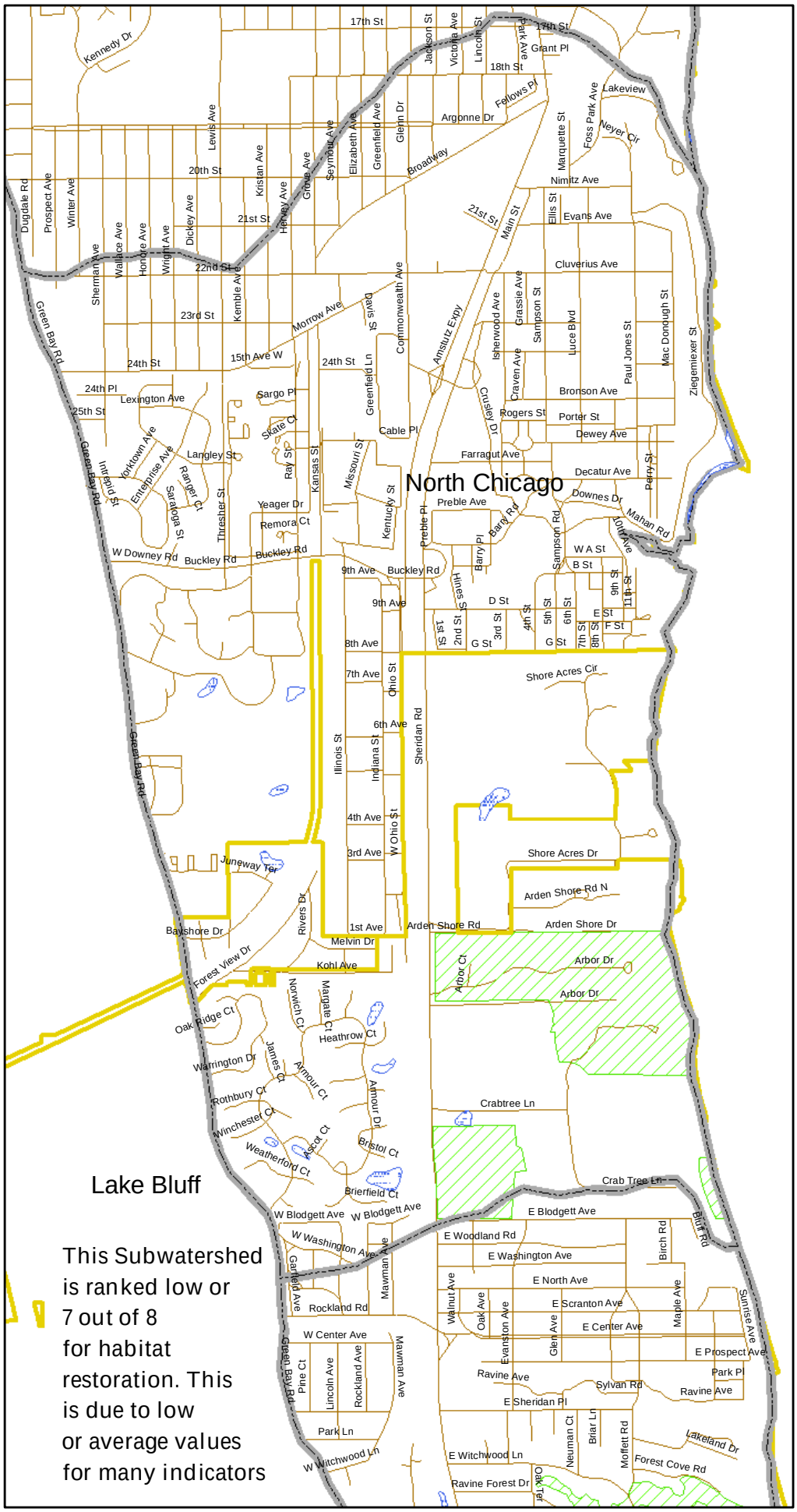
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



Pettibone Creek has the lowest habitat score at just 15.44. Generally, it ranks very poorly for nearly every indicator. The sub-watershed does contain a small, though not insignificant, percentage of protected habitat, but the percentage of pervious surfaces is relatively low, and there is very little unprotected wetland. The average distance between habitats is comparatively large, there are few threatened or endangered species and no partner projects. There is also no watershed plan in place for Pettibone Creek.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	5.67%	0.3651	6	2.1905	18.9%
Pervious Surface Coverage	31.28%	0.1122	3	0.3366	2.9%
# Sites Monitored	2	0.4701	1	0.4701	4.1%
Total Edge to Area Ratio (ft/acre)	91.0	0.7840	4	3.1358	27.1%
Avg Nearest Distance Between Habitats (meters)	4.61	0.2223	7	1.5564	13.5%
Total # Threatened and Endangered Species	12	0.3320	3	0.9961	8.6%
# Partner Projects	0	0.1268	2	0.2535	2.2%
Hydric Soils Coverage	4.35%	0.3572	1	0.3572	3.1%
Unprotected Wetlands (acres)	12	0.2244	7	1.5706	13.6%
Watershed Plan-in-Place (1=yes, 0=no)	0	0.2343	3	0.7030	6.1%
Average Nearest Distance Between Partner Sites (ft)	9999999	0.0000	4	0.0000	0.0%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked low or 7 out of 8 for habitat restoration. This is due to low or average values for many indicators

Pettibone Creek Watershed

Habitat Priority Area

Ranked 7 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

2

1:24,865

0 0.05 0.1 0.2 0.3 0.4 Miles

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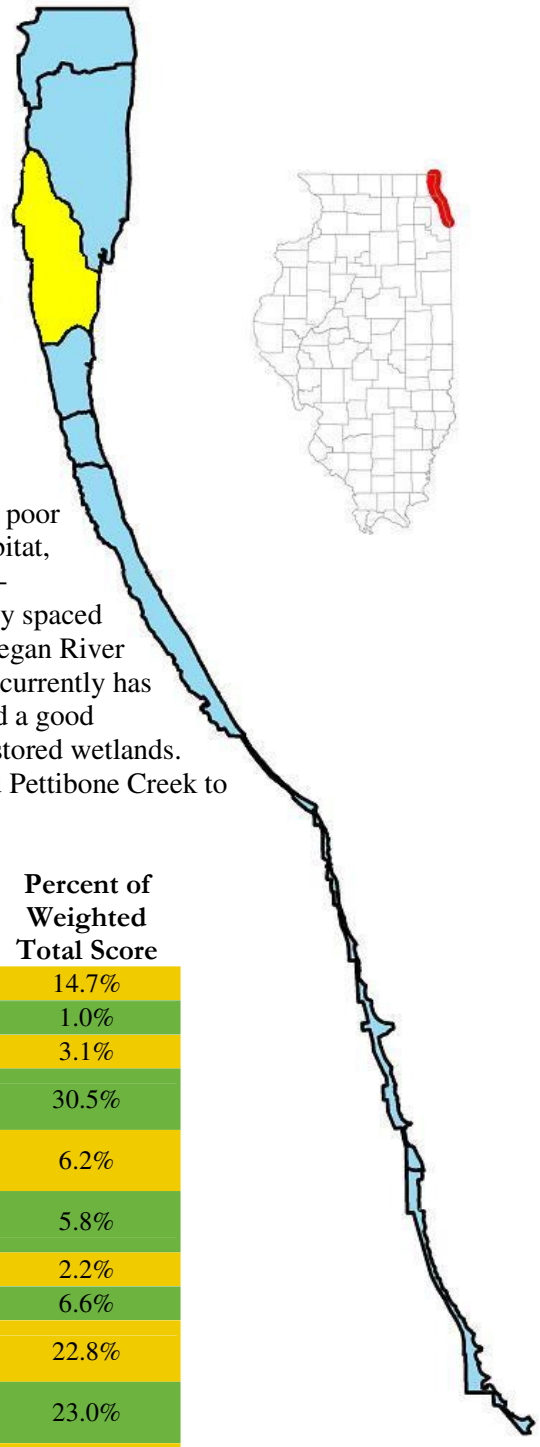
WAUKEGAN RIVER

Habitat Summary

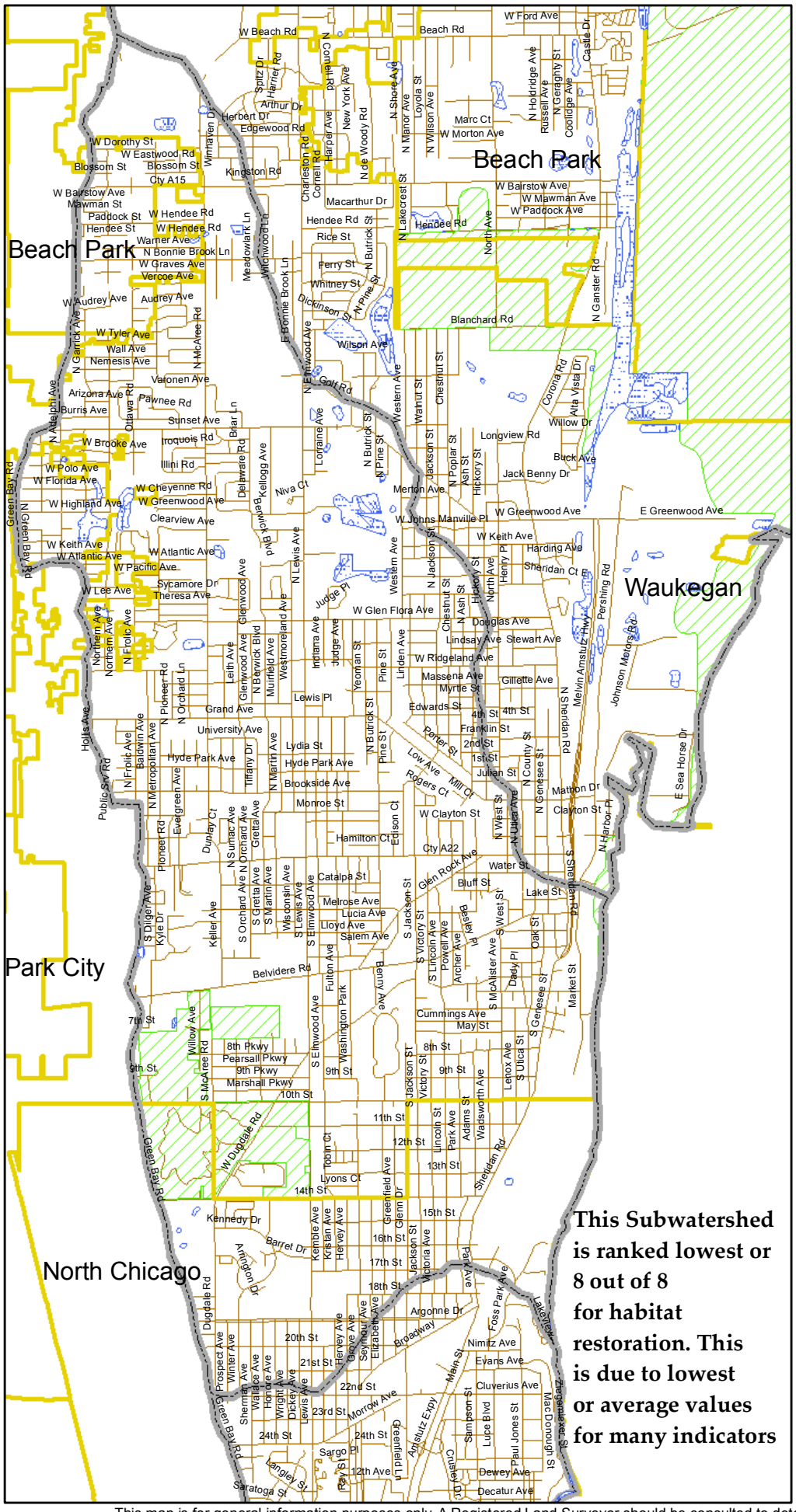
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



The Waukegan River sub-watershed ranks sixth of eight with a poor habitat score of 23.25. Only a small percentage of land is protected habitat, and the percent coverage of pervious surfaces is the lowest of eight sub-watersheds. What little habitat/pervious surfaces exists is comparatively spaced out, as indicated by the large average distance between habitats. Waukegan River contains the fewest number of threatened or endangered species, and it currently has no partner projects. It has a moderate area of unprotected wetlands, and a good percentage of land with hydric soils which could potentially support restored wetlands. Like the Dead River and Kellogg Creek sub-watersheds to its north and Pettibone Creek to its south, no watershed plan has been drafted for Waukegan River.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	4.93%	0.3371	6	2.0224	14.7%
Pervious Surface Coverage	23.28%	0.0401	3	0.1203	1.0%
# Sites Monitored	1	0.3536	1	0.3536	3.1%
Total Edge to Area Ratio (ft/acre)	76.5	0.8826	4	3.5304	30.5%
Avg Nearest Distance Between Habitats (meters)	5.7	0.1029	7	0.7200	6.2%
Total # Threatened and Endangered Species	3	0.2226	3	0.6678	5.8%
# Partner Projects	0	0.1268	2	0.2535	2.2%
Hydric Soils Coverage	9.81%	0.7579	1	0.7579	6.6%
Unprotected Wetlands (acres)	72	0.3762	7	2.6331	22.8%
Watershed Plan-in-Place (1=yes, 0=no)	1	0.8864	3	2.6593	23.0%
Average Nearest Distance Between Partner Sites (ft)	9999999	0.0000	4	0.0000	0.0%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



Waukegan River Watershed

Habitat Priority Area

Ranked 8 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

N
W E
S

1:48,640

0 0.1 0.2 0.4 0.6 0.8 Miles

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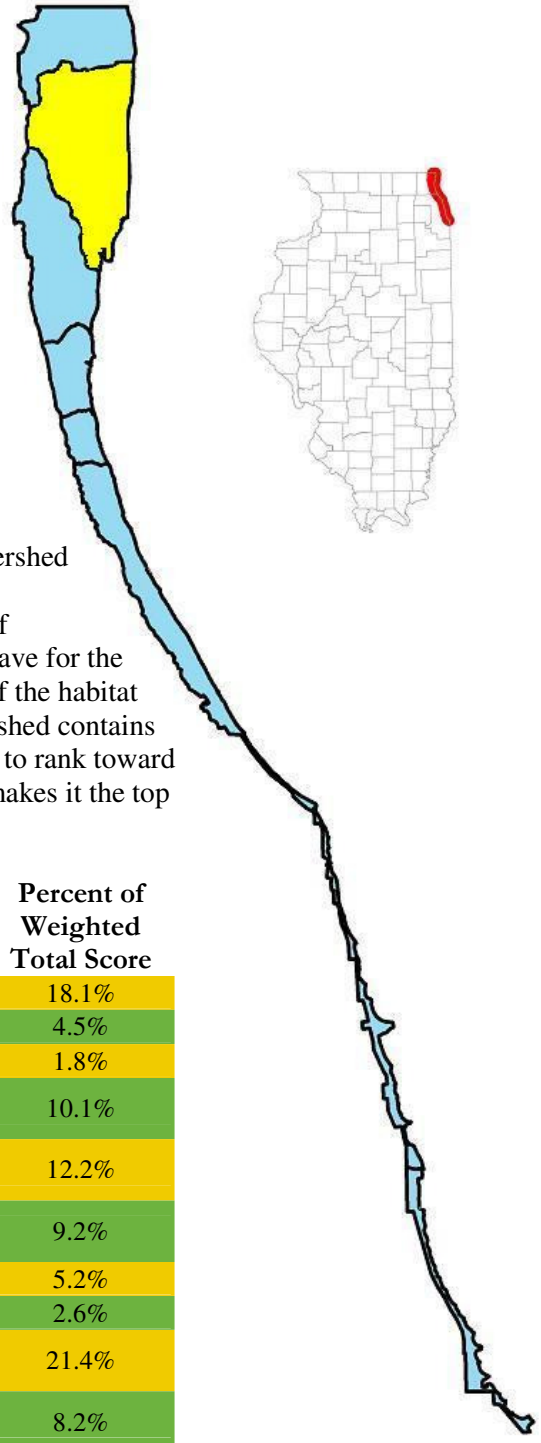
DEAD RIVER

Habitat Summary

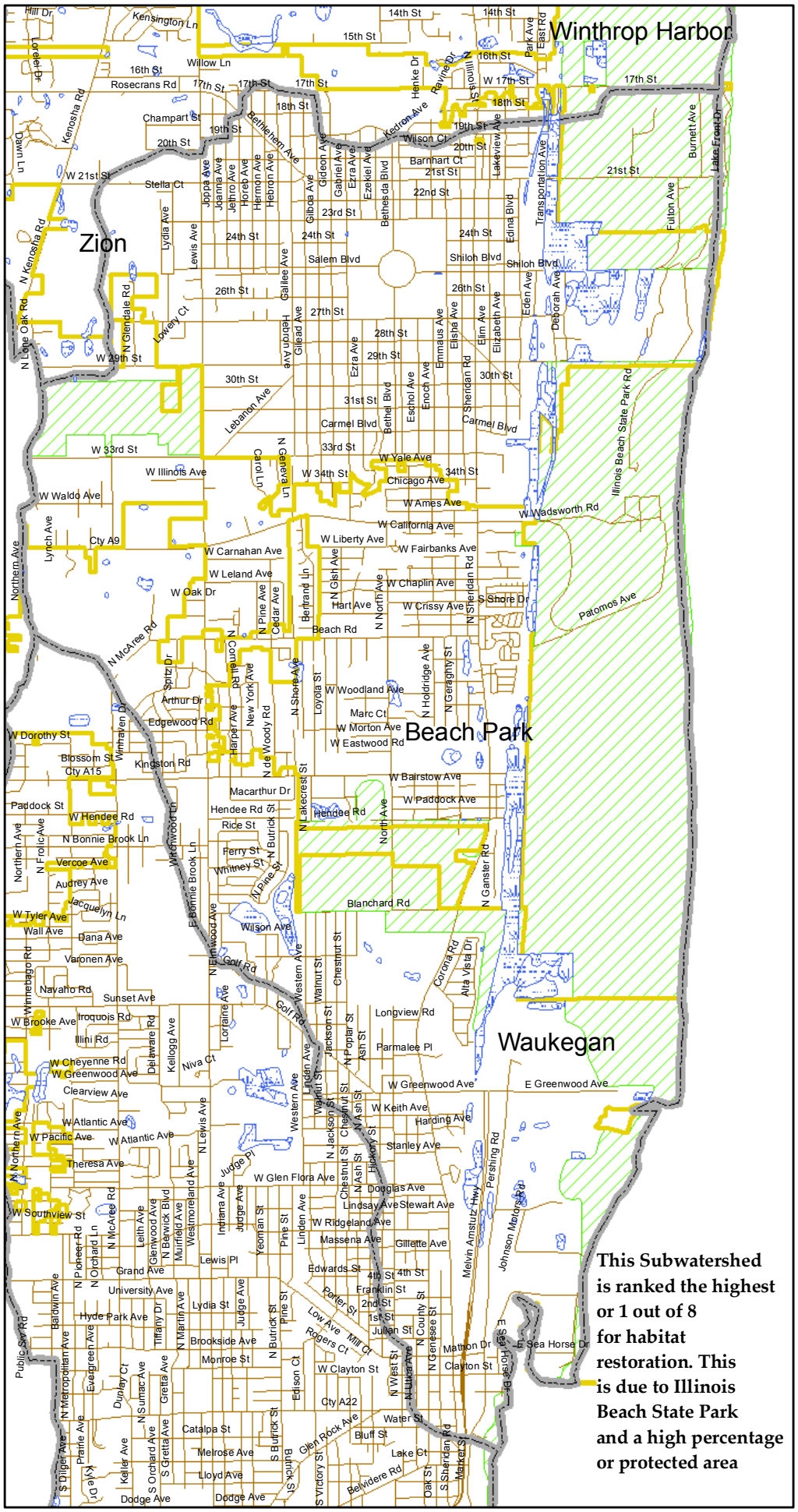
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



The Dead River sub-watershed has the highest habitat score at 95.95. This is due in large part to the fact that the southern section of Illinois Beach State Park comprises a significant portion of the sub-watershed (refer to the map on the next page). Consequently, Dead River contains the largest percentrage of protected habitat as well as the greatest area of unprotected wetlands. Additionally, because the park is uninterrupted save for the decommissioned Zion Nuclear Power Station, it ranks highly in terms of the habitat perimeter to area ratio (a measure of habitat contiguity). The sub-watershed contains the greatest number of threatened and endangered species. It also tends to rank toward the middle or top for nearly every other indicator as well, all of which makes it the top ranked watershed for habitat.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	27.75%	0.9706	6	5.8235	18.1%
Pervious Surface Coverage	49.01%	0.4886	3	1.4659	4.5%
# Sites Monitored	3	0.5892	1	0.5892	1.8%
Total Edge to Area Ratio (ft/acre)	86.5	0.8185	4	3.2741	10.1%
Avg Nearest Distance Between Habitats (meters)	2.6	0.5635	7	3.9442	12.2%
Total # Threatened and Endangered Species	83	0.9847	3	2.9541	9.2%
# Partner Projects	7	0.8388	2	1.6776	5.2%
Hydric Soils Coverage	11.00%	0.8238	1	0.8238	2.6%
Unprotected Wetlands (acres)	417	0.9870	7	6.9089	21.4%
Watershed Plan-in-Place (1=yes, 0=no)	1	0.8864	3	2.6593	8.2%
Average Nearest Distance Between Partner Sites (ft)	104498	0.5350	4	2.1400	6.6%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



Dead River Watershed

Habitat Priority Area

Ranked 1 of 8

Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

N
W E
S

1:51,684

0 0.1 0.2 0.4 0.6 0.8 Miles

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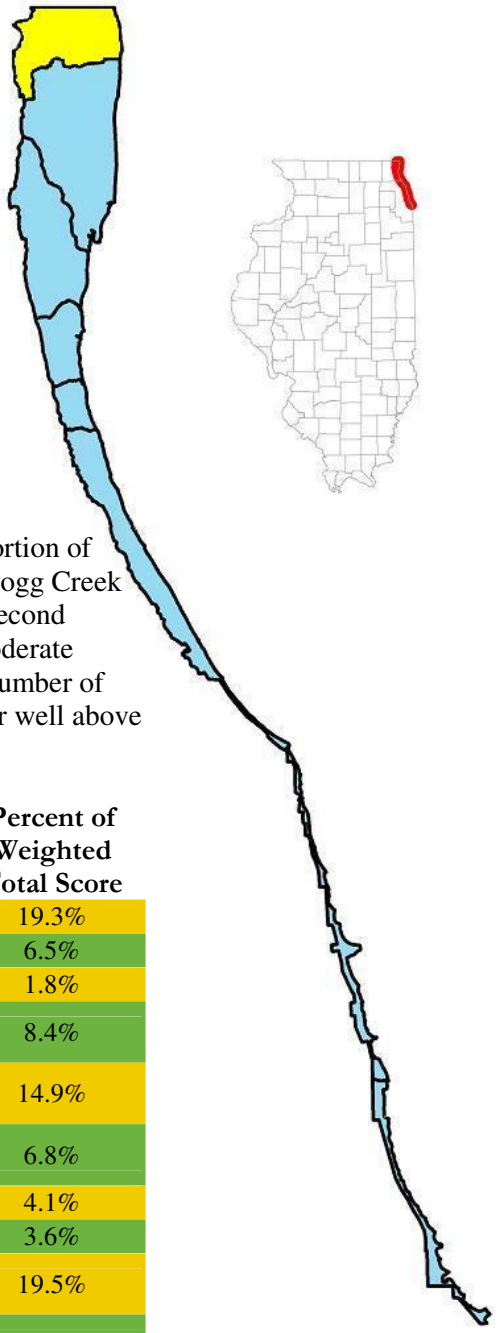
KELLOGG CREEK

Habitat Summary

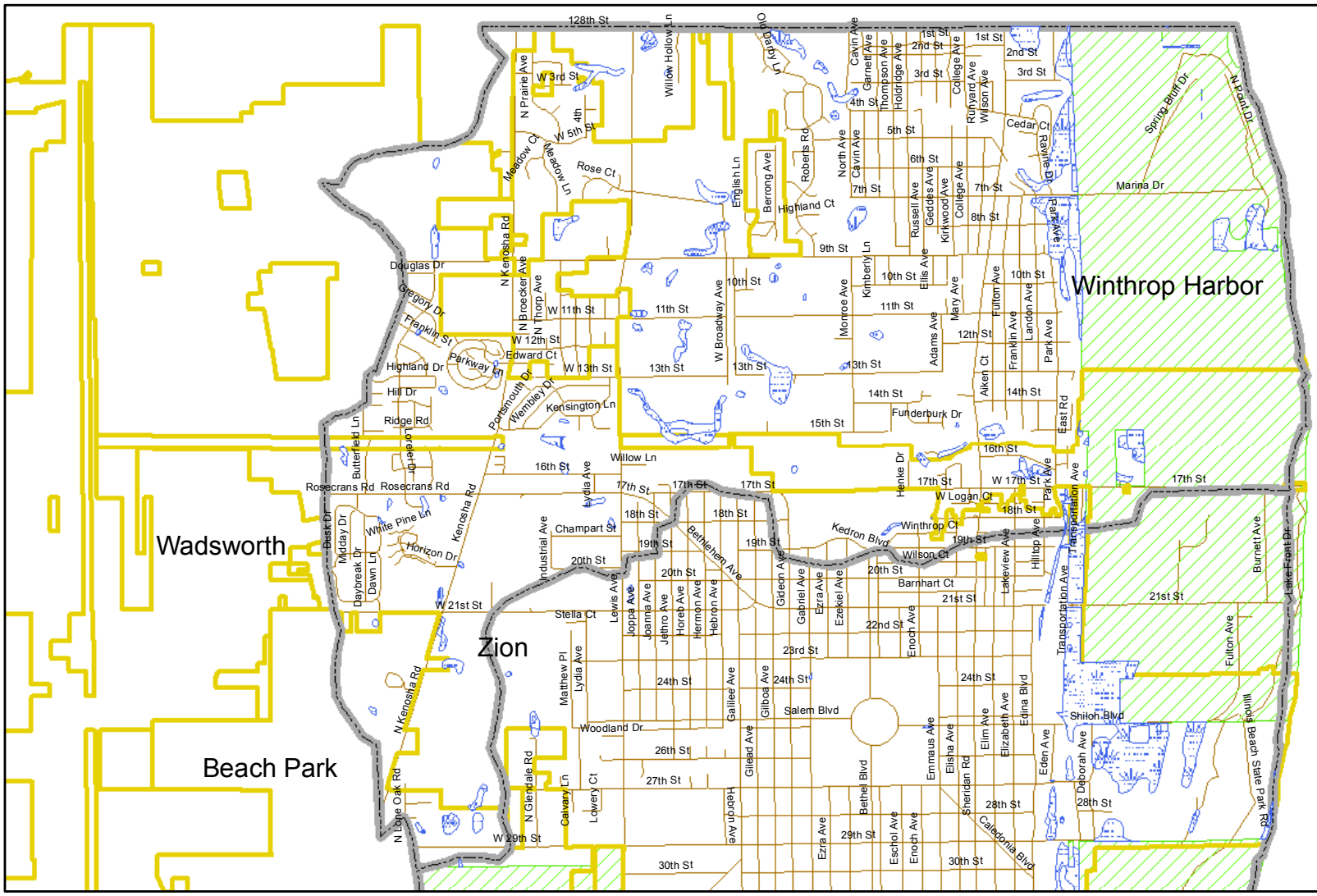
Sub-watershed Name	Habitat Score (0-100, 100=highest)
Dead River	95.95
Kellogg Creek	81.25
Bluff Ravine South	75.15
Chicago South	47.28
Bluff Ravine North	25.36
Waukegan River	23.25
Evanston-Chicago North	20.26
Pettibone Creek	15.44



The Kellogg Creek sub-watershed has the second highest habitat score at 81.25. Like its neighbor sub-watershed Dead River to the south, Kellogg Creek's score is largely attributable to presence of the northern portion of Illinois Beach State Park (refer to the map at the end of this chapter). Kellogg Creek contains the second largest percentage of protected habitat as well as the second greatest area of unprotected wetlands. Including the park, it contains a moderate amount of pervious surface coverage, and it is home to the third greatest number of threatened and endangered species. Kellogg Creek tends to rank around or well above average in terms of nearly every other indicator as well.

Indicator	Measure-ment	Rank*	Weighting Factor	Weighted Score	Percent of Weighted Total Score
Protected Area Coverage	18.50%	0.8298	6	4.9786	19.3%
Pervious Surface Coverage	51.65%	0.5589	3	1.6766	6.5%
# Sites Monitored	2	0.4701	1	0.4701	1.8%
Total Edge to Area Ratio (ft/acre)	115.2	0.5452	4	2.1806	8.4%
Avg Nearest Distance Between Habitats (meters)	2.67	0.5508	7	3.8553	14.9%
Total # Threatened and Endangered Species	30	0.5886	3	1.7659	6.8%
# Partner Projects	4	0.5303	2	1.0607	4.1%
Hydric Soils Coverage	13.89%	0.9324	1	0.9324	3.6%
Unprotected Wetlands (acres)	194	0.7201	7	5.0405	19.5%
Watershed Plan-in-Place (1=yes, 0=no)	1	0.8864	3	2.6593	10.3%
Average Nearest Distance Between Partner Sites (ft)	123653	0.3041	4	1.2165	4.7%

* Ranks range from 0.0 to 1.0, with 0.0 indicating the least amount of concern *for that indicator* and 1.0 representing the most concern.



This Subwatershed is ranked high or 3 out of 8 for habitat restoration. This is due to Illinois Beach State Park and a high percentage or protected area

Lake Michigan Watershed Ecosystem Partnership
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Legend

- Unprotected Wetland
- Watershed Boundaries
- Municipal Boundaries
- Protected Areas
- Roads

* The number of T&E species was a factor in watershed ranking

N
W E
S

1:42,313

0 0.1 0.2 0.4 0.6 0.8 Miles

Kellogg Creek Watershed

Habitat Prority Area

Ranked 3 of 8

Disclaimer: This map is for general information purposes only. A Registered Land Surveyor should be consulted to determine the precise location of features on the ground. This map does not constitute a regulatory determination and is not a base for engineering design. This map is intended to be viewed and printed in color.

Lake Michigan Ravines

A stretch of restored Hutchins Ravine, just north of Fort Sheridan

As the glacial ice which formed the Great Lakes made its retreat, it left behind a series of moraines – huge mounds of gravel, sand and clay – the youngest of which is known as the Lake Border Upland, a discontinuous bluff in northern Racine County and then stretching from Waukegan south to Winnetka. At some points standing as high as 140 feet above Lake Michigan, the Lake Border Upland is home to the ravines, a rare set of geologic and ecologic formations. Rainwater flowing across the Upland and down the bluffs into the lake over hundreds of years created the ravines – unique and beautiful ecological habitats capable of supporting species of plants found nowhere else in the region. With the development of cities along the coast, however, the very same forces which slowly sculpted the ravines over hundreds of years have drastically accelerated, increasing the rates of erosion far beyond what they ever approached historically and threatening these rare and fragile places.

This section of the report analyzes 47 ravines to determine which face the greatest threat of rapid, unstable erosion. The first part of this section takes a brief look at the geologic forces which created the ravines in order to next understand how urban development threatens their stability. The indicators used to assess the erosion threat facing the ravines are then introduced, followed by a brief summary of the results.

Background

The Lake Michigan ravines developed as a result of the unique geology of the Lake Border Upland along the coast of Lake Michigan. Driven by the relentless pull of gravity, rainwater falling on the Upland region inevitably flowed either west into the wetlands and marshes drained by the Skokie and Chicago Rivers or east, over the bluffs and directly into Lake Michigan. The ravines were gradually carved out over time as water eroded the land as it moved towards the lake. The same erosion processes which created the ravines continue today, but they have been drastically accelerated by the increased volume of water moving through the ravines as a consequence of urban development.

The bluffs through which ravines cut their path consist of various layers of clay and sand and gravel. Early on in the life of a ravine, water moving through it erodes sharply downward into the bed. As the depth of the bed becomes deeper, the steepness of the banks increases. Because water seeping through the ground into the ravine tends to travel along the intersections of these layers, they become prone to move across each other. At a certain point of instability, the layers suddenly slip over one another, causing the banks to collapse, or slump, into the ravine. Over time, water flowing down the banks from up above smoothes out the slumps, with the net result that the ravine becomes wider and the banks less steep than before.

As it continues to deepen and widen, the depth of the stream bed toward the mouth of the ravine begins to level off at the level of Lake Michigan. As the slope of the channel flattens out, the speed of water flowing through it begins to slow. Over time the rate of downward cutting and bank slumping declines, although even in mature ravines it never stops completely. The head of the ravine, meanwhile, continues to extend back into the land where conditions resemble the mouth of the ravine early on.

Early in evolution of ravines, this process of downward cutting and slumping makes it impossible for plants to establish themselves on the rapidly eroding banks. As the ravine widens and the slope of the banks declines, eventually they become stable enough to allow plants to establish themselves. Their roots help to further stabilize the banks by decreasing surface erosion from water flowing down into the ravine; by creating a dense matte of roots underground that stabilizes the soil and hold the banks together; and by absorbing water from the ground, thereby lessening the possibility of slumping. As the ravine further matures and widens, the rate of slumping will decline, making it increasingly possible for plants and trees to establish themselves and in turn help to further stabilize the banks. This positive feedback cycle eventually result in a mature ravine capable of supporting a variety of plants, shrubs, flowers and trees.

The ravines have a unique microclimate which is much cooler and moister than the surrounding area as a consequence of their shape and proximity to Lake Michigan. Those who live close to Lake Michigan are well familiar with the so-called “lake effect,” in which the water of the lake modulates the air temperature inland, such that areas close to the lake are cooler in spring and summer and warmer in the fall and winter. The same process is even more pronounced within the banks of the ravines, which trap moisture and cool air carried by spring

winds blowing off the lake. The result is a microclimate capable of supporting threatened and endangered species of northern plants and trees rarely found this far south. Standing among the sugar maples, basswoods, red oaks and white ash trees are northern relics such as paper birch, beech and white cedar. Nestled within the slopes of the ravines are rare species of plants and flowers such as the Canada buffalo berry, starflower, dwarf scouring rush (at one point two of the regions three records of this plant were found in ravines), various orchids, heart-leaved plantain and male fern[1]. Many of these species, already rare, have become more so or have disappeared entirely, with the mismanagement and degradation of the ravines under the pressures of urban development.

The colonization and subsequent development of the land surrounding the ravines has greatly accelerated the pace of the geologic forces which first created them. Putting aside certain cases of wanton abuse, the primary force responsible for the ravines's continued degradation is the increased volume of water flowing into and through them. The proliferation of impervious surfaces and turf grass along the upper perimeter of ravines where native trees and plants once grew has greatly increased the flow of rainwater runoff down the surface of their banks. The result is an increase in the rate of surface erosion across the banks and in the quantity and velocity of water flowing through the ravine.

Image 1: Stormwater outlet in McCormick-Janes Ravine. The concrete structure has failed due to the slumping of the banks, likely due to the large volumes of stormwater discharged during heavy storms.

The greater quantity of water in turn increases the level of downward stream cutting, making the lower banks adjacent to the stream much steeper and increasing the frequency of slumping. The slumping in particular has a devastating effect on the ability of plants and trees to grow on the banks. The ravines are dealt a second major blow by the numerous storm sewer outlets which drain stormwater from the surrounding streets into the ravines. These outlets, some of which are several feet in diameter, cause enormous destruction to the banks where they discharge and dramatically increase the quantity and velocity of water in the ravines.

In a sense, the ravines are becoming younger as the conditions within them approach what they were early on in their formation. Predictably, over time the slope of the stream bed will level off even further, the steepness of the banks will decline as the ravine further widens, and plants and trees will again be able to survive on the slopes rather than topple over in mudslides. Given enough time, the ravines might adapt to the increased volume of water, although some species of plants and flowers which disappeared in the process might never return. In the short term, however, the accelerated rate of erosion spells disaster for the trees and herbaceous growth which make the ravines of such ecological significance. It also should give landowners along the tops of the ravines reason for concern, some of whose houses are already too close to the ever-expanding edge.

[1] Greenberg, pg. 290. "Ravines Then and Now," Park District of Highland Park.

Ravines Indicators

The following chart presents the various criteria, or indicators, by which the erosion risk score for each ravine was determined. The Background section of this chapter served to introduce the various factors affecting ravine erosion which appear now as indicators. Next to each indicator are the units of measure, a brief explanation, a one-word description of how it impacts erosion potential (i.e. positively or negatively), and a one-digit weighting factor. Since not all criteria are expected to have the same impact on erosion, weighting factors are used to take into account the greater relevance or importance of certain indicators over others.

Indicator	**Unit of Measure**	**Explanation/Comments**	**Positive** impact/***low*** risk score or **Negative** impact/***high*** risk score	**Weighting Factor**
Residential and Stormwater Outlets	#	Total number of all known stormwater outlets draining into a given ravine	negative	8
Density of Stormwater and Residential Outlets, Dumps, Sewers, and Exposed Pipes	#/acre	Total number of all outlets, dumps and exposed pipes within a given ravine divided by ravine area	negative	7
Eroding Bank Length	ft	Total length of badly eroding banks (i.e. ranked 1 or 2 out of 5)	negative	7
Eroding Bed Length	ft	Total length of badly eroding ravine channel (i.e. ranked 1 or 2 out of 5)	negative	7
Failing Structures	#	Includes failing concrete or wooden bank retaining walls, gabions, or other concrete structures	negative	4
Eroding Gullies	#	Total number of badly eroding gullies (i.e. ranked 1 or 2 out of 5)	negative	4
Exposed Pipes	#	Total number of exposed storm or sanitary sewer pipes	negative	4
Average Channel Slope	slope %	A measure of the average steepness of the ravine channel (i.e. "rise/run")	negative	3
Average Bank Slope	slope %	A measure of the average steepness of the ravine banks perpendicular to the channel (created from 10ft DEM)	negative	3
Log Jams	#	Total number of log jams interrupting stream flow across the bed	negative	3
Knick Points	#	Total number of knick points or bed grade drops	negative	3
Average Nearest Distance of Buildings from Ravines (50ft limit)	ft	Average nearest distance of buildings to the top of the ravine banks within 50ft of the banks	positive	2
Average Nearest Distance of Buildings from Ravine (100ft limit)	ft	Average nearest distance of roads to the top of the ravine banks within 100ft of the banks	positive	2
Area of Homes Within 50ft of Ravine	acre	Total acreage of buildings within 50ft of the ravine	negative	2

Area of Roads Within 100ft of Ravine	acre	Total acreage of roads within 100ft of the ravine	negative	2

Qualitative Field Assessment Criteria

With three notable exceptions, gathering data for each of the indicators above was straightforward and quantitative. For example, data regarding the number of stormwater outlets draining into a given ravine was gathered by researchers simply walking through the ravine and counting each outlet (the locations of all of these outlets were also recorded using portable global positioning system devices and can be found on the maps included in this chapter). Data regarding the total acreage of homes within a certain distance of the ravines was gathered using satellite maps and analyzed by computer. Data regarding the length of eroding ravine banks, beds and gullies, however, required that a qualitative assessment be made on site within the ravine. Uniform stretches of ravine banks and stream beds were ranked on a five-point scale along the entire length of the ravine. Gullies were similarly ranked on a five-point scale and their locations were recorded using GPS coordinates. Descriptions of the scales for these indicators are given below.

Bed Rank

1 Very Unstable

Stretches of the ravine stream bed with a rank of 1 represent the most severely eroding state. The stream bed in these cases is extremely unstable and shows signs of active vertical erosion (down-cutting), including exposure of bare clay. Often the stream is also actively eroding the area beneath the edge of the lower bank or around man-made structures (e.g. concrete retaining walls or gabions), at which point they are considered to be failing. In places the bed may have eroded far down enough to expose underlying storm or sanitary sewer pipes. Stream bed reaches with a rank of 1 are in immediate need of remediation.

Image 2: Severely eroding stretch of bed in Ravine 10L with a log jam in the lower foreground. Notice the severe undercutting of the bank at the lower right of the image as well as the exposed clay beneath it (zoom in using your PDF reader to see the exposed clay – the resolution of the picture is high).

2 Unstable

Reaches with a rank of 2 show signs of active vertical erosion and scour but less severely than those of rank 1. Exposed clay is evident, as is bank under-cutting. Exposed infrastructure or failing structures may also be present. These stretches are distinguished from those of rank 1 by the severity of the erosion rather than qualitative differences. Stream bed reaches of rank 2 are also in immediate need of treatment.

3 Somewhat Unstable-Somewhat Stable

Reaches of rank 3 represent somewhat unstable beds and show some evidence of down-cutting and scour. Minor bank under-cutting will be evident and failing structures may be observed up or downstream of these reaches. The stream beds are typically un-armored and are moderate in terms of stability.

4 Stable

Reaches of rank 4 are considered stable and show only minor evidence of scour and down-cutting. Bank under-cutting will be very minor and these reaches may be armored with natural or man-made structures in place.

5 Very Stable

Reaches of rank 5 are very stable, with armoring in place. These show no evidence of active bed or bank erosion.

Bank Rank

1 Very Unstable

Stretches of ravine banks with a rank of 1 represent the most severely eroding state. A rank of 1 was reserved for the largest and most severe slumps or landslides, some of which are dozens of feet tall and included a major vertical portion of the bank. These sections are often very steep and the slumps have large areas of exposed soil with no stable plant growth and show evidence of recent movement. The slumping portion of the bank will have clearly and sharply sheered away from the rest of the bank, creating a well-defined scarp. Large trees in the slump will have toppled over while those above or straddling the scarp will have exposed roots. Any man-made structures present are considered to have failed.

Image 3: Ravine 10L in northern Highland Park. The bed, dry when this image was taken, runs along the bottom right side of the image. A stormwater outlet immediately upstream is the likely cause of this slump.

2 Unstable

Ravine banks with a rank of 2 are unstable and will have many of the same characteristics as those of rank 1, but to a lesser degree. These stretches have slumped significantly and recently with much of the soil exposed and no stable plant growth. The scarp is still well-defined but typically not as tall. Large trees will also have toppled over and their roots will also be exposed. Man-made structures are considered to have failed.

3 Somewhat Unstable-Somewhat Stable

Ravine banks are given a rank of 3 are assigned to banks that are only marginally stable or somewhat unstable. In some cases the lower portion of the bank is unstable though the upper portion may be steep but shows no signs of instability. Typically this is the case when vertical erosion by the stream has greatly increased the steepness of the lower bank and the middle of the bank is also relatively steep but well vegetated, thus increasing the potential for a major slump. In other cases a slump may be moving very slowly as indicated by the presence of a minor scarp or young trees with bent trunks, especially towards the bottom. Banks which show signs of serious surface erosion, such as very little herbaceous growth or trees whose upper roots are somewhat exposed are also considered to be a 3. Man-made structures may or may not be considered failing.

Image 4: An example of surface erosion of a stretch of bank in Hutchins Ravine. Notice the nearly complete lack of vegetation, in contrast to the area on either side.

Image 5: A bent tree with exposed upper roots in Ravine 10L, indicative of slumping and surface erosion. There is also a distinct lack of ground level vegetation, and although difficult to discern in this image, a scarp runs across the upper portion of the bank.

4 Stable

Ravines banks with a rank of 4 are considered stable. The banks will not have any visible signs of active slumping and will be well vegetated with stable, erect trees. The banks are moderately or minimally steep and will gradually level off towards the bottom where they meet the stream bed. Bank under-cutting may be present but will be minimal. Man-made structures such as concrete retaining walls or gabions may be present and in good condition.

5 Very Stable

Ravines banks with a rank of 5 are the most stable. The banks are well-vegetated, trees are upright and there are no signs of slumping or erosion. The banks are moderately steep midway down the slope and gradually become flat towards the bottom where they meet the stream bed. The lower banks of the stream bed are well-armored and there is no evidence of bank under-cutting.

Image 6: The banks and bed of this stretch of Hutchins Ravine, which borders the northern edge of Fort Sheridan, are very stable.

Gullies

1 Very Severe

Gullies of rank 1 are the most severe. They are very deep and wide and show signs of active, severe vertical or lateral erosion. The banks of the gullies will be very steep due to the high rate of erosion. These gullies are a significant threat to the overall stability of the bank which they cut across.

2 Severe

Gullies of rank 2 show signs of active, severe erosion but to a lesser degree than rank 1 gullies. The banks of the gullies are also very steep. Like gullies of rank 1, there is no vegetation along the banks. Exposed roots from nearby trees may be visible. These gullies are also a significant threat to the overall stability of the bank.

3 Moderate

Gullies of rank 3 still show signs of active vertical and lateral erosion, but they do not have rates of erosion of the same order as those of rank 2 or 1. They are shallower and the slopes of the banks are not nearly as steep. Typically the banks are still devoid of vegetation, although exposed tree roots are generally absent. Generally these gullies do not threaten the overall stability of the bank.

4 Stable

While gullies of rank 4 are still eroding vertically and laterally over time, the rate of erosion is slow and the gullies are stable. The bottom of the gullies may be armored with rocks or gravel or man-made concrete channels. Lateral erosion along the banks is minimal, and vegetation is typically present. These gullies tend to have flatter slopes and are evolving into side branches of the ravines.

5 Very Stable

Gullies of rank 5 are well-armored, have stable and well-vegetated banks and show minimal signs of erosion. They tend to be the flattest of all gullies and are well on their way to becoming side branches. They are distinguished from fully established ravine branches primarily by the steeper slope of their channels and their much shorter length.

Data Gaps

One of the primary data gaps for the ravines is a lack of hydrologic data during various weather conditions (e.g. dry weather, a 25-year storm, etc.). The number of municipal and residential stormwater outlets is used as a proxy in lieu of these data to estimate the relative impact of stormwater on ravine erosion. This metric, however, fails to distinguish between stormwater and residential outlets; instead, each type is given the same weight. Thus, a 6-inch plastic, residential "elephant hose" from a gutter downspout is assumed to carry as much stormwater as a 4 foot-diameter municipal stormwater outlet. A better approach would be to distinguish between municipal and residential outlets and then measure the volume of water

discharged by a representative sample of each type, as well as the total volume of water moving through a ravine during various conditions.

A lack of direct data on surface runoff into the ravines from the surrounding land constitutes a second data gap. This study uses building and urban infrastructure surrounding the ravines as an indirect measure of the quantity of surface runoff. A better approach would be to model surface runoff based on the topography of the land adjacent to the ravines or to directly measure the volume and velocity of runoff during various weather conditions.

Finally, this study does not contain data on the diversity or land coverage of flora on the slopes and banks of ravines. These data provide a useful measure of the health of a ravine, and their incorporation into future studies would strengthen the veracity and utility of the analysis.

Results Summary

The overall ravine erosion risk scores are given in the table to the right. The range of possible scores is zero to 100, from least to greatest erosion threat. The overall scores were calculated by evaluating the sum of the weighted indicators scores with the cumulative probability distribution function using the average and standard deviation of the total weighted indicator ranks for all 47 ravines (refer to the Scoring and Methodology section of this report for a detailed explanation of how overall risk scores are calculated). The purpose of this statistical analysis is simply to convert the arbitrarily scaled total weighted indicators to more intuitive, meaningful scores from 0 to 100.

Figure 1 below illustrates the distribution of the *total weighted indicators scores* (yellow bars) for the 47 ravines and the cumulative probability curve (red) used to determine the overall erosion risk scores. The distribution of scores generally approximates a normal distribution, what most people know as a bell-curve, such that most scores tend to cluster around the average (28.48) and fewer are distributed far from the average in either direction. The red curve in the graph represents the overall erosion risk score for the corresponding total weighted indicators score. Notice that the *average* total weighted indicator score corresponds to an overall score of *exactly* 50 out of 100.

In general, the ravines with the highest overall erosion risk scores also tend to rank among the top for several highly weighted indicators, such as the number of stormwater and residential outlets which drain into the ravine or the total length of severely eroding bank or bed (see indicator ranks/scores on the Ravine Indicators Data Table). Similarly, ravines with moderate overall scores tend to either rank in the middle or bottom for highly weighted indicators but toward the top for lowly weighted indicators. Ravines with low overall scores tend to rank toward the bottom for nearly every indicator, although some occasionally rank toward the middle for lowly weighted indicators. Thus, the

Ravine Name	Erosion Risk Score (0-100, 100=highest)	Rank (of 47)
Bartlett Ravine	21.35	36
Carmel Park Ravine	9.65	45
Cemetery Ravine	35.22	26
Clark's Ravine	84.58	7
Crabtree Ravine	22.65	33
Gangstar Ravine	7.61	47
Glen Flora Tributary	9.52	46
Hutchins Ravine	12.55	44
Lillian Dells Ravine	30.18	28
Mayflower Ravine	65.83	16
McCormick/Janes Ravine	82.77	9
No Name1	20.60	37
No Name2	21.40	35
No Name3	47.88	22
No Name4	26.62	30
No Name5	25.94	31
No Name6	21.65	34
No Name7	18.70	40
No Name8	15.28	43
No Name10	27.59	29
No Name11	22.92	32
Pettibone Creek/Shore Acres Ravine	71.88	13
Ravine 1C	39.07	25
Ravine 1L	92.66	5
Ravine 2C	77.30	11
Ravine 2L	48.80	21
Ravine 3C	16.76	41
Ravine 3L	98.80	3
Ravine 4C	84.16	8
Ravine 4L	71.47	14
Ravine 5C	78.57	10
Ravine 5L	49.89	20
Ravine 6C	42.94	24
Ravine 6L	43.28	23
Ravine 7C	63.79	17
Ravine 7L	98.92	2
Ravine 8L	58.65	19
Ravine 9L	69.74	15
Ravine 9L2	20.21	38
Ravine 10L	99.33	1
Ravine Park Ravine	61.26	18
Schenck Ravine	34.54	27
South Ravine	85.95	6
Stanley Ravine	19.32	39
Van Horne Ravine	16.05	42
Walden Ravine	73.55	12
Witchhazel/Seminary Ravine	95.54	4

weighting factors applied to the indicators play a very important role in determining which ravines have the highest overall erosion risk scores. Refer to the Ravines Indicators Data Table for the indicator ranks for each ravine.

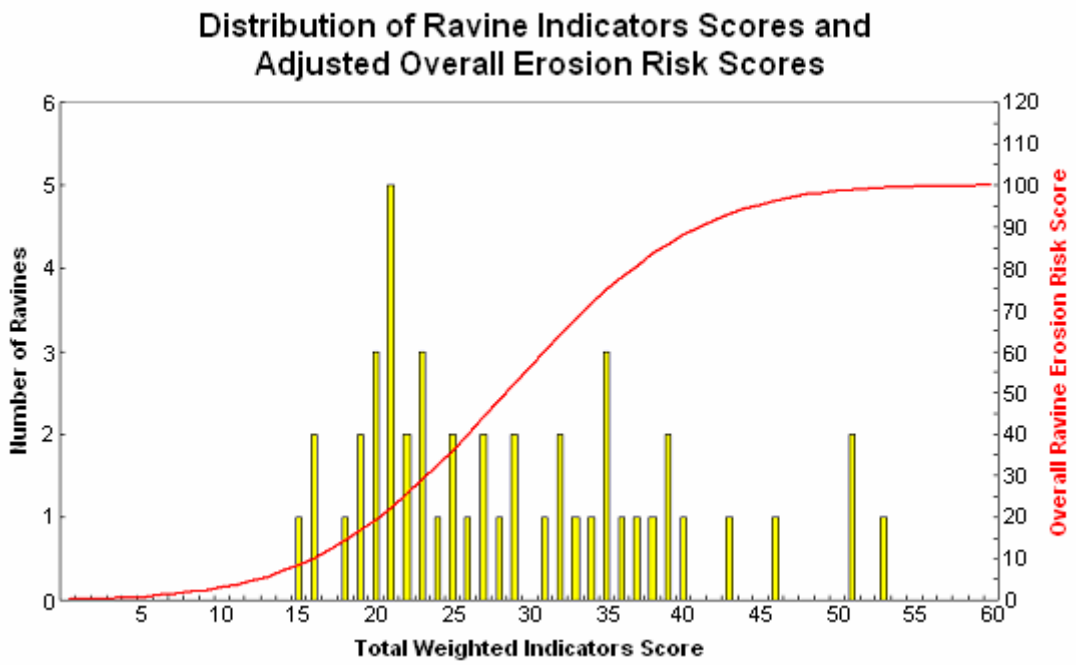


Figure 1: A histogram of ravine total weighted indicators scores plotted against the normal distribution cumulative probability function (red). The distribution of indicators scores can be approximated by a normal distribution (not shown), and the cumulative probability function is used to calculate overall ravine erosion risk scores from the indicators scores.

Ravine Recommendations

1. Develop mailing list of landowners and units of government adjacent to high priority ravines and distribute ravine stability maps. The highest ranked ravines for erosion potential are:
    a. **Ravine 10L**
    b. **Ravine 7L**
    c. **Ravine 3L**
    d. **Witchhazel / Seminary Ravine**

2. Consider ravine stabilization in 3 smaller ravines that have the highest percentage of unstable bed and bank length but did not rank high in the overall priorities for erosion potential. These sites offer an opportunity to conduct a complete restoration as opposed to larger ravines where a complete restoration might be cost-prohibitive.
    a. **Ravine 4L**; 38% severely eroding channel and 46% severely eroding banks
    b. **Ravine 7C**; 38% severely eroding channel and 34% severely eroding banks
    c. **Clark's Ravine**; 13% severely eroding channel and 34% severely eroding banks

3. Target timber thinning and invasive removal in the following ravines (in order of importance). These are the most stable ravines and drain to Illinois Beach State Park.
    a. **Carmel Park Ravine** (in high priority subwatershed for habitat restoration)
        - 11ac required
    b. **Glen Flora Ravine** (in high priority subwatershed for habitat restoration)
        - 18ac required
    c. **Gangster Ravine** (in high priority subwatershed for habitat restoration)
        - 10ac required
    d. **Dead Dog Creek** (in high priority subwatershed for habitat restoration)
        - 20ac required
    e. **Bull Creek** (in high priority subwatershed for habitat restoration)
        - Over 50ac required
    f. **Waukegan River**

4. Coordinate with and engage US Navy on Pettibone Creek to conduct ravine restoration.

5. Coordinate grant applications with implementation efforts in Waukegan River and other watershed with approved watershed plans.

6. Prioritize partner project sites and select one to pursue for funding.

	Bartlett Ravine	Carmel Park Ravine	Cemetery Ravine	Clark's Ravine	Crabtree Ravine	Gangster Ravine	Glen Flora Tributary	Hutchins Ravine
Acres	15.60	12.22	7.62	12.36	1.83	14.07	20.62	14.64
Sq. Ft.	679727.98	532321.36	331927.20	538249.55	79749.26	613070.80	898319.45	637515.11
Density of Outlets, Exposed Pipes, Dumps (#/acre)	0.513	0.327	2.100	4.208	1.092	0.213	0.388	0.205
Rank (0.0 – 1.0)	0.1478	0.1267	0.4122	0.8087	0.2282	0.1148	0.1334	0.1140
Number of Stormwater outlets	8	4	16	51	2	3	6	3
Rank	0.3081	0.2741	0.3811	0.7144	0.2578	0.2659	0.2909	0.2659
Number Failing Structures	1	1	3	4	0	0	1	0
Rank	0.3145	0.3145	0.4317	0.4934	0.2616	0.2616	0.3145	0.2616
Number Log Jams	1	1	0	13	6	4	3	7
Rank	0.2260	0.2260	0.1871	0.8121	0.4722	0.3659	0.3159	0.5266
Number Knick Points	0	0	0	0	0	0	0	0
Rank	0.2604	0.2604	0.2604	0.2604	0.2604	0.2604	0.2604	0.2604
Number Exposed pipes	0	0	0	1	0	0	1	0
Rank	0.3529	0.3529	0.3529	0.4025	0.3529	0.3529	0.4025	0.3529
Number Eroding Gullies (Ranked 1 or 2)	3	0	3	4	1	1	0	0
Rank	0.5208	0.2216	0.5208	0.6275	0.3108	0.3108	0.2216	0.2216
Length Eroding Bank (Ranked 1 or 2)	109.86	0.00	530.15	2726.39	167.74	63.01	338.23	97.50
Rank	0.2606	0.2393	0.3503	0.8310	0.2722	0.2514	0.3079	0.2581
Length Eroding Channel (Ranked 1 or 2)	163.41	146.07	532.56	1038.89	0.00	0.00	39.39	91.35
Rank	0.3051	0.2991	0.4444	0.6435	0.2503	0.2503	0.2631	0.2803
Channel Slope (percent)	0.0210	0.0090	0.0270	0.0250	0.0820	0.0078	0.0074	0.0140
Rank	0.2302	0.1241	0.2981	0.2745	0.9162	0.1158	0.1131	0.1633
Average Bank Slope (percent)	38.00	12.19	48.22	50.33	45.79	23.58	22.63	40.40
Rank	0.3424	0.0000	0.8491	0.9080	0.7551	0.0074	0.0051	0.4728
Average Dist Buildings (within 50ft top of ravine; ft)	153	313.8	273.5	124.1	128.7	257.2	292.8	379
Rank	0.4891	0.1137	0.1811	0.5732	0.5600	0.2143	0.1462	0.0460
Average Dist Roads (within 100ft top of ravine; ft)	77	137.1	106.1	187.8	255	571.5	286.1	174
Rank	0.8071	0.6881	0.7533	0.5685	0.4018	0.0128	0.3286	0.6022
Total Area Buildings (within 50ft of ravine; acres)	1.77	0.13	0.14	1.22	0.16	0.63	1.09	0.48
Rank	0.5032	0.2410	0.2416	0.4089	0.2444	0.3137	0.3859	0.2905
Total Area Roads (within 100ft of ravine; acres)	3.75	2.64	1.29	1.04	0.06	1.47	1.09	1.65
Rank	0.8511	0.6963	0.4510	0.4036	0.2391	0.4851	0.4124	0.5183
Sum of ***Weighted*** Indicator Scores	20.6913	15.7146	24.7580	38.4641	21.1209	14.4443	15.6414	17.2221
Ravine Erosion Risk Score (0-100)	**21.35**	**9.65**	**35.22**	**84.58**	**22.65**	**7.61**	**9.52**	**12.55**
Overall Rank (Out of 47, 1=Highest)	**36**	**45**	**26**	**7**	**33**	**47**	**46**	**44**

	Lillian Dells Ravine	Mayflower Ravine	McCormick /Janes Ravine	No Name1	No Name2	No Name3	No Name4	No Name5
Acres	6.11	15.74	38.01	0.98	1.74	5.14	2.35	1.77
Sq. Ft.	266071.59	685841.71	1655787.52	42617.45	75581.02	223746.63	102349.21	76886.92
Density of Outlets, Exposed Pipes, Dumps (#/acre)	1.637	1.080	0.500	2.044	1.729	3.894	1.702	2.266
Rank	0.3220	0.2262	0.1463	0.4011	0.3393	0.7611	0.3343	0.4462
Number of Stormwater outlets	10	17	18	2	3	19	3	4
Rank	0.3258	0.3906	0.4001	0.2578	0.2659	0.4098	0.2659	0.2741
Number Failing Structures	1	5	10	0	0	4	1	1
Rank	0.3145	0.5553	0.8203	0.2616	0.2616	0.4934	0.3145	0.3145
Number Log Jams	5	9	34	2	1	12	2	0
Rank	0.4183	0.6330	0.9999	0.2691	0.2260	0.7731	0.2691	0.1871
Number Knick Points	0	1	3	0	0	0	0	0
Rank	0.2604	0.6298	0.9886	0.2604	0.2604	0.2604	0.2604	0.2604
Number Exposed pipes	0	0	1	0	0	1	1	0
Rank	0.3529	0.3529	0.4025	0.3529	0.3529	0.4025	0.4025	0.3529
Number Eroding Gullies (Ranked 1 or 2)	1	6	16	0	0	0	1	0
Rank	0.3108	0.8082	0.9998	0.2216	0.2216	0.2216	0.3108	0.2216
Length Eroding Bank (Ranked 1 or 2)	371.92	3331.39	7665.48	0.00	38.66	772.18	62.99	296.23
Rank	0.3151	0.9079	1.0000	0.2393	0.2467	0.4065	0.2514	0.2989
Length Eroding Channel (Ranked 1 or 2)	103.81	935.25	3512.61	477.34	27.06	156.59	623.63	77.56
Rank	0.2845	0.6041	0.9978	0.4227	0.2590	0.3028	0.4807	0.2757
Channel Slope (percent)	0.0450	0.0320	0.0250	0.0250	0.1090	0.0380	0.0630	0.1050
Rank	0.5379	0.3609	0.2745	0.2745	0.9897	0.4412	0.7642	0.9853
Average Bank Slope (percent)	46.20	42.77	47.35	37.01	43.00	43.33	48.78	38.92
Rank	0.7728	0.6048	0.8185	0.2928	0.6168	0.6347	0.8665	0.3909
Average Dist Buildings (within 50ft top of ravine; ft)	52.1	101.4	674.4	41.3	100.6	115.1	120.3	136.6
Rank	0.7620	0.6373	0.0001	0.7858	0.6395	0.5990	0.5842	0.5370
Average Dist Roads (within 100ft top of ravine; ft)	137.3	296	714	85	261.5	172	909.3	82
Rank	0.6877	0.3065	0.0009	0.7931	0.3861	0.6071	0.0000	0.7984
Total Area Buildings (within 50ft of ravine; acres)	1.12	1.75	1.19	0.36	0.25	0.46	0.35	0.22
Rank	0.3911	0.4997	0.4035	0.2735	0.2578	0.2870	0.2712	0.2535
Total Area Roads (within 100ft of ravine; acres)	0.92	0.87	0.41	0.42	0.05	0.45	0.00	0.47
Rank	0.3827	0.3722	0.2944	0.2958	0.2375	0.3012	0.2307	0.3038
Sum of ***Weighted*** Indicator Scores	23.3870	32.4740	37.7422	20.4352	20.7076	27.9569	22.3557	22.1512
Ravine Erosion Risk Score (0-100)	**30.18**	**65.83**	**82.77**	**20.60**	**21.40**	**47.88**	**26.62**	**25.94**
Overall Rank (Out of 47, 1=Highest)	**28**	**16**	**9**	**37**	**35**	**22**	**30**	**31**

	No Name6	No Name7	No Name8	No Name10	No Name11	Pettibone Creek/Shore Acres Ravine	Ravine 1C	Ravine 1L
Acres	1.60	2.65	1.47	2.08	0.89	68.09	16.12	31.00
Sq. Ft.	69626.59	115458.89	63965.15	90764.12	38913.32	2966128.67	702103.89	1350301.54
Density of Outlets, Exposed Pipes, Dumps (#/acre)	1.877	1.132	1.362	2.400	2.239	0.470	2.047	4.258
Rank	0.3679	0.2344	0.2726	0.4737	0.4405	0.1427	0.4017	0.8157
Number of Stormwater outlets	3	3	2	5	2	29	24	116
Rank	0.2659	0.2659	0.2578	0.2824	0.2578	0.5080	0.4586	0.9854
Number Failing Structures	0	0	0	3	0	10	5	9
Rank	0.2616	0.2616	0.2616	0.4317	0.2616	0.8203	0.5553	0.7767
Number Log Jams	0	2	0	0	1	12	1	6
Rank	0.1871	0.2691	0.1871	0.1871	0.2260	0.7731	0.2260	0.4722
Number Knick Points	0	0	0	1	0	0	0	3
Rank	0.2604	0.2604	0.2604	0.6298	0.2604	0.2604	0.2604	0.9886
Number Exposed pipes	0	0	0	0	0	0	4	8
Rank	0.3529	0.3529	0.3529	0.3529	0.3529	0.3529	0.5574	0.7473
Number Eroding Gullies (Ranked 1 or 2)	0	1	0	0	0	4	1	3
Rank	0.2216	0.3108	0.2216	0.2216	0.2216	0.6275	0.3108	0.5208
Length Eroding Bank (Ranked 1 or 2)	0.00	289.39	0.00	42.89	107.15	3060.92	76.81	1290.77
Rank	0.2393	0.2974	0.2393	0.2475	0.2601	0.8775	0.2541	0.5321
Length Eroding Channel (Ranked 1 or 2)	0.00	34.90	0.00	0.00	50.13	3158.47	523.66	1272.74
Rank	0.2503	0.2616	0.2503	0.2503	0.2666	0.9936	0.4409	0.7265
Channel Slope (percent)	0.0760	0.0550	0.0490	0.0500	0.0960	0.0110	0.0280	0.0200
Rank	0.8793	0.6709	0.5925	0.6059	0.9690	0.1389	0.3103	0.2198
Average Bank Slope (percent)	43.82	44.47	34.25	47.77	43.27	32.91	33.52	42.03
Rank	0.6602	0.6928	0.1750	0.8337	0.6314	0.1308	0.1501	0.5640
Average Dist Buildings (within 50ft top of ravine; ft)	164.9	560.8	60.3	128.6	79.3	347.8	54.5	110
Rank	0.4544	0.0013	0.7430	0.5603	0.6961	0.0726	0.7565	0.6134
Average Dist Roads (within 100ft top of ravine; ft)	126.2	90.4	125	309	355.1	141	117	219.5
Rank	0.7119	0.7833	0.7144	0.2785	0.1904	0.6794	0.7312	0.4896
Total Area Buildings (within 50ft of ravine; acres)	0.03	0.00	0.36	0.36	0.33	2.90	3.15	6.26
Rank	0.2280	0.2236	0.2721	0.2726	0.2679	0.6892	0.7270	0.9743
Total Area Roads (within 100ft of ravine; acres)	0.35	0.70	0.41	0.34	0.00	11.33	2.80	2.16
Rank	0.2842	0.3422	0.2943	0.2830	0.2307	1.0000	0.7235	0.6137
Sum of ***Weighted*** Indicator Scores	20.7918	19.7627	18.4358	22.6431	21.2080	34.1568	25.7560	42.6971
Ravine Erosion Risk Score (0-100)	**21.65**	**18.70**	**15.28**	**27.59**	**22.92**	**71.88**	**39.07**	**92.66**
Overall Rank (Out of 47, 1=Highest)	**34**	**40**	**43**	**29**	**32**	**13**	**25**	**5**

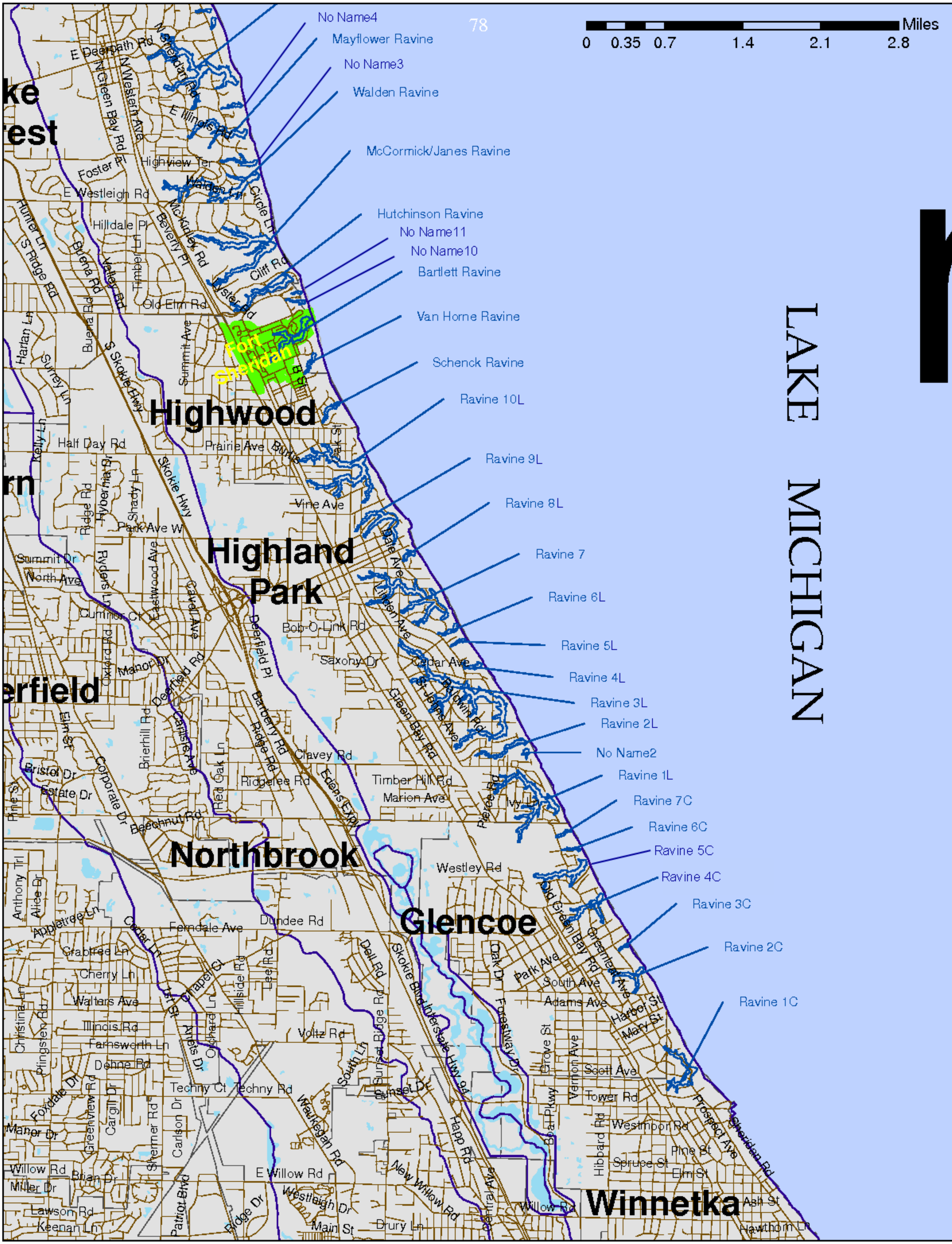
	Ravine 2C	Ravine 2L	Ravine 3C	Ravine 3L	Ravine 4C	Ravine 4L	Ravine 5C	Ravine 5L
Acres	8.99	7.78	0.99	64.21	13.04	3.23	15.48	1.59
Sq. Ft.	391680.26	338762.69	43081.82	2796996.87	568198.48	140897.93	674359.28	69448.38
Density of Outlets, Exposed Pipes, Dumps (#/acre)	5.783	3.986	0.000	3.473	3.680	5.565	3.940	8.781
Rank	0.9546	0.7757	0.0947	0.6884	0.7253	0.9427	0.7685	0.9994
Number of Stormwater outlets	49	29	0	185	48	18	57	14
Rank	0.6972	0.5080	0.2420	1.0000	0.6885	0.4001	0.7627	0.3623
Number Failing Structures	5	3	0	38	12	1	7	1
Rank	0.5553	0.4317	0.2616	1.0000	0.8902	0.3145	0.6736	0.3145
Number Log Jams	5	2	0	10	5	9	2	2
Rank	0.4183	0.2691	0.1871	0.6830	0.4183	0.6330	0.2691	0.2691
Number Knick Points	2	0	0	4	2	2	1	1
Rank	0.9040	0.2604	0.2604	0.9994	0.9040	0.9040	0.6298	0.6298
Number Exposed pipes	3	2	0	35	0	0	0	0
Rank	0.5055	0.4536	0.3529	1.0000	0.3529	0.3529	0.3529	0.3529
Number Eroding Gullies (Ranked 1 or 2)	2	3	0	8	6	2	6	0
Rank	0.4127	0.5208	0.2216	0.9218	0.8082	0.4127	0.8082	0.2216
Length Eroding Bank (Ranked 1 or 2)	811.01	553.50	0.00	2894.00	1111.05	1197.44	1033.40	157.36
Rank	0.4157	0.3556	0.2393	0.8556	0.4883	0.5093	0.4693	0.2701
Length Eroding Channel (Ranked 1 or 2)	436.12	93.75	0.00	3833.76	970.40	1005.13	1052.71	144.03
Rank	0.4066	0.2811	0.2503	0.9992	0.6176	0.6308	0.6486	0.2984
Channel Slope (percent)	0.0430	0.0220	0.1070	0.0180	0.0420	0.0530	0.0210	0.0850
Rank	0.5103	0.2409	0.9877	0.1998	0.4964	0.6454	0.2302	0.9311
Average Bank Slope (percent)	42.95	42.17	43.60	36.58	40.96	46.08	41.23	42.04
Rank	0.6145	0.5719	0.6489	0.2722	0.5042	0.7675	0.5191	0.5644
Average Dist Buildings (within 50ft top of ravine; ft)	61.8	61.8	41	55.7	44.5	77.3	60.6	90.2
Rank	0.7395	0.7395	0.7865	0.7538	0.7789	0.7012	0.7423	0.6676
Average Dist Roads (within 100ft top of ravine; ft)	167.4	147	277	168	199.3	337	257	133.2
Rank	0.6181	0.6658	0.3495	0.6167	0.5400	0.2227	0.3969	0.6967
Total Area Buildings (within 50ft of ravine; acres)	1.78	2.00	0.65	11.56	3.15	0.80	4.12	0.43
Rank	0.5042	0.5419	0.3167	1.0000	0.7262	0.3401	0.8471	0.2830
Total Area Roads (within 100ft of ravine; acres)	1.14	0.70	0.13	5.01	0.74	0.32	0.66	0.27
Rank	0.4221	0.3430	0.2504	0.9497	0.3493	0.2791	0.3363	0.2717
Sum of ***Weighted*** Indicator Scores	35.8187	28.1829	19.0298	50.5927	38.2890	34.0369	36.2360	28.4513
Ravine Erosion Risk Score (0-100)	**77.30**	**48.80**	**16.76**	**98.80**	**84.16**	**71.47**	**78.57**	**49.89**
Overall Rank (Out of 47, 1=Highest)	**11**	**21**	**41**	**3**	**8**	**14**	**10**	**20**

	Ravine 6C	Ravine 6L	Ravine 7C	Ravine 7L	Ravine 8L	Ravine 9L	Ravine 9L2	Ravine 10L
Acres	1.58	3.22	1.92	39.03	2.93	12.62	5.96	39.90
Sq. Ft.	68893.22	140224.94	83631.09	1700265.12	127455.88	549568.09	259757.11	1737918.45
Density of Outlets, Exposed Pipes, Dumps (#/acre)	5.691	2.485	5.729	4.150	4.785	4.835	0.671	3.534
Rank	0.9498	0.4914	0.9518	0.8004	0.8795	0.8846	0.1676	0.6995
Number of Stormwater outlets	7	8	3	145	6	56	3	107
Rank	0.2994	0.3081	0.2659	0.9981	0.2909	0.7550	0.2659	0.9748
Number Failing Structures	1	0	3	13	2	4	3	15
Rank	0.3145	0.2616	0.4317	0.9167	0.3716	0.4934	0.4317	0.9549
Number Log Jams	4	5	7	29	7	8	1	19
Rank	0.3659	0.4183	0.5266	0.9989	0.5266	0.5805	0.2260	0.9559
Number Knick Points	0	2	1	2	1	0	0	2
Rank	0.2604	0.9040	0.6298	0.9040	0.6298	0.2604	0.2604	0.9040
Number Exposed pipes	0	0	0	16	8	3	1	34
Rank	0.3529	0.3529	0.3529	0.9563	0.7473	0.5055	0.4025	1.0000
Number Eroding Gullies (Ranked 1 or 2)	3	0	5	7	0	2	0	12
Rank	0.5208	0.2216	0.7252	0.8737	0.2216	0.4127	0.2216	0.9939
Length Eroding Bank (Ranked 1 or 2)	202.27	809.94	553.48	2731.55	655.82	1163.26	51.47	3586.43
Rank	0.2793	0.4155	0.3556	0.8318	0.3791	0.5010	0.2491	0.9311
Length Eroding Channel (Ranked 1 or 2)	279.90	436.86	624.76	1360.13	288.09	244.74	72.58	3949.17
Rank	0.3472	0.4069	0.4811	0.7548	0.3502	0.3343	0.2740	0.9995
Channel Slope (percent)	0.0600	0.0590	0.0700	0.0310	0.0870	0.0290	0.0610	0.0250
Rank	0.7310	0.7194	0.8322	0.3479	0.9398	0.3226	0.7423	0.2745
Average Bank Slope (percent)	35.20	44.06	45.38	42.47	47.26	40.77	38.46	44.91
Rank	0.2117	0.6722	0.7364	0.5883	0.8151	0.4935	0.3662	0.7144
Average Dist Buildings (within 50ft top of ravine; ft)	60.4	102.5	217.7	58.7	64	63	113.1	73.7
Rank	0.7428	0.6342	0.3078	0.7468	0.7342	0.7366	0.6046	0.7103
Average Dist Roads (within 100ft top of ravine; ft)	179.3	165	137	116.3	372.2	183.4	83.6	183
Rank	0.5894	0.6238	0.6883	0.7327	0.1626	0.5793	0.7956	0.5803
Total Area Buildings (within 50ft of ravine; acres)	0.49	0.45	0.00	7.92	0.69	2.96	0.70	5.80
Rank	0.2914	0.2857	0.2238	0.9962	0.3223	0.6992	0.3243	0.9601
Total Area Roads (within 100ft of ravine; acres)	0.44	0.40	0.55	4.56	0.12	1.07	1.24	3.55
Rank	0.2982	0.2922	0.3170	0.9230	0.2485	0.4086	0.4406	0.8279
Sum of ***Weighted*** Indicator Scores	26.7334	26.8193	31.9352	50.9954	30.6205	33.5445	20.3008	52.7076
Ravine Erosion Risk Score (0-100)	**42.94**	**43.28**	**63.79**	**98.92**	**58.65**	**69.74**	**20.21**	**99.33**
Overall Rank (Out of 47, 1=Highest)	**24**	**23**	**17**	**2**	**19**	**15**	**38**	**1**

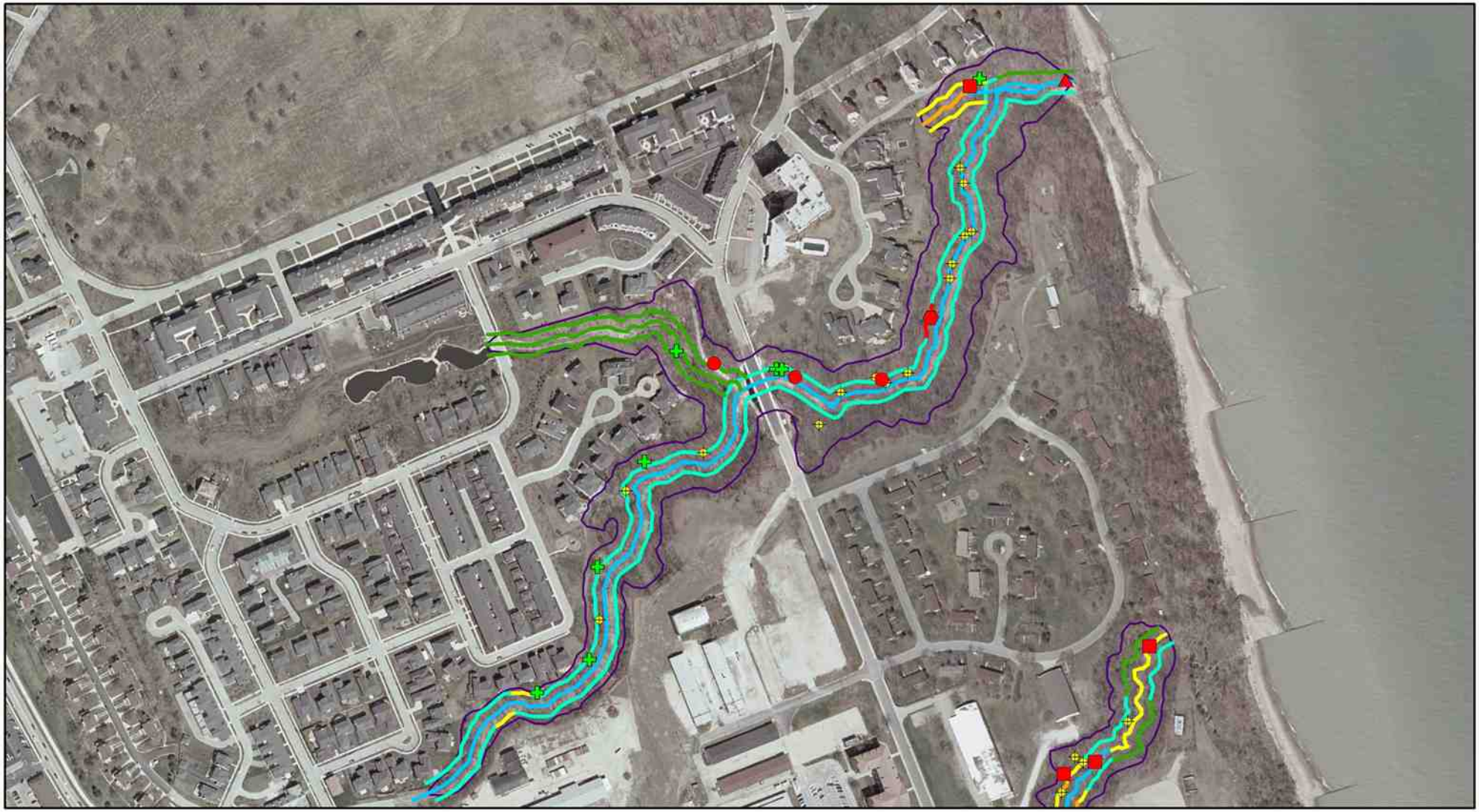
	Ravine Park Ravine	Schenck Ravine	South Ravine	Stanley Ravine	Van Horne Ravine	Walden Ravine	Witchhazel /Seminary Ravine
Acres	13.40	4.16	23.40	5.37	3.45	32.30	43.81
Sq. Ft.	583726.66	181367.86	1019160.39	233917.20	150414.11	1407166.20	1908364.32
Density of Outlets, Exposed Pipes, Dumps (#/acre)	3.433	0.961	1.923	1.117	0.579	1.764	2.214
Rank	0.6809	0.2080	0.3770	0.2321	0.1559	0.3461	0.4355
Number of Stormwater outlets	46	3	45	5	2	57	79
Rank	0.6708	0.2659	0.6617	0.2824	0.2578	0.7627	0.8964
Number Failing Structures	0	1	6	0	1	10	8
Rank	0.2616	0.3145	0.6158	0.2616	0.3145	0.8203	0.7276
Number Log Jams	5	14	16	2	5	8	19
Rank	0.4183	0.8466	0.9024	0.2691	0.4183	0.5805	0.9559
Number Knick Points	0	1	2	0	0	0	0
Rank	0.2604	0.6298	0.9040	0.2604	0.2604	0.2604	0.2604
Number Exposed pipes	0	0	0	0	0	0	17
Rank	0.3529	0.3529	0.3529	0.3529	0.3529	0.3529	0.9671
Number Eroding Gullies (Ranked 1 or 2)	2	2	4	1	2	7	13
Rank	0.4127	0.4127	0.6275	0.3108	0.4127	0.8737	0.9973
Length Eroding Bank (Ranked 1 or 2)	1843.35	658.53	5288.44	554.61	485.08	1688.97	5011.61
Rank	0.6621	0.3798	0.9942	0.3558	0.3401	0.6270	0.9907
Length Eroding Channel (Ranked 1 or 2)	416.57	330.65	1414.99	90.85	139.90	339.67	1091.32
Rank	0.3990	0.3662	0.7718	0.2802	0.2969	0.3696	0.6629
Channel Slope (percent)	0.0190	0.0480	0.0160	0.0250	0.0080	0.0160	0.0210
Rank	0.2097	0.5790	0.1810	0.2745	0.1171	0.1810	0.2302
Average Bank Slope (percent)	46.21	41.84	44.54	34.65	42.46	43.06	44.23
Rank	0.7732	0.5533	0.6962	0.1901	0.5878	0.6202	0.6810
Average Dist Buildings (within 50ft top of ravine; ft)	95.9	131.4	109.6	46	400	101.2	115.5
Rank	0.6523	0.5521	0.6145	0.7756	0.0329	0.6378	0.5978
Average Dist Roads (within 100ft top of ravine; ft)	155	146	252	104.9	117	150	155
Rank	0.6474	0.6681	0.4091	0.7557	0.7312	0.6590	0.6474
Total Area Buildings (within 50ft of ravine; acres)	1.50	0.48	3.15	1.47	0.03	3.49	4.20
Rank	0.4555	0.2900	0.7275	0.4505	0.2278	0.7733	0.8549
Total Area Roads (within 100ft of ravine; acres)	1.86	0.47	1.05	1.56	0.68	4.95	6.84
Rank	0.5586	0.3036	0.4055	0.5015	0.3399	0.9467	0.9939
Sum of ***Weighted*** Indicator Scores	31.2817	24.5793	39.0436	19.9863	18.7489	34.6482	45.1333
Ravine Erosion Risk Score (0-100)	**61.26**	**34.54**	**85.95**	**19.32**	**16.05**	**73.55**	**95.54**
Overall Rank (Out of 47, 1=Highest)	**18**	**27**	**6**	**39**	**42**	**12**	**4**

Miles
0 0.5 1 2 3 4
LAKE MICHIGAN
Winthrop Harbor
Zion
Beach Park
Wadsworth
Gurnee
Waukegan
North Chicago
Green Oaks
Lake Bluff
No Name9
Dead Dog Creek
Kellogg Ravine
Carmel Park Ravine
Bull Creek
Gangstar Ravine
Glen Flora Tributary
No Name1
Stanley Ravine
No Name8
Waukegan River/Yeoman Creek
Perched Wetland, Foss Park
Pettibone Creek/Shore Acres Ravine
Crabtree Ravine
Lillian Dells Ravine
Ravine Park Ravine
South Ravine
Cemetery Ravine
Clark's Ravine

Miles
0
0.5
1
2
3
4
Perched Wetland, Foss Park
Pettibone Creek/Shore Acres Ravine
Crabtree Ravine
Lillian Dells Ravine
Ravine Park Ravine
South Ravine
Cemetery Ravine
No Name7
Clark's Ravine
No Name6
No Name5
Witchhazel/Seminary Ravine
No Name4
Mayflower Ravine
No Name3
Walden Ravine
McCormick/Janes Ravine
Hutchinson Ravine
No Name11
No Name10
Bartlett Ravine
Van Horne Ravine
Schenck Ravine
Ravine 10L
Ravine 9L
Ravine 8L
Ravine 7L
Ravine 6L
Ravine 5L
Ravine 4L
Ravine 3L
Ravine 2L
Ravine 1L
Ravine 7C
Ravine 6C
Ravine 5C
Ravine 4C
LAKE MICHIGAN
North Chicago
Green Oaks
Lake Bluff
Lake Forest
Highwood
Bannockburn
Highland Park
Deerfield
Northbrook
Glencoe
Fort Sheridan
20th Pl
20th St
22nd St
Buckley Rd
Waukegan Rd
N Skokie Hwy
Superior St
Great Lakes Dr
Green Bay Rd
Illinois St
Sheridan Rd
Sampson St
Paul Jones St
Atkinson Rd
Arbor Dr
Basil Rd
Rockland Rd
Park Ln
N Shore Dr
Sherwood Dr
Park Ave
Spruce Ave
Gage Ln
W Laurel Ave
Oak Knoll Dr
Acorn Trl
Burton Dr
Academy Rd
Football Dr
N Field Dr
W Kennedy Rd
S Waukegan Rd
Stable Ln
Tallgass Ln
W Everett Rd
Country Pl
S Ridge Rd
S Skokie Hwy
Butler Dr
Buena Rd
Valley Rd
S Green Bay Rd
Beverly Pl
Lester Rd
Old Elm Rd
Lawrence Ave
Estate Ln
Interstate Hwy 94
W Old Mill Rd
Harlan Ln
Surrey Ln
Arbor Ln
Half Day Rd
Mayor Ln
Ridge Rd
Prairie Ave
Bunte
Vine Ave
Dutty Ln
Telegraph Rd
Park Ave W
Sunset Ln
E Cerasa Dr
North Ave
Berkeley Rd
Cummor Ct
Elmwood Ave
Cavell Ave
Bob-O-Link Rd
Linden Ave
Westgate Rd
Saxony Dr
Ridge Rd Sumac Rd
Broadview Ave
St Johns Ave
Deerfield Rd
Castlewood Ln
Pine St
Elm St
Brierhill Rd
Carlisle Ave
Red Oak Ln
Clavey Rd
Pierce Rd
Ivy Ln
Marion Ave
Takeda Pkwy
Wilmot Rd
Laurel Ave
Estate Dr
Corporate Dr
Portwine Rd
Timber Trl
Riverwoods Rd
Saunders Rd
Glendenin Ln
Trillium Ln
Interstate Hwy 94
Commercial Ave
Sanders Rd
Hueh Rd
Helen Dr
Pfingsten Rd
Westley Rd
E Dundee Rd
Dundee Rd
Thornwood Ln



Miles
0 0.35 0.7 1.4 2.1 2.8
LAKE MICHIGAN
No Name4
Mayflower Ravine
No Name3
Walden Ravine
McCormick/Janes Ravine
Hutchinson Ravine
No Name11
No Name10
Bartlett Ravine
Van Horne Ravine
Schenck Ravine
Ravine 10L
Ravine 9L
Ravine 8L
Ravine 7
Ravine 6L
Ravine 5L
Ravine 4L
Ravine 3L
Ravine 2L
No Name2
Ravine 1L
Ravine 7C
Ravine 6C
Ravine 5C
Ravine 4C
Ravine 3C
Ravine 2C
Ravine 1C
Fort Sheridan
Highwood
Highland Park
Northbrook
Glencoe
Winnetka
E Deerpath Rd
N Green Bay Rd
N Western Ave
N Sheridan Rd
E Illinois Rd
Highview Ter
Foster Pl
E Westleigh Rd
Walden Ln
Circle Ln
McKinley Rd
Beverly Pl
Hilldale Pl
Hunter Ln
S Ridge Rd
Brenna Rd
Valley Rd
Timber Ln
Cliff Rd
Old Elm Rd
Lyster Rd
Summit Ave
Buena Rd
S Skokie Hwy
Harlan Ln
Surrey Ln
Half Day Rd
Prairie Ave
Burtis
Park St
Kelly Ln
Hybernia Dr
Shady Ln
Skokie Hwy
Ridge Rd
Vine Ave
Park Ave W
Dale Ave
Summit Dr
North Ave
Ryders Ln
Eastwood Ave
Cavell Ave
Linden Ave
Cumnor Ct
Bob-O-Link Rd
Deerfield Pl
Saxony Dr
Oxford Rd
Manor Dr
Deerfield Rd
Cedar Ave
St Johns Ave
Baldwin Rd
Green Bay Rd
Elm St
Brierhill Rd
Castlewood Ave
Barberry Rd
Ridge Rd
Clavey Rd
Red Oak Ln
Ridgelee Rd
Edens Expy
Timber Hill Rd
Marion Ave
Pierce Rd
Ivy Ln
Bristol Dr
Estate Dr
Corporate Dr
Pine St
Beechnut Rd
Westley Rd
Old Green Bay Rd
Anthony Trl
Alice Dr
Appletree Ln
Cedar Ln
Ferndale Ave
Dundee Rd
Dell Rd
Skokie Blvd
Oak Dr
Greenleaf Ave
Park Ave
South Ave
Adams Ave
Harbor St
Mary St
Crabtree Ln
Cherry Ln
Chapel Ct
Hillside Rd
Lee Rd
Walters Ave
1st St
Orchard Ln
Illinois Rd
Anets Dr
Voltz Rd
Sunset Ridge Rd
Interstate Hwy 94
Forestway Dr
Grove St
Vernon Ave
Scott Ave
Christina Ln
Pfingsten Rd
Farnsworth Ln
Dehne Rd
South Ln
Techny Ct
Techny Rd
Sunset Dr
Tower Rd
Foxdale Dr
Greenview Rd
Cargill Dr
Shermer Rd
Carlson Dr
Waukegan Rd
Happ Rd
Bell Pkwy
Hibbard Rd
Westmoor Rd
Prospect Ave
Sheridan Rd
Manor Dr
Pine St
Spruce St
Elm St
Willow Rd
Brian Dr
E Willow Rd
New Willow Rd
Miller Dr
Lawson Rd
Patriot Blvd
Ridge Dr
Westleigh Dr
Central Ave
Willow Rd
Ash St
Keenan Ln
Main St
Drury Ln
Hawthorn Ln



Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,117

0 0.03 0.06 0.12 Miles

Bartlett Ravine

Ranked 36 out of 47

For Erosion Potential

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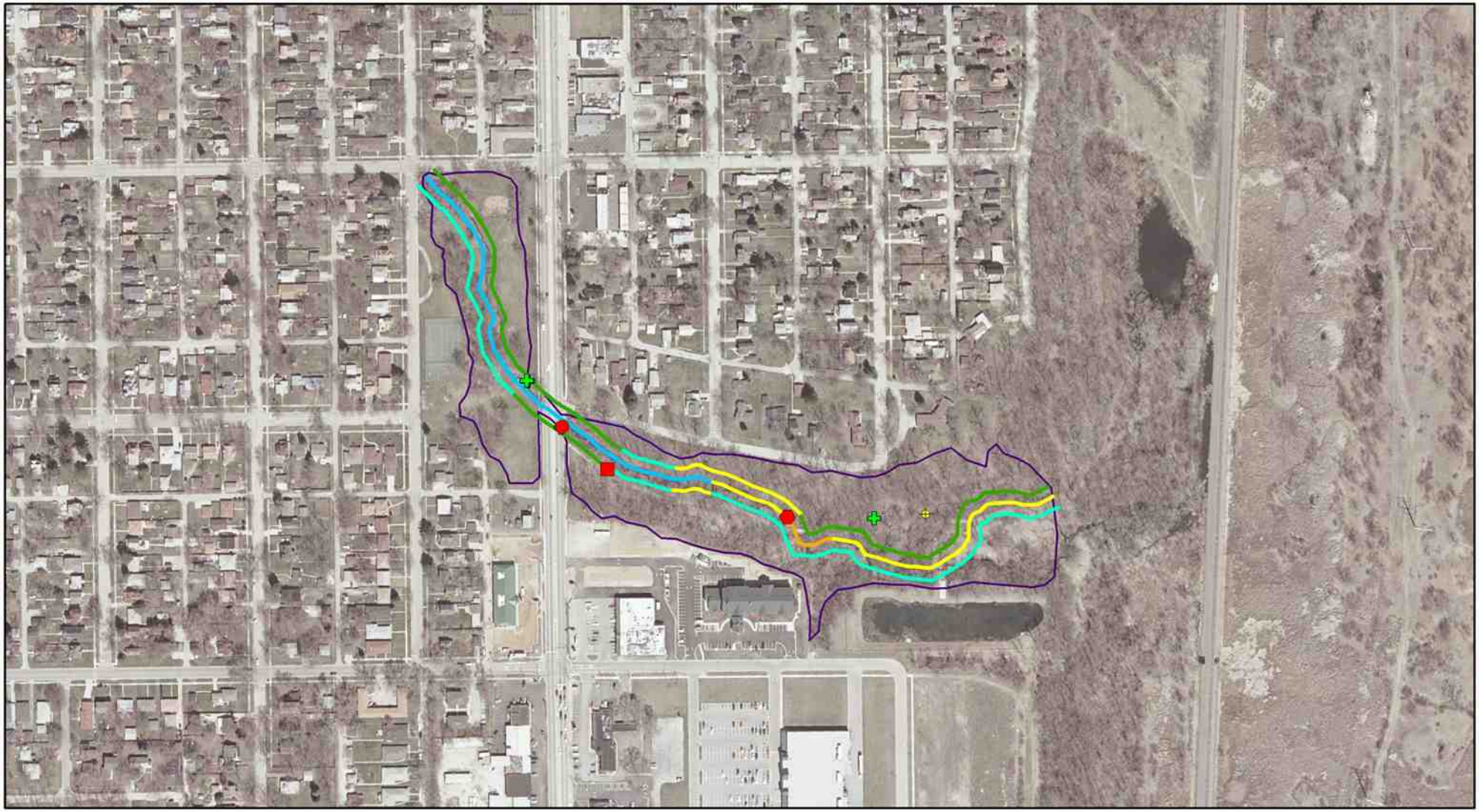

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,563

0 0.025 0.05 0.1 Miles

Carmel Park Ravine

Ranked 45 out of 47

For Erosion Potential

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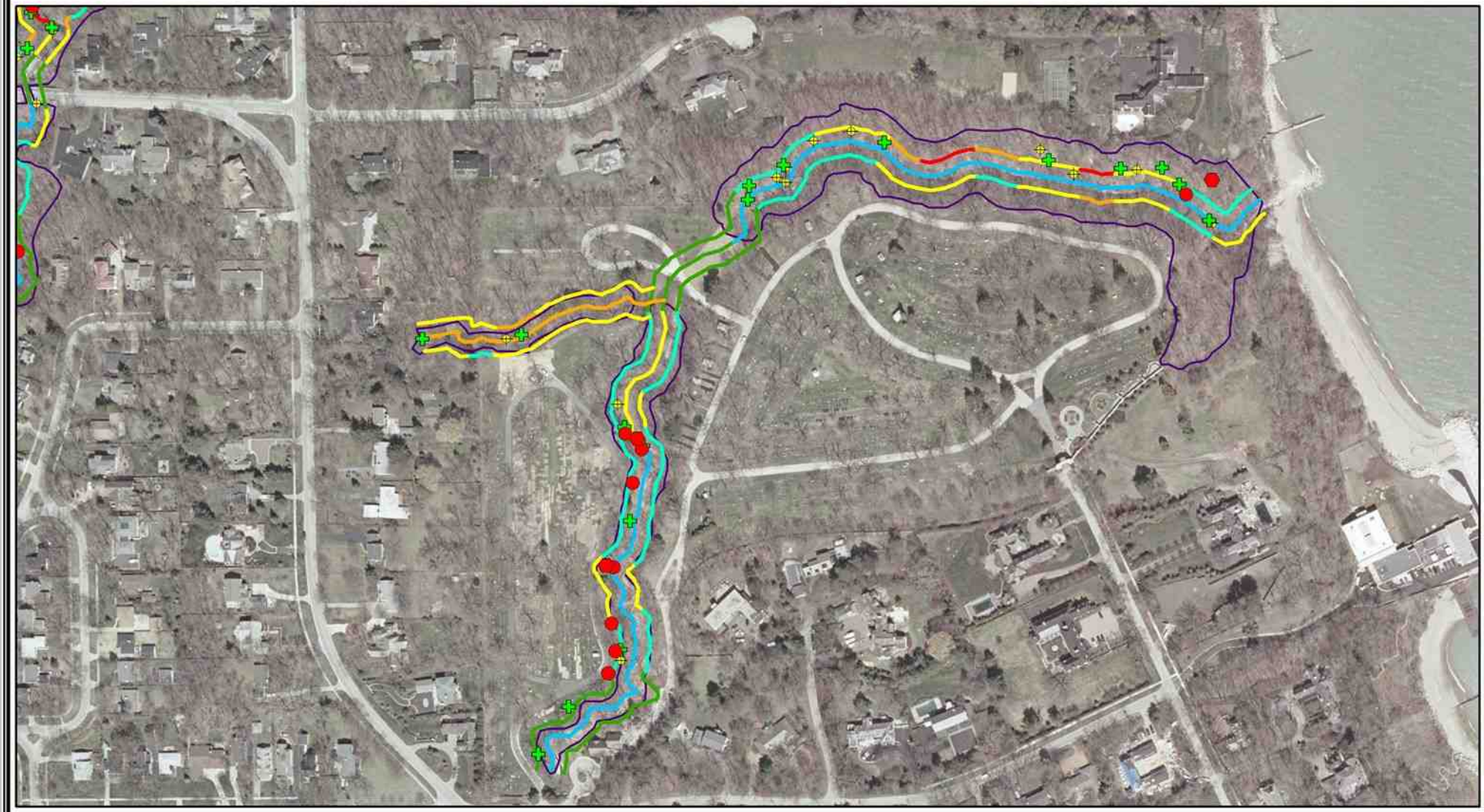

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,725

0 0.025 0.05 0.1 Miles

Cemetery Ravine

Ranked 26 out of 47

For Erosion Potential

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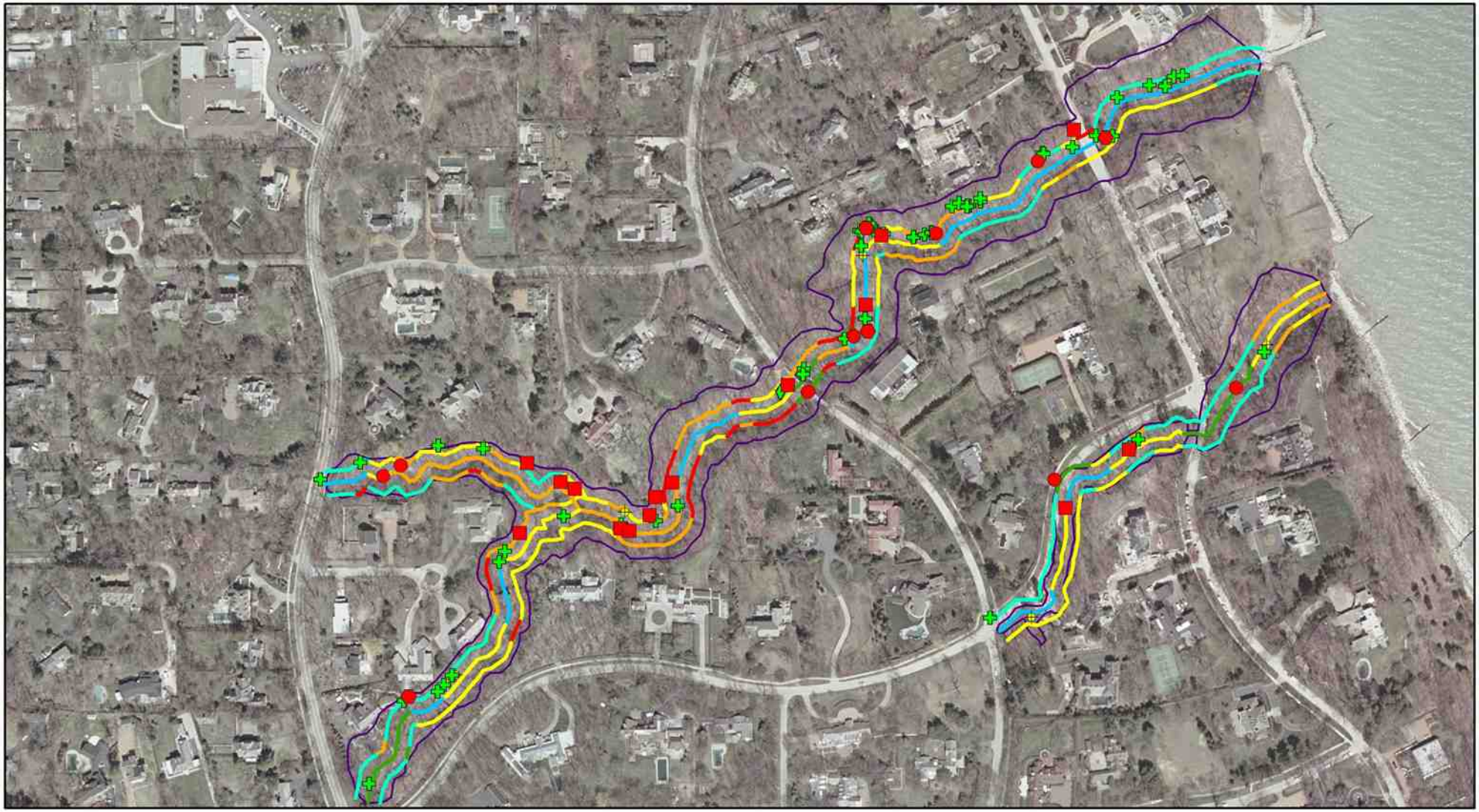

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Legend

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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,217

0 0.025 0.05 0.1 Miles

Clark's Ravine

Ranked 7 out of 47

For Erosion Potential

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Legend

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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:1,982

0 0.0125 0.025 0.05 Miles

Crabtree Ravine

Ranked 33 out of 47

For Erosion Potential

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Gangstar Ravine

Ranked Lowest or 47out of 47

For Erosion Potential

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank
- 1
- 2
- 3
- 4
- 5

Bank Stability Rank
- 1
- 2
- 3
- 4
- 5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,757

0 0.02 0.04 0.08 Miles

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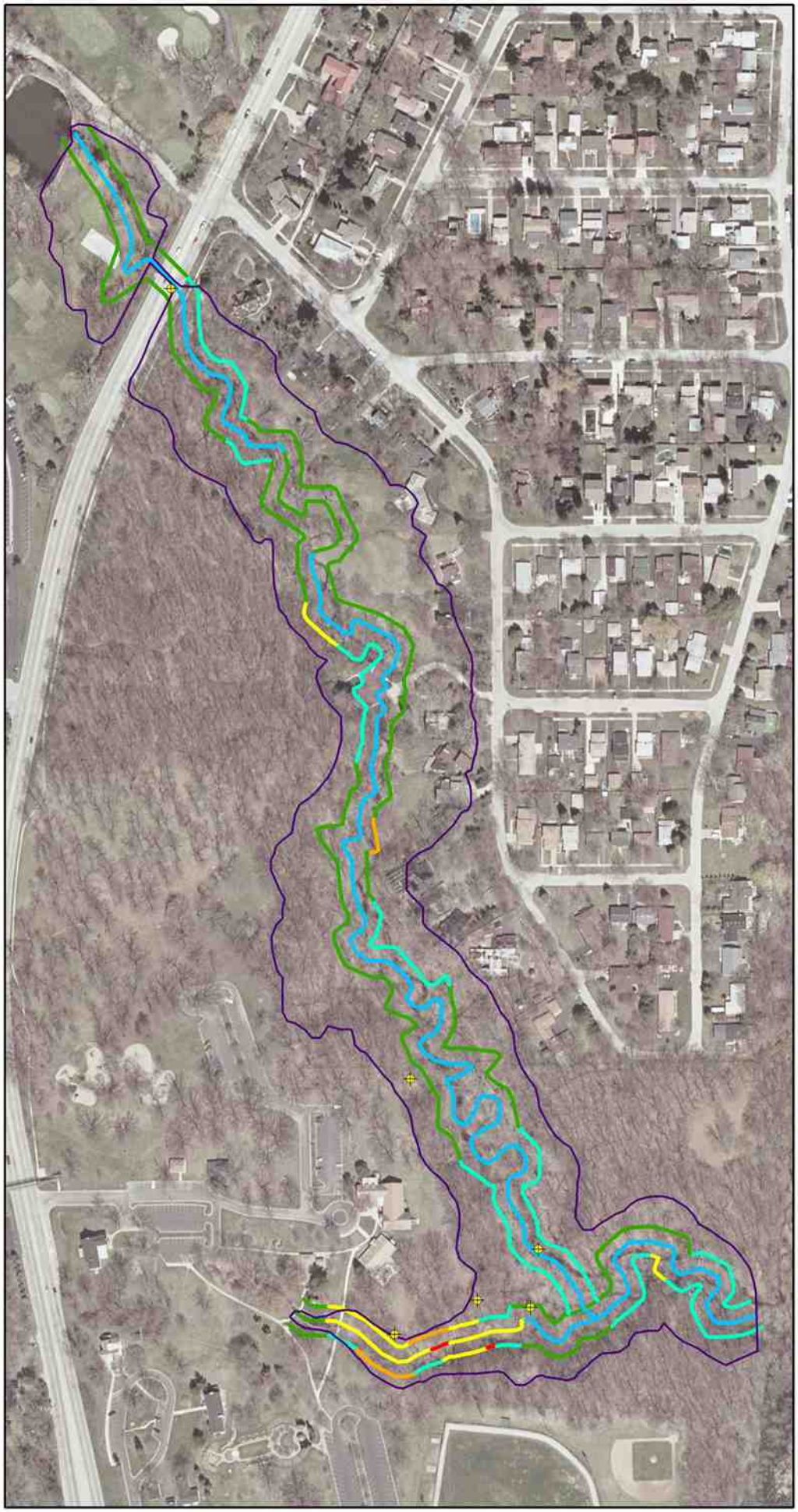

Glen Flora Tributary

Ranked 46 out of 47

For Erosion Potential

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank
- 1
- 2
- 3
- 4
- 5

Bank Stability Rank
- 1
- 2
- 3
- 4
- 5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,757

0 0.02 0.04 0.08 Miles

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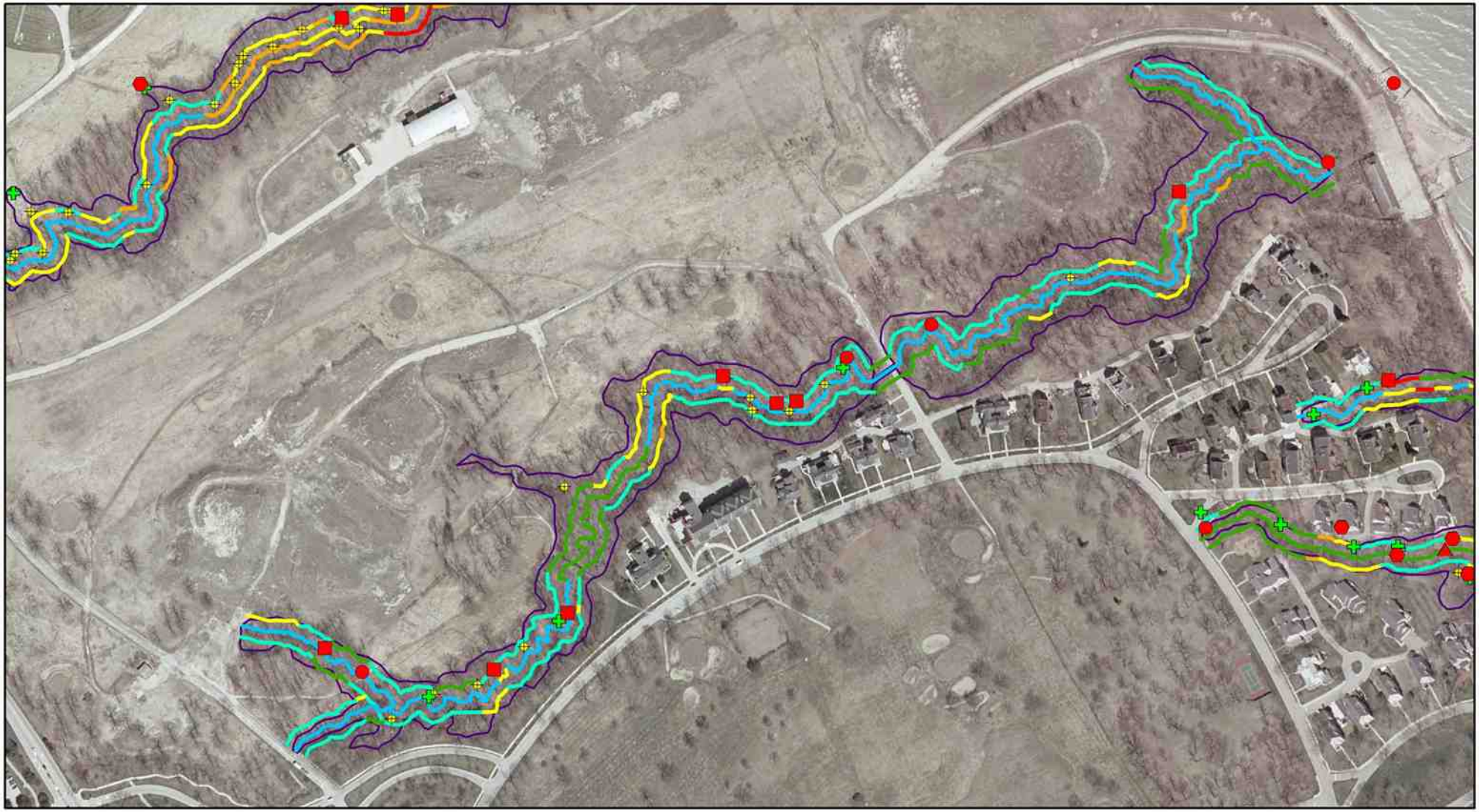

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312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,596

0 0.03 0.06 0.12 Miles

Hutchins Ravine

Ranked 44 out of 47

For Erosion Potential

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Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,093

0 0.02 0.04 0.08 Miles

Lillian Dells Ravine

Ranked 28 out of 47

For Erosion Potential

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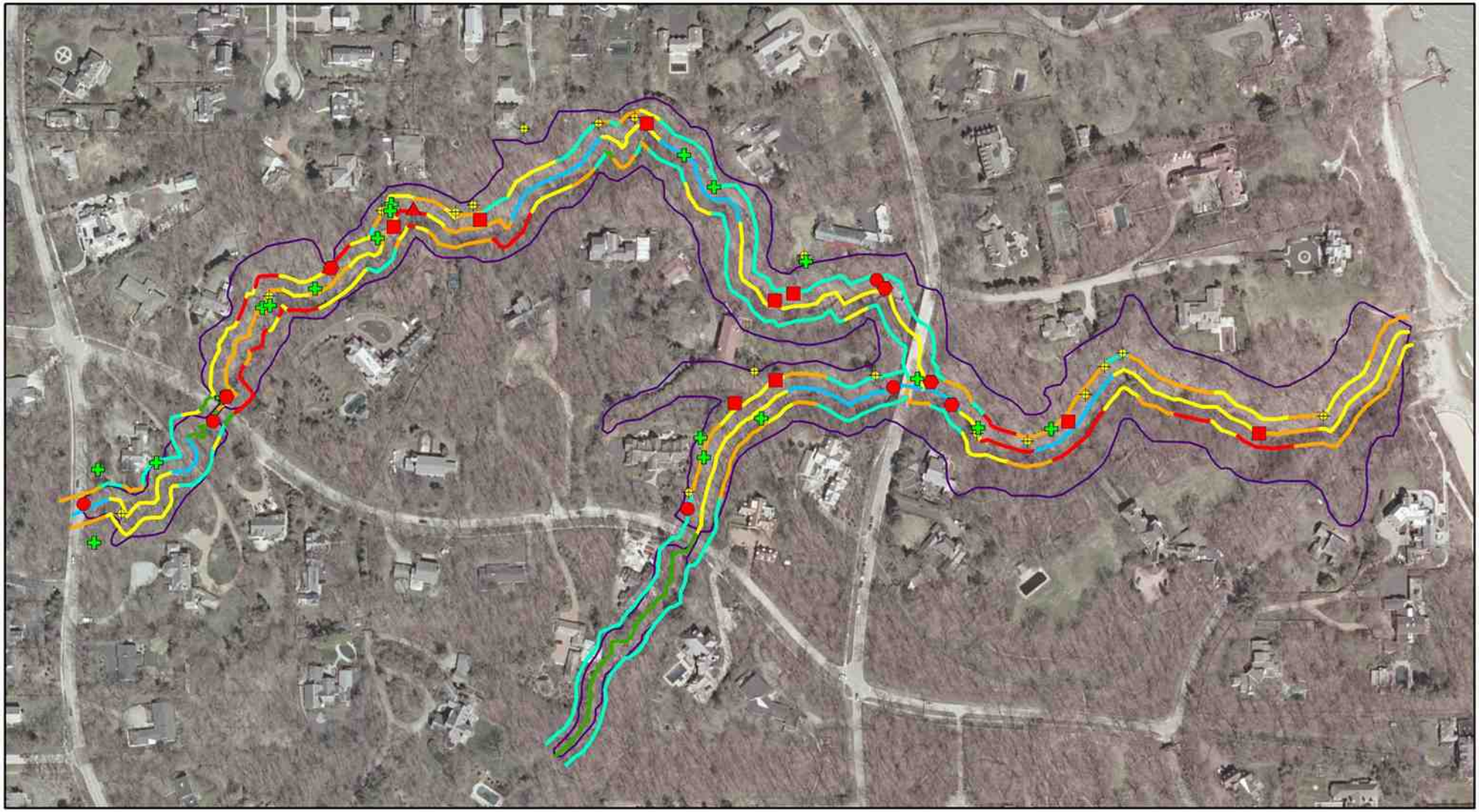

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312-939-0838

Date: 2/2009

Legend

- Gully
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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,600

0 0.025 0.05 0.1 Miles

Mayflower Ravine

Ranked 16 out of 47

For Erosion Potential

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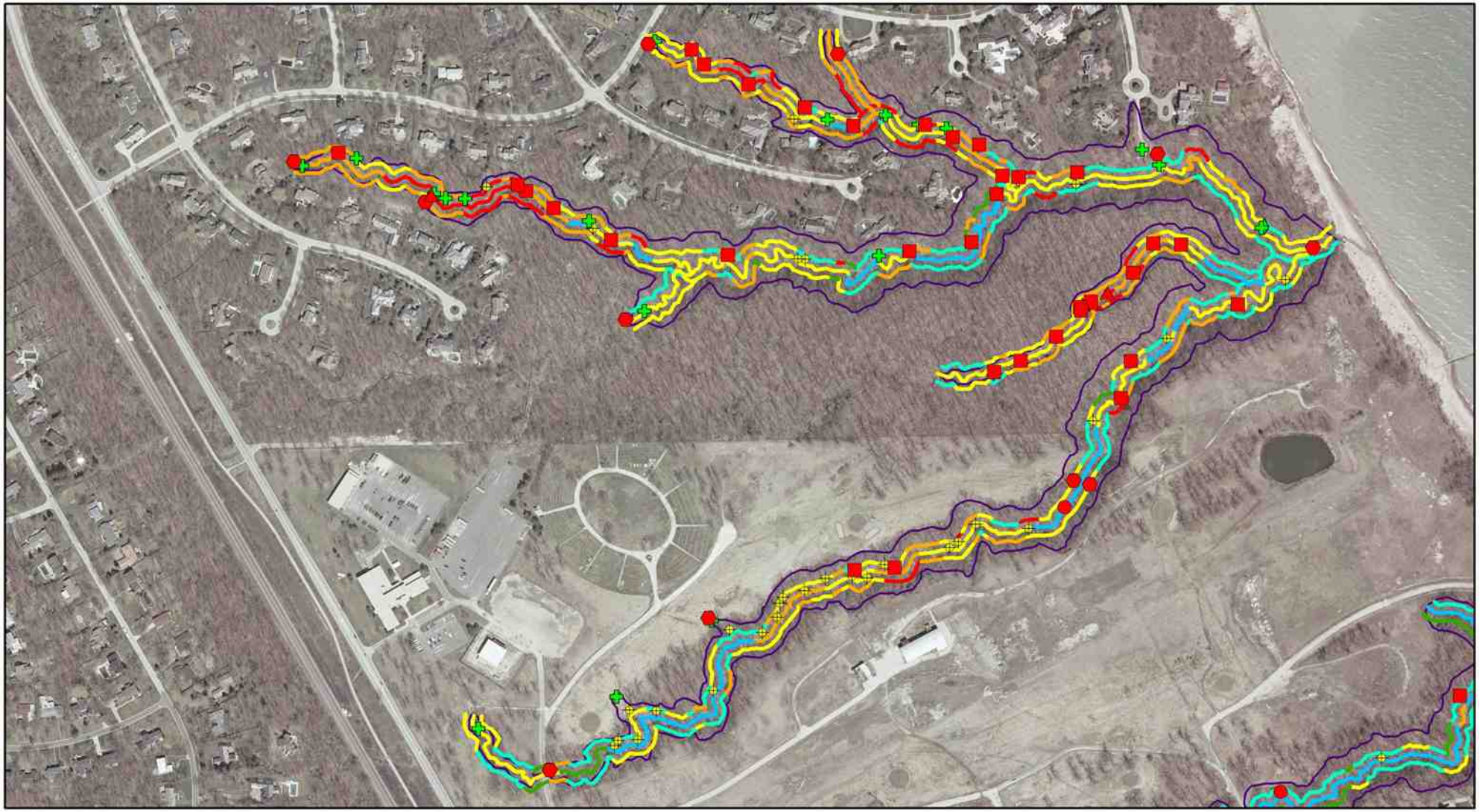

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- Log Jam
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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:6,344

0 0.04 0.08 0.16 Miles

McCormick / Janes Ravine

Ranked 9 out of 47

For Erosion Potential

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Legend

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- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:1,646

0 0.01 0.02 0.04 Miles

No Name1 Ravine

Ranked 37 out of 47

For Erosion Potential

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Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

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17 N. State St., Suite 1390
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312-939-0838

Date: 2/2009

Legend

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- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,252

0 0.0125 0.025 0.05 Miles

Ravine No Name 2

Ranked 35 out of 47

For Erosion Potential

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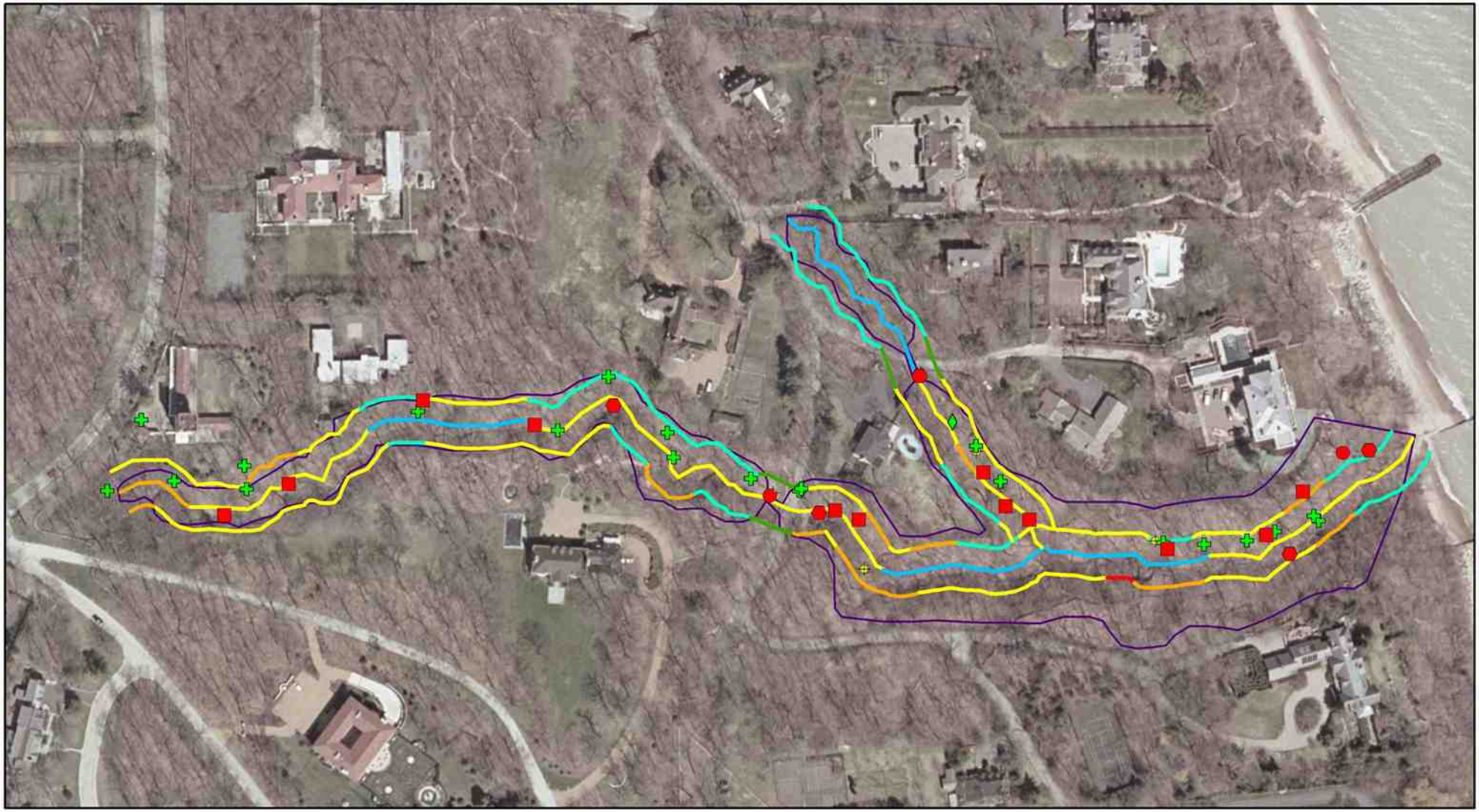

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Chicago, IL 60602
312-939-0838

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Legend

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- Log Jam
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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,304

0 0.015 0.03 0.06 Miles

No Name 3 Ravine

Ranked 22 out of 47

For Erosion Potential

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,221

0 0.015 0.03 0.06 Miles

No Name 4 Ravine

Ranked 30 out of 47

For Erosion Potential

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- Log Jam
- Knick Point
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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,454

0 0.015 0.03 0.06 Miles

No Name5 Ravine

Ranked 31 out of 47

For Erosion Potential

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,454

0 0.015 0.03 0.06 Miles

No Name6 Ravine

Ranked 34 out of 47

For Erosion Potential

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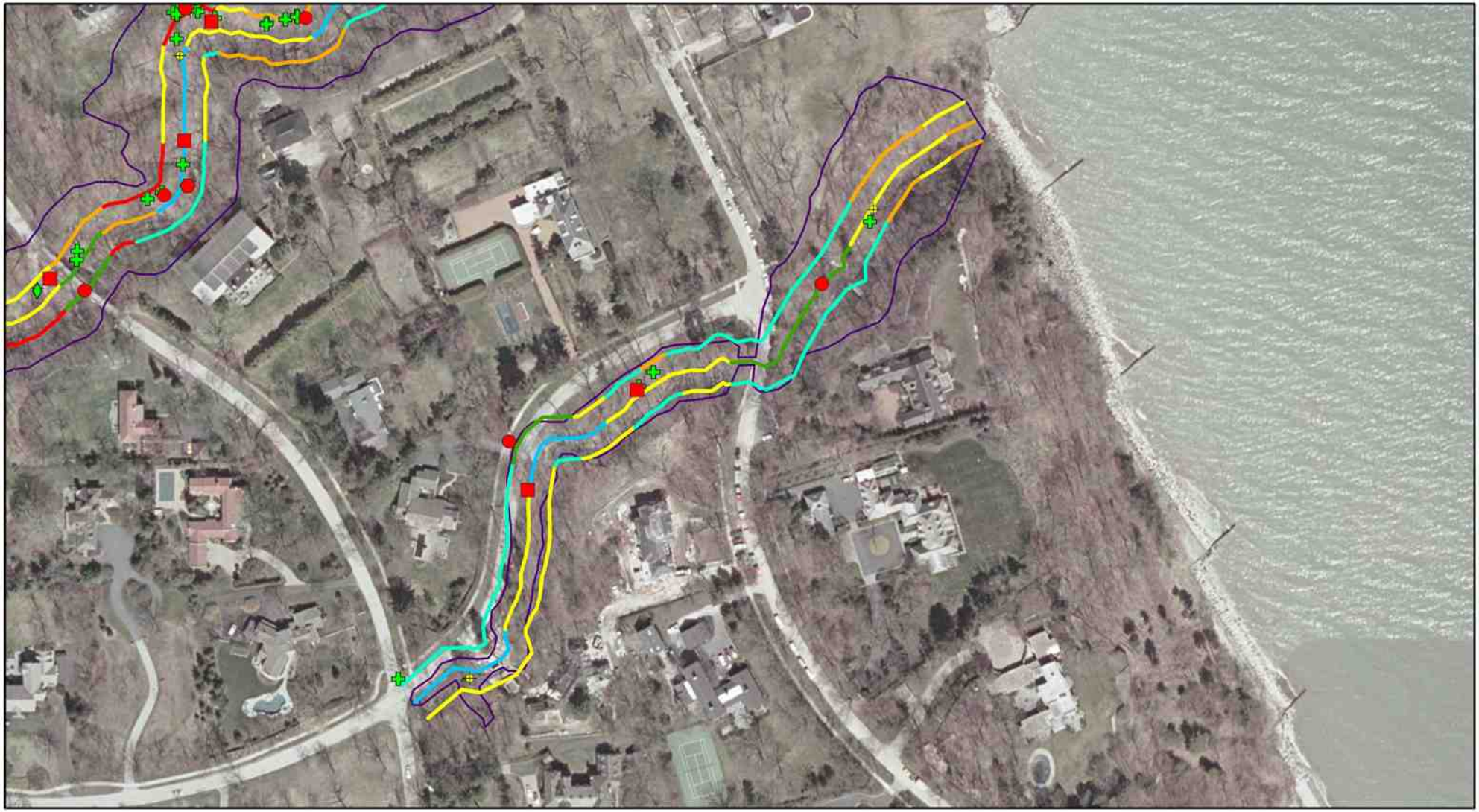

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Legend

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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,454

0 0.015 0.03 0.06 Miles

No Name7 Ravine

Ranked 40 out of 47

For Erosion Potential

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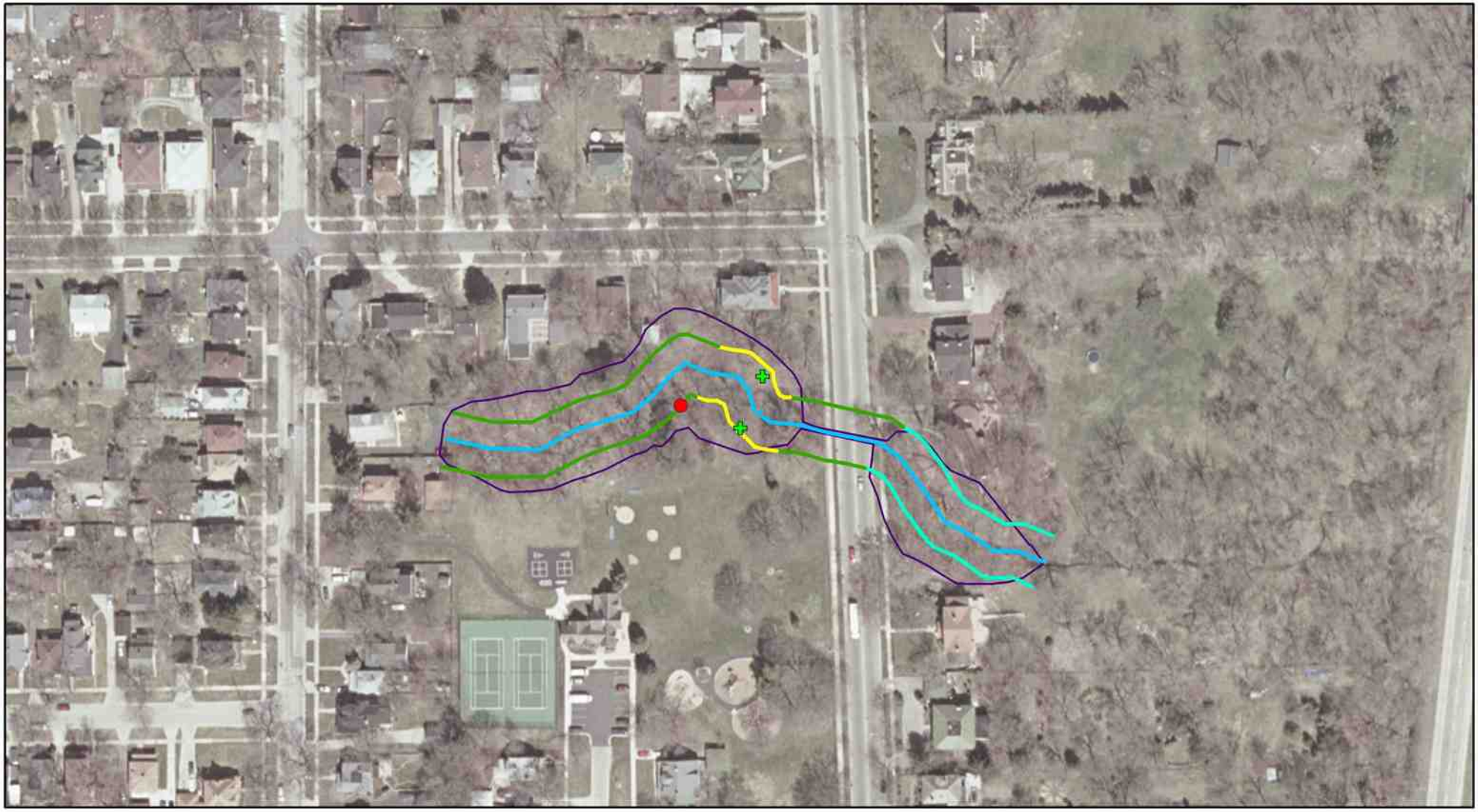

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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:1,907

0 0.0125 0.025 0.05 Miles

No Name8 Ravine

Ranked 43 out of 47

For Erosion Potential

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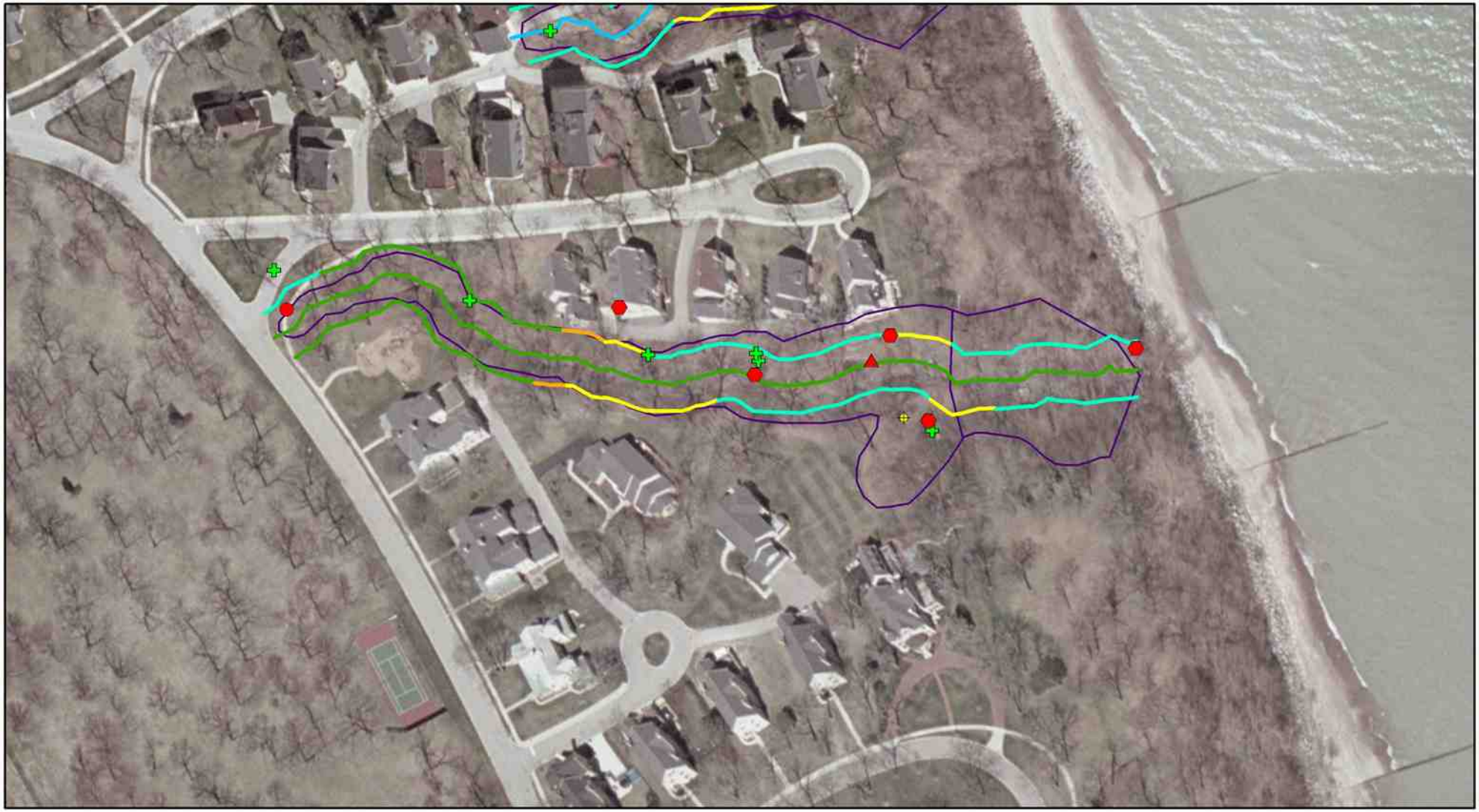

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:1,883

0 0.0125 0.025 0.05 Miles

No Name10 Ravine

Ranked 29 out of 47

For Erosion Potential

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Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
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Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:1,883

0 0.0125 0.025 0.05 Miles

No Name11 Ravine

Ranked 32 out of 47

For Erosion Potential

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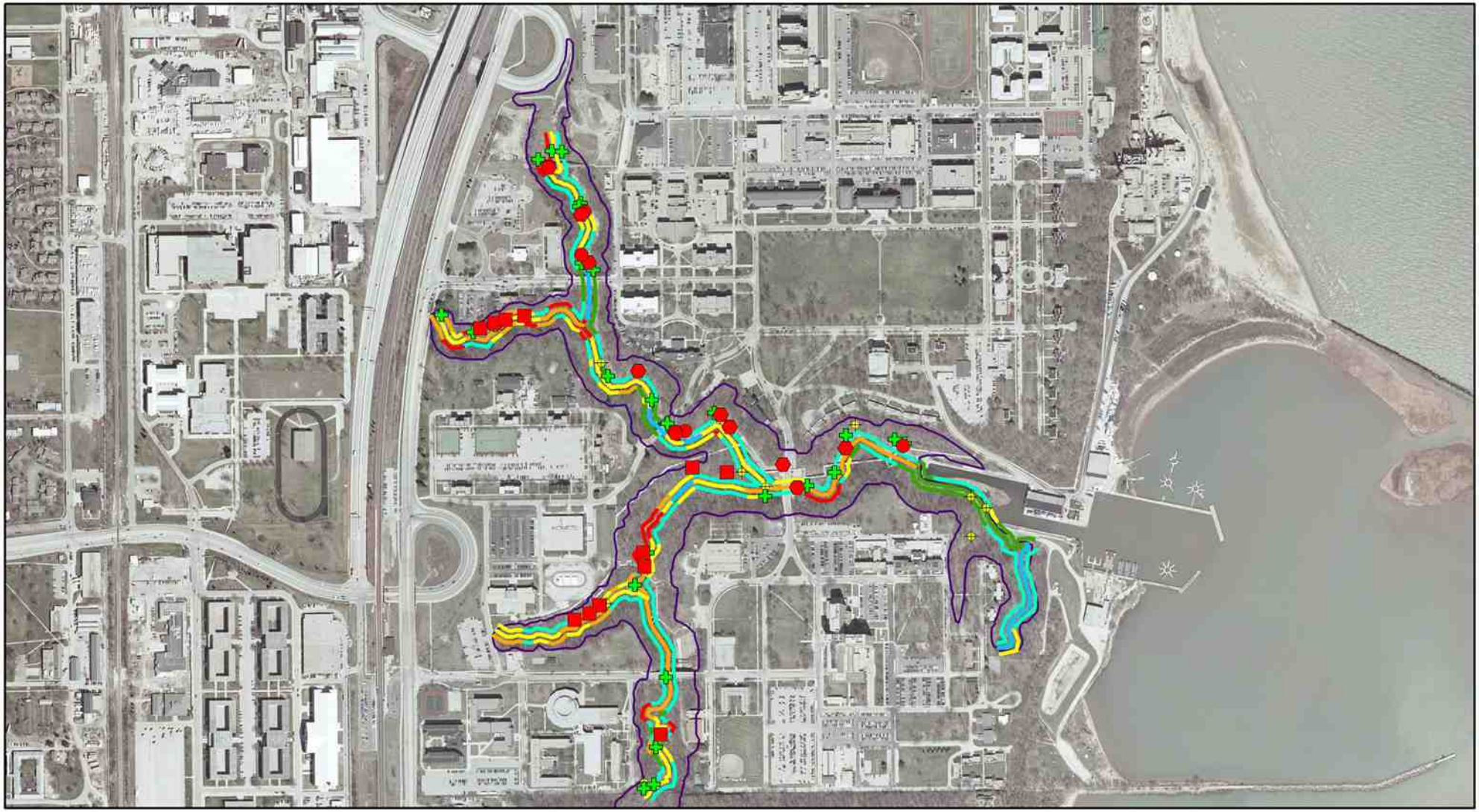

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

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Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:8,791

0 0.05 0.1 0.2 Miles

Pettibone Creek Shore Acres Ravine

Ranked 13 out of 47

For Erosion Potential

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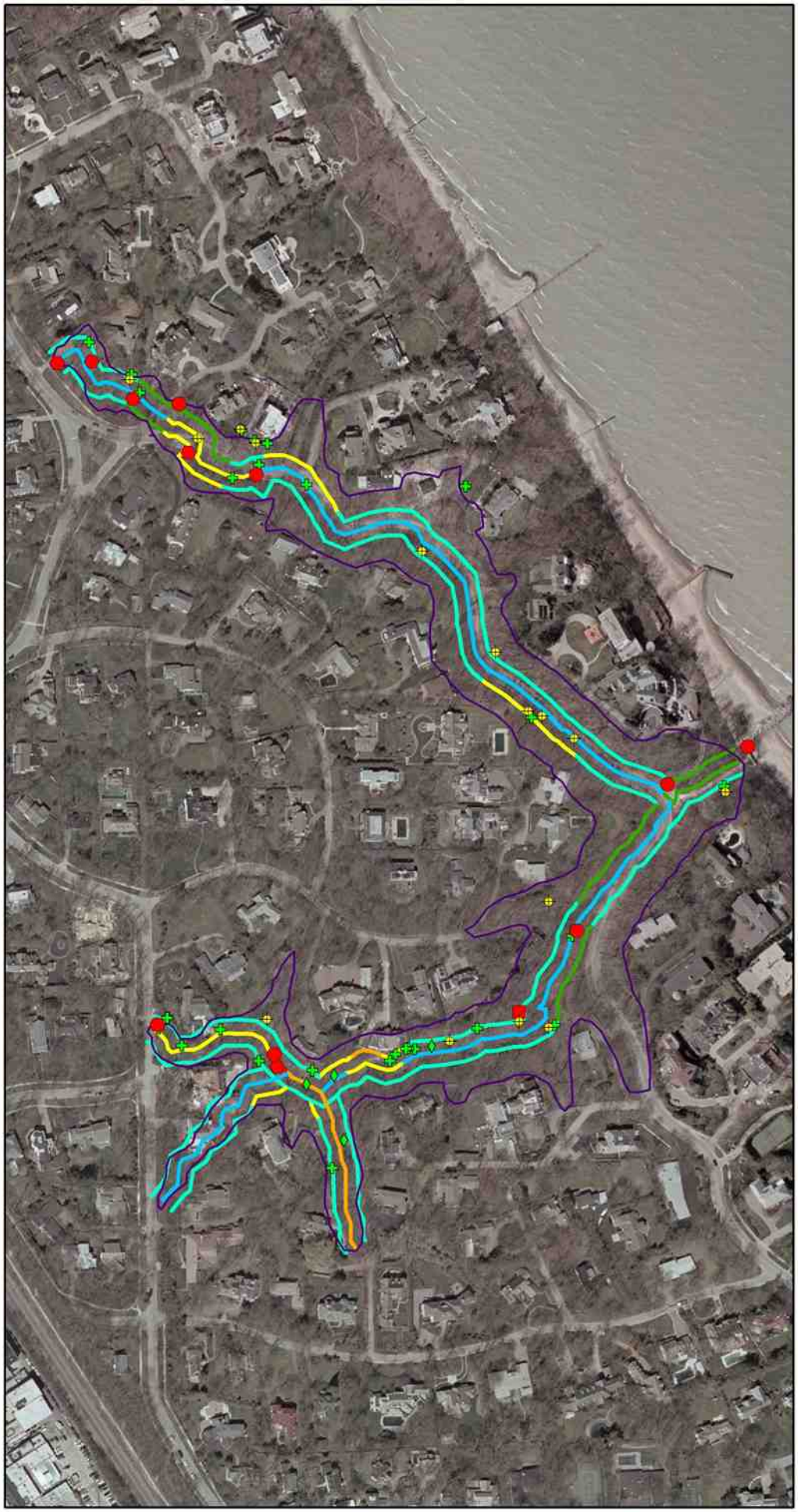

Ravine 1C

Ranked 25 out of 47

For Erosion Potential

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank
- 1
- 2
- 3
- 4
- 5

Bank Stability Rank
- 1
- 2
- 3
- 4
- 5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,231

0 0.025 0.05 0.1 Miles

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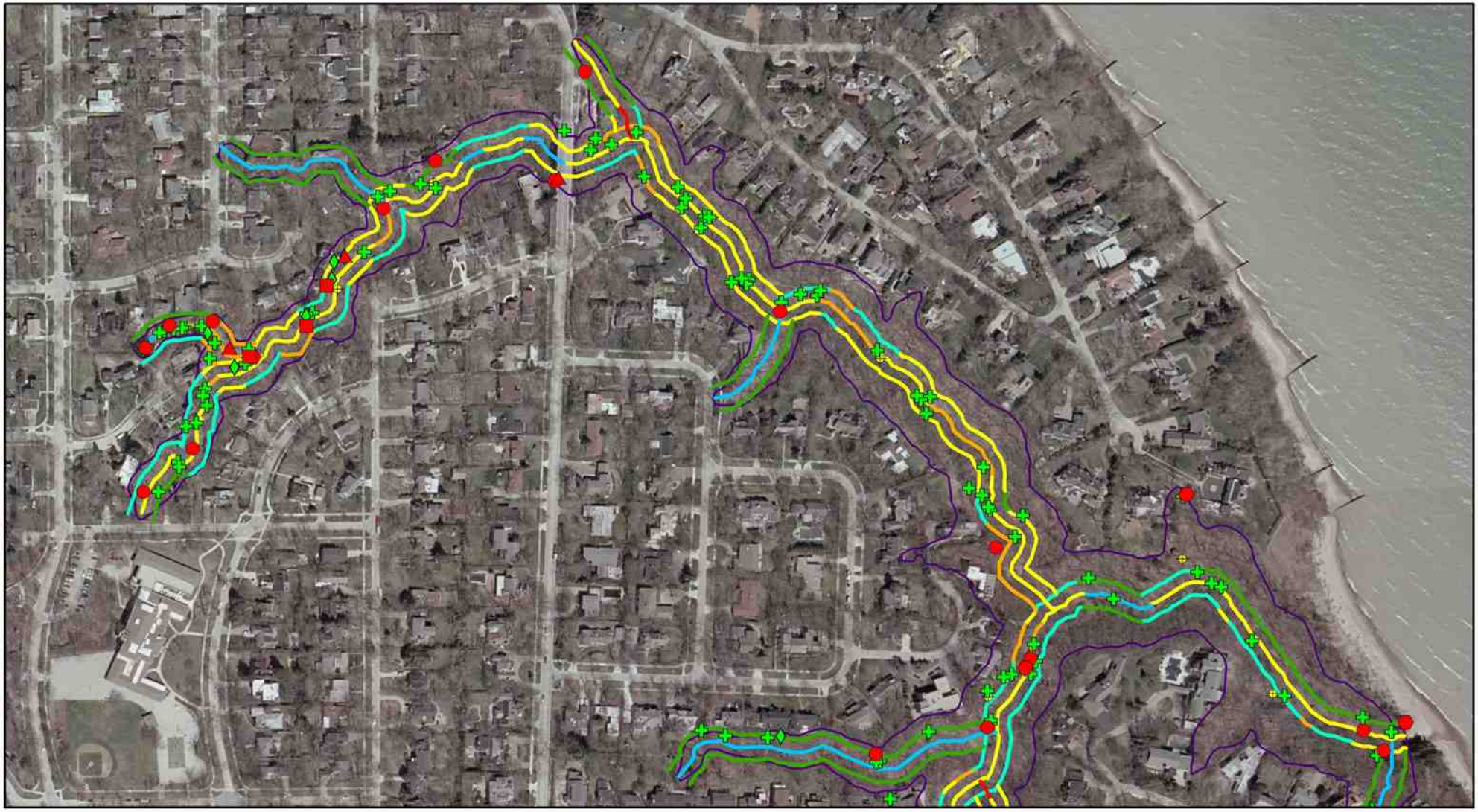

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
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Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,112

0 0.02 0.04 0.08 Miles

Ravine 1L North Section Ranked 5 out of 47

For Erosion Potential

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Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,100

0 0.025 0.05 0.1 Miles

Ravine 1L South Section Ranked 5 out of 47

For Erosion Potential

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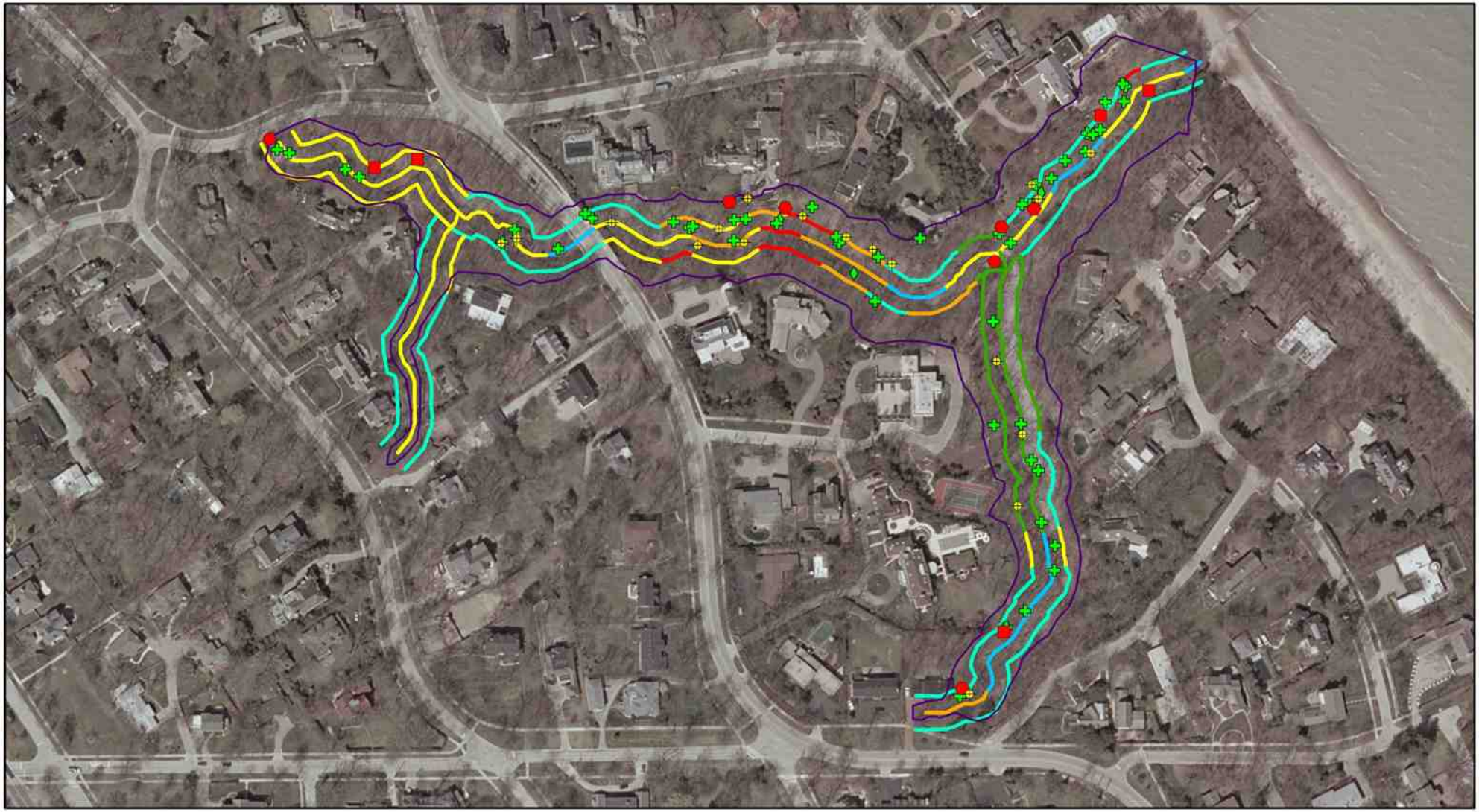

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

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312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,082

0 0.015 0.03 0.06 Miles

Ravine 2C

Ranked 11 out of 47

For Erosion Potential

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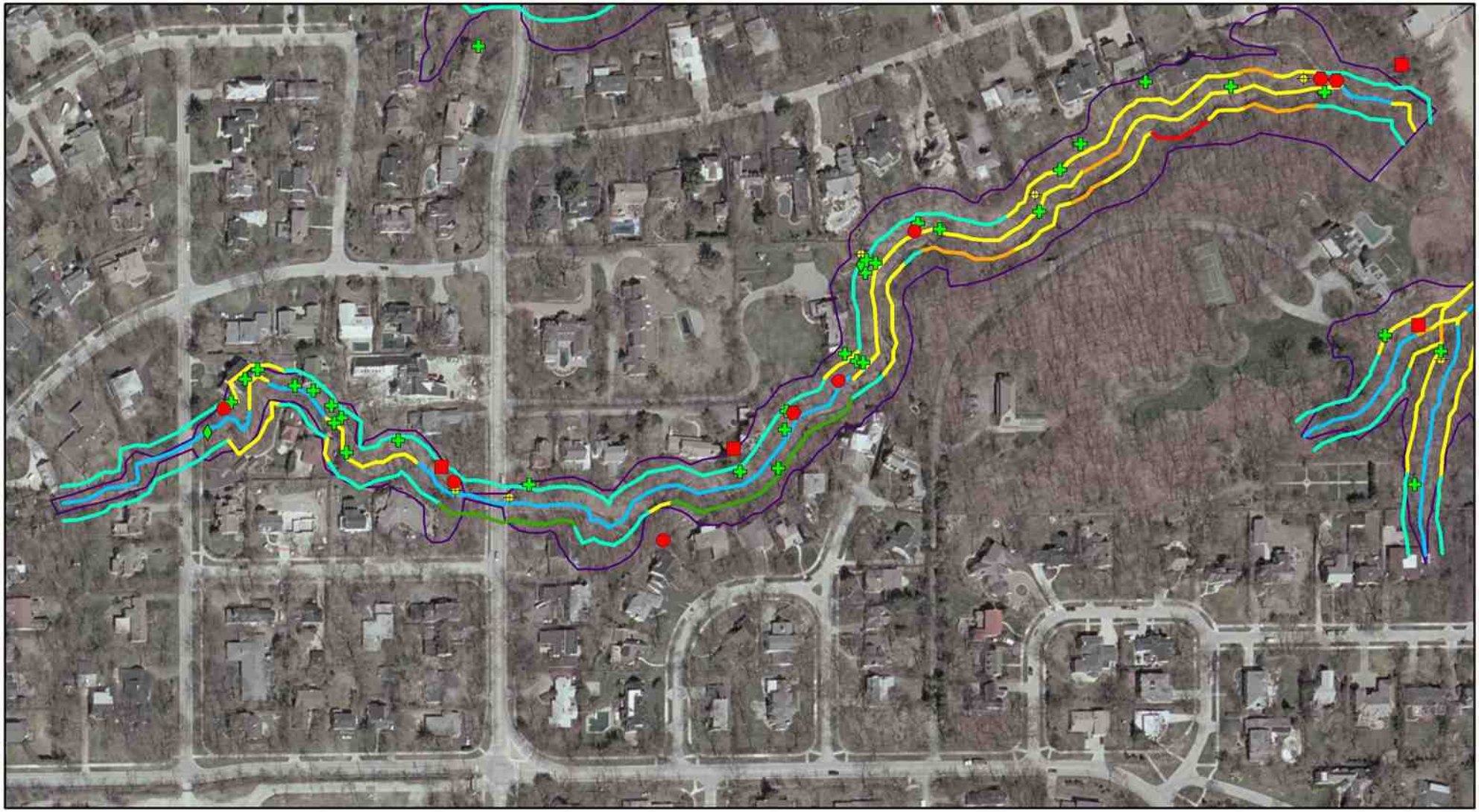

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,055

0 0.02 0.04 0.08 Miles

Ravine 2L

Ranked 21 out of 47

For Erosion Potential

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Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,053

0 0.01 0.02 0.04 Miles

Ravine 3C

Ranked 41 out of 47

For Erosion Potential

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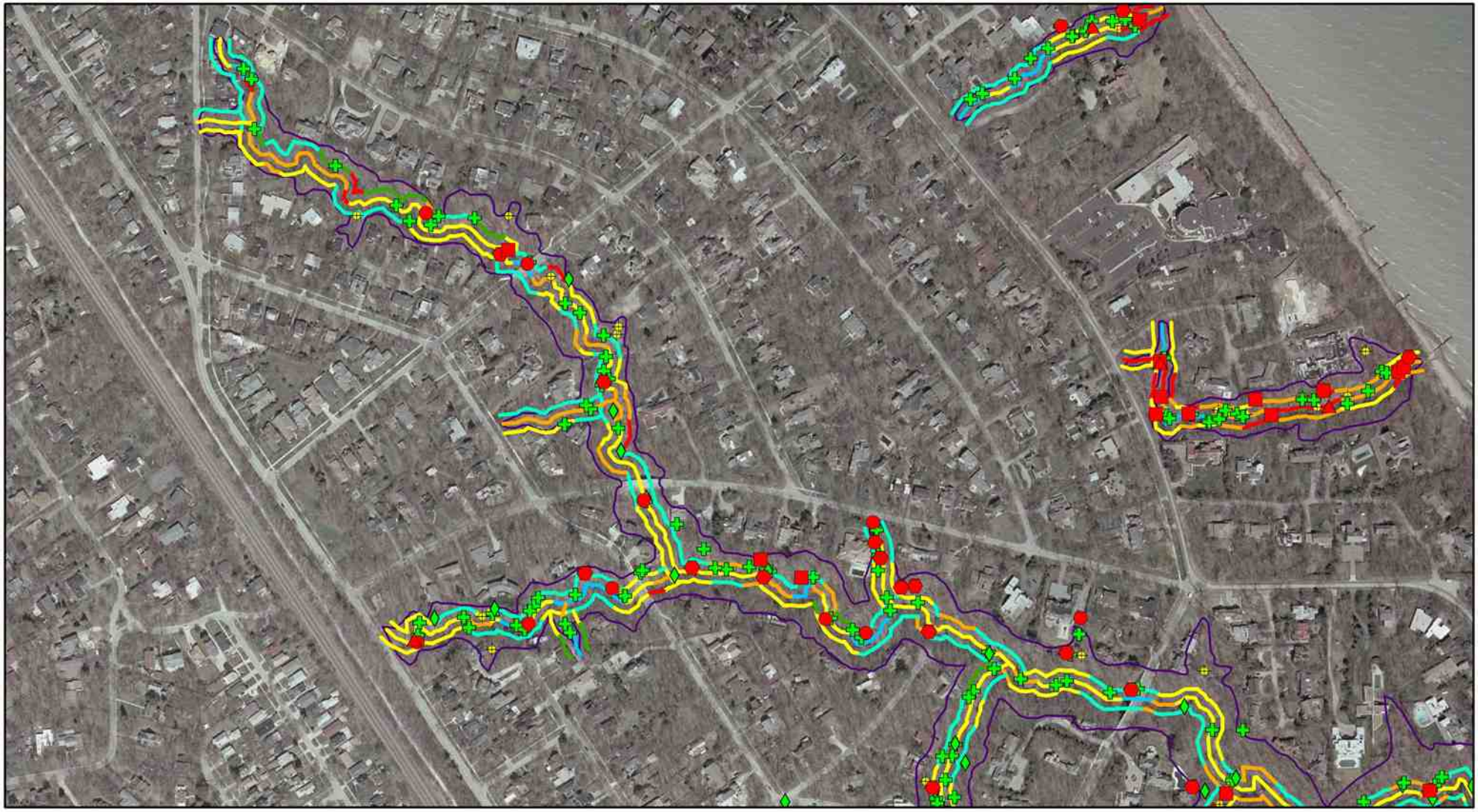

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Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,552

0 0.03 0.06 0.12 Miles

Ravine 3L North Section Ranked 3 out of 47

For Erosion Potential

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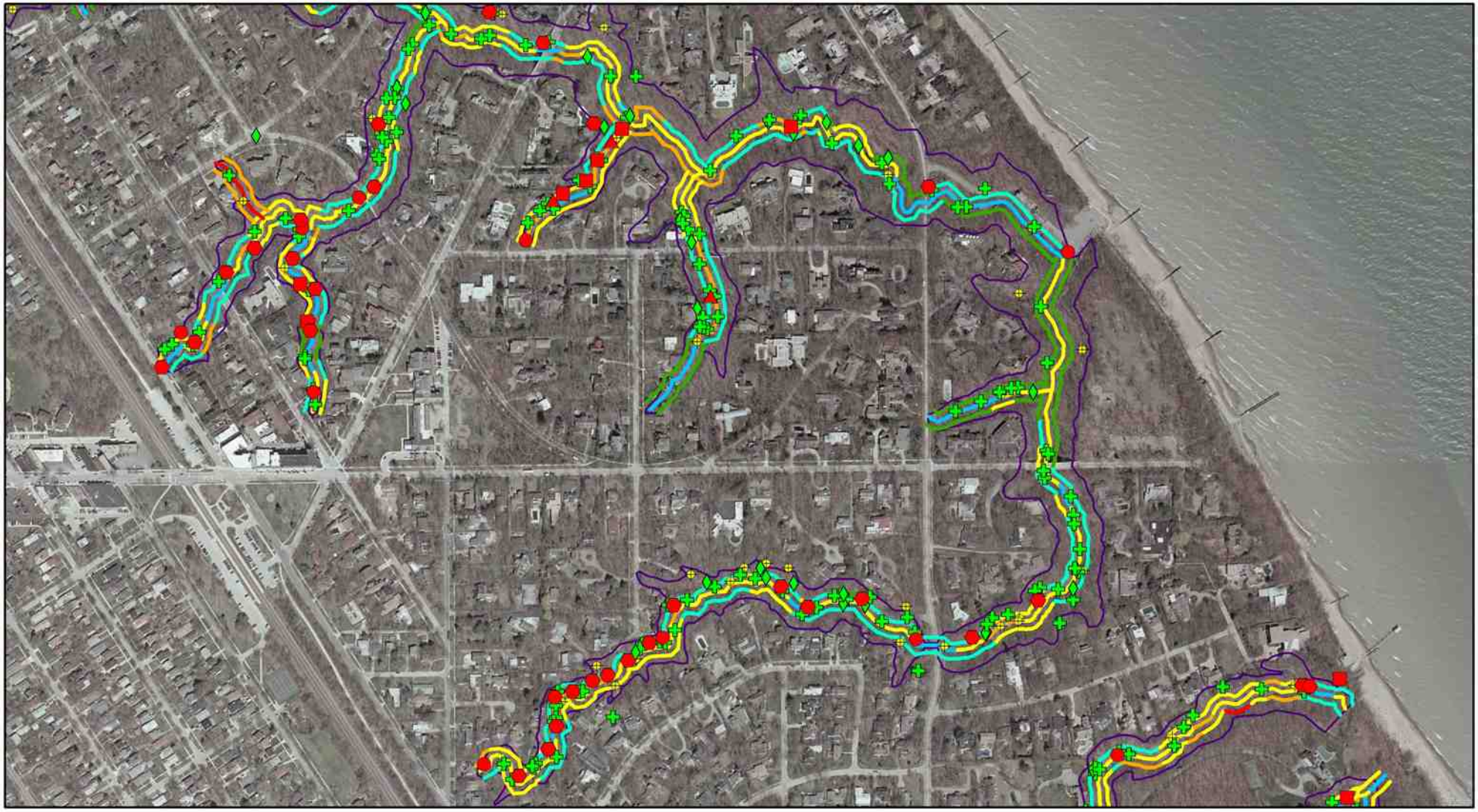

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

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312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:6,689

0 0.03 0.06 0.12 Miles

Ravine 3L South Section Ranked 3 out of 47

For Erosion Potential

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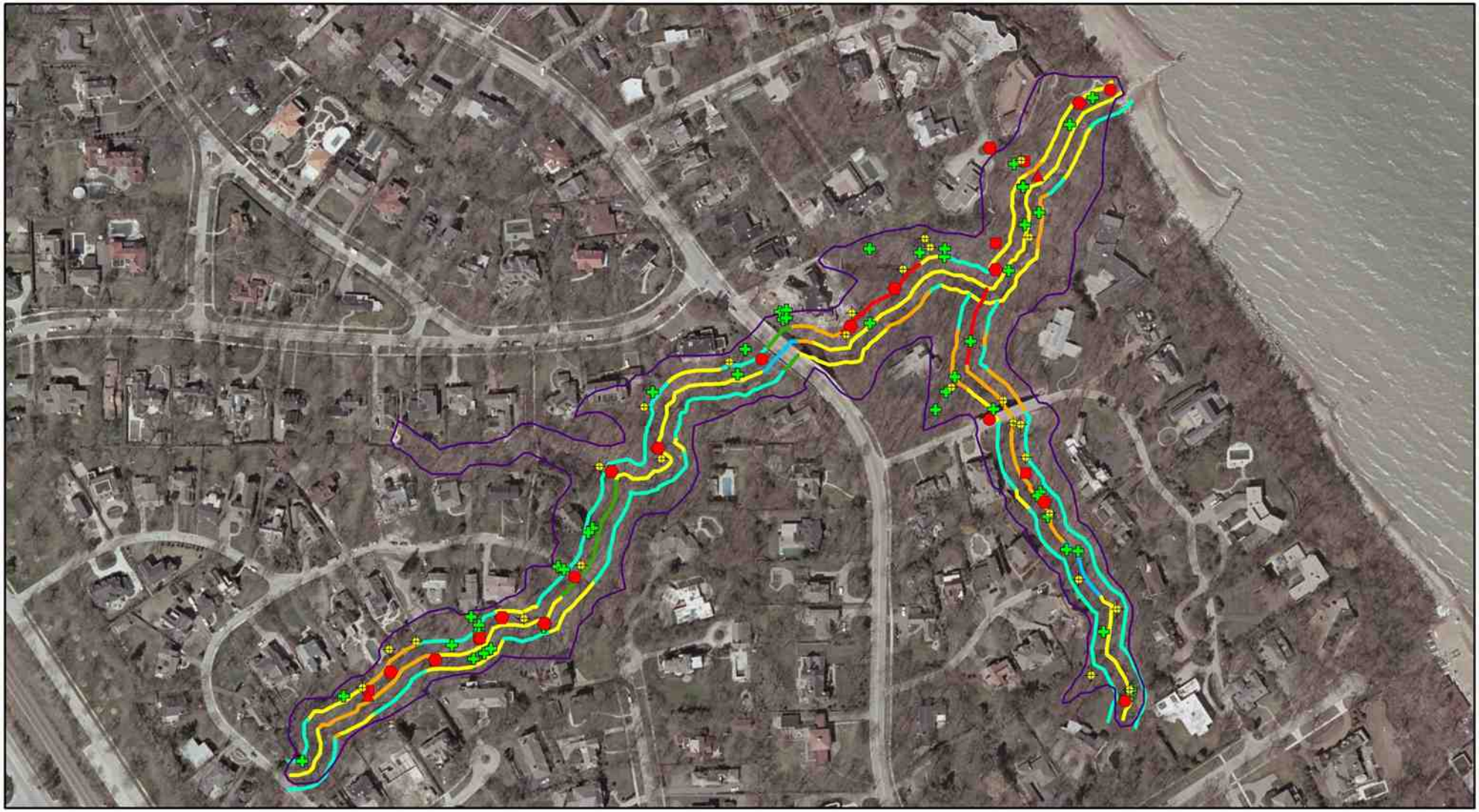

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,679

0 0.015 0.03 0.06 Miles

Ravine 4C

Ranked 8 out of 47

For Erosion Potential

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Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

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17 N. State St., Suite 1390
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312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,406

0 0.01 0.02 0.04 Miles

Ravine 4L

Ranked 14 out of 47

For Erosion Potential

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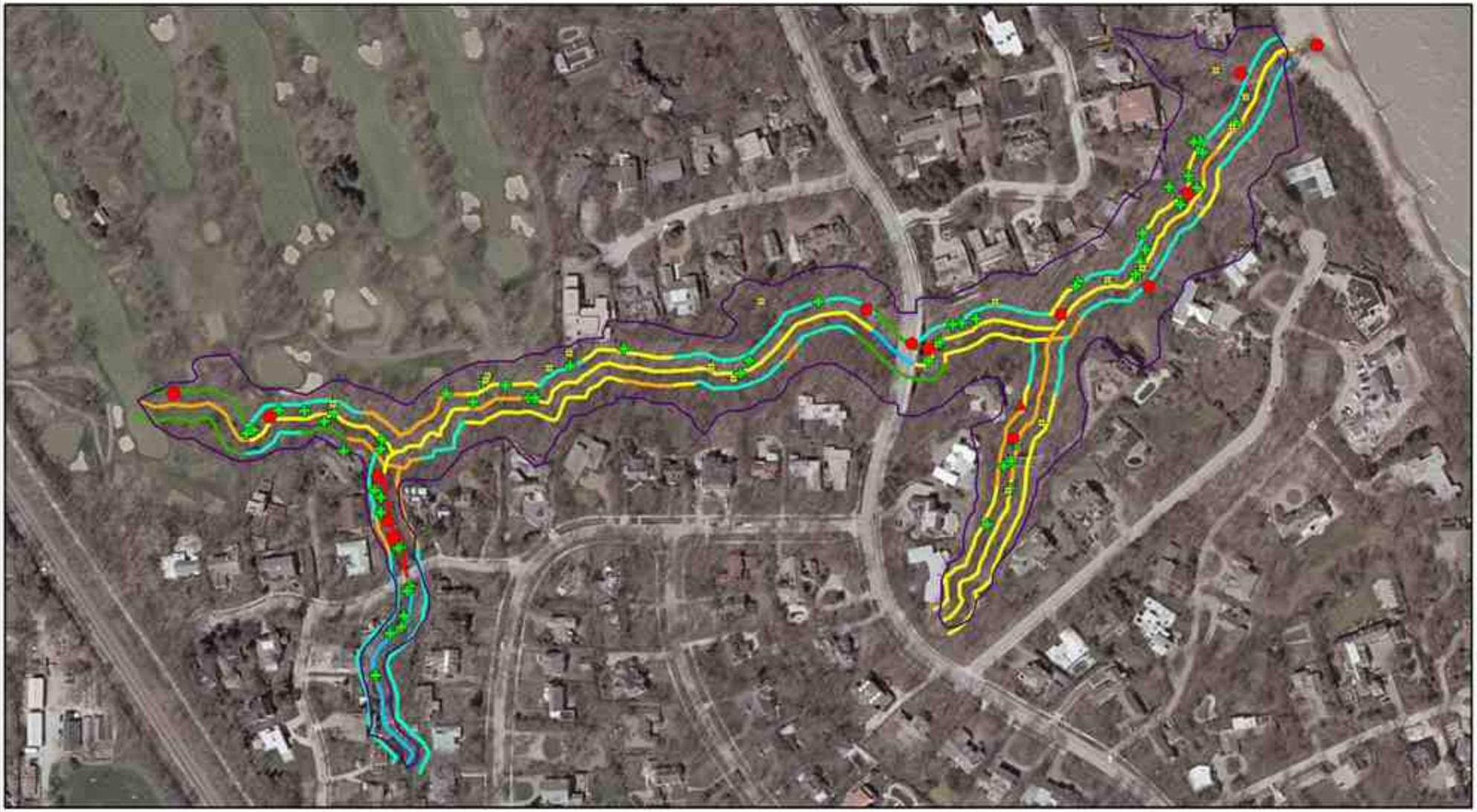

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,679

0 0.015 0.03 0.06 Miles

Ravine 5C

Ranked 10 out of 47

For Erosion Potential

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Date: 2/2009

Legend

- Gully
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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,169

0 0.01 0.02 0.04 Miles

Ravine 5L

Ranked 20 out of 47

For Erosion Potential

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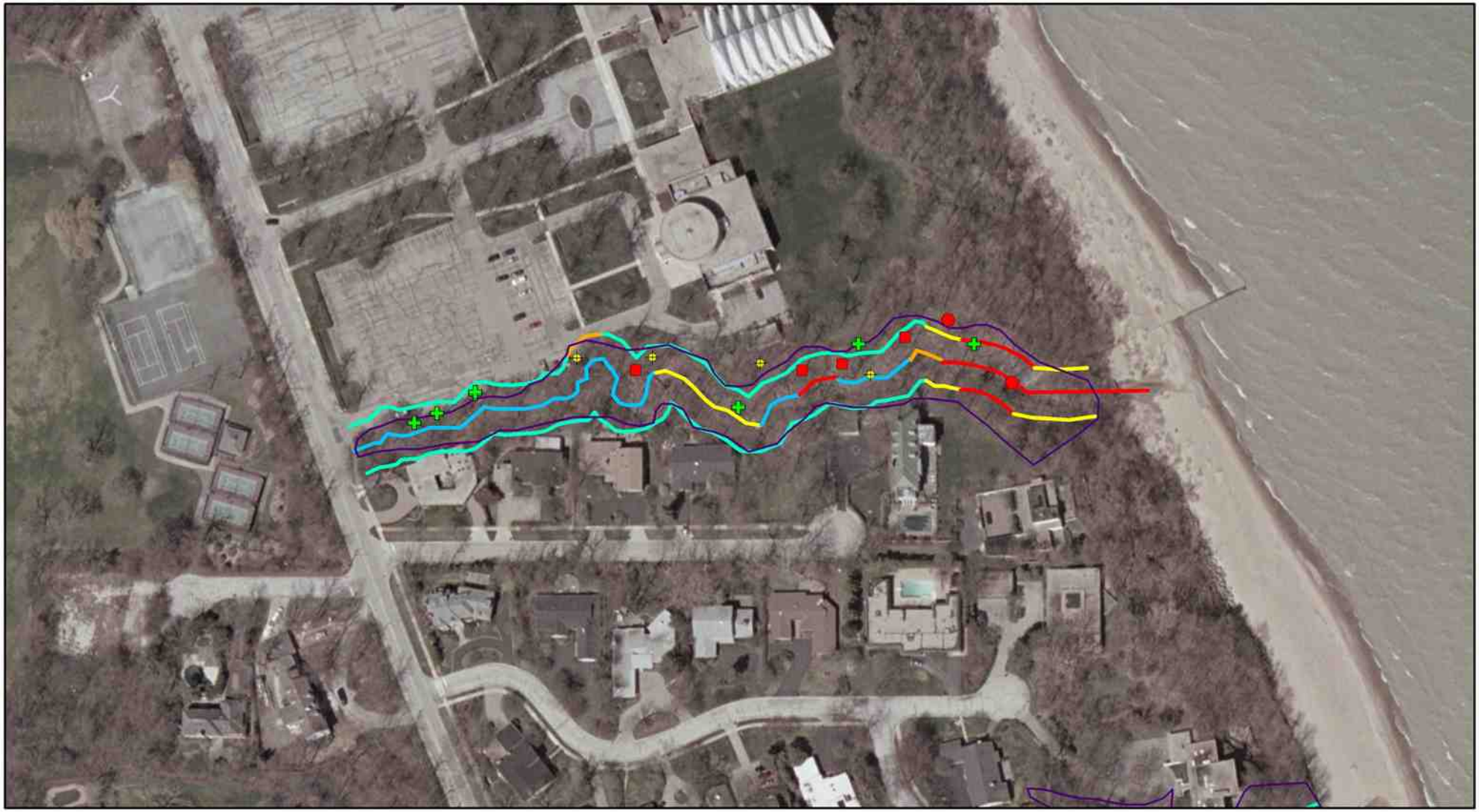

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312-939-0838

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Legend

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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,086

0 0.01 0.02 0.04 Miles

Ravine 6C

Ranked 24 out of 47

For Erosion Potential

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Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,169

0 0.01 0.02 0.04 Miles

Ravine 6L

Ranked 23 out of 47

For Erosion Potential

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Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,083

0 0.01 0.02 0.04 Miles

Ravine 7C

Ranked 17 out of 47

For Erosion Potential

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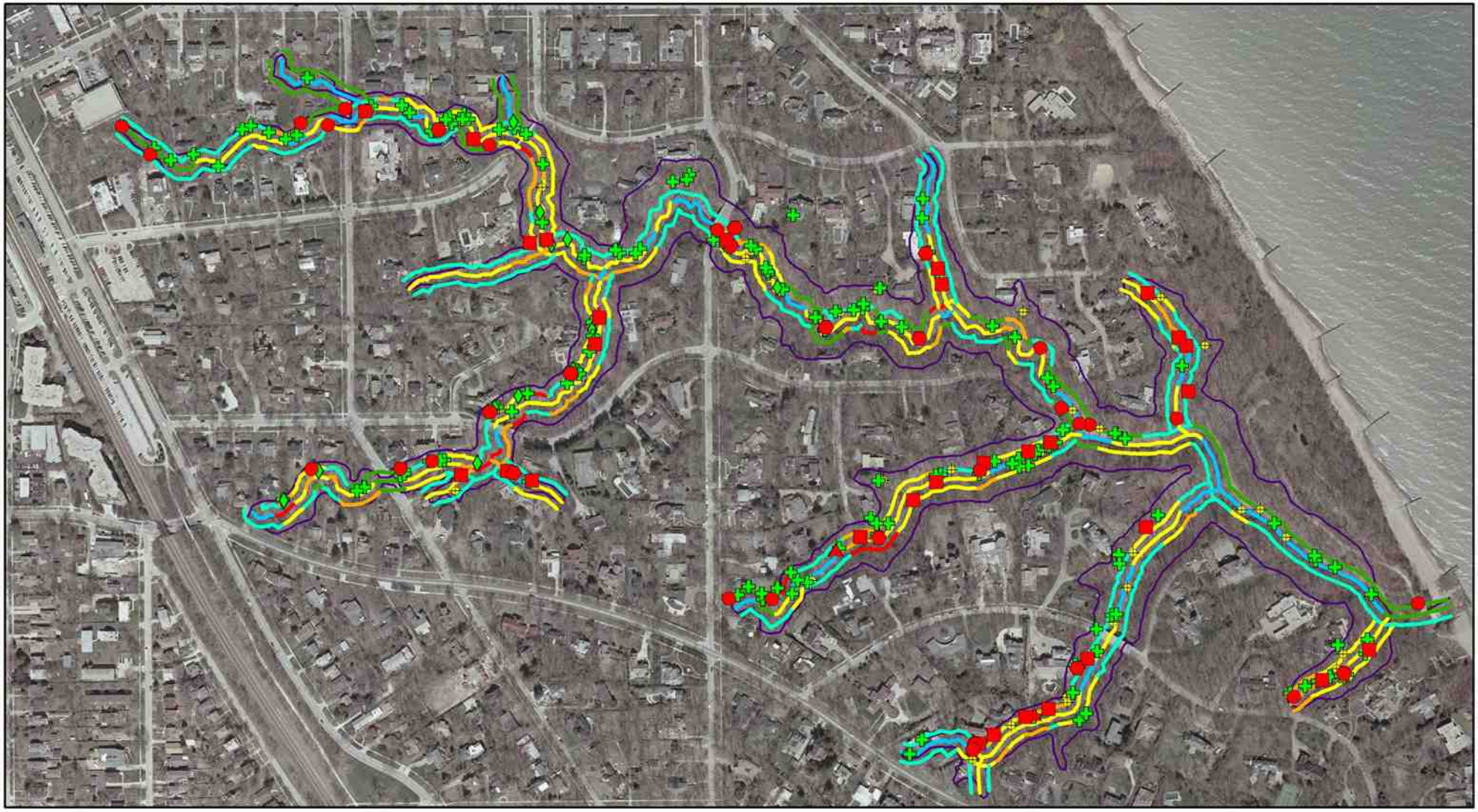

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Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,778

0 0.035 0.07 0.14 Miles

Ravine 7L

Ranked 2 out of 47

For Erosion Potential

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Legend

- Gully
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- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,363

0 0.015 0.03 0.06 Miles

Ravine 8L

Ranked 19 out of 47

For Erosion Potential

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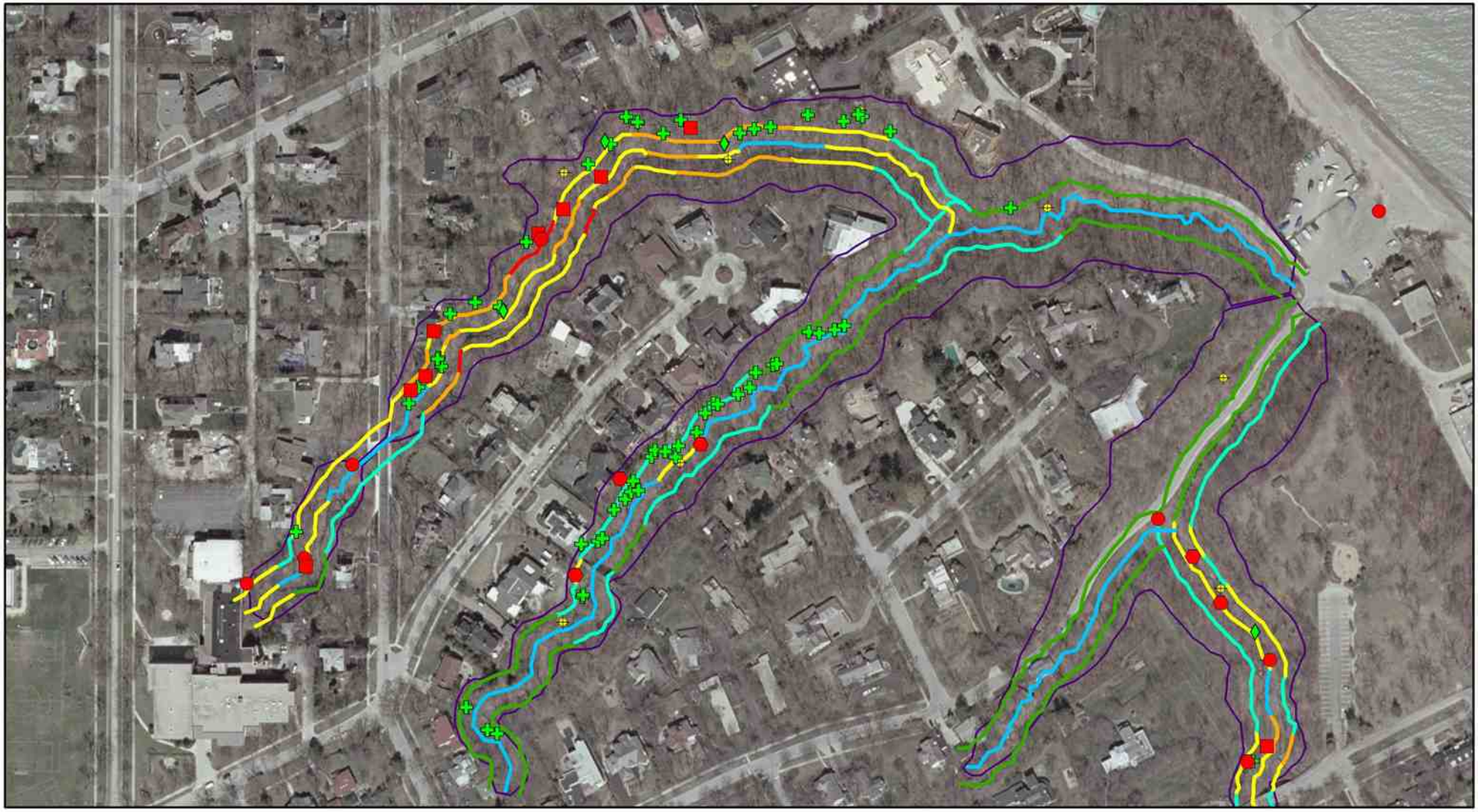

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312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,206

0 0.02 0.04 0.08 Miles

Ravine 9L

Ranked 15 out of 47

For Erosion Potential

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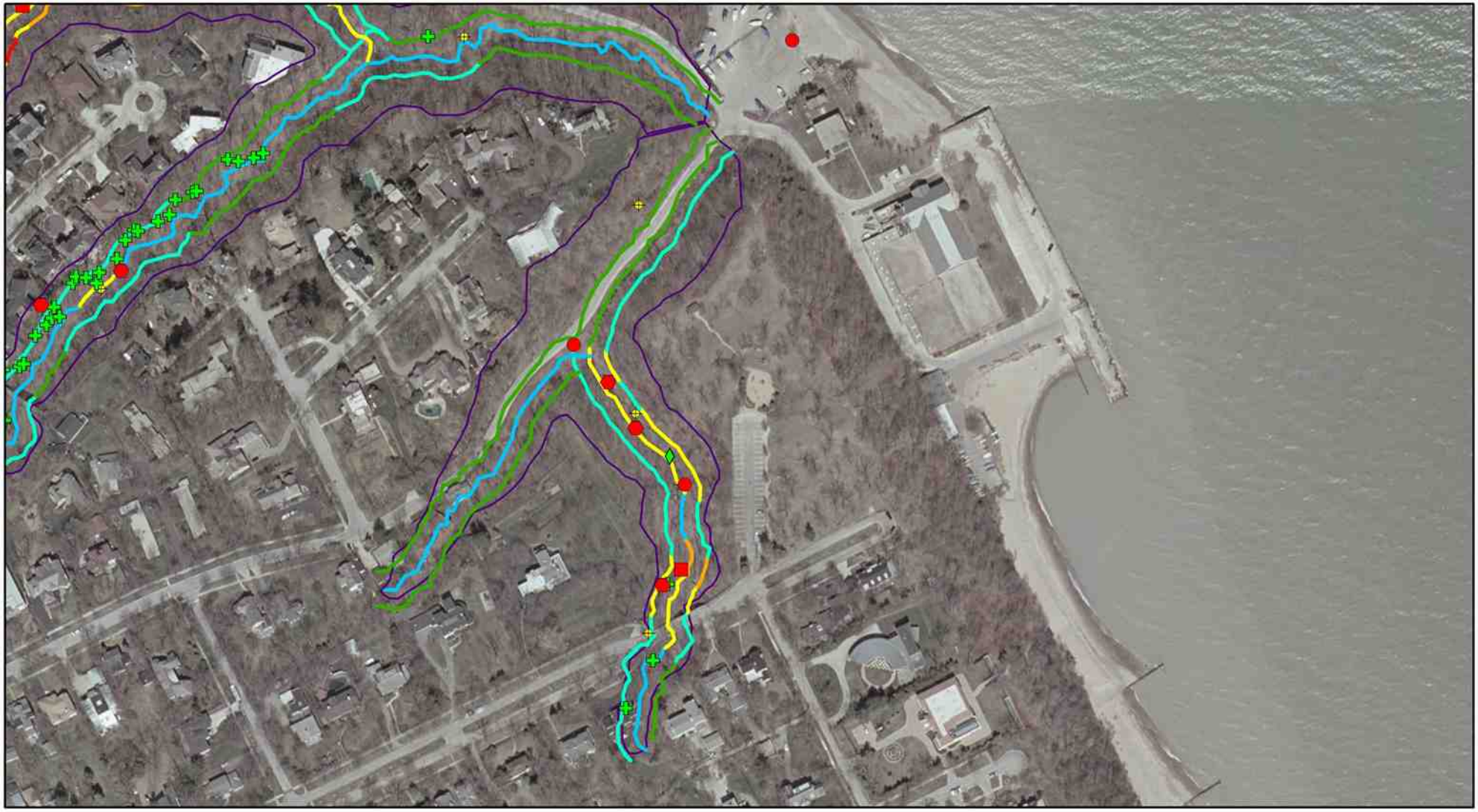

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312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,244

0 0.02 0.04 0.08 Miles

Ravine 9L2

Ranked 38 out of 47

For Erosion Potential

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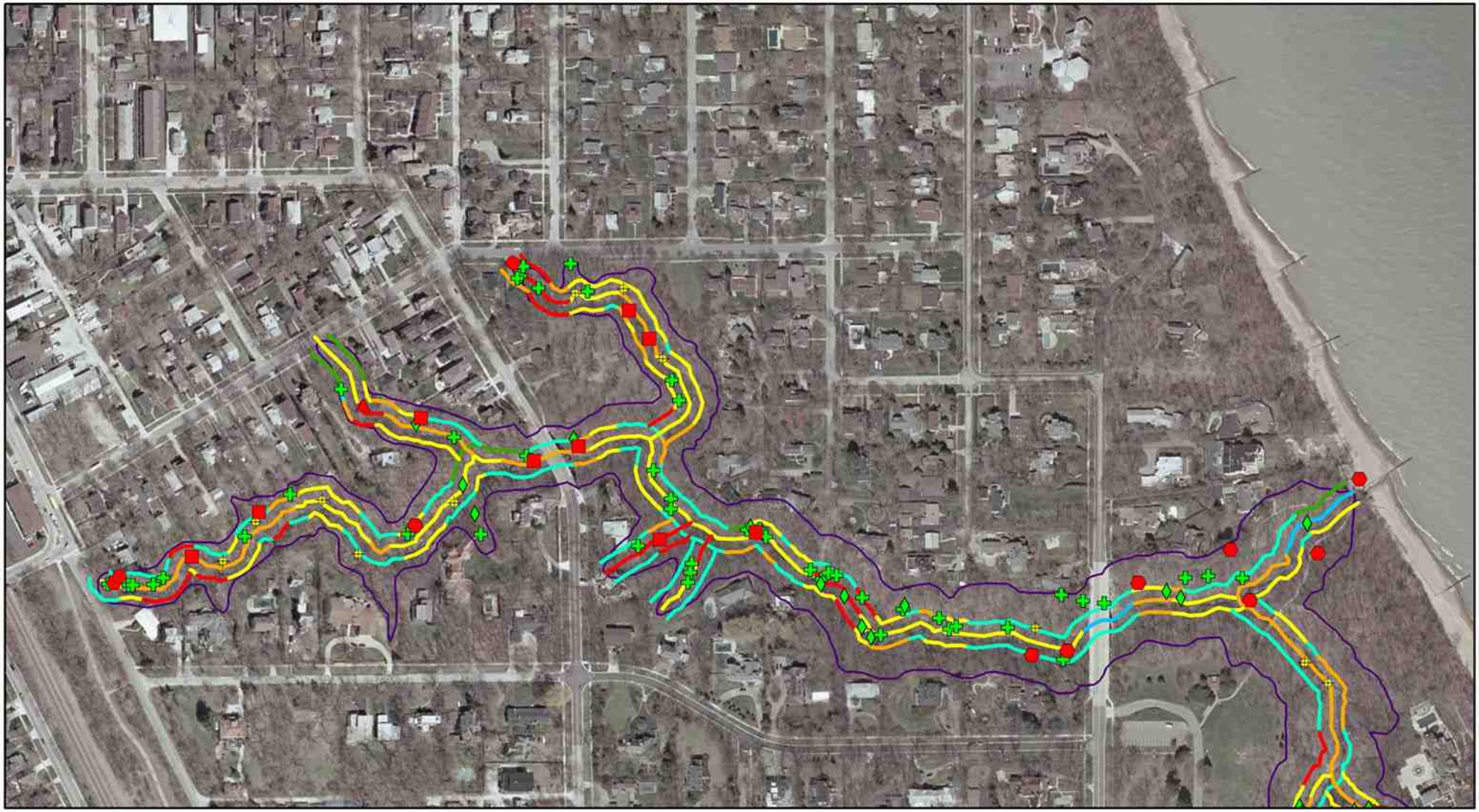

Lake Michigan Watershed Ecosystem Partnership Strategic Subwatershed Identification

c/o Alliance for the Great Lakes
17 N. State St., Suite 1390
Chicago, IL 60602
312-939-0838

Date: 2/2009

Legend

- Gully
- Existing/Working Structure
- Failing Structure
- Log Jam
- Knick Point
- Residential/Municipal Stormwater
- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,298

0 0.025 0.05 0.1 Miles

Ravine 10L North Section Ranked Highest or 1 out of 47

For Erosion Potential

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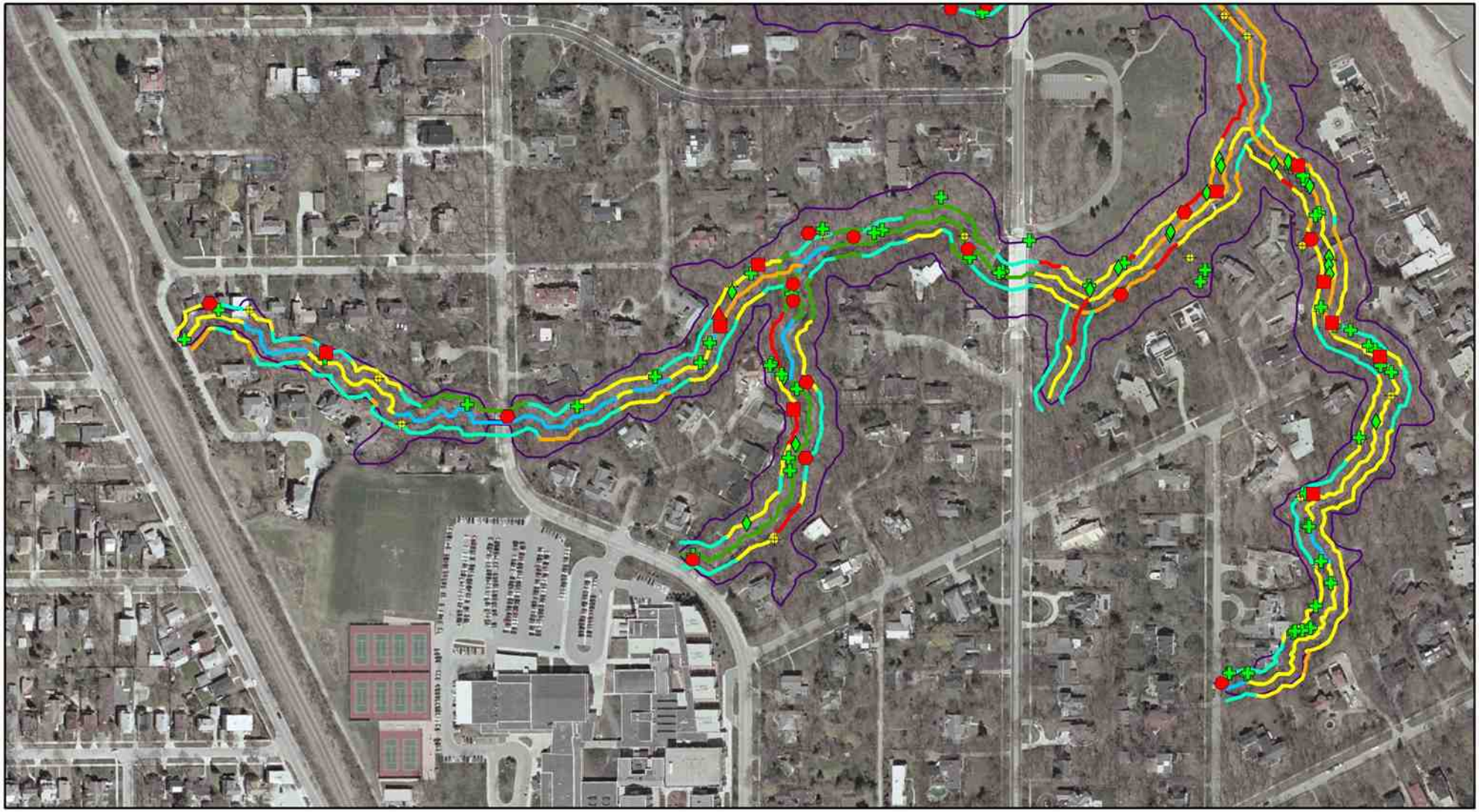

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,298

0 0.025 0.05 0.1 Miles

Ravine 10L South Section Ranked Highest or 1 out of 47

For Erosion Potential

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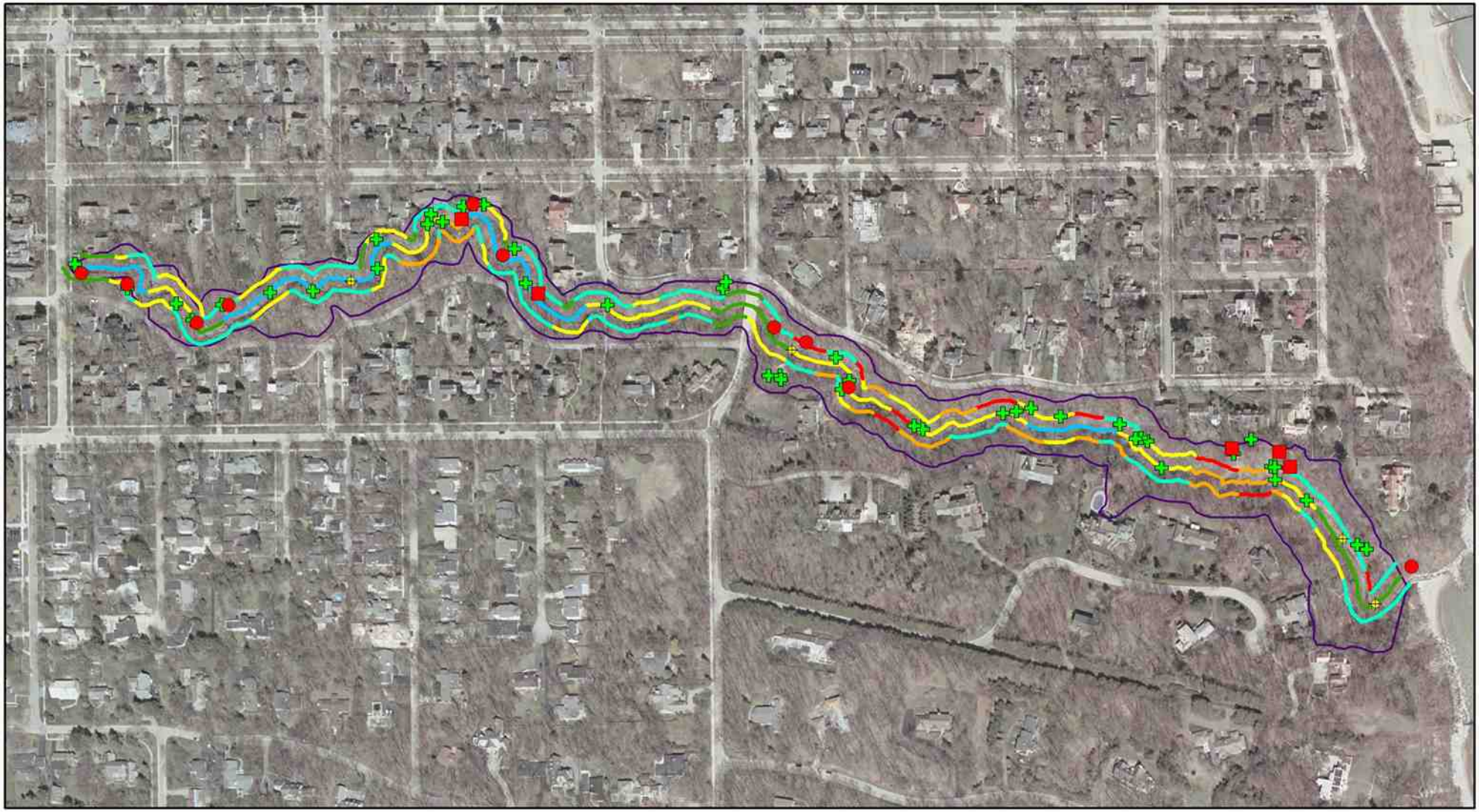

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:4,336

0 0.025 0.05 0.1 Miles

Ravine Park Ravine

Ranked 18 out of 47

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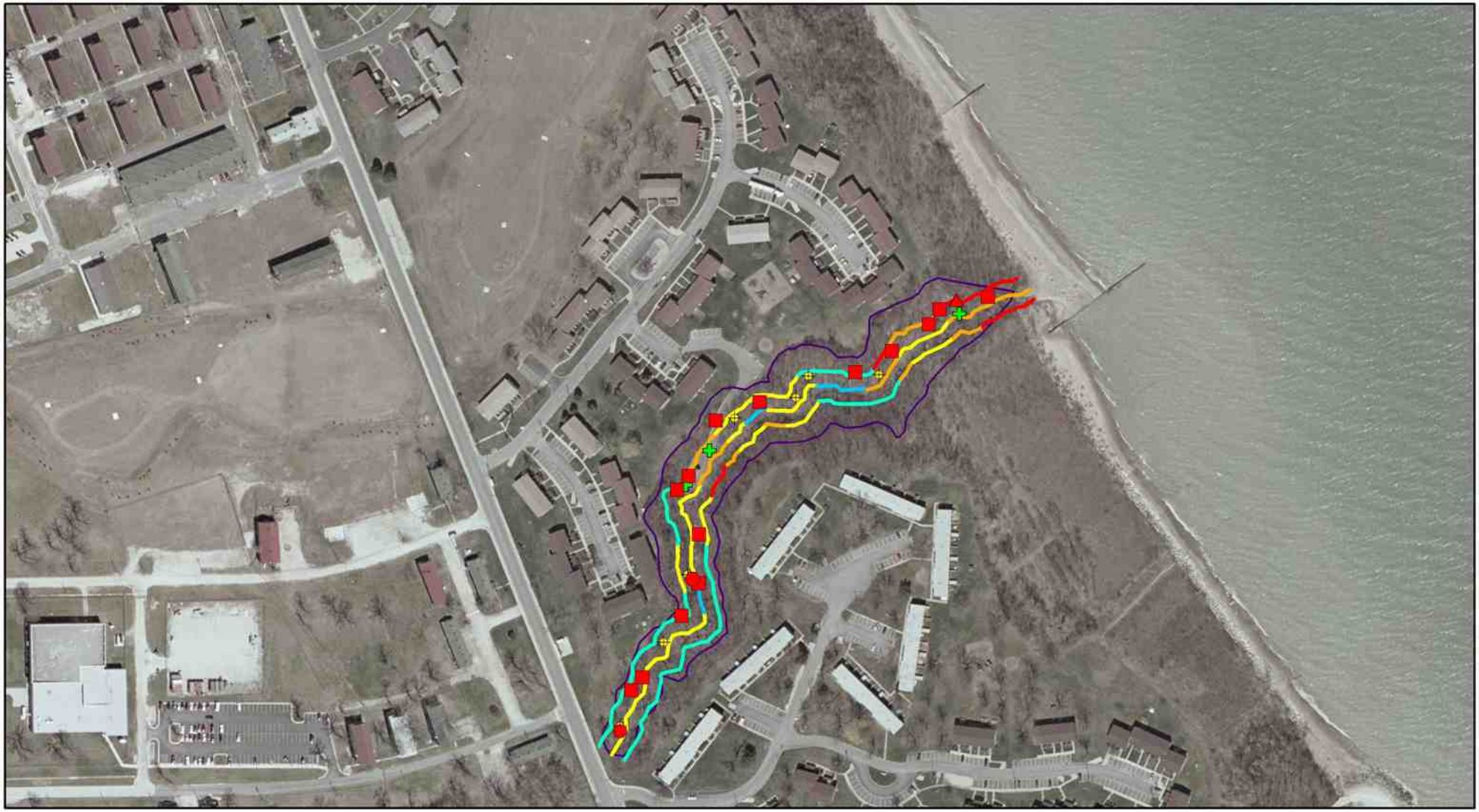

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- Exposed Pipe
- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:3,568

0 0.02 0.04 0.08 Miles

Schenck Ravine

Ranked 27 out of 47

For Erosion Potential

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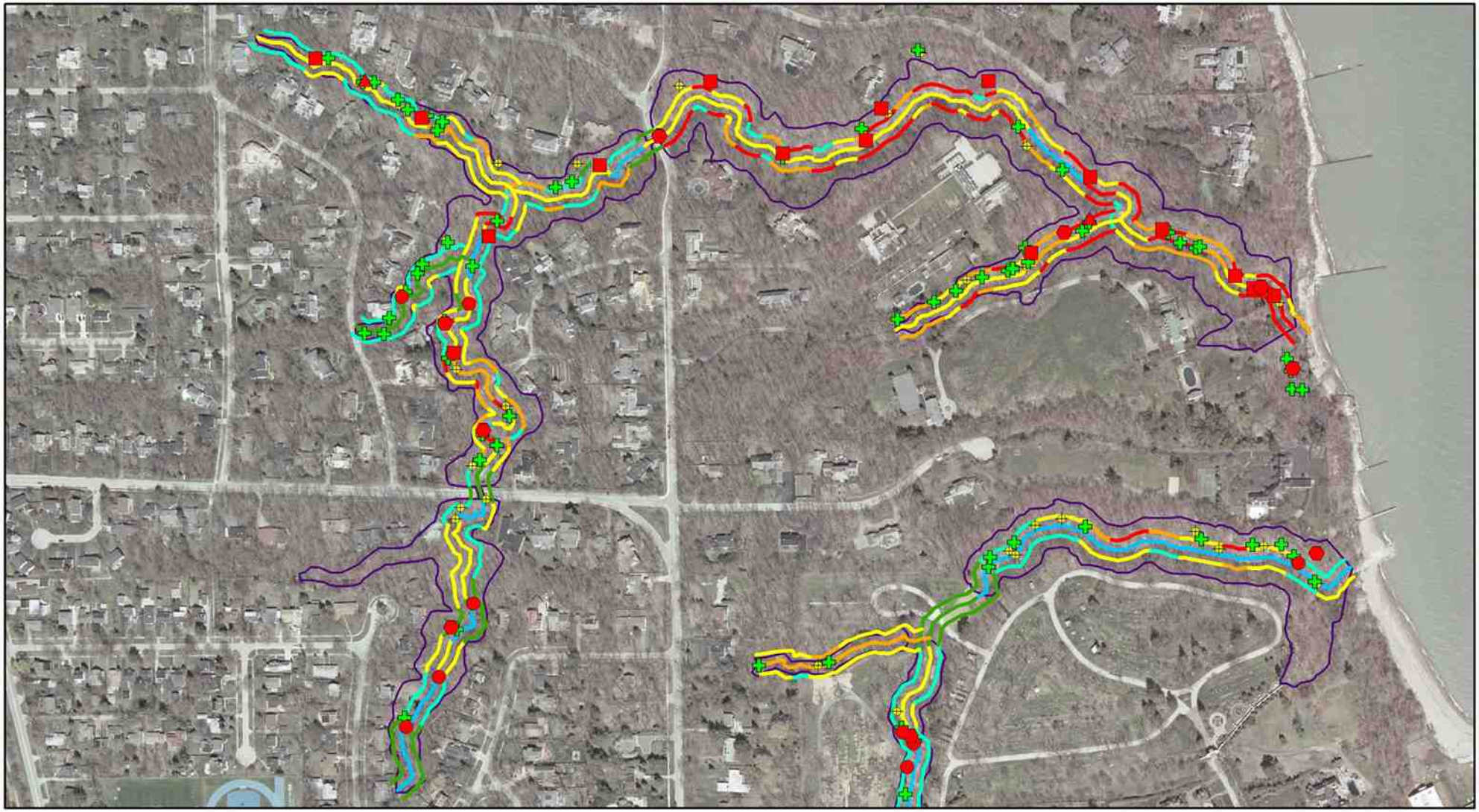

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- Top of Bank

Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,294

0 0.03 0.06 0.12 Miles

South Ravine

Ranked 6 out of 47

For Erosion Potential

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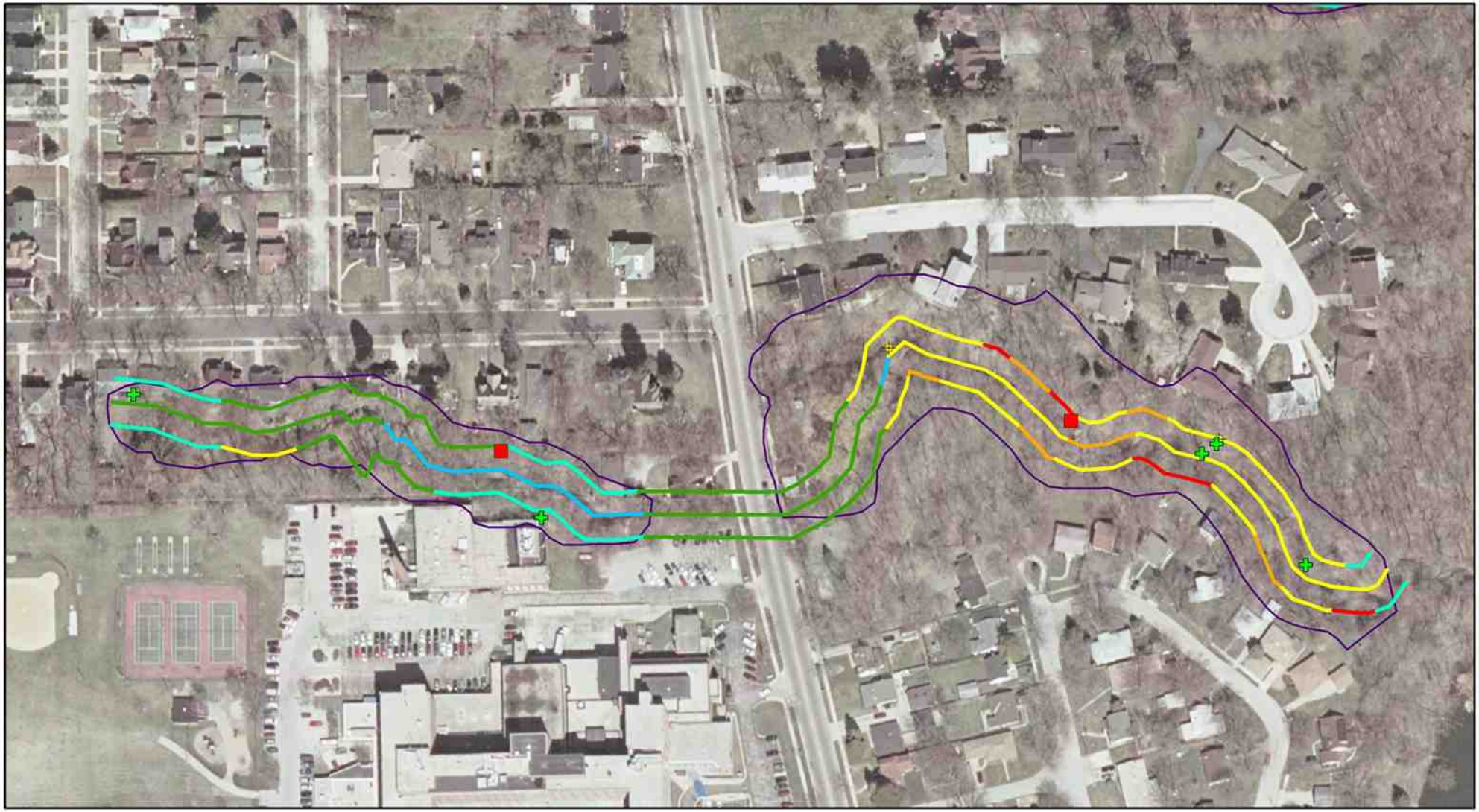

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Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,213

0 0.015 0.03 0.06 Miles

Stanley Ravine

Ranked 39 out of 47

For Erosion Potential

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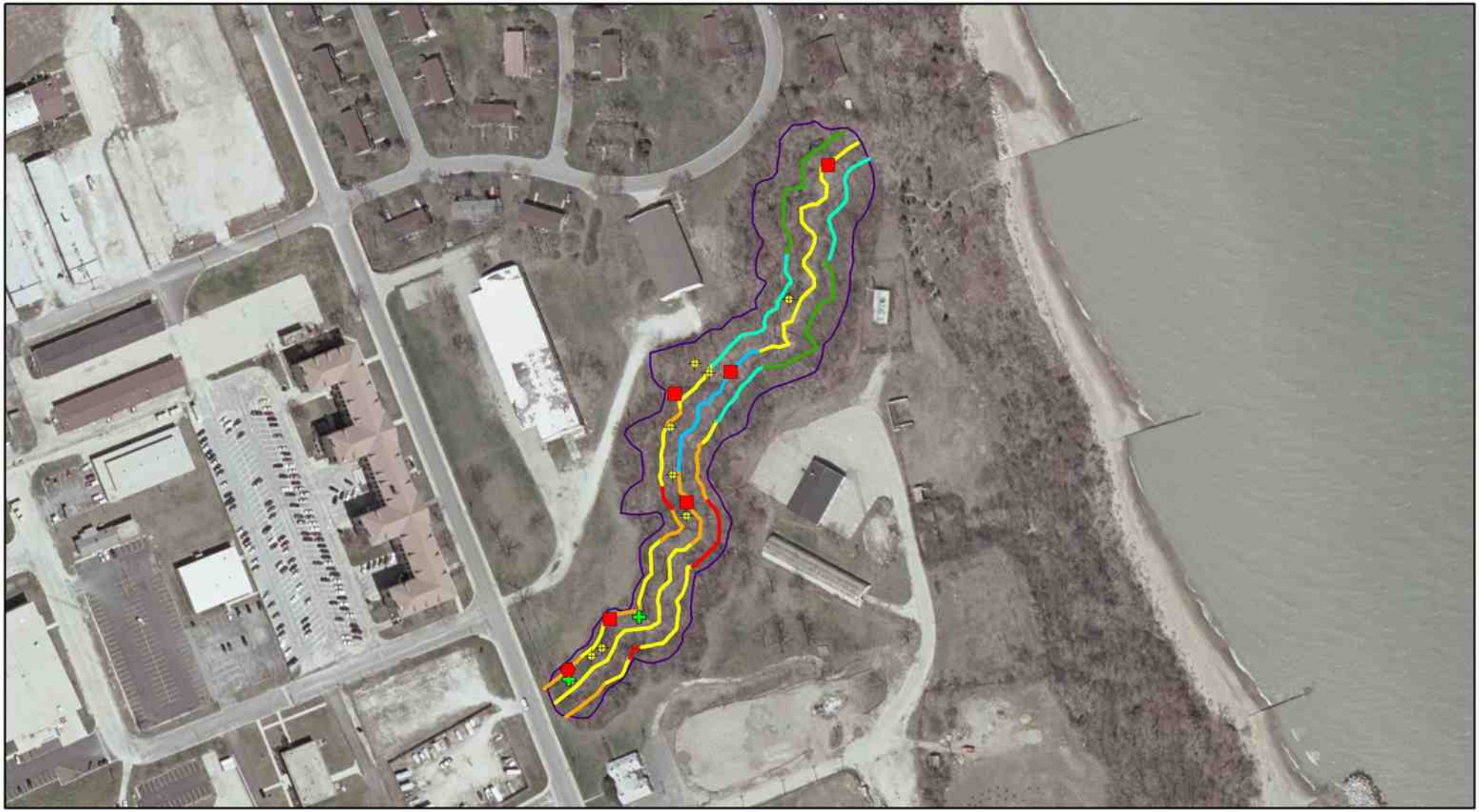

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Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:2,858

0 0.015 0.03 0.06 Miles

Van Horne Ravine

Ranked 42 out of 47

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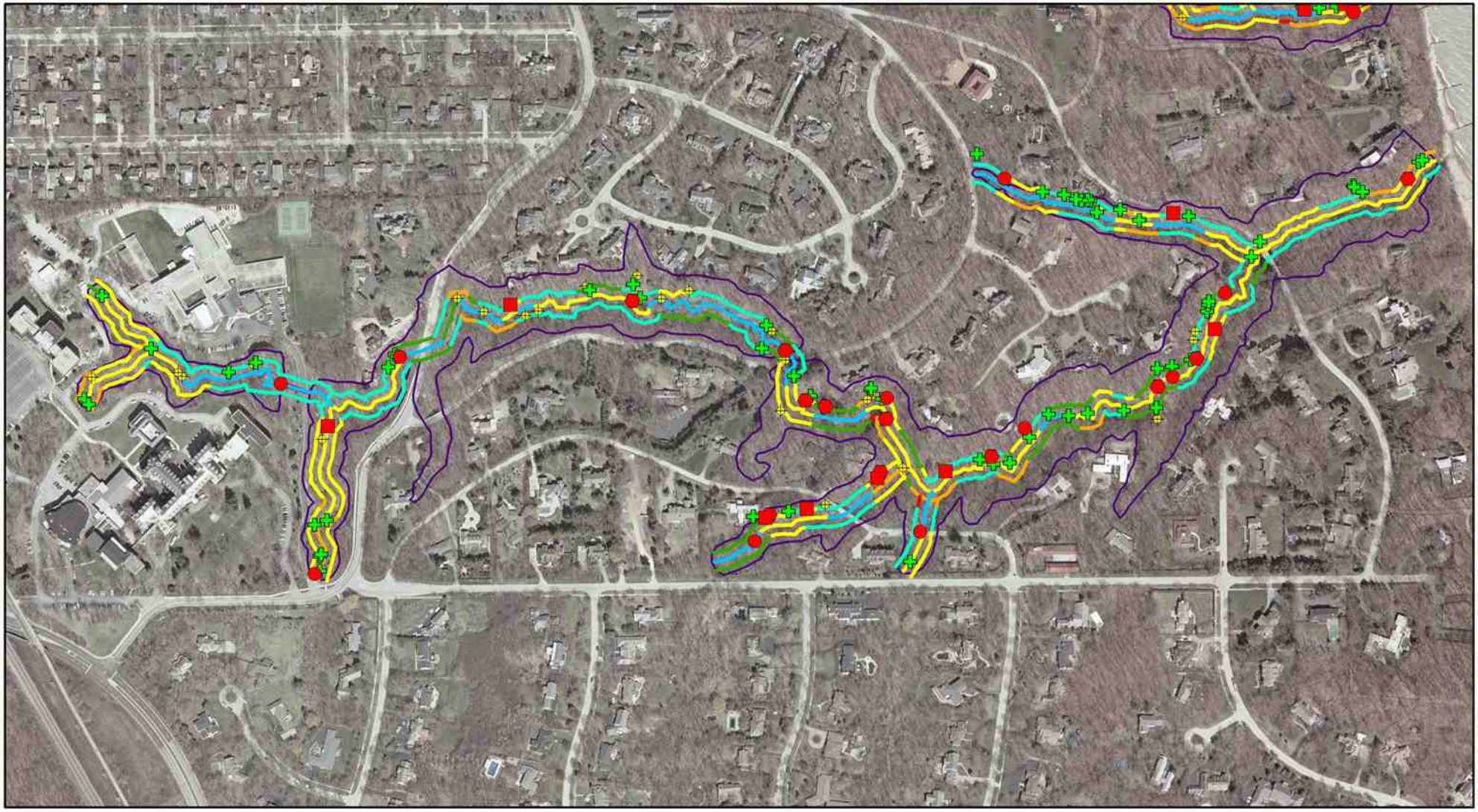

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Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,729

0 0.035 0.07 0.14 Miles

Walden Ravine

Ranked 12 out of 47

For Erosion Potential

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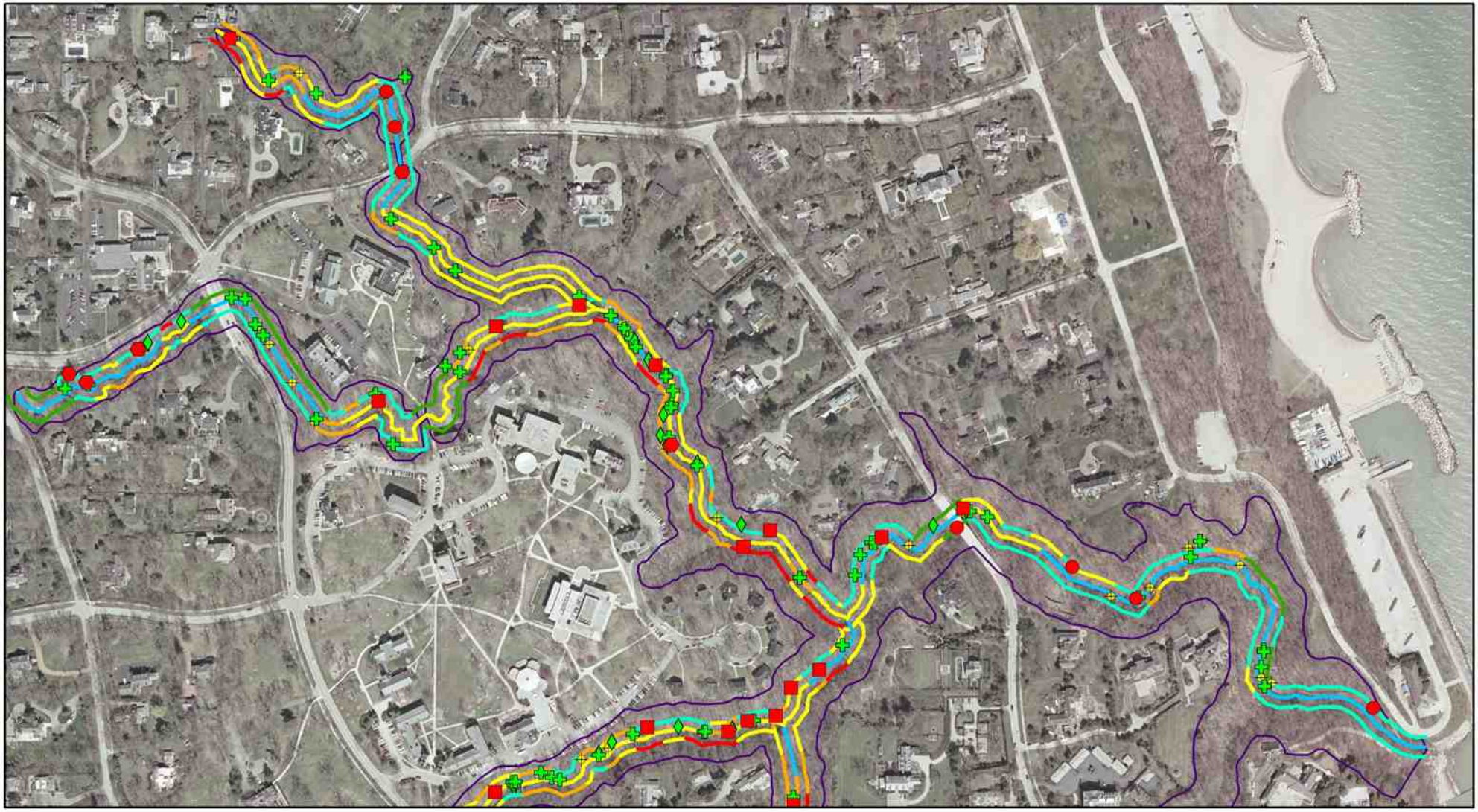

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Channel Stability Rank	Bank Stability Rank
1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,204

0 0.0375 0.075 0.15 Miles

Witchhazel Seminary Ravine North Section Ranked 4 out of 47

For Erosion Potential

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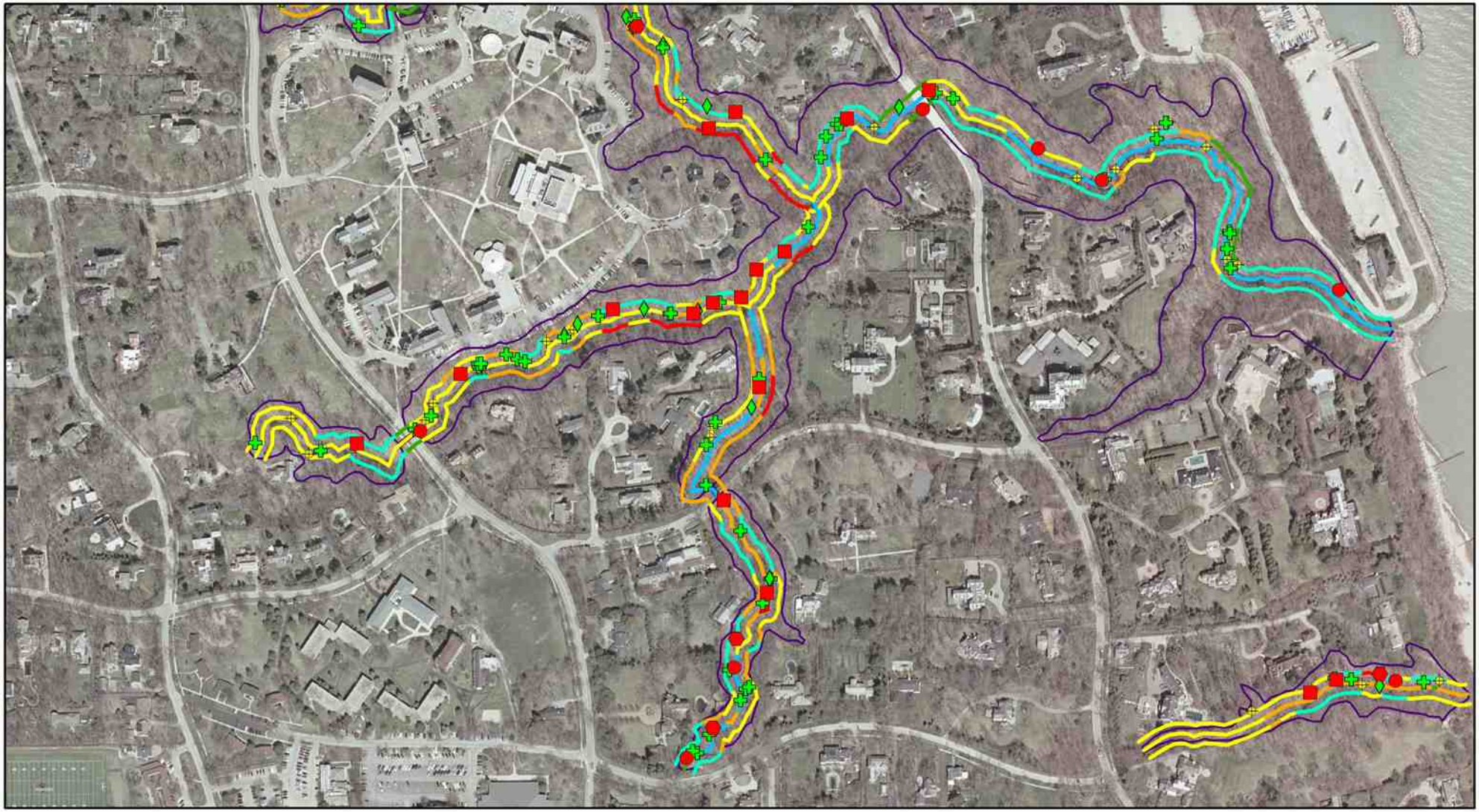

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1	1
2	2
3	3
4	4
5	5

* sections with a rank of 1 are considerd the worst

N
W E
S

1:5,204

0 0.0375 0.075 0.15 Miles

Witchhazel Seminary Ravine South Section Ranked 4 out of 47

For Erosion Potential

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