Report

Lilydale Regional Park Natural Resources Management Plan

City of St. Paul, Division of Parks and Recreation

May 2009

Project Number 000211-08110-0

Bonestroo

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Bonestroo

May 31, 2009

Ms. Alice Messer, Landscape Architect
City of St. Paul, Department of Parks and Recreation
50 West Kellogg Street, Suite 840
St. Paul, MN 55102

Re: Lilydale Regional Park Natural Resources Management Plan
Bonestroo File No.: 000211-08110-0

Dear Alice:

Please find attached the Report for the Lilydale Regional Park Natural Resources Management Plan. The plan includes summaries of existing conditions for plant communities, natural areas, water resources, and environmental hazards/contaminated soils. The report also includes summaries of potential future actions related to the management of natural resources as well as the lingering issues related to environmental hazards.

Overall, protecting and monitoring the water quality of Pickerel Lake is a top priority with bluff stabilization and dump site clean up following. Because Pickerel Lake is a focal point for the park master plan, the need to protect and maintain the water quality of Pickerel Lake is a high priority, along with the role it plays as wildlife habitat and supporting the best quality natural areas in the park. Pickerel Lake is the natural amenity within the park that visitors will be drawn to and the park is designed around with the road being realigned to provide gathering space adjacent to the lakeshore.

As well, the report provides a brief overview of the findings of this effort relative to the most recent park concept plan. Importantly, the existing conditions at the site alone do not prevent implementation of the concept master plan in its most recent form. However, the cost and practical implications of working in some areas may be substantial.

Thank you for the opportunity to work with you on this project. We hope you find this information useful for you, other staff, and advisory groups that you work with.

Sincerely,

BONESTROO

Paul J. Bockenstedt
Project Manager/Ecologist

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Introduction

Lilydale Regional Park (LRP) lies along the Mississippi River in the heart of St. Paul, Minnesota. The site is within an ecologically significant stretch of the river. Likewise, the area that is now Lilydale Regional Park has substantial human history, including hosting the former site of the City of Lilydale. The City of St. Paul, Department of Parks and Recreation is in the process of planning for long-term management and potential development of the park to showcase its natural features and enable increased public access.

To better understand the existing ecological conditions of the natural communities and water resources present, as well as the influence of past human use of the area, St. Paul Parks hired Bonestroo in 2008 to conduct a field-based inventory of natural areas/land cover types and water resources, as well as review existing information on environmental contamination. This information will help to form the technical foundation for park planning efforts and will help frame the practical possibilities for human recreational use of the park, as well as the opportunities for ecological restoration and management.

A BRIEF LOOK AT THE NATURAL HISTORY OF THE STUDY AREA

The particular resource elements present in any particular area and their patterns in the landscape are the result of historical processes, including climate, hydrology, plant, animals and their interactions, as well as human decisions and activities. This section very briefly describes the role some of these interactions have played in determining the present day composition of natural communities and landscapes in the area.

GLACIAL LANDSCAPES

The topography of the region was most heavily influenced by the last period of glaciation (the "Wisconsin Stage"), which ended in east-central Minnesota about 10,000 years ago. The Des Moines Lobe of this most recent glaciation entered the area from the northwest, sculpting the landscape and leaving behind a variety of deposits, including drift/till and outwash composed of sand and gravel, and windblown deposits of very fine sands in upland areas. The Grantsburg sublobe of the Des Moines ice sheet surged to the northeast from what is now the Twin Cities area, extending into western Wisconsin. Most of LRP occurs within the floodplain of the current Mississippi River. At the end of the last glacial period, this river served as a conduit for meltwater and the sediment it carried.

AFTER THE GLACIERS

After the glaciers melted, spruce trees and tundra colonized the periglacial environment in the region. This was later followed by pine barrens and mixed boreal forests with a bracken fern-dominated ground layer. As the climate of the region warmed dramatically about 9,000 years ago, evergreen trees began to decline, and prairie expanded into the region, along with elm and oak forests. The climate remained in this warm period until about 7,000 years ago, when midgrass prairie reached its maximum extent in Minnesota, and covered the southwest half of the state, including the Twin Cities region.

Prairie, oak woodlands and brushlands, and oak savanna – consisting of scattered trees with a prairie-like ground cover – dominated the central and eastern Minnesota region until about 4,000 years ago, when the climate gradually became cooler and moister.

Oak thickets spread, and oak woodlands came to dominate some upland areas, interspersed with tall grass and wet prairies. White pines also migrated to south approximately to the north edge of the Twin Cities as the climate cooled. About 300 years ago, the climate became especially moist and cool, and fires became less frequent. As a result, extensive forests of elm, sugar maple, and basswood (known as the Big Woods) developed in eastern Minnesota, including a patch documented across the river just to the northwest of LRP. With this, the major patterns of vegetation in the area at the time of Euro-American settlement were in place.

INFLUENCE OF LANDFORM AND CLIMATE ON VEGETATION TYPES

Plant communities that exist in any given area are the result of numerous biological and physical factors. These work in concert to influence plant communities in subtle ways, and sometimes in dramatic and immediate ways such as drought, or a tornado. Biological factors include such varied things as the presence or absence of pollinators, burrowing activities, herbivory, or over utilization of an area by a single species or number of species.

Of the physical factors, two have a consistently strong influence in the shaping of plant communities. These are climate and landform. The climate in this region of Minnesota is considered to be continental and subhumid, with long, cold winters and relatively brief, warm summers. Wide fluctuations in temperature and precipitation strongly influence the plant communities present in the region and cause plants to be adapted to extremes, rather than averages.

Landforms also have a profound impact on the type of plant communities found in any area. Direct glacial and stream modification of the landscape, such as the deposition of till, moraine, or sediment, and the influence of periglacial processes such as outwash, have formed the vast majority of the landforms in this region. Materials associated directly with glaciers, such as till and moraine tend to be unsorted in the area and would be found at the top of the bluff. Sorted materials would be encountered in the floodplain of the Mississippi River as a result of the glacial meltwater rivers, and the Mississippi as we know it today.

In addition to the influences of climate and landform, landscape position also has a profound impact on the type of plant communities supported. Slope steepness, position, and aspect (direction a slope faces) all strongly influence the plant species that can occur in an area. Slope aspect plays a significant role since it can exaggerate the influence of the sun; the amount of water plants lose through their leaves on south- and southwest-facing slopes makes these areas more hospitable to prairie or dry oak communities. North-facing slopes tend to be moister and are more likely to support woodlands/forests.

Pre-Historic Influence of Humans on the Landscape

Ideas about the history of Native Americans and their influence on the local landscape are still evolving as archeologists continue to find new evidence. Native Americans have probably inhabited and hunted in the region for over 10,000 years. While their impacts were not as great as those of European settlers, Native Americans used a wide variety of plants and animals for food, and altered vegetation patterns for cultivation by setting fire to broad expanses of landscape.

Native Americans (and European fur traders) used fire to hunt game; create desired habitat; clear the landscape for travel, communication and defense; and obtain firewood. While some of the historic fires in the region would have occurred naturally, the activities of Native Americans undoubtedly accounted for the vast majority of fires. Prairies, savannas, and oak forests are fire-dependent plant communities, and would most likely not have been present in the Twin Cities Area at the time of European settlement without these fires.

Vegetation at the Time of Settlement

According to the General Land Office (GLO) survey notes (generally compiled in this region of Minnesota in the 1850's and 1860's) the presettlement vegetation of LRP was comprised of *River Bottom Forest* along the Mississippi River and its floodplain, and *Oak Openings and Barrens* in upland areas. Oak Openings and Barrens are generally thought to have been areas that varied from open, savanna-like areas to forests with patchy tree canopy cover.

Post-Settlement Influences on the Landscape

As the Twin Cities region was settled, increasingly intense human activities began to change the landscape and natural communities. In the Twin Cities today, over 95% of the native plant communities present at the time of Euro-American settlement have been substantially altered, or completely lost to activities such as row crop agriculture. As these remaining natural areas became smaller and increasingly isolated from one another, the risks of losing native plant and animal species and their complex ecological interactions increases. Some examples of changes since Euro-American settlement include:

- Roads and the railroads began to fragment forests and other communities.
- Agriculture affected hydrology by draining wetlands and altering creeks.
- Vegetation was altered through clearing, plowing, cessation of regular fires, and incompatible grazing techniques/levels.
- Soil erosion increased where native cover was removed, adding sediments to creeks, wetlands and lakes.
- Development and conversion of native plant communities to rowcrop agriculture continues to further fragment natural communities.
- Non-native, aggressive species such as European buckthorn, reed canary grass, and honeysuckle continue to expand.

From a water resources perspective, perhaps the largest impacts have been associated with the changes in drainage patterns associated with urban development. As landscapes have been changed from open undeveloped conditions to a suburban or urban condition, native soils that previously infiltrated much of the precipitation falling on those areas were compacted and covered with impervious areas such as streets, driveways, parking lots, and roof tops. These changes by themselves dramatically increased the volume and rate of runoff compared to the undeveloped condition. To protect property from flooding, stormwater drainage facilities are installed to quickly convey the runoff volumes downstream.

While the facilities provided an efficient way of moving water off the developed landscape quickly, the additional volume and higher flows often overwhelmed the natural drainage channels to which they discharged, causing instability in those channels and delivering eroded sediment to downstream areas in much higher amounts than under the natural condition. In addition, increased human activity – especially vehicle use and lawn maintenance – increased the amount of pollutants available to be washed off the landscape during precipitation events. The increased runoff volume together with increased pollutant amounts mean that an urban landscape delivers far more pollutants to receiving waters at the downstream end of the system than the landscape did under the natural condition. This is important because Pickerel Lake and its adjacent wetlands are at the downstream end of a storm drainage system serving portions of the cities of Mendota Heights, West St. Paul, and St. Paul. Much of this area was developed before modern stormwater treatment practices were common place.

As well, the park area has a long history of use and impacts by humans since Euroamerican settlement, particularly in the latter half of the 20^{th} century. Until the 1970s, the park was the location of the small town of Lilydale with approximately 600 residents. In addition to numerous homes and related out buildings, the property has been the location of a number of industrial and commercial operations including but not limited to a brick yard, an automobile salvage yard, a marina and a demolition landfill.

By the early to mid 1970s, frequent flooding provided the impetus for relocation of nearly all of the businesses and residents. It appears that some of the remaining vacant structures were consolidated into one or more on-site demolition fill areas at about that time. As the property became sparsely inhabited, a 20-year period of promiscuous solid waste disposal ensued. The following excerpt is from a Minnesota Pollution Control Agency (MPCA) site visit conducted November 24, 1972, “A drive through the lower Lilydale area revealed an ugly mess. Generally junked autos, demolition wastes and various other solid wastes were strewn about the entire area.” There are records of significant surficial cleanups that were conducted in both 1987 and 1988 with the latter reportedly resulting in the removal of 77 tons of waste. Despite these efforts, illegal dumping apparently continued until about 1990 when guard rails were erected along both sides of Lilydale Road and West Water Street. This measure effectively limited vehicular access to the more secluded areas of the park that proved most attractive to illegal “midnight dumpers”.

Project Methodology

INTRODUCTION

This portion of the report is broken down into three sections, including the natural areas inventory/land cover mapping, water resource analysis, and environmental hazards/contaminated soils. The methods for each of these respective subject areas is described in greater detail below.

NATURAL AREAS INVENTORY/LAND COVER MAPPING

This Land Cover Classification and Natural Areas Inventory project was conducted for all natural and semi-natural areas within the LRP. A brief summary of the methodology is provided below.

GATHER AND REVIEW BACKGROUND INFORMATION

To provide a more detailed understanding of the study area, ecologists working on the project collected and reviewed available information on natural resources. This included information about vegetation at the time of European Settlement, biological survey information for Ramsey and Dakota Counties, wetland and water resource information, information about existing corridors, and the county soil survey.

MINNESOTA COUNTY BIOLOGICAL SURVEY

The Minnesota County Biological Survey (MCBS) conducted an inventory of select remaining natural communities and ground surveys, including the Mississippi River corridor that LRP lies in. At that time the plant communities in LRP were determined to be either too degraded or too small in size to be included in the survey. There have been several rare species documented in the park, including bald eagle and Blanding's turtle. In the case of the eagle, there is at least one active nest in the park. Blanding's turtles tend to be seasonally migratory and generally less noted by the general public, perhaps explaining in part the lack of recent documentation.

MINNESOTA LAND COVER CLASSIFICATION SYSTEM (MLCCS)

Staff ecologists reviewed the existing MLCCS data previously completed by MnDNR, National Park Service, and Dakota County SWCD to both identify the location of natural communities, and to evaluate the quality of the data. The existing MLCCS data including mapping that was primarily based on aerial photo analysis as well as viewing from nearby vantage points. As a result, detailed information about plant community species composition, structure and restoration potential was not available. Natural and semi-natural areas within the MLCCS GIS layer were compared to aerial photos for a preliminary verification of cover type, and were then plotted on the base maps for the field inventory effort.

MINNESOTA ROUTINE ASSESSMENT METHOD (MNRAM) WETLAND INVENTORY

Wetlands within the park were field assessed using the MnRAM method for evaluation Function and Value. Field data gathering specifically included the Wildlife and Education portions of the method. Data was then entered into a Microsoft Access database specifically designed for MnRAM. The electronic data and results of MnRAM were provided to parks staff as part of the final deliverable.

PREPARATION OF FIELD BASE MAPS

After review of the MLCCS and MnRAM information, project ecologists plotted 2005 Farm Services Administration (FSA) true-color low altitude aerial photographs at a scale of 1"= 200'. Available electronic data layers such as the National Wetlands Inventory, geopolitical boundaries, parcel boundaries, transportation information, and DNR Natural Heritage (MCBS) data are also printed on these plotted photos to assist in the field review. MLCCS data for natural and semi-natural areas, as well as information from the wetland inventory, was also included on the base maps.

FIELD INVENTORY

Field inventory work and land cover classification took place between late summer and fall of 2008. During the field review, a 5-digit MLCCS code was assigned to the natural and semi-natural areas. Other pertinent data was also recorded including notations using MLCCS Modifiers and Field Check Levels (see below).

The field survey also included identification of dominant plant species within a given natural community. Intensity of inventory effort was related to the overall quality of an area. In general, good quality natural communities were more thoroughly inventoried and more extensive searches conducted for uncommon or rare species. The field inventory emphasized gathering data on the composition, structure and function of natural communities, including disturbance indicators such as exotic species and erosion. This information provides a solid starting point for assessing the current condition of the community and can be used to develop management recommendations.

LAND COVER CLASSIFICATION

MLCCS BACKGROUND

The Minnesota Land Cover Classification System Version 5.4 was used to classify land cover within the city. A brief explanation of the method and its application to this project is provided below. *The complete 273 page MLCCS Manual can be viewed/downloaded on the MnDNR web site at the following address: http://www.dnr.state.mn.us/mlccs/index.html.*

MLCCS has a five-level hierarchical system of land cover codes to describe natural, semi-natural, and cultural land cover types. Natural land cover types include areas such as forests, prairies, wetlands, shrublands, and other similar areas. Semi-natural areas are those dominated by nonnative plant species, but are not actively planted/maintained by humans through activities such as mowing/cutting. Cultural land cover types are areas that can be thought of as developed or substantially impacted by humans. These typically include paved (impervious) areas, agricultural fields, pastures and frequently manipulated grasslands, quarries, and others.

Progression through each of the five levels of the system represents an increased level of detail in land cover classification. In this framework, Level 1 is the least detailed and Level 5 is the most detailed. For the purposes of this project, all natural and semi-natural areas within the city were classified to the greatest level of detail practical (typically, Level 4 or Level 5).

MLCCS MODIFIER CODES

Several 'classes' of MLCCS modifiers were assessed in the field while conducting the land cover classification at LRP. These modifiers were assessed based on the methodology and definitions provided in the MLCCS training manual. Once assessed, the modifier values were entered into the GIS database for each land cover polygon. Below is a brief summary of the most commonly used MLCCS modifiers for this project.

NATURAL COMMUNITY QUALITY MODIFIER (M_34X)

The M_34x modifier was developed as part of MLCCS methodology as a cursory method to assess the general natural quality of natural community and semi-natural land cover types. This modifier has four general categories. The assessment method is based on general ecological variables, and is applied in the same manner for all natural community types. The following is the description of the M_34x modifier from the MLCCS training manual:

34x - Modifiers for natural community quality ranking

The natural plant community sites can be given a natural quality ranking, based on the DNR's Natural Heritage's Element Occurrence Ranking Guidelines[*] (EOR). See "Natural Community Modifiers" for a discussion of the Element Occurrence Ranking Guidelines.

Refer to the EOR Guidelines to evaluate the specific natural communities. Non-native, altered and disturbed communities should only be given a non-native ranking (NN or NA). Valid codes and general definitions for modifier M_34x are:

- **A** = highest quality natural community, no disturbances and natural processes intact. Site must be visited entirely or partially to accurately assess its natural quality at this level (fld_level = 3 or 4). Modifier code = 341
- **B** = good quality natural community. Has its natural processes intact, but shows signs of past human impacts. Low levels of exotics. Site must be visited entirely or partially to accurately assess its natural quality at this level (fld_level = 3 or 4). Modifier code = 342
- **C** = moderate condition natural community with obvious past disturbance but is still clearly recognizable as a native community. Not dominated by weedy species in any layer. Minimally, the site must be visited from the edge to accurately assess its natural quality at this level (fld_level = 2, 3 or 4). Modifier code = 343
- **D** = poor condition of a natural community. Includes some natives, but is dominated by non-natives and/or is widely disturbed and altered. Herbaceous communities may be assessed with this ranking from a distance (fld_level = 1) if large masses of invasive species are present and the entire community is visible. Modifier code = 344
- **NA** = Native species present in an altered / non-native plant community. This NA ranking can only be used if the site is field checked from the edge or to a greater degree (fld_level 2, 3, or 4), thus confirming the presence of native species within a non-native community. Modifier code = 345
- **NN** = Altered / non-native plant community. These semi-natural communities do not qualify for natural quality ranking. Using NN signifies the site has been field checked and confirms it is a semi-natural community. Modifier code = 346

[*] http://files.dnr.state.mn.us/ecological_services/nhnrp/eoranks2001.pdfp/eoranks2001.pdf

INVASIVE SPECIES MODIFIERS (M_4XX)

The M_4xx modifiers represent invasive plant species occurring within land cover polygons. For the purpose of this project, the percent cover of each species of interest was estimated. These species are important to have because of their invasive nature and potential threats to native plant communities and biological diversity of native habitats. The cover classes used to assess invasive species aerial cover (i.e. as viewed from above) is a follows:

Cover Class/Estimated Percent Cover for Invasive Species

Cover Class	*Description*
0	*Unknown, or if field checked, plants not observed*
1	*Observed, unknown quantity*
2	*1 – 5% Coverage*
3	*6 – 25% Coverage*
4	*26 – 50% Coverage*
5	*51 – 75% Coverage*
6	*76 – 100% Coverage*

The following is a list of invasive plant species modifier numbers. Where these may have been encountered, they were recorded for aerial coverage within land cover polygons:

- 400 - Overgrown prairie/savanna
- 401 - Overgrown woodland
- 402 - Purple loosestrife
- 403 - Eurasian water milfoil
- 404 - Curly-leafed pondweed
- 405 - Flowering rush
- 406 - Narrow-leaf cattail
- 407 - Crown vetch
- 408 - Common and glossy buckthorn
- 409 - Leafy spurge
- 410 - Tartarian honey suckle
- 411 - Garlic mustard
- 412 - Reed canary grass
- 413 - Smooth brome
- 414 - Spotted knapweed
- 415 - Exotic thistle
- 416 - Siberian elm
- 417 - Phragmites
- 418 - Grecian foxglove
- 419 - Amur maple
- 420 - Black locust
- 421 - Absinthe sage
- 422 - Dames rocket
- 499 - Other

FIELD-CHECK LEVEL

A field-check level modifier was assigned to appropriate areas. The field-check level indicates the degree to which an individual polygon was checked in the field during the land cover assessment. Where access was permitted, most of the natural area polygons within this project were visited wholly/partially or viewed from edge. The following is a list of field check modifier values and their associated description:

- 0 = site not visited

- 1 = viewed the site from a distance
  Was not able to walk to the site, but was able to discern the dominant vegetation. Masses of invasive species may be visible, and thus were recorded (buckthorn, reed canary grass, crown vetch, etc). Depending on the perceived quantity of invasive species, a natural quality ranking of D may or may not be discernable.

- 2 = visited the edge of the site
  Walked or drove to the edge of the site, and was able to inventory some invasive species and speculate on its natural quality. Depending on the perceived quantity of invasive species, a natural quality ranking of C or D may or may not be discernable.

- 3 = visited part of the site
  Walked into the site and was able to confidently inventory most invasive species present and assess its natural quality - A, B, C or D. Wetlands that are inventoried from the edges in several places should be given this field check level.

- 4 = visited the entire site
  Was able to inventory all invasive species present and assess the site's natural quality - A, B, C or D.

Other Modifier Codes that were applied, where possible:

- 247 - Trails
- 6XX series - Forestry modifiers
- 72X series - Water modifiers, Built features
- 73X series - Water modifiers, Wetland features
- 74X series - Water modifiers, Stream features
- 75X series - Water modifiers, Spring feature

SEARCH FOR RARE PLANT SPECIES

Where natural areas occur, particularly those of better quality, there is the potential for the occurrence of rare species. Recognizing this, the plant ecologists from Bonestroo who conducted field inventory work made an effort to search habitats that had a high likelihood of supporting rare plants.

WATER RESOURCE ANALYSIS

An evaluation of Pickerel Lake and the contributing watersheds was conducted during this project. This process included the following steps:

1. **Gather and review background information.** The condition of a lake is profoundly influenced by the nature of its watershed. Thus, one of the first pieces of information in which we were interested was the extent of the natural and man-made drainage system that conveys stormwater to the lake and park. Stormwater management plans and information from Mendota Heights, West St. Paul, and the City of St. Paul was used to develop a map showing the approximate drainage area as well as the major stormwater conveyance routes to the Lake and Park. Geologic and hydrogeologic information was also reviewed.

   We found no site specific hydrolgeologic information that pertained to Pickerel Lake, but there was considerable information on the general geologic and hydrogeologic relationship between the major aquifers in the area and the lakes and wetlands of the Mississippi River floodplain in this area. We also obtained information from past fishery surveys conducted by MnDNR, the most recent of which occurred in 2004. We also looked for historical water quality data for the Lake, but found little that would help characterize the quality of the lake relative to current standards. Finally, we gathered information on the elevations and water quality of the River relative to the lake in this area to help assess the nature of interactions between the two (i.e. the frequency of flooding of the lake from the River and its potential implications from a management standpoint.)

2. **Conduct field review, focusing on Pickerel Lake.** Several visits were made to the project area in September 2008, and again in January 2009 to observe field conditions. Qualitative observations were made regarding the species composition and relative abundance of submergent and emergent aquatic plants in the Lake. In addition, observations were made on the location and condition of major seeps/springs, ravine stability issues, and major erosion features affecting the lake and associated wetland complex.

3. **Chemical sampling of Pickerel Lake.** As part of the field review in September 2008, two water samples were taken from the lake, one near the deepest part of the lake and the other in an inshore area just off the boat landing. The samples represented two significantly different conditions found in the lake, with the sample in deeper water reflective of an undesirable turbid water condition with minimal aquatic plant growth and the inshore sample reflective of a clear water condition with an abundant rooted aquatic plant community comprised largely of native species. Both samples were analyzed for total phosphorus and chlorophyll a and the values compared to recently adopted state eutrophication standards for shallow lakes similar to Pickerel Lake. Water column sampling to assess the condition of a lake is usually conducted bi-weekly or monthly between May and September, but a single sample late in the year can be used to roughly gage water quality conditions during a time of the year where water quality is likely to be near its seasonal worst.

ENVIRONMENTAL ISSUES/CONTAMINATED SOILS

A file review and field evaluation of prior existing and known environmental hazards was conducted for Lilydale Regional Park as part of this project. The environmental review was intended to provide an overview of the general environmental condition of the site and the previous investigations of that environmental condition. The review included the steps described below.

Gather and Review Existing Information

Information pertaining to the historical use and environmental condition of the property was obtained from a variety of sources as follows:

CITY OF ST. PAUL

The City of St. Paul Department of Parks and Recreation provided number of documents for our review including:

- Phase I and Phase II Environmental Site Assessment reports completed in 2004 by Delta Environmental Consultants, Inc. (Delta) covering a 2-acre portion of the 400 acre site;
- A 1-foot topographic survey of most of the site that was prepared by Sunde Land Surveying;
- An oblique aerial photograph of the southern third of the site that appears to have been taken in the early 1970s;
- A plan prepared in 1996 by HNTB Corporation (HNTB) to restore three wetland areas within the boundaries of the site with the intent of mitigating wetland impacts resulting from improvements at Holman Field; and,
- Various documents submitted to the Minnesota Public Utilities Commission (MPUC) by Xcel Energy (Xcel) in support of a natural gas pipeline routing permit through the park.

MINNESOTA POLLUTION CONTROL AGENCY

Information pertaining to the site was obtained from various sources at the Minnesota Pollution Control Agency (MPCA) including:

- Information posted and maintained for public review on the MPCA's web site including tanks and leaking tanks lists for the cities and zip code areas encompassing the site, and a web-based GIS application with spatial and tabular information pertaining to State and Federal Superfund sites, dumps, landfills, and certain other data bases of potential environmental problem sites;

- Files of the MPCA Groundwater and Solid Waste Division that are available for public review including files for the following sites:
  - "J.C. White Demolition" (unpermitted dump site);
  - "Lilydale Marina Demolition" (unpermitted dump site);
  - "Kamish Demolition" (unpermitted dump site);
  - "Twin City Brick Demolition" (unpermitted dump site); and
  - "Lilydale Park Dump Site" (Voluntary Investigation and Cleanup program site).

MINNESOTA DEPARTMENT OF HEALTH

Information pertaining to water wells at and near the site was obtained from the Minnesota Department of Health's (MDH) County Well Index (CWI). The available information includes well location and construction records.

HISTORICAL INFORMATION GATHERERS

Historical aerial photographs of the site and surrounding area were purchased from Historical Information Gatherers, Inc. (HIG). The photographs acquired and reviewed include those taken in 1937, 1940, 1953, 1957, 1964, 1970, 1974, 1979, 1980, 1984, 1991, 1997, 2000, 2002 and 2006, and one photograph taken in 1947 covering only the brick yard portion of the site.

SITE RECONNAISSANCE

A walking reconnaissance of the site was conducted on December 10, 2008 by Mr. Clinton Jordahl of Bonestroo. Mr. Jordahl meets the definition of an Environmental Professional as defined in §312.10 of 40 CFR 312. He is a Professional Geologist with more than 18 years experience conducting environmental site assessments and he has personally completed or supervised the assessment of more than 700 properties. At the time of the reconnaissance, the ground surface was covered with several inches of snow. While snow cover limited the ability to observe conditions such as soil staining, it is our opinion that a second review conducted in the absence of snow cover would be unlikely to materially affect the outcome of this field assessment or recommendations made in this report.

Inventory and Analysis Results

INTRODUCTION

This section of the report includes summaries of key findings for the project. Similar to previous sections, it is broken down by major subject area, including natural areas inventory/land cover mapping, water resource analysis, and environmental hazards/soil contamination.

NATURAL AREAS INVENTORY/LAND COVER MAPPING

LAND COVER MAPPING

To provide a general overview of the land cover for Lilydale Regional Park, a map of the MLCCS land cover polygons for the park are included in a figure on the following pages. It is important to note that this project sought to update, refine, and provide greater levels of detail for land cover types. This effort resulted in changes to over one half of the polygons previously mapped by the MnDNR and Dakota County. Where updates were made, it reflects the increased on-the-ground effort for this project as a way of providing detailed site-level planning information. Land cover updates most commonly included changes to polygon size and shape, as well as community type and quality ranks. Additional detail was also added to prior existing information through the use of MLCCS Modifier codes, documenting features such as invasive species, springs/seeps, wetland, and others.

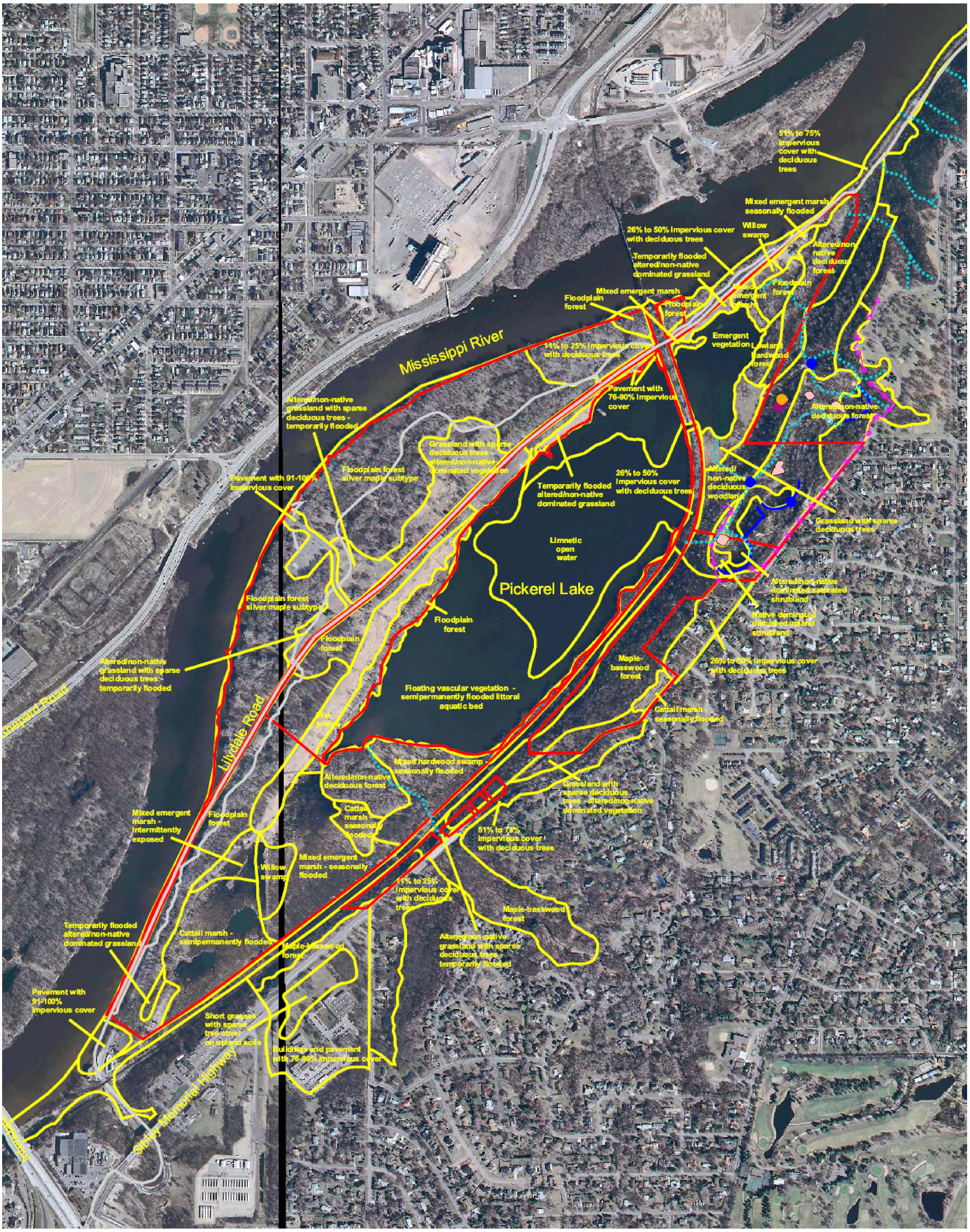
NATURAL AREA DESCRIPTIONS

Below are descriptions for natural areas occurring at Lilydale Regional Park. Semi-natural areas (disturbed, altered, and dominated by nonnative plants) are not described in detail here. Descriptions for these cover types can be found in the MLCCS Manual. Due to the size of this document, it is not included with this report. However, it can be viewed at or downloaded from the MnDNR web site at the following address: http://www.dnr.state.mn.us/mlccs/index.html. Likewise, cultural land cover types (those highly modified by humans) such as roads, parking lots, and developed/mowed park areas are not described here.

Natural community types described below include the community type, quality rank and a community code that corresponds to the code shown on the map(s) on the following pages. Also included is a text description of the community as it was observed within the park.

Floodplain Forest
Community: LRP-1
MLCCS Code: 32210
Rank: C to D

This forest area encompasses a large part of the floodplain of the Mississippi River, on both sides of Water Street. The variability in rank is a result of much of this forest being of relatively recent origin following the abandonment of the former city of Lilydale, with a few areas having some larger trees and the three-dimensional structure and composition more characteristic of an intact floodplain forest. Despite the variability in structure, fair to poor plant species composition in most areas, and abundance of invasive species, it is an important large forest patch along this urban reach of the Mississippi River. It supports bald eagle nests and has a historic record for the state threatened Blanding's turtle.



Lilydale Regional Park - Landcover Types

LEGEND

- Fence line
- Fossil pit
- Trails
- Stream
- Park boundary
- Land cover type polygons
- Lilydale fossil bed
- Echo cave
- Brick oven
- Water fall

2000 0 2000 4000 Feet

Bonestroo

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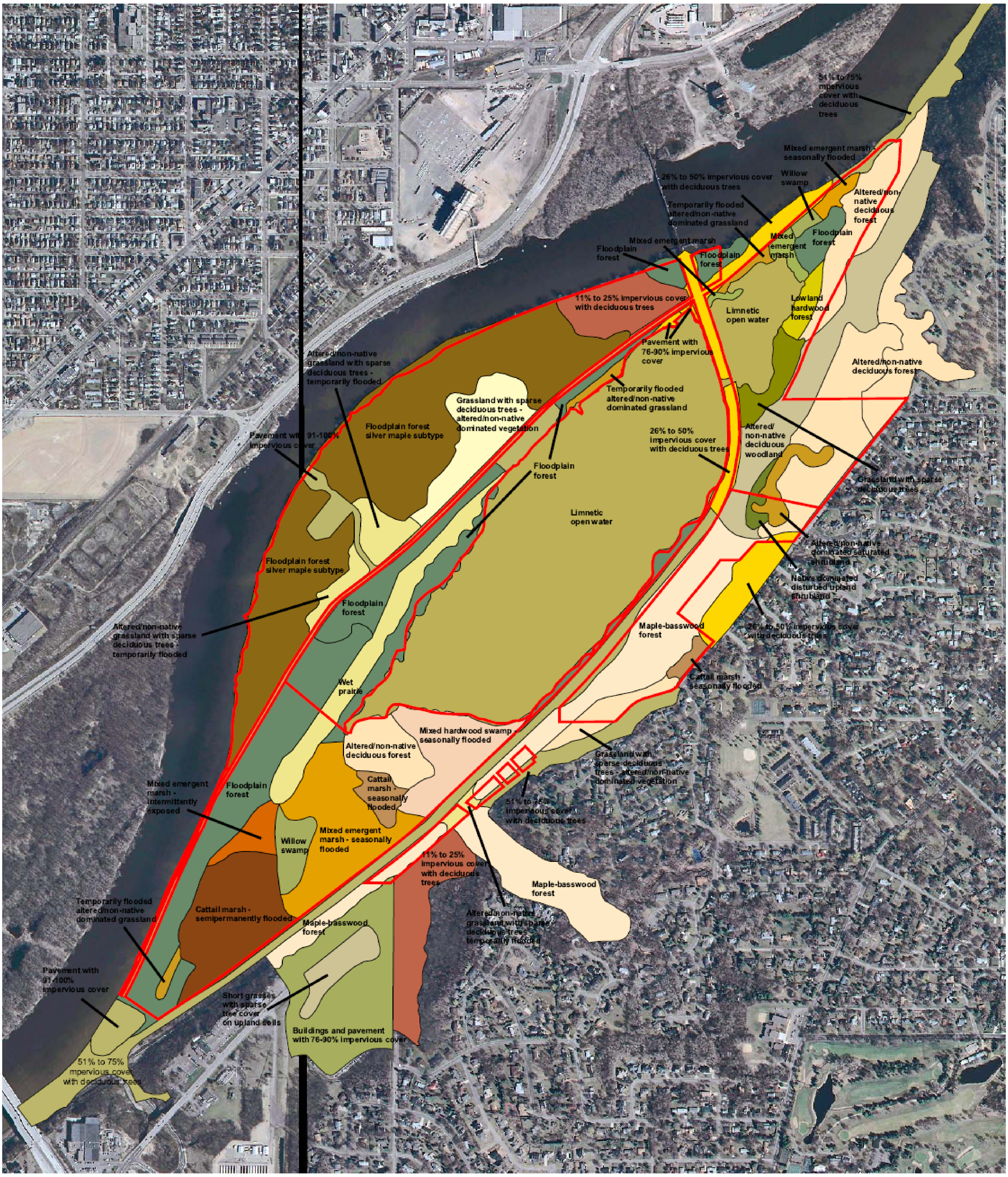

Lilydale Park - Land Cover Types

LEGEND

- Lilydale_reg_park_boundary.shp
- 11% to 25% impervious cover with deciduous trees
- 26% to 50% impervious cover with deciduous trees
- 26% to 50% impervious cover with perennial grasses and sparse trees
- 51% to 75% impervious cover with deciduous trees
- Altered/non-native deciduous forest
- Altered/non-native deciduous woodland
- Altered/non-native dominated saturated shrubland
- Altered/non-native grassland with sparse deciduous trees - temporarily flooded
- Buildings and pavement with 76-90% impervious cover
- Cattail marsh - seasonally flooded
- Cattail marsh - semipermanently flooded
- Dry oak savanna sand-gravel subtype
- Floodplain forest
- Floodplain forest silver maple subtype
- Grassland with sparse deciduous trees
- Grassland with sparse deciduous trees - altered/non-native dominated vegetation
- Limnetic open water
- Maple-basswood forest
- Medium-tall grass altered/non-native dominated grassland
- Mixed emergent marsh
- Mixed emergent marsh - intermittently exposed
- Mixed emergent marsh - seasonally flooded
- Mixed hardwood swamp - seasonally flooded
- Native dominated disturbed upland shrubland
- Oak forest
- Other exposed/transitional land with 0-10% impervious cover
- Pavement with 76-90% impervious cover
- Pavement with 91-100% impervious cover
- Short grasses and mixed trees with 26-50% impervious cover
- Short grasses with sparse tree cover on upland soils
- Temporarily flooded altered/non-native dominated grassland
- Wet prairie
- Willow swamp

N W E S

2000 0 2000 Feet

Bonestroo

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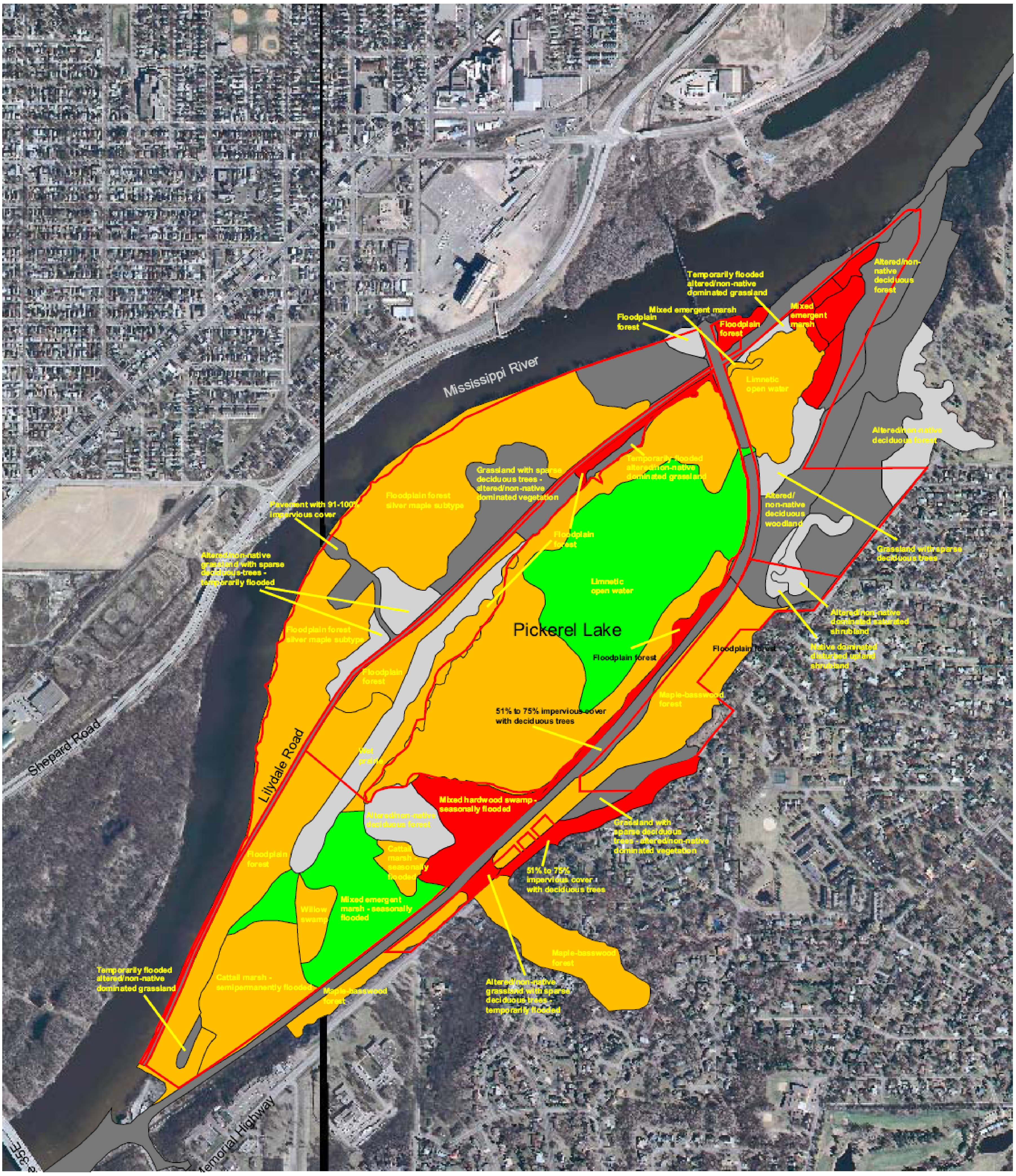


2005 Aerial

Lilydale Park - Natural Area Quality Ranking

LEGEND

Lilydale Regional Park Boundary

Cover Type Quality Rank

- High (B rank)
- Moderate (C rank)
- Poor (D rank)
- NA > 50% Native Plant Cover
- NN - < 50% Native Plant Cover

900 0 900 Feet

Bonestroo

K:/211/21108110/GIS/lilydalerp_12_17_02.apr

The canopy of this forest varies from tall and nearly closed to patchy with multiple age classes of mostly young trees. In areas with mature trees characteristic of floodplain forest, massive cottonwoods form a supercanopy over silver maple, with lesser amounts of elm, green ash, black walnut, and black willow. The subcanopy commonly includes boxelder, which sometimes occurs in very thick stands of pole-size trees (~6 inches in diameter). Nonnative trees encountered frequently here include Siberian and black locust, both found abundantly in some areas.

The shrub layer here is variable in thickness with the most commonly encountered species including sandbar willow, red raspberry, black raspberry, false indigo, as the nonnatives Tatarian honeysuckle and European buckthorn. Both of these nonnative shrubs occur frequently here. The ground layer includes a mix of natives and nonnatives. The native species present tend to be adapted to disturbance levels above those normally found within a floodplain forest, which by virtue of frequent flooding tends to have frequent disturbance.

Floodplain forest northwest of where the rail line goes over Water Street. Notice the few large cottonwood in the foreground and the dense growth of younger trees in the background.

Natives observed here that are characteristic for this community type include giant goldenrod, Virginia stickseed, side-flowering aster, green-headed coneflower, sneezeweed, wood nettle, Virginia wildrye, white grass, satin grass, and several species of sedges. Nonnative species outnumber natives in this forest, both in total cover and by total number of species. Some of the more prominent and/or highly invasive nonnative species observed here include absinthe sage, garlic mustard, motherwort, Japanese hedge parsley, and reed canary grass.

Emergent Marsh
Community: LRP-2
MLCCS Code: 61620, 61720
Rank: BC to D

This emergent marsh plant community occurs as a fringe along Pickerel Lake. It is characterized by vegetation that grows in water, but has leaves or other structures above the water surface and includes areas between the shore edge and approximately three feet deep. The quality is variable here with some pockets of very nice quality in close proximity to areas with obvious signs of past disturbance and litter/junk that are dominated by nonnative plants. The areas nearest to shore include a variety of sedges, grasses, rushes, and flowering plants. The most commonly observed native plants nearest the shore include river bulrush, several species of sedges (including lakebank sedge), sneezeweed, touch-me-not, broad-leaved cattail, blue flag iris, water horehound, water dock, and ostrich fern. Also present in varying amounts are nonnative plants, which dominate some areas. Nonnatives frequently observed include reed canary grass, purple loosestrife, and less frequently narrowleaf and/or hybrid cattail. Given the magnitude of past human urban and industrial activities around the lake, it is in some ways remarkable that areas of moderately good quality emergent marsh persist around the lake.

NOTE: *There is also a submergent plant community within Pickerel Lake. Because the submergent plant community type is more closely tied to the water quality of the lake, it is described in greater detail in the Water Resource Analysis portion of this section.*

Maple-Basswood Forest
Community: LRP-3
MLCCS Code: 32150
Rank: C to D

There are several portions of maple-basswood forest within the park. These are found along the northwest-facing bluff over Pickerel Lake. Similar to other natural communities in the park, past human activities have impacted this forest type, resulting in a rather wide range in quality. Despite a relatively continuous canopy comprised of trees characteristic for the community type, the vast majority of this forest is of moderate (C) to relatively poor (D) quality. This is the result of impacts of landform modification (excavation), the youth of most trees, and the at best fair quality of the ground layer in most areas.

Better quality areas have a canopy comprised of a mix of sugar maple, red oak, bur oak, and basswood with locally abundant amounts of hackberry and green ash. Mature trees in the better quality areas tend to be in the 10-14 inch diameter range. The shrub layer varies in thickness, relative to the amount of sugar maple in the canopy and subcanopy. Where sugar maple is the dominant canopy and subcanopy tree, light levels at the shrub and ground layer are low enough to prohibit growth of most shrubs save young sugar maple seedlings and saplings. In somewhat drier areas with a greater proportion of oaks and more canopy gaps the shrub layer is more prominent and includes the native species chokecherry, juneberry, gooseberry and nannyberry.

This segment of maple-basswood forest occurs on the bluff overlooking Pickerel Lake. Notice the different age classes for trees – an indicator of better quality areas.

The ground layer varies in quality and native versus nonnative species composition. The most commonly observed native herbaceous species tend to be associated with at least moderate levels of disturbance and include sweet cicely, white snakeroot, and honewort. There are some small areas with moderately good quality ground layer, but these are the exception rather than what is common here. Some species observed in these better quality areas include pointed-leaf tick trefoil, heartleaf aster, zigzag goldenrod, wild ginger, and a few species of sedges.

Obvious signs of disturbance include old roads, debris, and mounds of earth that appear to have been associated with clay mining. Some of these mounds have obviously been in place for many decades as evidenced by the large sugar maple and basswood growing on top of them that could be no less than 50 or 60 years old.

Despite the disturbance to the landform and plant community widely evidenced here, there are areas of substantial beauty, including springs, seeps, and small waterfalls. These oases of striking beauty amid disturbance serve as a reminder of the value of urban natural areas.

Mixed Hardwood Swamp
Community: LRP-5
MLCCS Code: 32420
Rank: C

This forest lies on the northwest side of the railroad embankment at the outlet of the largest bluff ravine drainage way entering the park. The vegetation characteristics here vary depending on whether they occur in areas of springs/seeps, or in areas of sedimentation/disturbance. The spring/seep area is small in size, but of moderately good quality, overall. This better quality area is located at the northeast side of the community, along the railroad tracks closest the shore of Pickerel Lake. The areas that receive the outfall resulting from bluff top runoff have significant sedimentation and therefore more disturbance and nonnative, invasive plants.

This photo shows the better quality portion of the mixed hardwood swamp, dominated by black ash trees.

Generally, this is a patchy to closed canopy forest dominated by black ash, varying in size from approximately four to fourteen inches in diameter. Silver maple is less frequently encountered here as a co-dominant canopy tree. The shrub layer varies from moderately thick to sparse with willow and red osier dogwood most common.

In better quality areas, the ground layer includes a nice diversity of native grasses, sedges, rushes, and forbs. Some natives encountered in the herbaceous layer of better quality areas include bluejoint grass, Virginia wildrye, white grass, ostrich fern, angelica, spotted joe-pye weed, touch-me-not, and several species of sedges. In disturbed areas, nonnative species were more common in the ground layer, including nonnatives reed canary grass and garlic mustard.

Other Natural Communities Present
Mixed Emergent Marsh
MLCCS Code: 61620, 61720
Rank: C

There is an emergent marsh located in the southwest-central portion of the park, southwest of Pickerel Lake and southeast of Water Street. This emergent marsh is of moderately good to good quality and dominated by the native bur-reed. At the time of the field inventory, there was approximately 1-2 feet of water in this area with numerous black ash snags. These dead trees indicate that the water level of the wetland has been raised. Overall, this is a nice quality emergent marsh and should require little in the way of management. Despite this, it should be periodically observed for early detection of nonnative species invasion, including purple loosestrife and/or narrowleaf cattail. This wetland type provides important habitat for a variety of wildlife, some which may only use the area seasonally. Blanding's turtle have been documented in the area and may use these wetlands, as will the more common painted turtle and others. These wetland types, along with the cattail marsh are valuable for frogs and toads, waterfowl, and other birds common to wetland edges such as the abundant red-wing blackbird, common yellowthroat, and several species of heron. Less likely to be found here, due to the level of human activity and disturbance, are bird species such as the American bittern.

A mixed emergent marsh area at Lilydale Regional Park dominated by bur-reed (Sparganium eurycarpum) shown in the foreground.

Cattail Marsh
MLCCS Code: 61430, 61510, 61510, 61610
Rank: D

There are several cattail marshes here that are marginal as native plant community types due to the significant presence of the invasive, nonnative narrowleaf and/or hybrid cattail. Although broadleaf cattail is considered native to the region and grows in a manner that allows diverse wetland plant communities to exist, the nonnative, invasive cattails typically grow in dense monocultures which exclude other plants and suppress other plant species. For this reason, it was given a low qualitative rank of D.

Descriptions for Select Semi-natural Communities Present
Altered/Nonnative Deciduous Forest
MLCCS Code: 32170
Rank: Not applicable

There are several areas of disturbed, nonnative dominated forest at LRP. These occur on portions of the bluff, bluff top and floodplain that have moderate to severe disturbance. The bluff top forest appears to have been more open in the past with scattered native trees, including some oaks. The bluff segments are associated with disturbance from past brickyard operations and similar disturbance. Disturbed forest below the bluff is most closely associated with buried rubble fields.

Common characteristics across these areas are that the majority of tree cover is from the nonnative, invasive Siberian elm, or less frequently pioneering and weedy native species such as boxelder. Likewise the shrub layer has substantial nonnative cover, including European buckthorn and Tatarian honeysuckle. The ground cover tends to have high levels of invasive garlic mustard common, with other nonnatives such as spotted knapweed, smooth brome and others occurring less frequent.

Grassland with Sparse Deciduous Trees – altered/nonnative dominated vegetation
MLCCS Code: 62140
Rank: Not applicable

There are several areas within the park that fall into this category. These occur along Water Street. One area is a buried rubble field from the old city of Lilydale that is characterized by nonnative grasses with scattered pioneering nonnative and weedy native trees and shrubs. Immediately adjacent to this, along the entrance road to the boat ramp is an area planted to native prairie species. Because this area is a mix of native and nonnative species and does not fit well within a remnant plant community type classification, it was mapped as this altered cover type and assigned a modifier code of “401”, designating it a planted community.

WATER RESOURCE ANALYSIS

INTRODUCTION

This section summarizes the findings and management recommendations associated with the assessment of Pickerel Lake. The first sub-section provides a basic primer on lake ecology and characterization that will provide a background to better understand later sub-sections. Later sections present a summary of Pickerel Lake and its watershed, the condition of the Lake itself, appropriate metrics to use in determining whether water quality is satisfactory, and guidance for management of the lake environment.

LAKE MANAGEMENT PRIMER

TYPES OF LAKES

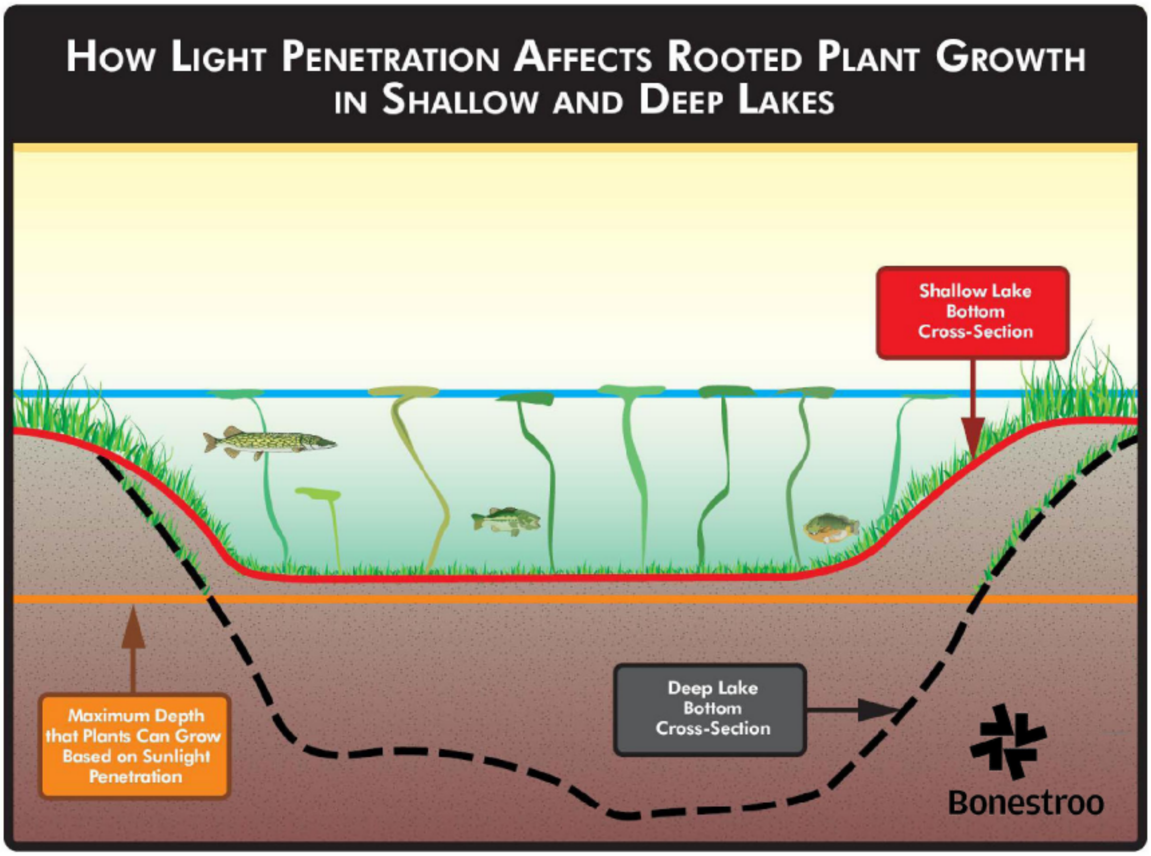
There are two types of lakes that are distinguished for lake management purposes: shallow lakes and deep lakes. This distinction is made on the basis of certain physical characteristics. Differences in the physical characteristics of lakes affect how lakes respond to seasonal changes and watershed inputs, and different management strategies are employed depending on lake type. Pickerel Lake is a shallow lake, but a comparison of deep and shallow lakes is presented in the following sections to provide an understanding of what makes shallow lakes like Pickerel Lake unique.

DEEP LAKES

By definition, a deep lake is a water body with at least 20% of the lake having a depth of 15 feet or greater (Minnesota Pollution Control Agency 2005). Because of their depth, deep lakes exhibit a seasonal phenomenon known as "thermal stratification." Stratification occurs in the summer and winter seasons due to meteorological influences.

During stratification a deep lake becomes separated into three zones. The epilimnion is the top portion of a stratified lake and is enriched with oxygen while the hypolimnion is the bottom portion and is often devoid of oxygen (anoxic) in all but the least polluted lakes. A thermocline is an area in the middle portion (metalimnion) of a stratified lake. The thermocline is characterized by rapid temperature change separating the upper and lower layers. In part because of their stratification, deep lakes are better able to withstand the impacts of pollutant loading because they can store at least some of the pollutants in those deeper, isolated waters for much of the year. This can keep the pollutants from mixing into the upper layers of the lake where most of the biological activity takes place. Every year, there is a time during the spring and fall, however, where the temperature differences between the shallow and deep water diminish and the whole lake mixes or "turns over". Thus, deep lakes are often referred to as dimictic, meaning they mix twice a year.

Another important characteristic of deep lakes is that a significant portion of the bottom of the lake is too deep for adequate light penetration to support rooted aquatic vegetation growth. The figure on the following page shows how light limitation and depth characteristics can affect rooted plant growth in deep and shallow lakes. This is why deep lakes are predominantly open water, no matter what their water quality.



City of St. Paul

Light Limited Compensation Depth in Lakes

LILLYDALE REGIONAL PARK
NATURAL RESOURCE MANAGEMENT PLAN

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SHALLOW LAKES

Shallow lakes are defined as those with 80% or more of their surface area having a depth of 15 feet or less (MPCA 2005). Shallow lakes are distinct from wetlands, which are defined by specific language and criteria.

Shallow lakes can be strongly affected by wind and wave action. It is not uncommon to see a shallow lake that is intermittently weakly stratified, then mixed periodically during the open water season. Because they can mix many times throughout the open water period, they are referred to as “polymictic”. The constant mixing during open water conditions facilitates a high degree of interaction between the water and underlying sediment. This dynamic makes shallow lakes more prone to nutrient enrichment compared to deep lakes of similar surface area and watershed size. During winter, the limited volume of shallow lakes can result in low oxygen condition which can result in fish kills. These low oxygen conditions often have a greater negative impact on game fish species like bass, northern, and walleye than on rough fish like carp and bullhead because the former require higher levels of oxygen in the water to survive.

In a natural, pristine state, shallow lakes typically have clear water and a rich aquatic vegetation community almost everywhere in the lake that is dominated by rooted aquatic plants (Scheffer 1998). The figure on the following page shows a picture of a relatively pristine shallow lake in northeastern Minnesota compared to a highly turbid shallow lake in the Twin Cities area. Note the abundance of emergent and submergent vegetation in the relatively pristine system.

Shallow lakes with a low nutrient content usually have vegetation dominated by relatively small rooted aquatic plants. Shallow lakes that receive large stormwater inputs from urban areas (like Pickerel Lake) often have significantly higher concentrations of plant nutrients like phosphorus than pristine lakes. In these lakes, the total mass of aquatic plants increases as more nutrients are available to support plant growth. Plants that fill the entire water column or concentrate much of their growth near the lake surface dominate the vegetative community in these lakes. If something is done to eradicate the rooted aquatic plants, algal blooms often result which can lead to a highly turbid condition in the lake. Ultimately, shading by the algal blooms leads to a collapse of the rooted aquatic vegetation due to light limitation. Invertebrates associated with the vegetation disappear and with these the birds and fish that rely on plants and invertebrates for food. Once a lake has turned to a turbid condition without rooted aquatic plants, it is difficult to restore it to a clear water vegetated state (Scheffer 1998).

minimally impacted shallow lake

turbid shallow lake

City of St. Paul

Comparison of Turbid Shallow Lake with Minimally Impacted Shallow Lake

LILLYDALE REGIONAL PARK NATURAL RESOURCE MANAGEMENT PLAN

Bonestroo

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In short, there is no such thing as a shallow lake without abundant vegetation (whether algae or rooted aquatic plants or some combination thereof); it is more a question of what types of plants will dominate in the system. A native rooted aquatic plant–dominated system with clear water is generally considered the most desirable condition of shallow lakes because of the diversity and perceived value of the plants and animals it supports. Further, state water quality standards also support achieving this type of condition. The management goal for Pickerel Lake should be to achieve a clear water condition with a diverse emergent and submergent native-dominated plant community.

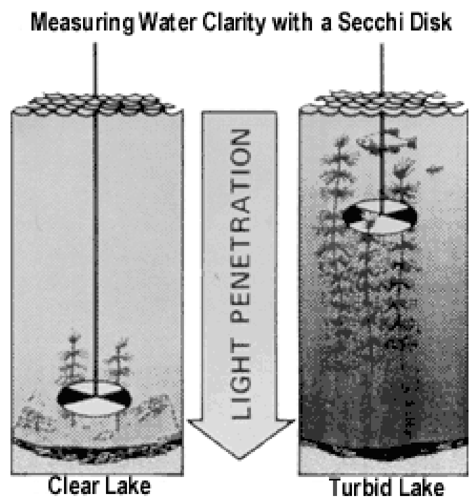
WATER QUALITY VARIABLES

Water quality data typically collected for lakes to assess their condition focus on parameters like total phosphorus, dissolved oxygen concentrations, chlorophyll-a, and secchi disk transparency.

Total Phosphorus (TP) is a measure of all of the different forms of phosphorus in water. TP includes phosphorus dissolved in water, suspended in water, attached to sediments, or incorporated in algae and other organisms. Because of the importance of phosphorus in controlling lake quality, the next report section provides a more detailed explanation of its role in lake ecology.

Dissolved Oxygen (DO) refers to the uncombined molecular oxygen that is in solution in water. Aquatic plants and algae produce DO as a result of photosynthesis while fish, zooplankton, and bacteria consume DO. Generally, DO concentrations provide insight on:

- Habitat suitability for fish and other vertebrate populations;
- Stratification of a lake system; and
- Potential for internal nutrient cycling.



A secchi disk provides a visual estimate of water clarity and the depth of light penetration in a lake. Water clarity is a key physical parameter affecting user perceptions of the suitability of a lake for recreation. As water clarity decreases, human perceptions of the suitability of a lake for recreational use also decrease.

A secchi disk is a circular disk with alternating white and black quadrants. It is lowered through the water column and the depth at which it disappears from view is recorded as the water clarity.

The chlorophyll-a concentration is a measure of algae (phytoplankton) in the water. The amount of algal growth strongly influences the clarity of the water. In general, higher phosphorus concentrations cause more algal growth which decrease water clarity. High chlorophyll-a concentrations indicate a nutrient-rich environment with large amounts of algae in the lake water.

Role of Phosphorus in Lake Quality

Phosphorus is an essential nutrient for plant growth. It is the nutrient most commonly limiting plant and algae growth in lakes in the upper Midwest. This is because when compared with other plant nutrients such as nitrogen, phosphorus supply in a lake is generally lowest relative to demand by algae.

> *If phosphorus concentrations are low, algal growth will often be low. Conversely, high phosphorus concentrations often foster high algal productivity.*

Algae obtain almost all of their nutrients from the water column in a dissolved form. A balanced population of algae is an important part of the biological system within a lake. However, too great an abundance of algae adversely affects both the ecology of the lake as well as the suitability of the lake for use by people. Under nutrient enriched conditions (i.e., high phosphorus concentrations in the water column), populations of certain types of algae can explode during the summer growing season causing what is commonly referred to as a "bloom".

Phosphorus concentration is the most critical factor in the quality of any lake. Controlling and reducing the amount of phosphorus that reaches a lake is essential in managing lake quality. Phosphorus can be delivered to a lake from a watershed in many ways. Elevated phosphorus loadings from developed areas are in part a consequence of more runoff volume as a result of increased impervious surfaces such as roads, rooftops, and driveways. They are also a consequence of higher concentrations of pollutants in runoff from urbanized areas. For example, major sources of phosphorus in urban runoff include improperly applied fertilizers containing phosphorus, vegetative material left on hard surfaces, soil and dust particles, and animal waste. Municipal storm drainage systems installed to prevent flooding provide an efficient vehicle for delivery of these pollutants from their places of origin to the receiving water.

Internal Nutrient Cycling

Elevated nutrient loading (phosphorus) to lake systems can greatly affect lake management strategies. As a result of long-term elevated phosphorus loads, a lake can accumulate a large reserve of phosphorus in its sediments. Phosphorus accumulation promotes a perpetual condition of internal nutrient cycling within a lake system.

Internal nutrient cycling can exist in both shallow and deep lakes. The cycling process is triggered by periods of low Dissolved Oxygen (DO) at the sediment/water interface as a result of thermal stratification. Low DO causes the nutrient enriched bottom sediments to release the accumulated phosphorus content into the overlying water. The phosphorus released from the sediments is made available to algae at the lake surface during periods of mixing. In shallow lakes, intermittent calm summer conditions promote a temporary lake stratification which is frequently broken by the mixing effect of wind and wave actions. The mixing transfers sediment-released phosphorus from lower to upper layers of the lake. The re-introduction of phosphorus to the water column from bottom sediments is known as "internal loading." The loading contributes to algae blooms that negatively affect the ecology of the lake as well as the suitability of the lake to support desirable uses such as swimming, fishing, or boating. Eventually the algae die, sink to the bottom of the lake and decompose, ultimately returning the organic material (including phosphorus) back to the sediment and completing the internal nutrient cycle.

Most rooted aquatic plants obtain their nutrients from lake sediments. Nutrient enriched sediments can foster an overabundance of aquatic plants causing nuisance conditions. The proliferation of the aquatic plant curly leaf pondweed can also contribute to internal nutrient loads. This plant grows during early spring before water temperatures are favorable for other aquatic plants. Curly leaf pondweed completes its growing cycle and begins to die off by mid-summer. As with algal blooms, curly leaf pondweed sinks to the lake bottom and decomposes, further contributing to TP reserves and internal release of phosphorus by oxygen depletion during decomposition.

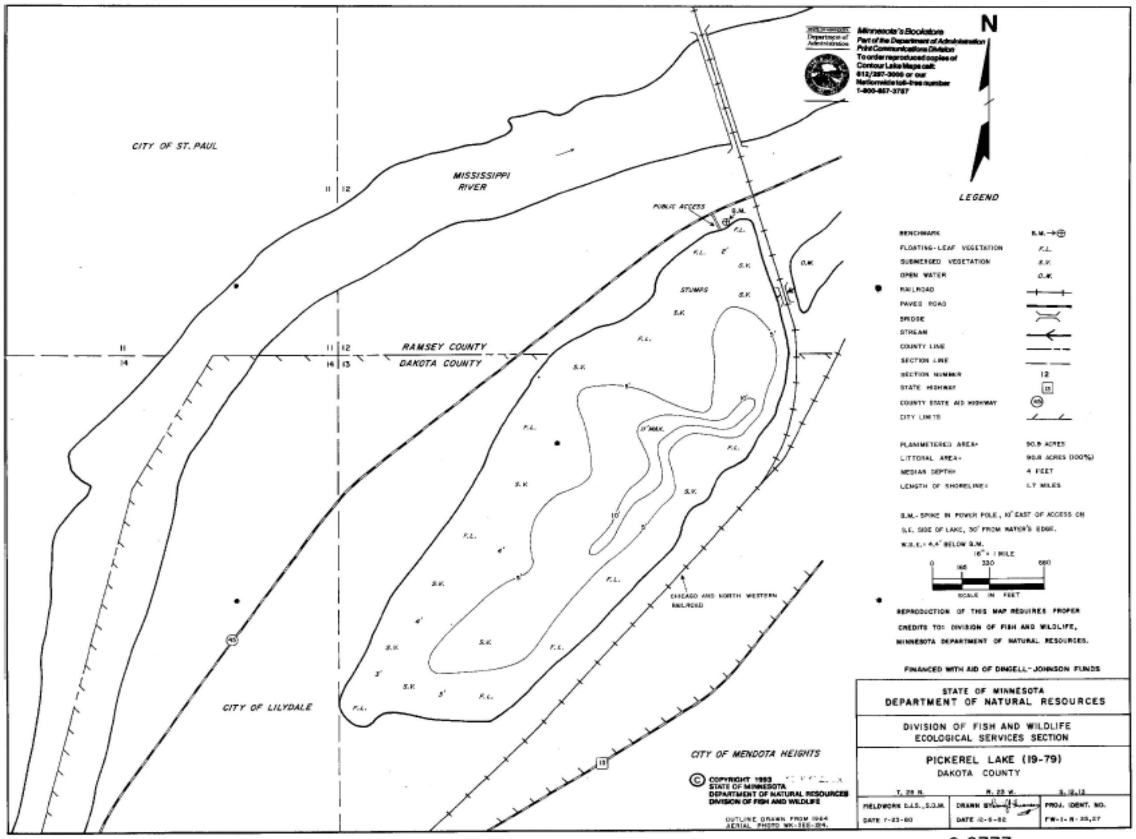
Effective lake management strategies must account for internal nutrient cycling dynamics. In-lake conditions favoring internal phosphorus recycling can cause poor water quality conditions to persist even with aggressive watershed management efforts. Even if watershed inputs are brought to near-zero conditions, water quality can remain poor until the reserves of phosphorus in the sediment are exhausted, a process which could possibly take decades.

LAKE AND WATERSHED OVERVIEW

Key information characterizing Pickerel Lake and its watershed is shown in the table below. A bathymetric map of Pickerel Lake showing water depths throughout the Lake is presented on the following page and a map showing the area outside the Park draining to the lake is shown in the next section.

Key Characteristics for Pickerel Lake

DNR Identification Number	19-0079-00
Ecoregion within which lake is located	North Central Hardwood Forest (NCHF)
Surface Area (ac)	78.4
Volume (acre-feet)	~392
Maximum depth (ft.)	11
Mean depth (ft.)	~5
% of lake area less than 15 feet deep	100%
Watershed Area (acres)	~795
Watershed: Lake Area ratio	10:1



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City of St. Paul

Bathymetric Map of Pickerel Lake

LILLYDALE REGIONAL PARK
NATURAL RESOURCE MANAGEMENT PLAN

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Important "take home" messages from the above information are as follows:

– Pickerel Lake would be considered a shallow lake, since all of the lake is less than 15 feet deep. The natural condition of a shallow lake in the North Central Hardwood Forest ecoregion is a clear-water condition with a diverse community of aquatic plants dominated by native emergent and submergent species. In the case of Pickerel Lake, water quality good enough to meet state standards will mean that rooted aquatic plants will have sufficient light to grow in water less than 10 feet deep and thus could colonize the vast majority of the bottom area of the lake.

– Pickerel Lake has a moderately large watershed area to lake area ratio of 10:1. Natural lakes often have ratios of 5:1 or less. A large watershed to lake area ratio is common in urbanized areas because of the connection provided by storm drainage systems to facilitate stormwater conveyance and flood control in urbanized area. A large ratio often indicates that the lake is vulnerable to stress from watershed pollutant inputs.

LAKE AND WATERSHED ASSESSMENT

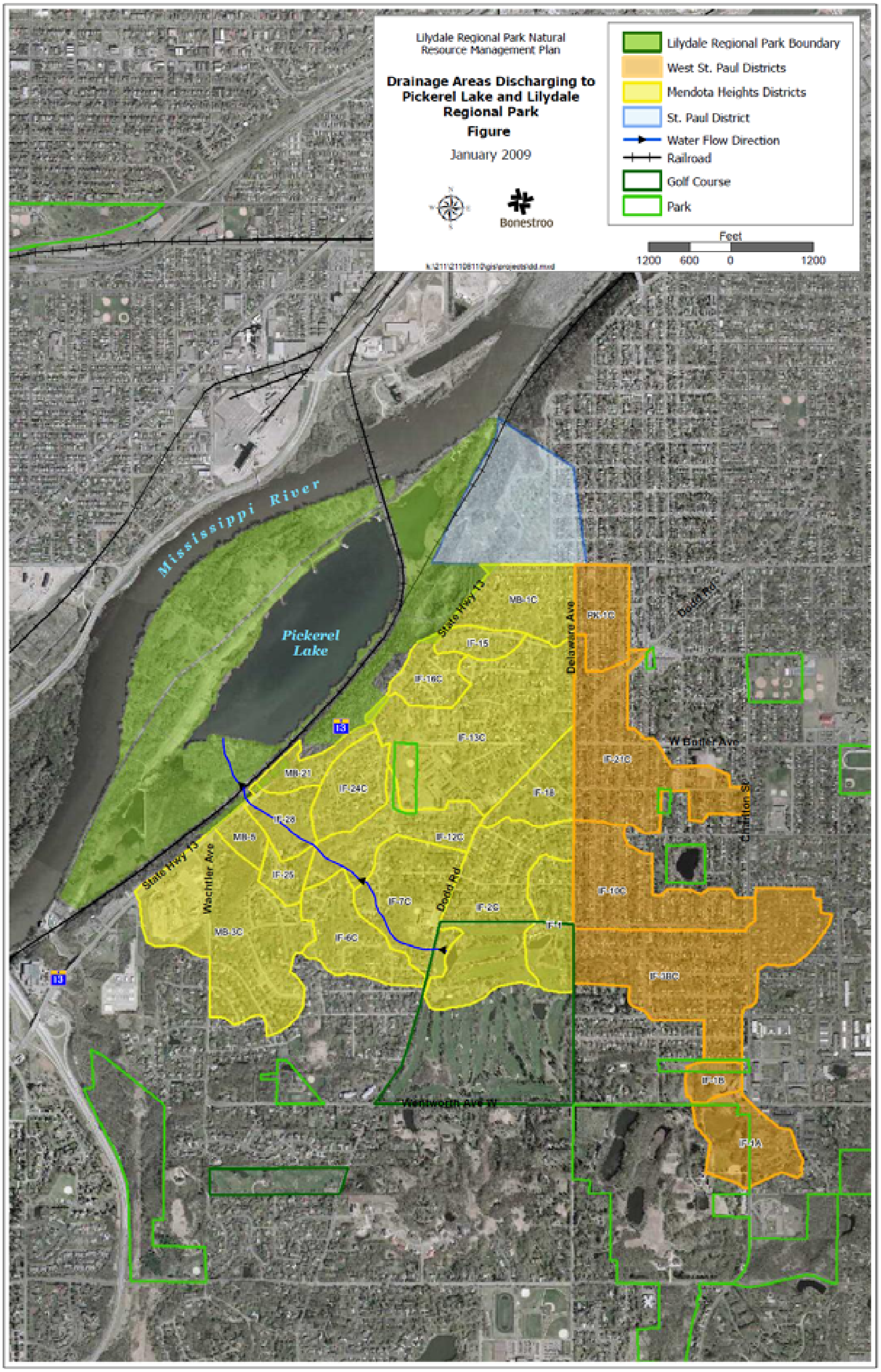
Following is a summary of Pickerel Lake and its watershed based on a review of existing data and a field assessment conducted in September 2008.

Watershed/Inflows. A map of the approximate watershed land area draining to Pickerel Lake is shown on the following page. As shown, Pickerel Lake receives runoff from portions of Mendota Heights, West St. Paul, St. Paul and Lilydale. Ivy Falls Creek is the major drainage input to the lake and is shown in blue. All of the subwatersheds with a prefix of "IF-" discharge runoff to Ivy Falls Creek. (Subwatersheds with other prefix's generally have their own local discharge points over the Mississippi River bluff and down into the Park.) In total, over 90% of the watershed to Pickerel Lake enters the Lake through Ivy Falls Creek. The creek drops almost 100 feet from the Mississippi River bluff along the east edge of the Park to a crossing under the railroad track. Once under the railroad track, it has carved an open channel that connects to the far southwestern end of Pickerel Lake. Due at least in part to the large amount of stormwater runoff discharged to the channel and the channel's steep gradient, this reach of the channel is severely eroded and shows evidence of delivering high sediment and other pollutant loads to Pickerel Lake.

It should be noted that groundwater appears to be another significant hydrologic input to the Pickerel Lake system and adjacent wetland complex. This is important because groundwater is usually of much higher quality than surface water runoff. A review of the Dakota County Geologic Atlas (Balaban and Hobbs, 1990) and local well logs (Minnesota Department of Health, 2009) verifies that Pickerel Lake, and other surrounding lakes and wetlands in the Minnesota and Mississippi River Valleys in Dakota County, are fed by groundwater discharge. The geology near Pickerel Lake shows that Mississippi River has cut a valley with over 250 feet of immediate relief between the lake and the bluff on the south side of the valley, with over 300 feet of relief between the lake and portions of West St. Paul.

The river valley partially or wholly truncates the Decorah Shale, Platteville Dolomite, and St. Peter Sandstone bedrock units. All three units are used locally in the Lilydale and West St. Paul area for water producing wells, meaning all three bedrock units are wholly or partially saturated south of the bluff line. Ambient groundwater flow direction is towards the Mississippi River, which is the regional discharge point for all upper bedrock aquifers in this portion of Dakota County. Saturated head levels in bedrock and drift aquifers between West St. Paul and Pickerel Lake show over 200 feet of head loss, with discharge in the direction of the river. The wetlands and lakes located in the floodplain of the river receive the groundwater discharge from these truncated aquifers, before either discharging the water to the Mississippi River or through loss via evapotranspiration.

Additionally, the river valley also acts as the regional discharge point of the underlying Prairie du Chien and Jordan aquifers. While the river valley does not penetrate into the Prairie du Chien and Jordan aquifers in the immediate area around Pickerel Lake, water level data for these aquifers indicates that groundwater flow is towards the river. Discharge occurs through upwelling into the river valley as the confining pressure of these aquifers is released. This discharge either enters the river directly, or enters surrounding wetlands and lakes. It is believed this type of upwelling is also responsible for a number of rare calcareous fens and trout streams located in the nearby Minnesota River Valley.


Lilydale Regional Park Natural Resource Management Plan
Drainage Areas Discharging to Pickerel Lake and Lilydale Regional Park
Figure
January 2009
Bonestroo
Lilydale Regional Park Boundary
West St. Paul Districts
Mendota Heights Districts
St. Paul District
Water Flow Direction
Railroad
Golf Course
Park
Feet
1200 600 0 1200
Mississippi River
Pickerel Lake
State Hwy 13
Delaware Ave
Dodd Rd
W Butler Ave
Charlton St
Wachtler Ave
Wentworth Ave W
MB-1C
PK-1C
IF-15
IF-16C
IF-13C
IF-21C
MB-21
IF-24C
IF-18
IF-28
MB-5
IF-12C
IF-25
IF-7C
IF-2C
IF-10C
MB-3C
IF-6C
IF-1B
IF-4A

A final significant watershed influence on Pickerel Lake is the Mississippi River. Pickerel Lake and adjacent wetlands are part of the Mississippi River floodplain and as such provide temporary overbank storage during flood events. Past documents (Ramsey County) have indicated that the water elevation in Pickerel Lake under normal conditions is about 692 feet above Mean Sea Level (MSL) while the normal pool elevation of the Mississippi River in this area is about 687 ft. MSL. The River and the Lake are separated by upland, the low point of which is about 702 ft. MSL. Thus, the river stage would need to rise about 15 feet to over- top the intervening upland and join the River with the Lake. A river stage of 702 feet at this location is reached with a 10-year recurrence interval event. That is, on average, the chance of the River flooding the Lake each year is about 1 in 10. This interaction can have a significant influence on the lake, since it likely introduces poorer quality water from the River to the Lake and can allow the exchange of fish and other aquatic life between the two bodies of water.

Aquatic Plant Community. A healthy shallow lake system will have an abundance of native submergent (growing below the water surface) and emergent (growing at the waters edge with most of the plant above the water surface) aquatic plant species. Past MnDNR surveys of the lake were reviewed to obtain recent information on the aquatic community composition. We then conducted a qualitative vegetation survey as part of a general field reconnaissance of Pickerel Lake on September 9, 2008. Following are the main findings of this effort:

A good diversity of native aquatic plants was observed in the system. The table below summarizes the type and abundance of plants found in the system during an informal survey by MnDNR staff during the last fish population survey of the lake in 2004. With the exception of curly leaf pondweed, all these species were noted in the September 9, 2008 field visit as well.

Aquatic Plants Observed in Pickerel Lake

Plant Common Name	Abundance	Native (N) or Invasive (I)
Sago pondweed	Common	N
Native water milfoil	Common	N
Coontail	Common	N
Curly leaf pondweed	Common	I
White water lily	Common	N
Yellow lotus	Common	N
Blueflag iris	Common	N
Cattail	Common	I/N
Bureed	Common	N
River pondweed	Occasional	N
River bulrush	Occasional	N
Narrowleaf pond weed	Occasional	N
Flatstem pondweed	Occasional	N

The aquatic plant of most concern from a lake management standpoint is the invasive curly leaf pondweed. The figure on the following page shows typical light, moderate and heavy nuisance growths of curly leaf pondweed for Metro area lakes (McComas 2008), along with descriptions of the impacts at each growth level on lake surface use. As explained earlier in this section on internal loading, curly leaf pondweed grows aggressively in the spring but dies off by mid-summer and can cause a significant decrease in lake water quality (increase in total phosphorus, decrease in water clarity) from the mid-summer period into the fall. It, along with coontail, can also grow to nuisance densities at the surface of the lake, affecting surface uses such as boating, canoeing, and fishing. Rooted on September 9, 2008, submergent aquatic plants were observed to be growing to a depth of 6-7 feet in Pickerel Lake. Plants growing in depths greater than about 5 feet of water were generally not reaching the surface, while those growing in water depths less than 3 feet often were.

Fisheries Community. Fish surveys of Pickerel Lake have been conducted by the MnDNR in 1980, 1985, 1990, 2000, and 2004. The following is an excerpt from the most recent survey conducted on July 6, 2004 that summarizes the status of the lake.

"Bluegill are abundant but small, with an average length of 4.5 inches. Crappies are present in low to moderate numbers with an average length of 6.5 inches and a few up to 11 inches. Northern pike are abundant and ranged in length from 19 to 30 inches, with a 24 inch average. Other species present in low numbers are pumpkinseed sunfish, largemouth bass, walleye, yellow perch, carp, redhorse, freshwater drum, bowfin, black bullhead, yellow bullhead, and golden shiner."

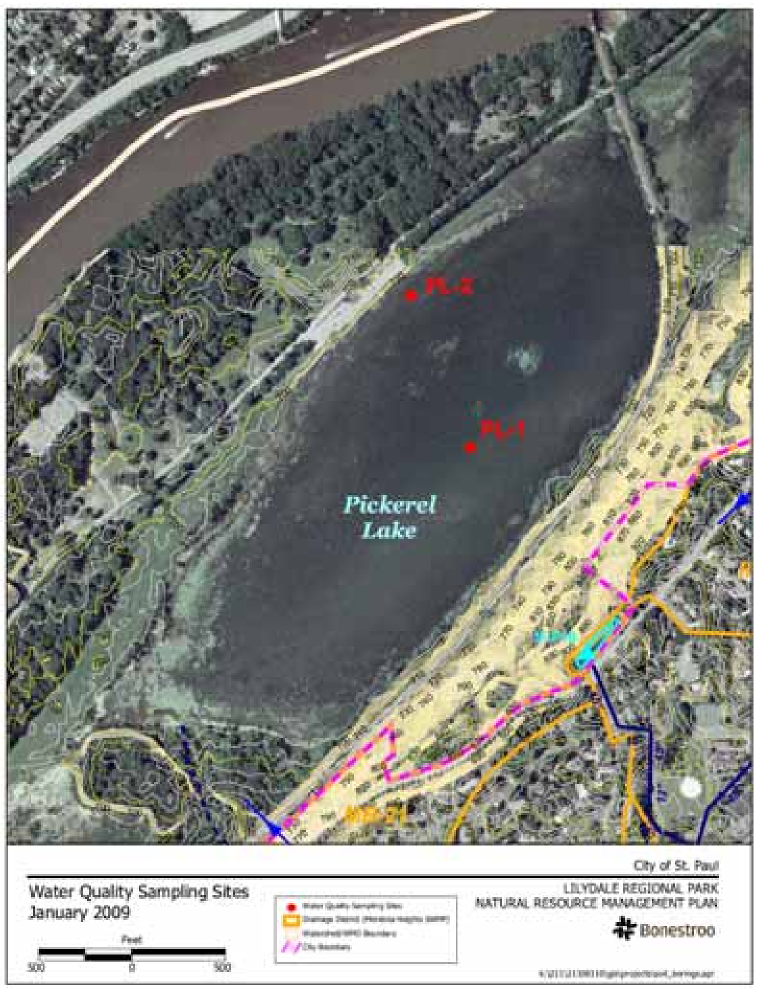
Following are some key findings with regard to the fishery in Pickerel Lake:

- A wide variety of fish species have been sampled in Pickerel Lake by MnDNR over the years. A number of these species, including redhorse, freshwater drum, bowfin, and carp are common in the Mississippi River and were probably introduced to the lake during periods of high water in the Mississippi River. Periodic inundation of Pickerel Lake by the Mississippi River is likely to continue to be a source of fish recruitment to the lake.
- Based on a comparison of the trap net data from MnDNR since 1980, the population of small bluegill has risen considerably since the 1980's while that of rough fish like black bullhead has fallen considerably. Too many of either species can negatively affect both water quality through predation on small animals (zooplankton) that help keep algal blooms in check as well as foraging in, and re-suspension of, lake bottom sediments.
- The dominant predator in the Pickerel Lake system are northern pike, though bowfin are also present and considered aggressive predators. Maintaining a good population of larger, predatory fish in Pickerel Lake to help control small panfish and bullhead populations will help protect water quality as well as provide opportunities for a quality fishing experience. If supported by MnDNR, stocking with other predators such as channel catfish could provide additional predatory controls for small panfish and bullhead.

- **Fish Spawning Areas**
  - Fish spawning habitat is limited for most fish species found in Pickerel Lake. Previous fish surveys conducted by the MnDNR describe lake bottom conditions as 90% muck, 8% sand/gravel, and 2% sand. These substrate conditions will limit bluegill and crappie spawning success.
  - Abundant submerged and emergent aquatic vegetation is abundant out to at least five feet of water depth and this growth is used by yellow perch for draping their egg sacks over. However, yellow perch spawning success is poor as evidenced by the low perch population.
  - Based on fish lengths measured in the 2004 fish survey, walleye and largemouth are scarce and the fish present are several years old. There is no apparent spawning occurring for these species.
  - Because there are no inflowing streams connecting to adjacent wetlands, which is a common feature for northern pike spawning, this means northern pike spawning will be relegated to in-lake areas. That condition is not the optimal spawning environment for northern pike.
  - In summary, spawning will occur on a limited basis in Pickerel Lake for a few species, but overall habitat is not well suited. When spawning does occur, it will be spotty and difficult to delineate. Therefore a map of spawning areas has not been prepared. However, as long as submerged vegetation and deadfall remain in the lake, there will be good habitat for fish survival and foraging.

LAKE WATER QUALITY

Other than some bacterial test data taken in the 1980's and some sporadic water clarity data collected during DNR fish assessments, virtually no historical water quality data was found for Pickerel Lake. As part of the September 9, 2008 field reconnaissance, samples were taken at two locations in the lake for lab analysis. One sample was taken near the deepest point in the lake and the other in a shallow inshore area near the boat landing off the west shore of the lake. Sampling locations for this effort are shown in the figure to the right on this page. The two samples were taken because they represent two different conditions in the ecology of Pickerel Lake (as well as in shallow water ecology in general). The sample from the deep part of the lake is representative of a turbid water condition caused by algal blooms and an absence of native rooted aquatic macrophytes. The sample from the shallow in-shore area is representative of a clear water condition with a vigorous native macrophyte community.



Water quality sampling results are shown in the table below. For reference, standards for total phosphorus, chlorophyll a, and water clarity recently adopted by the State of Minnesota (2008) for shallow lakes in the North Central Hardwood Forest ecoregion (NCHF) are also shown. These standards are used by the MPCA to help determine whether a lake should be listed as “impaired”. Lakes are generally considered for listing as impaired due to excess nutrients if the value for total phosphorus and at least one of the other two parameters (chlorophyll a or water clarity) is worse than the standard. Thus, the state eutrophication standards represent a reasonable initial goal for in-lake water quality for Pickerel Lake.

In-Lake Water Quality Data from Pickerel Lake on September 9, 2008

Parameter	Site		MPCA Standard	Comment
	Site PL-1 (deep)	Site PL-2 (shallow)		
Total Phosphorus (ug/l)[1]	57	27	<60	Both deep and shallow sample values better than standard
Chorophyll a (ug/l)[1]	26.2	6.7	<20	Deep lake sample worse than standard, shallow lake sample better
Water Clarity (meters)	1.0	>1.0 (Secchi disk visible on lake bottom)	>1.0	Deep water value at the standard, shallow water likely better than standard

[1] ug/l is micrograms per liter or parts per billion, which is a unit of concentration

[2] Water clarity is measured using a Secchi Disk (see figure illustrating Secchi disk earlier in report)

It is important to note that the MPCA values are most appropriately compared to an average seasonal value based on monthly or bi-weekly sampling data for samples taken from the deepest part of the lake during the June-September period. Here, we are comparing a single data point from Pickerel Lake from a late season sample to a standard based on multiple samples over the summer season. Nonetheless, water quality is typically relatively poor late in the season in shallow lakes, and these few data reflect late season water quality in Pickerel Lake that is generally better than would be expected based on the shallow depth of the lake and the moderately large, developed watershed.

One factor that may be contributing to better than expected water quality in the lake is the influence of groundwater. The evidence for significant groundwater inflows to the Pickerel Lake system was presented previously in the discussion of the watershed inflows to Pickerel Lake. Field observations made during a visit to the project area in January 2009 support this contention, as several open water areas in the shallow southern portion of the Lake were observed that were likely groundwater discharge locations. As already mentioned, groundwater is usually of much higher quality than surface water runoff. *Thus, one key to providing the best possible water quality in Pickerel Lake is to minimize the direct input of poorer quality surface water and let good quality groundwater be the main source of water to the lake.*

Curlyleaf Pondweed Growth Characteristics

(source: Steve McComas, Blue Water Science, unpublished)

Light Growth Conditions

Plants rarely reach the surface.

Navigation and recreational activities are not generally hindered.

Stem density: 0 - 160 stems/m^2
Biomass: 0 - 50 g-dry wt/m^2
Estimated TP loading: <1.7 lbs/ac

MnDNR rake sample density equivalent for light growth conditions: 1, 2, or 3.

Moderate Growth Conditions

Broken surface canopy conditions.

Navigation and recreational activities may be hindered.

Lake users may opt for control.

Stem density: 100 - 280 stems/m^2
Biomass: 50 - 85 g-dry wt/m^2
Estimated TP loading: 2.2 - 3.8 lbs/ac

MnDNR rake sample density equivalent for moderate growth conditions: 2, 3 or sometimes, 4.

Heavy Growth Conditions

Solid or near solid surface canopy conditions.

Navigation and recreational activities are severely limited.

Control is necessary for navigation and/or recreation.

Stem density: 400+ stems/m^2
Biomass: >300 g-dry wt/m^2
Estimated TP loading: >6.7 lbs/ac

MnDNR rake sample density has a scale from 1 to 4. For certain growth conditions where plants top out at the surface, the scale has been extended: 4.5 is equivalent to a near solid surface canopy and a 5 is equivalent to a solid surface canopy. Heavy growth conditions have rake densities of a 4 (early to mid-season with the potential to reach the surface), 4.5, or 5.

ENVIRONMENTAL ISSUES/CONTAMINATED SOILS

The environmental condition of Lilydale Regional Park has been an issue for more than 35 years with MPCA involvement dating back to at least 1972. Plans to develop the land as a regional park date back to at least 1973; however, it appears that uncertainty regarding environmental issues at the site have been limiting development since at least 1987. A comprehensive evaluation of the environmental condition of the site is complicated by the size of the site and diverse historical use of the property. A great deal of uncertainty remains regarding decades of uncontrolled waste disposal at the site, and the five or more separate areas of significant solid waste disposal and burial.

HISTORICAL CONTEXT

The date of first development of the property now encompassing the park is not clear from the information reviewed; however it is logical that development of that site would have begun in the mid to late 1800s if not earlier. Fort Snelling, which was founded in 1819, is only 2½ miles upstream from the park and the city of St. Paul was itself established by about 1839 on the north side of the river. According to maps and atlases included in the Delta Phase I ESA report, the area of the park was fully platted by 1884. An 1896 topographic map also included in the Delta report indicates the railroad causeway and a number of structures on the property. The brickyard was also reportedly established at about this same time.

The aerial photographs for the period 1937 through 1957 (see Appendix C) generally depict the site as a sparsely-populated area in gradual transition from light agricultural use to very low density residential use. The Twin City Brick facility is visible in each of these photos and it appears that the facility was expanded throughout this period by filling a portion of Pickerel Lake lying north of the railroad causeway.

The aerial photographs for the period 1964 through 1974 generally depict the addition of many trailer homes (primarily prior to 1970) along with some minor non-residential development. By the time the 1979 aerial photograph was taken, the brick yard, nearly all of the trailer homes, and most of the other structures had been demolished and/or removed from the site. The Lilydale Marina facility and a few scattered structures persist through at least 1980, but the site appeared largely vacant by the time the 1984 infrared aerial photograph was taken.

The City of St. Paul acquired the property for parkland in about 1981. Initially, the City struggled with people using the park as a dumping ground, but it appears that the installation of guard rails along the road running through the park had curtailed most of the dumping problems by about 1990. A parking lot and boat ramp to the Mississippi River along with several stretches of paved trail appear to have been added to the park in the 1990s.

There are a number of environmental concerns such as wells, septic systems, and general dumping issues that would be common to most of the parkland and will be discussed at the end of this section. In addition to the common concerns, there are six specific areas where past land usage has identified environmental concerns.

The following is a discussion of the specific and general environmental issues that have been identified at the site:

KAMISH DEMOLITION

The Kamish Demolition is included in the MPCA's list of unpermitted dumps. The site is located at the south end of Pickerel Lake generally in the NE¼ of the SE¼ of Section 14 T28N, R23W. The location of this dump is shown on the Site Map on the following page. In certain MPCA memoranda and correspondence, the site is also referred to as the "Joe Stevens" demo fill.

SITE RECONNAISSANCE

The site appears to be approximately 5 to 6 acres in areal extent and the waste pile rise 8 to 10 feet above the surrounding wetland. The site is completely surrounded by wetland but can be accessed via an unimproved trail that runs more or less east-west across the center of the fill area. The site is well vegetated with a canopy of mature trees and an understory consisting primarily of European buckthorn and a few other shrubs. The surface of the site is very uneven, apparently as a result of differential settlement possibly caused by voids in the fill material and/or by the decomposition of buried wood or other organic matter.

Waste material noted protruding through the ground surface and from the side slopes of the fill consisted primarily of concrete, but included appliances, scrap metal and at least one small drum. It was apparent that a transient population had been making some recent use of the site with accumulated litter in at least two encampment areas.

AERIAL PHOTOGRAPHS

The area appeared to be undisturbed wetland on the 1964 and earlier aerial photographs, but the landfill was nearly 3 acres in size by the time the 1970 aerial photograph was taken. The dump doubled in size to nearly 6 acres between 1970 and 1974, but was well vegetated by the time the 1979 aerial photograph was taken. Trails through the dumpsite were apparent on photographs taken in subsequent years and trails through this area were noted at the time of the site reconnaissance. It is therefore likely that some dumping occurred after the mid 1970s, but certainly the most significant volume of waste material was placed in this area some time prior to 1979.

CITY OF ST. PAUL

The Kamish Demolition site can be clearly seen in the oblique aerial photograph provided by the City. Comparing the size of the fill area apparent in this photo with the other aerial photographs, it is likely that the photo provided by the City was taken between 1970 and 1974. The top of the landfill appears smooth and even at this time. What appears to be a job trailer can be seen parked along the north side of the landfill and the photo gives every appearance that the site was being operated as a commercial demolition landfill at the time.

Importantly, this site was not addressed in any of the other information provided by the City nor was the area discussed in the Sunde survey.

2008 Dakota County Aerial

Date: 1/13/2009

Lilydale Regional Park Natural Resources Management Plan

Bonestroo 2335 West Highway 36 St. Paul, MN 55113 (651) 636-4600	City of St. Paul Division of Parks and Recreation	Site Map Job No. 211-08110-0 — Scale 0 150 300 600 Feet

MPCA FILES

The earliest records of this site included in the MPCA's files were two Polaroid photographs dated June 12, 1973. One of the photos was of the surface of the landfill and the other was of the side slope. Predominantly soil and concrete could be seen in the side slope photo. The top photo looked fairly typical of a demolition landfill with a smooth-graded top to provide easy access to dump trucks. Piles of end-dumped waste were lined up along the perimeter of the existing fill apparently waiting to be pushed down the side slope. As a follow up to their June 12, 1973 site visit, the MPCA sent a letter to the Mayor of Lilydale on June 18th requesting the City's help in ending the illegal dumping. The MPCA conducted a follow up visit April 2, 1974 and an Office Memorandum documenting the visit indicated that "some dirt and rock" was still being dumped at the Kamish site at that time.

The MPCA's files contained no additional information pertaining to this site for the period of April 1974 through March of 1987. It appears that beginning in the spring of 1987, or possibly earlier, the Metropolitan Airports Commission (MAC) developed a plan to enhance and enlarge Pickerel Lake to compensate for wetland impacts proposed to occur at Holman Field. It appears that the plan was to construct an approximately 6,000-foot long, 5-foot high levee (dike) between the lake and the Mississippi River. The intention was to raise the water level in the lake by one foot, prevent contaminated fish from entering the lake from the river, and create a swimming beach along the eastern side of the lake. This project appears to be the first point at which the real and/or perceived environmental problems of the site come in conflict with a reuse/enhancement scenario.

On March 31, 1987, and again on April 15, Mr. Gerald Stahnke of the MPCA and representatives of the U.S. Fish and Wildlife Service (USFWS) and the MnDNR visited the site. Mr. Stahnke's notes indicate that he observed primarily demolition material at the Kamish site, but he also noted the presence of "white goods, tires, pallets, oil burner drums, incinerator slag and several empty 55 gallon drums". He noted evidence of continued use of the dump by vandals including "piles of shingles, toys, furniture, appliances and clothing". He noted some possible evidence of leaching at two locations along the north side of the fill, but speculated that the discoloration may have been due to natural tannin in the water. He concluded that there wasn't enough information known about the Kamish Dump site to evaluate its potential impact on the wildlife and recreational enhancements that were being proposed by the MAC and City at that time. He made some general recommendations for additional evaluation and suggested that the project proposer(s) submit an investigation work plan to the MPCA for approval.

In January 1988, the City of St. Paul Department of Parks and Recreation hired Braun Engineering Testing, Inc. (now Braun Intertec Corporation) to conduct some soil borings at four known waste disposal areas lying within Lilydale Regional Park. A copy of Braun's report entitled "Preliminary Subsurface Environmental Assessment" and dated March 7, 1988 was included in the MPCA's files and reviewed for this assessment.

The Braun investigation included completing five 15-foot soil borings at the Kamish Demolition site on January 28 and 29, 1988. The borings were conducted with a hollow-stem auger rig and samples were collected with a 3” outside-diameter split spoon sampler. The samples collected from each boring were comprised of 10 individual samples each representing a discrete 18-inch interval from increasing depths as the borings were advanced. Each of the borings encountered demolition debris including concrete, wood, limestone and brick to the terminal depth of 15 feet. Since all five borings were terminated in fill material, the full extent of fill depth cannot be determined from the results of the Braun investigation.

Individual samples collected from the borings were reportedly screened for organic vapors with a HNu® Photo Ionization Detector (PID) which was calibrated to a benzene standard. Detectable organic vapor concentrations were present in samples collected from 2 of the 5 borings with the highest concentration being 7 parts per million (ppm). Their report does not indicate what lamp the PID was equipped with nor does it contain any information about the soil screening methodology employed. Nevertheless, during this period of environmental investigation in Minnesota most PIDs commonly in use were equipped with a 10.2 electron-Volt (eV) lamp, which is intended to detect primarily petroleum products and is wholly incapable of detecting any compounds with ionization potentials above 10.2 eV. Soil screening probably consisted of simply pointing the PID tip at the open split spoon sampler and observing the highest reading on the PID’s analog meter. The polyethylene-bag headspace methodology or even the somewhat more antiquated jar headspace method of soil screening was not commonly in use in 1988. *Given that the soils were probably screened in the open air at the end of January in Minnesota using an instrument with limited detection capabilities, the absence of positive soil screening results should probably not be relied on as indication of an absence of contamination.*

Braun collected a total of 7 samples for laboratory chemical analysis from the borings completed on the Kamish Demolition landfill. It appears that a single composite sample for each boring was created by combining a portion of each of the 10 discrete depth-interval sub-samples to form one composite sample. A single composite sample from each boring was submitted to Braun’s laboratory and chemically analyzed for the presence and concentration organochlorine pesticides, polychlorinated biphenyls (PCBs), and the 8 metals included in the Resource Conservation and Recovery Act (8-RCRA metals). Discrete or “grab samples” for hydrocarbon analysis were also collected from the two borings in which organic vapors were detected with the PID. These samples were collected from the depth intervals exhibiting the highest PID reading, which was the 12 to 13½ foot interval in one boring and the 10½ to 12 foot interval in the other. These depths would appear to correspond with the groundwater elevation in the area; however, Braun indicated that it did not encounter groundwater in any of the borings conducted on the Kamish site.

Hydrocarbons (quantified as fuel oil) were detected in both of the samples analyzed for hydrocarbons with a maximum concentration of 100 mg/kg reported. No organochlorine pesticides were detected in any of the samples collected from the Kamish Demolition site. Braun’s laboratory report indicates that PCBs were present in two of the five composite samples, but states that the concentrations detected were below their laboratory detection limits. Six of the eight targeted RCRA metals were present in the composite soil samples. In general, the concentrations detected were not significant; however the lead concentration appeared to be elevated in the samples collected from two of the five borings. Lead concentrations in both of these borings exceeded the Tier 2 Soil Risk Value (SRV) of 300 mg/kg, which is the MPCA’s health-base limit for recreational exposure risk scenarios.

In their Analysis and Recommendations section, Braun noted that the lead detections were from composite samples therefore the maximum lead concentration and the depth at which the lead contamination occurs could not be determined. Braun made several recommendations for additional investigation of the apparent fuel oil contamination in the area, and additional evaluation of the risk that may be posed by the residual lead contamination in the soil.

In April 1988, the St. Paul Department of Parks and Recreation submitted a copy of the Braun report to the MPCA for their review and comment. The MPCA conducted a follow up site visit on April 26, 1988 and met with City staff to discuss the proposed levee project on May 5, 1990. In a letter dated November 29, 1990, the MPCA responded to the Braun report saying that they did not have the authority to approve or disapprove of the proposed levee project. In three attachments to their letter the MPCA provided some very general constraints and objectives for site development that were not specific to the Lilydale Regional Park, and disclaimed any liability for its recommendations while reserving the right to take additional investigation and/or cleanup action at the site.

LILYDALE MARINA DEMOLITION

The Lilydale Marina Demolition site is included in the MPCA's list of unpermitted dumps. The site is located between the Mississippi River and Lilydale Road generally in the SW¼ of the NE¼ of Section 14 T28N, R23W. The location of this dump is shown on the Site Map in Appendix C.

SITE RECONNAISSANCE

The site appears to be a little more than 6 acres aerial extent with two large waste piles rising 12 to 18 feet above the surrounding terrain. In places the waste material is retained by stacked concrete and stone, and by wooden utility pole retaining walls. The site fronts approximately 700 feet along the river and 400 feet along the road with easy site access directly from Lilydale Road along what appears to have been the main access road to the marina. There is a petroleum pipeline located beneath this former access road however appurtenances associated with pipeline did not appear to be maintained, so it is possible that the pipeline is no longer in use. The site is well vegetated with a canopy of mature trees with some very large cottonwoods that appear to have been filled around. The surface of the site is very uneven likely as a result of differential settlement. Waste material noted consisted primarily of concrete, bituminous pavement, and dimension stone.

AERIAL PHOTOGRAPHS

The site appeared to be occupied by a home or perhaps small farmstead on the 1937 through 1953 aerial photographs with the surrounding land comprised primarily of woodland and small farm fields. Some land clearing and/or filling was apparent at the site by 1957 and multiple docks on the river can first be seen in the 1964 photo. Quite a large area of land disturbance was apparent at the site on the 1970 aerial photograph, but land filling must have been largely completed by 1974, as the two fill areas noted during the site reconnaissance appear to have been fully occupied with boat storage and/or camping trailers at that time. The marina was still in use at the time the 1980 aerial photograph was taken, but vacant by 1984.

CITY OF ST. PAUL

The Lilydale Marina Demolition site can be clearly seen in the oblique aerial photograph provided by the City. Once again, this photo likely dates from the period 1970 to 1974. Numerous boats, house boats, vehicles, trailers and other materials can be seen parked and/or stored on the demo-fill piles in this photo. A small marina building located between the debris piles and near the river can also be seen. It is possible that some filling was occurring on the northern demo pile at the time this photo was taken, but it is difficult to be sure due to the condition of the photo. Without necessarily knowing the motivation of the marina owner, it is possible that the fill was accumulated at the marina site to provide a storage area above the flood threat elevation.

The site was addressed by the Sunde survey but not in any of the other information provided by the City. The Sunde survey clearly shows the two fill areas as outliers in the otherwise comparatively flat landscape. Based on the Sunde Survey, it appears that up to 18 feet of fill is present at the Lilydale Marina site with the elevation of the top of the fill generally in the range of about 712 feet to 718 feet above mean sea level.

MPCA FILES

There are only a few references to the Lilydale Marina Demolition site in the MPCA files that were made available for our review. The first being notes from a site visit conducted June 12, 1973 during which MPCA staff noted simply that demo fill was being brought onto the site. In a letter to the Marina owner dated June 13, 1973, the MPCA noted that the site was not a permitted demolition disposal site and stated that all dumping of these wastes must cease. The owner of Lilydale Marina (Mr. Wayne Brown) apparently contacted the MPCA on June 19, 1973 to inform them that he hadn't been dumping at the site for more than a year and what the MPCA saw during their site visit was landscape work. In a follow up site visit on April 2, 1974, MPCA staff noted that the Lilydale Marina dump site was "inactive".

J.C. WHITE DEMOLITION

The J.C. White Demolition site is included in the MPCA's list of unpermitted dumps. The site is located on the northwest side of Pickerel Lake between Lilydale Road and the lake. It is generally located in the NW¼ of the NW¼ of Section 13 T28N, R23W. The location of this dump is shown on the Site Map earlier in this section.

SITE RECONNAISSANCE

The site appears to be a little less than 2 acres size, more or less level, and used as a parking lot for the park. The area is elevated approximately 5 or 6 feet above the surface elevation of Pickerel Lake and demolition material is exposed along a steep slope leading down to the lake. Site access is directly from Lilydale Road at the north end of the site. Waste material noted along the slope to the lake consisted primarily of concrete.

AERIAL PHOTOGRAPHS

The J.C. White Demolition site appeared to be undeveloped lowland adjacent Pickerel Lake in each of the aerial photographs from 1937 through 1957. A disturbed area perhaps ¾-acre in size was visible at the north end of the site on the 1964 photo, and it appears likely that land filling was occurring in this area at that time. This ¾-acre area is distinct but well vegetated in the 1970 photo with no indications of active dumping. The southern half of the J.C. White Demolition site appeared as undeveloped woodland and lowland in this photo.

It appears that the southern half of the site had been cleared and filled by the time the 1974 aerial photograph was taken and an approximately 100 foot by 40 foot building was visible on the southern half of the site. The area north of the building and between the building and the lake appeared disturbed in this photo, but the overall resolution of the photo was poor.

The site was vacant by 1979, and there were numerous tracks and trails across the site visible in this photo. The site appears substantially unchanged in the photographs from later years with variable amounts of land disturbance and some sparse vegetation apparent. By 2000, the site appeared to be largely cleared of vegetation and utilized as a parking lot more or less as noted during the reconnaissance.

CITY OF ST. PAUL

The City provided copies of a Phase I Environmental Site Assessment (ESA) report for site that was prepared by Delta Environmental Consultants in June 2004, and a Phase II ESA report also prepared by Delta in September of that same year.

The property was being used as a parking lot at the time of the Delta investigations and they noted demolition debris including asphalt, concrete, cobbles, brick and steel pipe protruding from the exposed side slope facing Pickerel Lake during their site visit. Delta conducted interviews, reviewed historical maps, and most of the same photographs reviewed for this assessment. They concluded that the site was undeveloped until about 1964 at which time it appeared that fill was first placed on the site. Delta was also provided with a copy of a map of the area entitled "Environmental Intrusions" that was prepared by or for the Ramsey County Open Space System and dated February 1973. This map generally depicted cultural features such as homes, roads, wells, etc., and indicated the presence of a used car sales facility on the property at that time.

Delta concluded that the site was a dump and was listed as such in the MPCA's records. They identified the presence of unregulated fill material at the site as a Recognized Environmental Condition (REC). Through their interviews, Delta determined that street sweepings had historically been dumped at the site as uneven settlement of the underlying fill produced ruts and low areas in the parking lot. Since these sweepings were not tested prior to placement, Delta concluded that their presence also constituted a REC. Through their review of the "Environmental Intrusions" map, Delta indentified a former used car lot at the site and a landfill and auto salvage yard across Lilydale Road from the site. Delta suggested that there was a potential for cross-contamination from the depicted off-site landfill/salvage yard, and that it represented a material threat to the site.

Delta essentially made four recommendations for additional work at the site including: remove and appropriately dispose of materials deposited at the property through uncontrolled dumping; sample the surface soil to assess the potential for negative impacts associated with the disposal of street sweepings; conduct a subsurface investigation to determine the nature and extent of fill material with analysis for lead, mercury and asbestos; and, review the MPCA's files for the Lilydale Park Dump site.

The Delta Phase II ESA consisted of the excavation of six test pits at the site on August 2, 2004. The test pits were more or less evenly spaced along the long axis of the site and excavated to depths of 9½ to 12 feet. While a certain amount of fill was present in each pit, it appears that demolition material, consisting largely of brick rubble and dolomite dimension stone, was most significantly concentrated in the northern half of the site. The two northern-most test pits were both terminated in demolition debris at depths of 9½ to 10 feet, so the depth of the fill in this area is not known. Groundwater was generally encountered at a depth of about 10 feet.

Soil samples collected from the test pits were screened for organic vapors with a PID equipped with a 10.6 eV lamp using a polyethylene-bag headspace methodology recommended by the MPCA. Organic vapors were only detected in the soil samples collected from one of the six test pits with the maximum concentration being 7.3 ppm in a zone where Delta field personnel noted a "petroleum-like odor".

One soil sample for laboratory chemical analysis was collected from each test pit. Samples were collected from the depth interval exhibiting the highest PID reading, or in the absence of positive PID readings, from the apparent water table elevation. Water samples were also collected from five of the six test pits, and surface samples were collected from shallow scrapings at locations near each test pit. All of the soil and water samples were submitted to Pace Laboratories and analyzed for the presence and concentration of Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), PCBs, and 13 priority pollutant metals. The surface samples were also tested for the presence of asbestos using Polarized Light Microscopy (PLM).

No asbestos, VOCs or PCBs were detected in any of the soil or groundwater samples collected by Delta. Trace metals were detected in each of the soil samples collected at the site, but with the exception of thallium, all metal concentrations were below the MPCA's Tier 2 SRVs. It should be noted however that Pace's lower laboratory detection limit for thallium (3.92 mg/kg to 5.51 mg/kg) was above the SRV for thallium (3 mg/kg), so it is possible that the SRV for thallium may have been exceeded in all the samples, but simply not detected by the analyses.

Antimony was present in two soil samples at a concentration above the MPCA's Tier 1 Soil Leaching Value (SLV), which is a concentration thought to present a leaching threat to groundwater; however no antimony was detected in any of the groundwater samples collected at the site. Arsenic was detected in three of the groundwater samples, but Minnesota hasn't established a Health Risk Limit (HRL) for arsenic. Therefore, Delta compared the arsenic concentrations to the federal standards for public drinking water supplies, and found that two samples exceeded that standard.

The MPCA's Tier 2 SRV for benzo(a)pyrene equivalents (BaP equivalents) was exceeded in two of the test pit samples and four of the surface samples, but there were no other significant SVOC detections. Delta speculated that the SVOC contamination may be a result of the deposition of street sweepings on the site.

In their recommendations section, Delta acknowledged the City's desire to develop this area into a canoe access and picnic area and recommended the discontinuation of the placement of street sweepings at the site. They recommended the removal of the waste material with characterization to meet disposal requirements. They also recommended the placement of clean fill and re-vegetation to cover the area.

This area of the park was covered by the Sunde survey and was included in the wetland restoration plan developed for the MAC by HNTB in 1996. The HNTB plan was to remove about 6 feet of fill across most of the two-acre site to restore the parking lot adjacent to Pickerel Lake as wetland. It is apparent that the HNTB plan was never completed in this area, possibly because of the complications imposed on the project by the presence of the demolition debris.

According to documents provided to the MPUC by Xcel, a natural gas pipeline was installed through this area in about 2006. Mr. Nick Boosali of the Xcel engineering department was contacted in an attempt to determine what Xcel may have encountered while installing the pipeline through the area; however, Mr. Boosali stated that the manager for that project was no longer with Xcel and he had limited personal knowledge of the project. He speculated that Xcel may have bored their pipeline beneath the fill material but he couldn't be sure and was reluctant to check their files.

MPCA FILES

The name J.C. White Demolition appears to trace back to a November 24, 1972 site visit conducted by the MPCA. In their notes of that visit MPCA staff wrote "Bob Brackey owner of Lilydale Auto Parts is leasing land that is being used for demolition disposal by J.C. White Demolition Co. The demolition disposal site is proceeding to fill in Pickerel Lake." The MPCA apparently spoke to Mr. Brackey in person and followed up with written correspondence on March 23, 1973; however a copy of this correspondence was not included in the MPCA's file for the site. Apparently Mr. Brackey called the MPCA on March 28, 1973 to clarify that he was not leasing land in the floodplain to a construction company for demo fill, but he himself was filling on his own land with demolition debris. Mr. Brackey stated that he had finished filling early in the summer of 1972 and was just planning to add some clean earth to cover parts that weren't yet covered. Mr. Brackey requested, and was apparently provided, solid waste regulations regarding demo debris.

On August 28, 1973, the MPCA sent Mr. Brackey a certified letter, a copy of which was included in the MPCA's files. The letter was a follow up to a site visit conducted August 23, 1973. In their letter the MPCA said that they found that an area west of, and across the road from, Brackey's auto parts business was being filled with demolition debris. The MPCA stated an expectation that the dumping would cease immediately and that any further dumping violations would be referred to the State Attorney General's office.

The last references to the J.C. White site in the MPCA's files were notes from a follow up site visit conducted April 2, 1974. In their notes, MPCA staff noted that the "Brackey" site was covered and there was "no change" in the J.C. White site, which leads to some confusion about which sites the MPCA was referring to and if "no change" means that land filling at the J.C. White site was ongoing.

Braun investigated this area of the park in with two borings as part of their January 1988 assessment. Braun was apparently confused about the history of the site and errantly referred to this area as the Lilydale Marina Demo Dump in their report. Their soil borings were completed to depths of 10½ to 12 feet below grade and encountered 6 to 9 feet of fill material. Their boring logs indicate that the fill included wood, concrete, limestone fragments and shale fragments. The fill material was underlain by natural alluvial deposits consisting of clay, sand and silt.

Braun reports that organic vapors were not detected in any of the soil samples collected from these borings when they were screened with a PID. Furthermore, no organochlorine pesticides, PCBs, or elevated concentration of the 8-RCRA metals were detected in any of the samples submitted to the laboratory for analysis. Braun made no specific recommendations for additional investigation and/or cleanup of this area of the park.

LILYDALE PARK DUMP SITE

The Lilydale Park Dump site is listed as an inactive site in the MPCA Voluntary Investigation and Cleanup Program (VIC) database. The MPCA's web site indicates a program enrollment date of January 4, 1989 and a program participation end date of April 17, 1998. The enrollment date actually precedes the establishment of the VIC program, but it would correspond to the time frame in which the City of St. Paul was seeking guidance from the MPCA with respect to their plans to build a levee to enhance Pickerel Lake. Therefore it likely collectively refers to the four different sites investigated by Braun in 1988. Specifically, the Kamish Demolition site, J.C. White Demolition site, Twin City Brick Demolition site, and a fourth unnamed landfill accumulated across Lilydale Road from the J.C. White site at the former location of an auto salvage yard operated by Bob Brackey (Lilydale Auto Parts). The Kamish, J.C. White and Twin City Brick Demolition sites are listed separately in the MPCA's databases and each is addressed individually in this report. Therefore, for the purposes of this discussion, the Lilydale Park Dump site will refer solely to the otherwise unnamed landfill area at the former location of Lilydale Auto Parts. A note in the MPCA's files suggests that they consulted a 1966 telephone book in 1988, and determined the address of Lilydale Auto Parts was 886 West Water Street.

The Lilydale Park Dump site is located on the northwest side of Lilydale Road between Lilydale Road and the Mississippi River. It is located on the boarder between Dakota and Ramsey Counties and appears to be partially located within both Counties. It is generally located in the NW¼ of the NW¼ of Section 13 T28N, R23W. The location of this dump is shown on the Site Map in Appendix C.

SITE RECONNAISSANCE

The site is an irregularly shaped area about 6 acres size rising about 10 feet above the surrounding terrain. The surface of the site is well vegetated with grasses and weeds but, in contrast to the surrounding landscape, it generally lacks trees. A small amount of concrete and wood was noted protruding through the uneven surface in several areas and primarily concrete could be seen looking down numerous collapses and voids. There where a number of voids noted where escaping landfill gases kept the immediate area free of snow.

AERIAL PHOTOGRAPHS

The Lilydale Park Dump site and surrounding land appeared to be undeveloped and partially wooded in both the 1937 and 1940 aerial photographs. A small building first appeared on the site in the 1953 photo. Some land clearing in the area surrounding this building had occurred by the time the 1957 aerial photograph was taken, and it appeared that some vehicles may have been accumulated on the property by that time. A much larger area north of the building appeared disturbed in the 1964 photo, and although the resolution of the photo was poor, it is apparent that the salvage facility had been significantly expanded by that time. The 1970 photo was a much better resolution image and an approximately 2½ acre auto salvage yard was clearly visible on the site. The salvage yard had roughly doubled in size by the time the 1974 aerial photograph was taken and it appeared to more or less occupy the foot print that is currently occupied by the landfill.

The site appeared to have been cleared of autos and buildings sometime before the 1979 photo was taken, and with the exception of some trails, the property appeared well vegetated with numerous small trees and/or shrubs. The trails were no longer visible on the 1980 photo and many of the trees and shrubs noted in the 1979 photo were no longer apparent. In each of the more recent photos, the site appeared more or less unchanged from photo taken in 1980.

Beginning with the 1940 photo, numerous trails leading to areas of land disturbance can be seen in the wooded area east of the Lilydale Park Dump site. The disturbed areas appear to have been waste disposal areas and both the trails and disturbed areas become more numerous in the 1950s vintage photos. The trails persist through the 1970 photo, but the areas of land disturbance were increasingly less apparent as the land appeared to become more heavily wooded. Cleared areas in the woods were once again apparent on the 1980 photo with at least two trails appearing to connect the cleared areas to the Lilydale Park Dump site.

CITY OF ST. PAUL

As previously indicated, the copy of the Delta Phase I ESA that was provided by City included a small portion of a map of the Lilydale area entitled "Environmental Intrusions", which was prepared for the Ramsey County Open Space System and dated February 1973. Although Delta only copied a portion of this map in their report, the following map note was included:

"Note: The following intrusions will be removed; all buildings, wells, cess pools, and secondary electrical lines. Buried telephone cables, not needed for future park development or adjacent land owners, will be removed. Transmission lines will be screened. Pipelines will remain. Landfills will be graded and landscaped to enhance the natural topograph. The Village Hall (an old one room country school) will be moved to the historical area of the park. Selected buildings and kilns of the Brick Co. will be maintained for historical significance. All streets and alleys will be vacated. Mendota Road will remain as access."

Based on the above, it appears that the Environmental Intrusions map was prepared in anticipation of clearing the lower Lilydale area for a park. The map indicated that a garage and office, apparently associated with an auto salvage yard, were located on the Lilydale Park Dump site. Presumably this was the location of Lilydale Auto Parts, operated by Bob Brackey.

The Environmental Intrusions map shows a hatched area more or less the shape of, and in the same location as, both the former Lilydale Auto Parts facility and the current Lilydale Park Dump. The hatched area is labeled "Landfill/Auto Salvage Yard" on the map. Since it appears that the area formerly occupied by the auto salvage yard is covered with solid waste, the hatching and note seems logical. However, the Environmental Intrusions map was dated February 1973 and the auto salvage yard was still clearly visible on the 1974 aerial photograph. It therefore appears that the map may be incorrectly dated to 1973. Alternately, the map may show the intent to construct a landfill on the auto salvage property as opposed to the existence of a landfill on the auto salvage property at that time.

The Lilydale Park Dump site was covered by the Sunde topographic survey. The land filled area is apparent as a small hill in the otherwise reasonably flat floodplain. The elevation of the top of the landfill is generally in the range of 710 to 712 placing it 10 to 16 feet above the surrounding terrain. A perimeter line drawn around the apparent landfill yields an area of about 6¼ acres.

MPCA FILES

The MPCA files available for review contained little information about this site. In their notes from a November 24, 1972 site visit, MPCA staff note that “Brackey’s junk yard is a terrible mess” and that “land just east of Brackey’s junk yard of unknown ownership looked like an old uncovered dump”. The notes of a MPCA site visit to the lower Lilydale area conducted April 2, 1974, indicate that the “Brackey” site was covered at that time. However, since his salvage business was still in operation in 1974, it’s not clear to which site the MPCA was referring. It’s possible that they may have meant the “old uncovered landfill” on “land just east of Brackey’s junkyard”, to which they referred in the notes from their November 1972 visit. As noted in the aerial photography section, it appears that dumping was occurring on the land just east of Brackey’s junk yard in the 1940s and 1950s, and possibly as late as 1964.

Braun completed two borings in this area during their January 1988 assessment. Both borings were completed to depths of 15 feet below grade and both encountered 13½ feet of fill which was underlain by topsoil and/or alluvial deposits. Their boring logs indicate that the fill material consisted primarily of bricks, concrete, and wood, in a matrix of clay and sand soil.

Braun reports that no organic vapors were detected in any of the soil samples collected from these borings when they were screened with a PID, and no PCBs were detected in any of the samples submitted to the laboratory for analysis. Trace concentrations of six of the 8-RCRA metals were detected in both samples, but the only element of concern appears to lead, which was detected at a maximum concentration of 380 mg/kg. This concentration is slightly above the 300 mg/kg SRV for lead.

The organochlorine pesticide analyses detected 4,4-DDT in one of the samples at a concentration of 0.1 mg/kg, which is a concentration equal to the lower laboratory detection limit and well below the MPCA’s SRV for 4,4-DDT at 18 mg/kg.

Once again, since Braun composited these samples, it’s not known if the 380 mg/kg lead concentration or the 0.1 mg/kg 4,4-DDT concentration represent the highest concentrations present in the soils at these locations, or if there were areas of higher concentration that were diluted by compositing the more polluted subsample with cleaner soil subsamples. Braun recommended additional testing to determine the actual maximum concentrations of these contaminants that may be present at the site, and an evaluation of the risk their presence poses to public health and the environment.

ARMOR COAT SITE

The Armor Coat site is an approximately 10½-acre area of the park bounded on the north by the Mississippi River, on the east by tracks of the Chicago, Northwestern Railroad, and on the south by Water Street. It is generally located in the SE¼ of the SW¼ of Section 12 T28N, R23W, and its location is shown on the Site Map in Appendix C. It does not appear that the property is included on any MPCA list of environmental problem sites, nor does it appear from the available information that it has been the subject of any previous environmental investigation or assessment.

A review of the MDH CWI produced a record for a well (#200427) that was drilled on this site in June 1964 for a company. The record available from the MDH CWI indicates as “Armo Coat”. According to the original information collected from the well driller, which is on file with the Minnesota Geological Survey (MGS), this well was actually drilled for a company called “Armor Coat” with an address of 845 West Water Street. Based on a review of aerial photography, it appears that property use in this area changed significantly from a presumptive agricultural use to apparent industrial use some time between 1957 and 1964. Therefore, lacking any other reliable documentation for this portion of the site, the name Armor Coat seems reasonably descriptive for the purpose of this assessment.

SITE RECONNAISSANCE

The Armor Coat site is a fairly level to gently rolling area that is partially-wooded with several open areas. There is a bituminous bike trail crossing the area and there are several irregular areas of broken and discontinuous bituminous pavement distributed across primarily the southern half of the site. A few blocks of concrete and stone were noted across the site particularly as shoreline armoring against the Mississippi River.

AERIAL PHOTOGRAPHS

The Armor Coat site appeared to be occupied by a small farmstead on the 1937 aerial photograph. There was a driveway leading from Water Street to what appeared to be a home, a barn and two or more small out buildings. The building site was surrounded by a few trees and the area along the river was wooded, but more than half of the site appeared to be comprised of cultivated fields at that time.

The only significant change to the site noted on the 1940 through 1957 aerial photographs was the clearing of more land and the expansion of the tilled area. With the exception of the building site, it appeared that most of the site was being farmed by 1957.

The 1964 aerial photo was not a particularly high resolution image, but it was obvious that land use at the site was in transition at that time. It was not apparent that any part of the site was being farmed in 1964. It appeared that much of the area surrounding the building site was disturbed in this photo, including the area where remnant bituminous pavement was observed during the reconnaissance. As previously indicated, the water well for Armor Coat was drilled in June of 1964.

Additional clearing, particularly along the river, occurred between 1964 and 1970. It appears that there were a couple of structures remaining at the building site in 1970, but overall, the site appeared to be predominantly open and vacant. What may have been no more than half a dozen vehicles and/or pieces of equipment were located in various positions across the site in the 1970 photo, but it was not possible to determine the nature of land use in this area at that time.

Three relatively small buildings were visible at the site on the 1974 aerial photograph and it was apparent that even more land clearing had taken place since 1970. Two of the structures were located more or less at the former farmstead location and the third was located approximately 150 feet to the west. The site appeared to be a flat open area in this photo with just a few trees located along the river and along Lilydale Road. There were no vehicles visible at the site in this photo and there was nothing visible that would indicate how the property was being used at that time.

There were no structures visible at the site on the 1979 aerial photograph, and with the exception of the bituminous-paved areas, vegetation was beginning to overtake the site. Some paths and trails (primarily focused around the bituminous-paved areas) were visible on this photo and on each of the photos through 1984; however, no paths or trails were apparent on the photos taken after 1984 as the site slowly began to take on the appearance noted at the time of the site reconnaissance.

CITY OF ST. PAUL

A map of the lower Lilydale area entitled “Synthesis/Site Analysis” and dated June 18, 2008, was included as “Attachment A” to the request for proposal that was issued by the City of St. Paul for the completion of this Natural Resources Management Plan. On this map, the Armor Coat site is indicated as having “remnant bituminous from old landfill & auto salvage yard” with “contaminated soils underneath”.

None of the aerial photographs reviewed for this assessment suggest that this area was ever used as an auto salvage yard. While a comparatively small amount of debris was noted in this area during the site reconnaissance, it is not apparent from observations made during our reconnaissance or from a review of the available historical aerial photographs that the site was ever used as landfill. Neither of the environmental investigations that were made available for our review during the completion of this assessment addressed this portion of the park and the conclusion that contaminated soils lie beneath the bituminous pavement seems at this point premature.

This area of the park was covered by the Sunde Survey which depicts the site as a more or less level area with an average elevation of about 700. Based on the Sunde Survey, it appears that bituminous pavement (excluding the bike trail) covers approximately 1½ acres of the site.

MPCA FILES

A review of the MPCA’s files produced no information specific to this area of the park.

TWIN CITY BRICK DEMOLITION

The Twin City Brick Demolition site is included in the MPCA’s list of Unpermitted Dumps. It is located at the former site of Twin City Brick which, according to an interpretive sign in the park, began operation in 1894. A review of aerial photographs suggests the facility was demolished between 1974 and 1979.

The site is generally located in the SW¼ of the SE¼ of Section 12 T28N, R23W at the northeast end of Pickerel Lake along, and either side, of an abandon Chicago Milwaukee St. Paul and Pacific Railroad grade. Its location is shown on the Site Map in Appendix C. The site is bordered on the north by Water Street; on the east by a 250-foot bluff into which several pits were dug to obtain brick-making clay; on the south by tracks of the Chicago, Northwestern Railroad and, on the west by Pickerel Lake and wetland areas peripheral to the lake.

SITE RECONNAISSANCE

The site is accessed from West Water Street at the north end of the park. There is a gravel parking lot located here that was gated at the time of our reconnaissance. There were two pole-mounted electrical transformers noted in this parking area that appeared to be very old and no longer in use. The wooded area southwest of the parking lot was strewn with large concrete fragments and other solid waste for a distance of about 400 feet. A gravel trail (apparently formerly named Joy Street) leads southwesterly from the parking lot a distance of approximately 1,500 feet to the former location of the brick plant on the northeast shore of Pickerel Lake. The land along this trail, and particularly the area between the trail and the abandon Chicago Milwaukee St. Paul and Pacific Railroad appeared unnaturally terraced suggesting it had been graded and filled. Brick, concrete and stone was exposed in the steep side slope between the railroad grade and the wetlands along Pickerel Lake. Erosion has exposed fill cross sections in a number of places revealing what appears to be ash and slag beneath the Chicago Milwaukee St. Paul and Pacific Railroad grade and in a berm or terrace along the southeast side of the trail as it approaches the former location of Twin City Brick.

It appears that all that remains of the Twin City Brick plant is an approximately 5,000 square/foot concrete slab, the remnants of one brick kiln, and a few piles of what appeared to be demolition debris, crushed concrete, and soil. The ruins of two concrete structures were also noted part-way up the bluff between the clay pits and the former brick yard site. Although the former use of these facilities wasn't necessarily apparent, it is assumed they were part of the clay and/or water management infrastructure.

AERIAL PHOTOGRAPHS

The brickyard is visible on each of the aerial photographs from 1937 through 1974. The facility appears to have occupied 5 or 8 acres (excluding the clay pits) along either side of the former Chicago Milwaukee St. Paul and Pacific Railroad just north of its intersection with the Chicago, Northwestern Railroad. Numerous buildings and open storage areas were clearly visible at the site in each of these photos with many apparent changes in site configuration and a general reduction in the total number of buildings over time. It appears that the facility was slowly expanded over time by filling in the northeastern corner of Pickerel Lake. By 1964, a total of approximately 6 acres of the lake had been filled.

Numerous trails between the brick facility and clay pits were visible southeast of the plant in each of these photos. The area along the access trail (Joy Street) appeared sparsely developed during this period with somewhat more concentrated development at the north end near the intersection with Water Street, and at the south end nearer to the brick yard. There were numerous indications of land filling at the site throughout this period particularly in the area between Joy Street and the abandon Chicago Milwaukee St. Paul and Pacific Railroad. An approximately 400-foot by 100-foot wetland area just southwest of the parking lot appears to have been filled between 1964 and 1970, and a concrete debris field was noted in this area during the site reconnaissance.

All of the buildings appear to have been removed from the brick plant site and from along Joy Street by the time the 1979 aerial photograph was taken. An approximately 1-acre cleared area persisted at the former location of the brick plant, but in this photo and each of the subsequent photos through 1991, the site appears more or less vacant and unchanged except for the re-growth of vegetation.

The site was partially flooded in the 1997 aerial photograph, but those areas visible appeared substantially unchanged from photographs taken in previous years.

It appeared that fill associated with the former brick facility had been removed from as much as 2½ acres of Pickerel Lake by the time the 2000 aerial photograph was taken. Much of the apparent building foundation that had persisted as a vegetation-free area following the demolition of the brick facility had also been removed (or covered) by that time. In this photo and all of the remaining photos from subsequent years, the Twin City Brick site appeared more or less as noted at the time of the site reconnaissance.

CITY OF ST. PAUL

The 1996 wetland restoration plan prepared by HNTB for the MAC included the removal of some of the fill that was placed in Pickerel Lake by Twin City Brick. The HNTB plan shows removal of up to 17 feet of fill from the lake bed and regarding across up to 8-acres of the site to restore a wetland area adjacent to the lake. It appears that the HNTB plan was implemented in this area resulting in the site changes first noted on the 2000 aerial photograph.

This area of the park was not covered by the Sunde Survey or any of the other documents provided by the City.

MPCA FILES

The earliest notes in the MPCA's files pertaining to the Twin City Brick site are from an April 2, 1974 site visit to follow up on the demo fills in the lower Lilydale area. The MPCA noted that the Twin City Brick site was "inactive; no change".

The MPCA visited the Twin City Brick Demolition site again in April 1987, and notes from that visit were included in their files. Once again, agency involvement with the site in this time period was in response to a request to build a dike around the lake, raising water levels to improve the lake, and to mitigate wetland impacts proposed for Holman Field. The MPCA noted the demolition fill in Pickerel Lake speculating that the brickyards were deposited in the lake when they were torn down. Debris noted at the site included bricks, railroad ties and a large berm of ash located along the east side of the entrance road to the brickyard. The MPCA speculated that the ash may have come from the brickyard kilns and suggested that the ash pile be evaluated.

Braun conducted three borings in this area during their 1988 assessment. Two of the borings appear to have been completed west of the railroad in the fill material that was removed from Pickerel Lake under HNTB's 1996 wetland restoration plan, and the third appears to have been completed just east of the railroad, more or less at the location of the last building on the site. Each of the borings was completed to a depth of 15 feet, and each was terminated in fill at that depth. Braun reported fill material consisting of bricks, shale, limestone and wood in a mixed mineral-soil matrix.

Braun reported that no organic vapors were detected emanating from the soil samples collected from these borings when they were screened with a PID, and that no organochlorine pesticides, PCBs, or elevated concentrations of the 8-RCRA metals were detected in the composite samples that were collected from these borings and submitted to the laboratory for analysis.

A low level of petroleum contamination (1.4 mg/kg quantified as fuel oil) was detected in a grab sample collected from one of the borings, however Braun did not indicate from what depth interval this sample was collected. Nevertheless, the Braun borings were only conducted to a depth of 15 feet below grade, and according to the wetland restoration plan prepared by HNTB, about 17 feet of fill was removed from the area where this boring was conducted. Since it appears that the HNTB plan was implemented more or less as designed in this area of the park, it appears likely that the petroleum-contaminated soil identified by Braun was removed from the site as part of the wetland restoration project.

COMMON ENVIRONMENTAL ISSUES

There are a number of environmental issues that are not necessarily specific to any particular land use or area of the site, but may factor into the environmental condition of the site as a whole.

PROMISCUOUS PUBLIC DUMPING

It appears that indiscriminate, random waste dumping occurred at the site from at least the early 1970s through the late 1980s. The MPCA's first file notes for the lower Lilydale area are from 1972 and suggest a wide spread problem by that time.

The MPCA's files contained an article from the April 10, 1988 St. Paul Pioneer Press Dispatch quoting the City Superintendent of Maintenance and Parks as saying "Last year, we took about 1,000 old tires, 100 stoves and refrigerators, 60 to 70 sofas and loads of other stuff off park land". Another cleanup conducted June 29, 1988 produced an additional 77 tons of waste, and is documented in a clipping from the June 30, 1988 Minneapolis Star Tribune on file with the MPCA.

In addition to the furniture, appliances, old tires, etc. the MPCA's files indicate at least two instances of documented drum disposal at the site. Nine barrels of chromium-containing street-marking paint waste were reported at the site in April 1987, and disposed of through the MPCA's Abandon Barrel Program. An additional dozen or so barrels possibly also containing street-marking paint waste and used oil were abandon at the site in April 1988.

WELLS AND SEPTIC SYSTEMS

Since there are not now and never have been municipal water and sewer services available to the homes and businesses formerly located in the lower Lilydale area, drinking water would have historically been taken from wells and disposed of in on-site septic systems. Septic systems of the period would likely have consisted of no more than a seepage pit or cesspool.

What appeared to be a collapsed cesspool or septic tank was noted in a wooded area along a trail leading from Lilydale Road to the Kamish Demolition site. Orange snow fence had been placed nominally around this hole, and it was the snow fence that drew attention to the otherwise inconspicuous area of the site.

The 1973 Environmental Intrusions map, a portion of which was included in the Delta Phase I ESA report, maps water well and cesspool locations and suggests that both will be removed. However, it appears that at least one cesspool was missed. If any other cesspools haven't been removed or filled, they may also represent a physical threat to park visitors. Any water wells that may have been missed present an opportunity for surface contamination to reach drinking water supplies.

While the use of a septic system (or even just a cesspool) at a residential site presents a low threat to significantly impact groundwater, the use of such systems at commercial or industrial facilities increases the likelihood of groundwater contamination. Identified commercial/industrial uses in the park include: Lilydale Marina, Twin City Brick, Armor Coat, Lilydale Auto Parts, and a body shop formerly located at 972 Lilydale Road, which appears to correspond to the Lilydale Auto Parts/Lilydale Park Dump site.

Recommendations

GENERAL COMMENTS

This section are divided into several areas, including the one immediately below that discusses potential constraints on developing the park as shown in the Draft Conceptual Site Plan. This is followed by management recommendations for the three major subjects covered in this report: natural areas, water resources, and contaminated soils. The last part of this section includes a summary table with an overview of priority ranking for recommendations among the subject areas.

PARK CONCEPT PLAN SITE CONSTRAINT SUMMARY

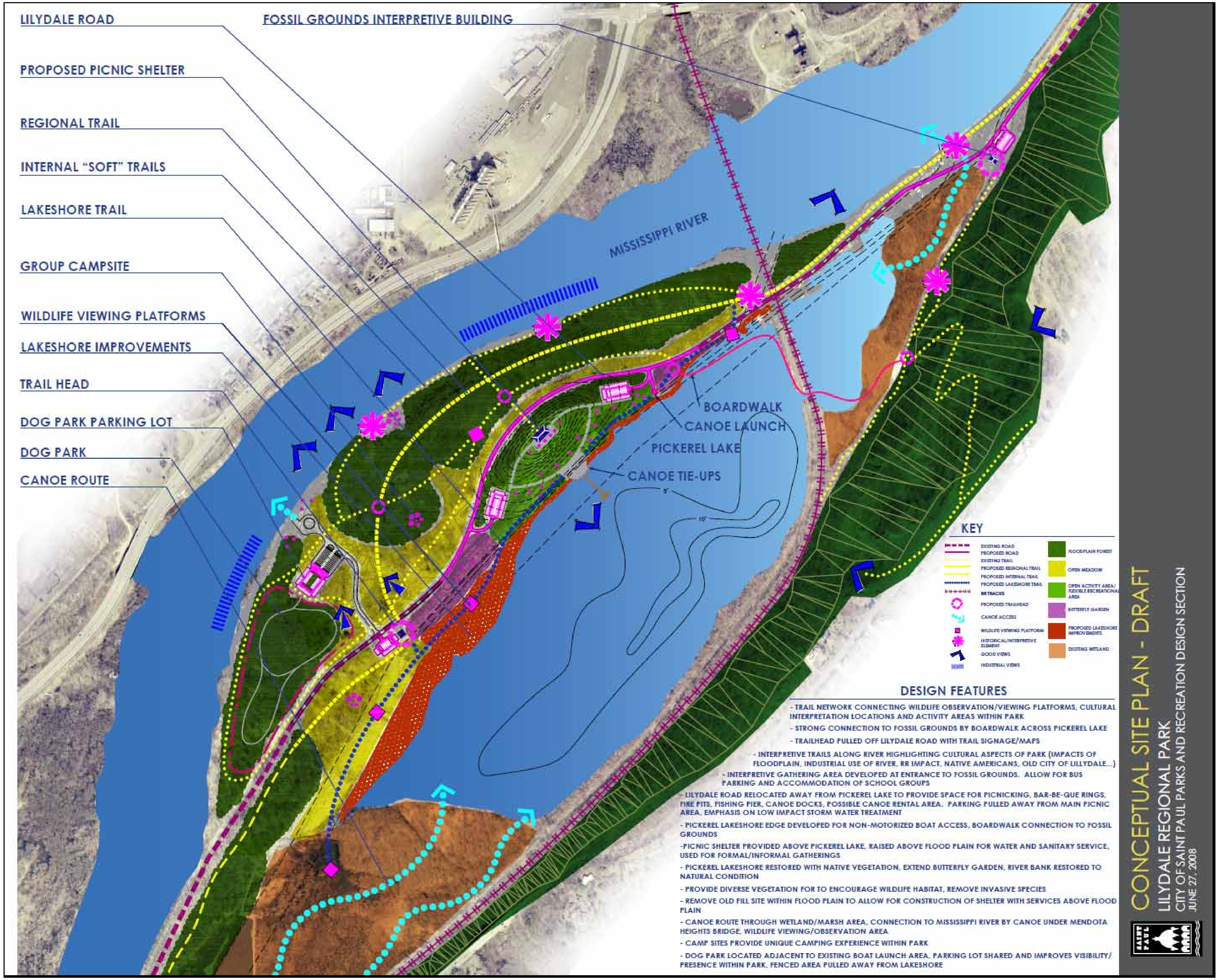
Below are brief overviews of how the inventory and analysis of the topic areas of this report informs the Draft Conceptual Site Plan for LRP. These summaries are intended to provide general guidance on what constraints may/may not exist as a result of the current condition of the studied resources found within the park. As indicated below and elsewhere in this report, additional study and inter-agency cooperation will be necessary and valuable for developing a final site plan and any construction documents that may later result from planning.

While developing LRP as shown on the Draft Conceptual Site Plan would involve significant commitment to waste management as discussed below, implementing the recommendations Water and Natural Resources Management should involve no extraordinary costs associated with environmental issues related to contamination. From the standpoint of potential future park development as shown on the Draft Conceptual Site Plan, the State Rules would not trigger an Environmental Assessment Worksheet (EAW) to review potential impacts or mitigation. However, there may be other triggers for environmental review here, for instance if outside funding sources are used for development, some funding sources/types would require further environmental review.

NATURAL FEATURES (PLANT COMMUNITIES, OTHER NATURAL FEATURES AND WILDLIFE)

Because most of the landscape within LRP has been modified (or highly modified) through human use for mining, factories, and transportation infrastructure, as well as activities within the river floodplain related to building and later abandonment/demolition of the city of Lilydale, the vast majority of the park is dominated by disturbed and/or altered plant communities.

The disturbed plant communities and plant assemblages present at the site in themselves present no restriction on the features illustrated on the Draft Conceptual Site Plan. Native plant communities that have avoided severe disturbance include maple-basswood forest in a few small pockets on the bluff, as well as several wetland communities on the southwest side of the park. While these occur in areas that would be unlikely for park development, they should be considered when planning for park features such as trails. No rare plant populations had been documented within the park prior to or during this project.



LILYDALE ROAD
FOSSIL GROUNDS INTERPRETIVE BUILDING
PROPOSED PICNIC SHELTER
REGIONAL TRAIL
INTERNAL "SOFT" TRAILS
LAKESHORE TRAIL
GROUP CAMPSITE
WILDLIFE VIEWING PLATFORMS
LAKESHORE IMPROVEMENTS
TRAIL HEAD
DOG PARK PARKING LOT
DOG PARK
CANOE ROUTE
MISSISSIPPI RIVER
BOARDWALK
CANOE LAUNCH
PICKEREL LAKE
CANOE TIE-UPS
KEY
EXISTING ROAD
PROPOSED ROAD
EXISTING TRAIL
PROPOSED REGIONAL TRAIL
PROPOSED INTERNAL TRAIL
PROPOSED LAKESHORE TRAIL
RR TRACKS
PROPOSED TRAILHEAD
CANOE ACCESS
WILDLIFE VIEWING PLATFORM
HISTORICAL/INTERPRETIVE ELEMENT
GOOD VIEWS
INDUSTRIAL VIEWS
FLOODPLAIN FOREST
OPEN MEADOW
OPEN ACTIVITY AREA/ FLEXIBLE RECREATIONAL AREA
BUTTERFLY GARDEN
PROPOSED LAKESHORE IMPROVEMENTS
EXISTING WETLAND
DESIGN FEATURES
- TRAIL NETWORK CONNECTING WILDLIFE OBSERVATION/VIEWING PLATFORMS, CULTURAL INTERPRETATION LOCATIONS AND ACTIVITY AREAS WITHIN PARK
- STRONG CONNECTION TO FOSSIL GROUNDS BY BOARDWALK ACROSS PICKEREL LAKE
- TRAILHEAD PULLED OFF LILYDALE ROAD WITH TRAIL SIGNAGE/MAPS
- INTERPRETIVE TRAILS ALONG RIVER HIGHLIGHTING CULTURAL ASPECTS OF PARK (IMPACTS OF FLOODPLAIN, INDUSTRIAL USE OF RIVER, RR IMPACT, NATIVE AMERICANS, OLD CITY OF LILLYDALE...)
- INTERPRETIVE GATHERING AREA DEVELOPED AT ENTRANCE TO FOSSIL GROUNDS. ALLOW FOR BUS PARKING AND ACCOMMODATION OF SCHOOL GROUPS
- LILYDALE ROAD RELOCATED AWAY FROM PICKEREL LAKE TO PROVIDE SPACE FOR PICNICKING, BAR-BE-GUE RINGS, FIRE PITS, FISHING PIER, CANOE DOCKS, POSSIBLE CANOE RENTAL AREA. PARKING PULLED AWAY FROM MAIN PICNIC AREA, EMPHASIS ON LOW IMPACT STORM WATER TREATMENT
- PICKEREL LAKESHORE EDGE DEVELOPED FOR NON-MOTORIZED BOAT ACCESS, BOARDWALK CONNECTION TO FOSSIL GROUNDS
-PICNIC SHELTER PROVIDED ABOVE PICKEREL LAKE, RAISED ABOVE FLOOD PLAIN FOR WATER AND SANITARY SERVICE, USED FOR FORMAL/INFORMAL GATHERINGS
- PICKEREL LAKESHORE RESTORED WITH NATIVE VEGETATION, EXTEND BUTTERFLY GARDEN, RIVER BANK RESTORED TO NATURAL CONDITION
- PROVIDE DIVERSE VEGETATION FOR TO ENCOURAGE WILDLIFE HABITAT, REMOVE INVASIVE SPECIES
- REMOVE OLD FILL SITE WITHIN FLOOD PLAIN TO ALLOW FOR CONSTRUCTION OF SHELTER WITH SERVICES ABOVE FLOOD PLAIN
- CANOE ROUTE THROUGH WETLAND/MARSH AREA, CONNECTION TO MISSISSIPPI RIVER BY CANOE UNDER MENDOTA HEIGHTS BRIDGE, WILDLIFE VIEWING/OBSERVATION AREA
- CAMP SITES PROVIDE UNIQUE CAMPING EXPERIENCE WITHIN PARK
- DOG PARK LOCATED ADJACENT TO EXISTING BOAT LAUNCH AREA, PARKING LOT SHARED AND IMPROVES VISIBILITY/ PRESENCE WITHIN PARK, FENCED AREA PULLED AWAY FROM LAKESHORE
CONCEPTUAL SITE PLAN - DRAFT
LILYDALE REGIONAL PARK
CITY OF SAINT PAUL PARKS AND RECREATION DESIGN SECTION
JUNE 27, 2008

However, the MnDNR Natural Heritage Database indicates two bald eagle nests, one of which was inactive in recent years. As well, there is one recorded sighting of the state threatened Blanding's turtle along Water Street on the southwest side of Pickerel Lake from 1990. The data base also includes the fossil grounds on site. While plants and animals listed as threatened or endangered at the state and/or federal level are afforded some level of legal protection, sites such as the fossil grounds are not afforded the same type/level of legal protection. From the standpoint of potential future park development as shown on the Draft Conceptual Site plan, the State Rules would not trigger an Environmental Assessment Worksheet (EAW) to review potential impacts or mitigation. However, there may be other triggers for environmental review here, for instance if outside funding sources are used for development, some funding sources/types would require further environmental review.

WATER RESOURCES

From the perspective of water resources present at the park, the potential recreational features proposed in the Draft Conceptual Site Plan are within the realm of possibility. Some lakeshore improvements proposed and already in progress will benefit the overall value of habitat and water quality. It will also be important to treat runoff from large impervious surfaces that are created as the park develops (especially parking lots and roadways) through incorporation of stormwater infiltration/filtration features. These features can be designed in ways that will complement the overall appearance of the park, will set a good example for the public, and should not interfere with the main uses of the park.

The canoe trail as currently under consideration could connect the degraded wetland to the southwest of Pickerel Lake in a far more direct manner than it is now connected, with possible adverse impacts on water quality in the Lake depending on the nutrient status of the wetland (i.e. whether it is enriched and could export additional phosphorus through the connection). This is particularly true if the City seriously considers re-routing the lower portion of Ivy Falls Creek to this wetland complex and away from the lake. Because the canoe trail as proposed will likely result in the excavation of a jurisdictional wetland, permitting requirements should be thoroughly evaluated during the planning and preliminary engineering phases. In general, the City of St. Paul should look to create partnerships with cities and other entities to manage the quantity and quality of runoff originating outside of the park, especially the stormwater being routed down Ivy Falls, reaching Pickerel Lake on its southwest side.

ENVIRONMENTAL HAZARDS/CONTAMINATED SOILS

From the standpoint of environmental hazards and contaminated soils, there is no contaminant known or suspected to exist at the site that would in and of itself prohibit development of the park as depicted on the Conceptual Site Plan, or arguably any other plan that could be developed for the site. However, development of park infrastructure and particularly construction within areas identified as presumptively contaminated should consider and may require substantial commitment to the regulatory processes, and the dedication of a significant amount of the City's financial resources. At this point there appears to be no regulatory requirement to either cleanup or further investigate the site, so the extent of this financial commitment and agency involvement is dependent solely on the extent to which the site is disturbed.

The complicated nature and wide spectrum of options (and associated costs) are difficult to fully consider in a summary, and without more specific site development plans. There are contaminants known to be present at the site, and there is a suite of contaminants and waste materials that can reasonably be expected to be encountered during site redevelopment. In our opinion there is no amount of additional physical investigation or testing that is unlikely to preclude the presence of any contaminant at the site and therefore we see limited value in additional physical testing in advance of development.

The general steps we would recommend in proceeding with the project are outlined below. The City may wish to enroll the site in the MPCA's Voluntary Investigation and Cleanup (VIC) program to receive technical assistance and/or liability assurance. The steps outlined below are not necessarily intended to comply with the requirements of the VIC program. If the City chooses to enroll in the VIC program, additional historical documentation, and additional sampling and testing would be required prior to implementing the steps outlined below.

- Develop a Response Action Plan (RAP) – The RAP takes into consideration the specific development activities being proposed for the park and the environmental impairment known to exist in those areas slated for construction. The MPCA typically reviews and approves RAPs for sites enrolled in VIC Program.
- Develop a Construction Contingency Plan (CCP) – The CCP puts into place contingencies to identify and manage unexpected wastes for which no specific provisions have been made in the RAP. A comprehensive contingency plan allows construction to continue while the unanticipated waste material is characterized for management and/or disposal. Similar to the RAP, the MPCA will review and approve of CCPs for sites enrolled in the VIC Program.
- Develop a Site Safety and Health Plan (SSHP) – The SSHP should address general safety considerations for the planned work on-site, as well as the identification of unique chemical and physical threats posed by the interaction with the waste material. The MPCA reviews, but does not approve SSHPs for sites involved in the VIC Program.

NATURAL AREAS MANAGEMENT RECOMMENDATIONS

SUMMARY

Most of the landscape, and thus the vegetation, within LRP has been modified by human activities. As a result, the recommended vegetation management at LRP focuses on maintaining the quality of the remaining intact native plant communities, as well as conducting management within "semi-natural" vegetation cover type areas to foster improvement of native species composition and function. This section includes a map with plant community restoration targets on the following page that reflect the desired future condition of both natural areas, as well as those areas currently dominated by nonnative plants.

Recommendations are given with the "restoration target" cover types in mind and broken into three areas based on landscape position within the park including:

- The bluff
- Wetlands in the vicinity of Pickerel Lake
- Other plant communities/forest areas within the floodplain of the Mississippi River

MANAGEMENT GOALS ACROSS ALL COVER TYPES AND MANAGEMENT AREAS

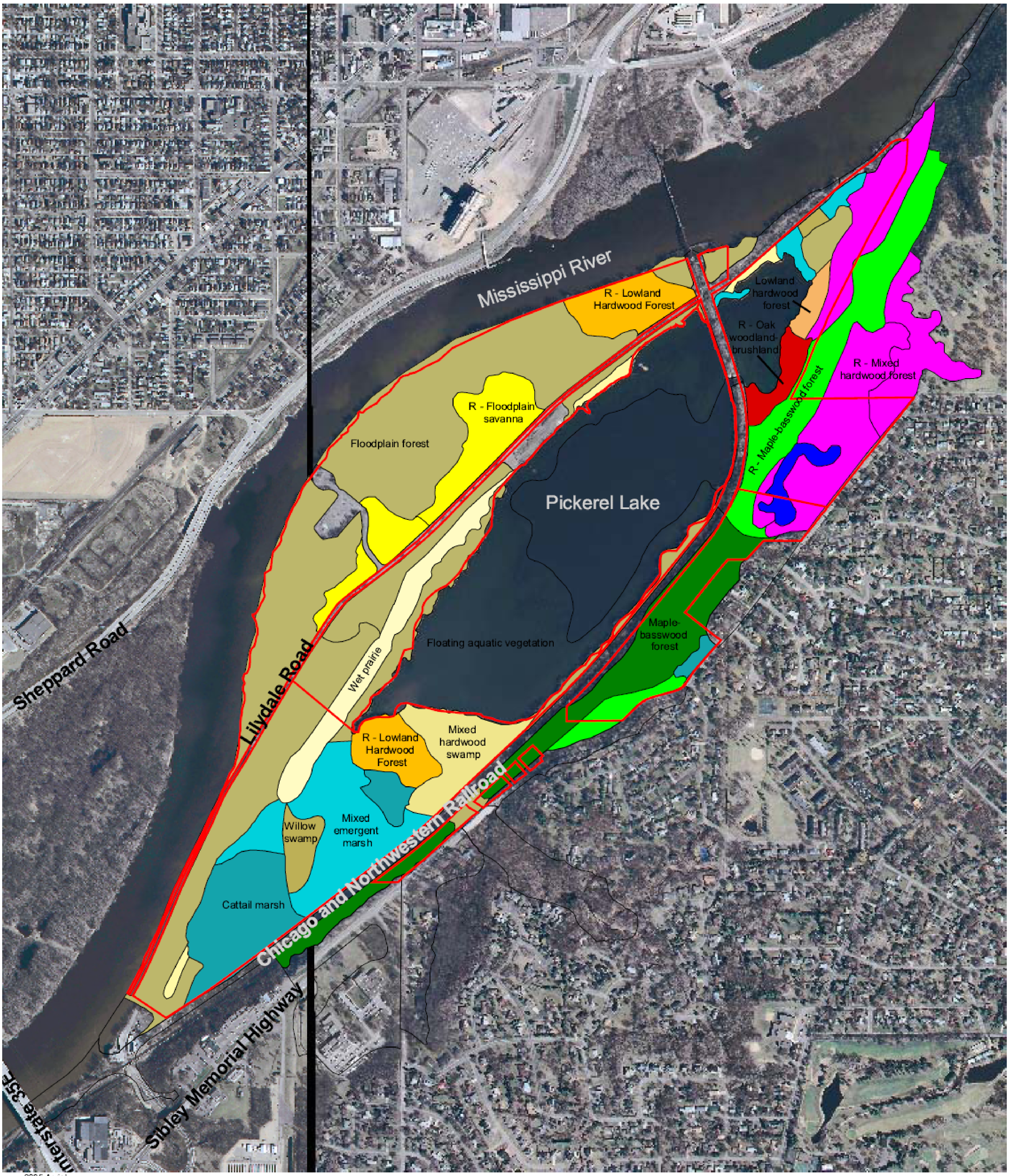
- Maintain or improve the native (natural) plant communities identified within LRP.
- Manage semi-natural cover types toward dominance by native plant species over time.
- Avoid or minimize impact to existing natural areas during future park development, with particular regard for the best quality areas that comprise a small percentage of the park's total cover.
- Where development does occur within the park, plan for infrastructure in a manner that enables cost effective natural areas management (e.g. trails can serve as firebreaks and/or access points for on-the-ground management).
- Provide recreational and educational opportunities compatible with sustaining natural community function and integrity.
- Carry out surface water and infrastructure planning both within the park and outside the park by engaging appropriate stakeholders (to reduce ravine erosion issues and for improved water quality).

NATURAL COMMUNITY MANAGEMENT ACTIVITIES

The management activities below are organized by restoration area, including the bluff, wetlands and other floodplain natural areas.

THE BLUFF

There are generally two forest cover types found on the bluff at LRP. These include sugar maple-basswood forest and disturbed "semi-natural" forest cover types. There are also several spring/seep areas that originate and/or run through LRP. Each of these areas is addressed below. The **sugar maple-basswood forest** segments on the bluff vary in quality with the better quality areas requiring only minor vegetation management, including cut/treat of invasive shrubs and treatment of the invasive nonnative garlic mustard. Likewise, there are several areas of moderate to severe ravine erosion at various points along the bluff, many of which occur in the same drainages as hillside springs/seeps. Maintaining or improving the quality of the sugar-maple basswood forest remnants is a priority for active management of natural areas on the bluff.



Lilydale Park - Natural Area Restoration Targets

LEGEND

Non-native Community Types - Restoration Potential

- R - Floodplain savanna
- R - Lowland Hardwood Forest
- R - Maple-basswood forest
- R - Mixed hardwood forest
- R - Oak woodland-brushland
- R - Shrub swamp, seepage subtype
- R - Wet prairie

Natural Community Types

- Cattail marsh
- Floodplain forest
- Lowland hardwood forest
- Maple-basswood forest
- Mixed emergent marsh
- Mixed hardwood swamp
- Wet prairie
- Willow swamp

Lilydale Regional Park Boundary

N W E S

2000 0 2000 Feet

K:/211/21108110/GIS/*.apr

For this reason, restoration of the bluff forest parcels should involve the following activities:

- Nonnative/invasive shrubs and tree management
- Management of garlic mustard
- Species enrichment - as appropriate, reintroduce species of woodland grasses and forbs
- Evaluate ravine erosion areas (other than Ivy Falls) and prioritize sites for intervention/ restoration

Each of these recommended management activities is expanded upon in the following pages.

NONNATIVE/INVASIVE SHRUB AND TREE MANAGEMENT

Nonnative shrubs should be managed, as well as weedier trees that interfere with the normal function of the healthy hardwood canopy trees. The first priority for management should be the remnant sugar maple-basswood forest areas of highest quality, with work extending outward from these, into lower quality native plant community types and then into the semi-natural/ disturbed forests dominated by nonnative species.

The primary invasive shrubs for removal include European buckthorn and Siberian elm. These should be controlled to the greatest extent possible. In areas where nonnatives occur in thick patches, cutting the smallest shrubs and trees first allows for easier handling of larger trees as piled and burned, or alternatively may be cut and dropped and allowed to decompose in place. The cut and drop approach is significantly less expensive than the pile and burn method, but is also less aesthetically pleasing where thick patches are cut. Managing the Siberian elm will be an especially challenging task due to the fact that it is dominant in several areas (e.g. hilltop, along trail to Bruce Vento's View) and because control is even sometimes difficult with the use of herbicides.

European buckthorn occurs in relatively thick patches in some areas and should be managed to improve the quality of the hardwood forests on the bluff at LRP

When cutting invasive deciduous trees and shrubs, it is important to treat cut stumps within 1 hour of cutting with an appropriate herbicide to minimize the chances for resprouting. For instance, a 25-50% solution of a glyphosate or picloram (Roundup or Garlon) herbicide applied to the outer edge of the flat cut surface works well. Treating cut stumps by using a spray bottle allows for treating only the edge of the stump with minimal risk of damaging any adjacent desirable plants. Treating the stumps with a herbicide is important because it minimizes resprouting. Stump resprouts create the arduous task of (re)cutting many stems where one previously existed. Resprouting can also increase the amount of shade at the ground level compared to before cutting, further hindering the improvement of the ground layer. When applying herbicides following the manufacturer's safety recommendations is critical, including the use of appropriate protective equipment such as chemical resistant gloves and eye protection.

We recommend that invasive species cutting occur between late fall and spring and that cut stems be allowed to fall in place. This method tends to limit deer movement in the forest and thereby reduces herbivory of native grasses and flowers. This gives any seeded/restored native plants a chance to establish before being subjected to pressure by deer. It has been our experience that even in areas of thick buckthorn, the cut and dropped stems of even large buckthorn will decay two to four years time. As mentioned previously, this approach also prevents the significant expense of labor to pile and burn cut material.

Managing invasive nonnative trees and shrubs should be thought of as a long-term practice that would require a substantial and systematic initial effort, with moderately intense follow up treatment in any particular area about three to five years following initial treatment. Management of invasive trees and shrubs should also be integrated with other management activities mentioned below to realize the greatest efficiency in time and expense, as well as the quickest and best improvement.

Cutting of invasive trees and shrubs throughout Lilydale Regional Park would be no small undertaking. Although the density of invasive shrubs and trees varies across the bluff and floodplain area of the park, it is fair to estimate that the labor hours needed per acre would range from a low of about one hour to over 40 hours per acre, with an estimated average of about 8 hours per acre. The areas that would require the greater effort include those dominated by nonnative shrubs and trees, especially Siberian elm. In addition to the labor cost, it would be fair to assume herbicide, perishable equipment, and other expenses would average about $250 per acre in 2009 dollars.

MANAGEMENT OF GARLIC MUSTARD

The nonnative garlic mustard is highly invasive in woodland and forest settings, and is common in some areas along the bluff. Management of this biennial weed should be viewed as a long-term activity which has been approached up to this point by restorationists primarily through repeated, well-timed herbicide applications. This is a labor intensive process usually conducted in fall and early spring using a low concentration (1-3%) of a broadleaf or non-specific contact herbicide such as glyphosate (Roundup). Fall and early spring work well because most native plants of value are dormant during this period and herbicide application as described above will not impact them.

Garlic mustard is an aggressive nonnative plant that can dominate forest ground layers and displace native species.

An alternative approach that may be coming in the near future is the use of biocontrol (some type of introduced predator and/or pathogen). Monitor progress with this approach through the Minnesota Department of Agriculture and/or the Invasive Species section of the MnDNR.

Treating garlic mustard at LRP will require a substantial long-term effort that must be weighed against management of other natural areas at LRP, as well as other parks in St. Paul. Similar to management of the woody invasive species, we recommend beginning management within the highest quality remnant native plant community types first and working outward into other areas as a second priority. It is important to keep in mind that garlic mustard seed gains mobility through people and wildlife and the seed bank may last for up to 10 years, making diligence and follow through especially important.

Similar to brush cutting, managing garlic mustard throughout Lilydale Regional Park would be no small undertaking. Initial intense treatment and several follow-up treatments would be required for basic control. Long-term suppression (total elimination of garlic mustard from LRP is not a reasonable expectation) will require sustained effort into the future. Although the density of garlic mustard varies across the bluff and floodplain area of the park, it is fair to estimate that the labor hours needed per acre would range from a low of about one hour to over 10 hours per acre, with an estimated average of about 4 hours per acre. The areas that would require the greater effort include the disturbed, nonnative dominated forests, floodplain forest, and bluff areas, in decreasing order of density. In addition to the labor cost, it would be fair to assume herbicide, perishable equipment, and other expenses would average about $200 per acre in 2009 dollars.

SPECIES ENRICHMENT

Many areas of forest along the bluff are currently lacking sufficient ground cover, or the ground cover is currently dominated by nonnative, invasive species. These areas would benefit from reintroduction of native grass and flower species in a manner that is coordinated with the management of invasive species described above.

This is particularly true for the forest areas currently dominated by nonnative species such as garlic mustard in the ground layer. Seeding native grasses (and flowers) in areas soon after invasive species management occurs will increase species richness and also offer competition to invasive species resurgences that may occur.

Grass and forb species should be selected with the idea of maintaining the fullest range of options for future treatment, as well as cost. For instance, if a broadleaf herbicide is chosen for long-term management of garlic mustard, planting native grasses (and forbs that would not be affected by a chosen herbicide) will allow the most efficient management in the future for garlic mustard. If species are planted that would be sensitive to the selected herbicide and/or the seasonal timing of application, the resources expended to plant those sensitive species will be lost.

Seeding methods for species enrichment in forest settings usually can include frost seeding or broadcast. Frost seeding is accomplished through broadcasting the seed on a bare soil surface between mid-November and mid-March, allowing the repeated freezing and thawing of the soil to work in the seed. Raking-in seed and packing the ground generally improves the success rate of frost seeding. Broadcast seeding can be done here early in the growing season. Success will be improved if the seeding is accomplished within a few weeks after a prescribed burn.

One additional note of caution on enrichment seeding in forest areas: Although it did not appear to be widespread, there was evidence of nonnative earthworms at select areas on the bluff. Nonnative earthworms are highly efficient seed predators that also remove forest floor litter, further impacting native species of grasses and flowers. Design of woodland/forest restoration seed mix(es) should take this into account.

Native grass, flower and sedge enrichment at LRP can be accomplished on an as-needed, site specific basis. For the purposes of general planning, it would be fair to estimate that approximately 30 acres of upland forest and floodplain forest would benefit from supplemental seeding of native species. The cost for native seeding can range widely depending on the species included in the seed mix and the rate seed is applied. Seeding costs, including labor for installation generally range from about $300 to $1,500 per acre, depending on rate of seeding and species included. Complicating matters is the fact that many native woodland and forest plants are difficult to collect and/or produce seed for, making most forest plant seeds expensive if they can be obtained through native seed vendors at all.

EVALUATE RAVINE AND CLAY PIT WALL EROSION AREAS

There are several relatively small ravines along the bluff line within LRP that exhibit varying levels of erosion. Erosion was generally observed along the mid to upper slope areas with some areas of incision exceeding 10 feet in depth. Soil, along with bedrock and glacial cobbles have been washed downhill and then deposited on the lower portions of the slope along several of these. In at least one instance, the sedimentation and large volume of water reach and are impacting the railroad tracks on the south side of Pickerel Lake. The sediment and nutrient laden water then cross under the railroad tracks and flow into Pickerel Lake, influencing water quality in the lake itself.

Similarly, erosion along the walls of former clay pits should be evaluated and prioritized for stabilization. In particular, there is one sheer slope that is close to a residential home.

Ravine erosion is severe in select locations along the bluff overlooking Pickerel Lake

This photo (right) shows the lower portion of one of the eroding ravines with substantial deposition of sediment and cobbles, burying the base of the trees in the upper middle portion of the picture. This sedimentation is also threatening the railroad grade (slightly visible through the trees at the top of the photo).

The sheer face of this former clay pit wall occurs in close proximity to a residential home.

To better understand the extent of ravine erosion on this bluff and former clay pits, a more detailed field review should be conducted that specifically inventories the location and severity of erosion features, as well as identify significant contributions, if any, by stormwater sources or individual site drainage from roof tops and yards located near the top of the bluff or adjacent to clay pits.

The inventory and subsequent report would:

- Identify potential approaches to controlling erosion at each site
- Identify any site issues related to the potential improvements
- Identify cost estimates/range of erosion control improvements
- Provide a decision matrix that identifies important factors in evaluating these sites
- Assist St. Paul Parks and its partners in prioritizing the sites for active management and restoration

Depending on the activities included in such a project and the level of detail provided through the work, we estimate that cost for this activity would likely range from approximately $11,000 to $15,000. Importantly, the results of this field-based review and the resulting recommendations can be used for planning and developing partnerships. These cooperative restoration efforts may include the city, county, state, or others and could potentially be funded from St. Paul Parks, as well as outside sources such as a municipal Capital Improvements Program or grants funding.

WETLANDS IN THE VICINITY OF PICKEREL LAKE

There are several wetland areas along the perimeter of Pickerel Lake. These include several wetland types that vary from very good to somewhat poor quality. The better quality wetland areas include an emergent marsh area dominated by bur-reed, as well as some pockets of black ash swamp. Some of the moderate to somewhat poor quality areas include cattail marshes dominated by hybrid and narrowleaf cattail. As well, the perimeter of select areas along Pickerel Lake support some wet meadow/emergent marsh areas with a mix of sedges, rushes, and flowers. Management recommendations are given below for each of these areas.

The **bur-reed dominated emergent marsh** occurs on the west end of Pickerel Lake, between a debris field from the former city of Lilydale and an access road out to an electric high tower. This area is of generally good to very good quality and no significant management needs were identified at the time of the field visits for this project. However, this area should be monitored periodically for potential colonization by the nonnatives purple loosestrife and/or nonnative cattail species.

There is one small **black ash swamp** located on the southwest side of Pickerel Lake, adjacent to the railroad grade. Similar to the bur-reed dominated emergent marsh, this area does not currently require active management. However, the substantial flows and sediment delivered to the adjacent area through Ivy Falls does have the potential to impact this ash swamp with the current flows. As a result, the runoff from the top of the bluff and how it is managed as it approaches and comes down Ivy Falls may have an impact here. Please see the water quality recommendations section for details. Likewise, there are nearby infestations of the nonnatives reed canary grass, stinging nettle and garlic mustard. This forest area should be monitored for colonization by invasive nonnative species and evaluated for potential action at that time.

The **cattail marsh** areas on the southwest side of the park are dominated by the nonnative narrowleaf and hybrid cattail species. These are difficult and costly to control under most circumstances. While these cattail areas could surely be managed toward dominance by native species characteristic of emergent marsh, the cost in terms of time and resources would be substantial and recommend that the primary activity in these cattail wetland areas be to monitor them for further degradation, such as infestations of purple loosestrife.

The **wet meadow/emergent marsh** areas along the northeast perimeter of Pickerel Lake include plants common to saturated or shallowly inundated settings, including bur-reed, bulrush, sedges and others. In some areas, the nonnative reed canary grass is present along the margins in some areas, as is the nonnative purple loosestrife. While reed canary grass can be managed to minimize spread, current tools and techniques available seldom achieve cost-effective control of this problem species and management is not recommended in this setting given other higher priority areas for management within LRP. Like reed canary grass, complete control of purple loosestrife is difficult to achieve in most settings. Despite this, in areas where purple loosestrife grows in sufficiently dense stands, biocontrol agent release is a viable option to minimize risks for purple loosestrife spreading and the development of monocultures of this problem species within a given area.

Additional information on purple loosestrife natural history and control can be viewed on the MnDNR website at: http://www.dnr.state.mn.us/eco/invasives/plprog.html. This web page includes methods for control of purple loosestrife, including chemical and biological control agents and the process for obtaining biocontrol agents.

Management of purple loosestrife using this approach would not involve a great expenditure of monies for materials. It would, however, require a fair amount of staff time to investigate the location and procedures for harvesting biocontrol agents, as well as the transport and release of these agents at the treatment site(s). This phase of biocontrol release would likely require somewhere between 20 and 40 hours of staff time. Likewise, once the biocontrol agent is released, it would be recommendable to monitor the site on a regular basis. Depending on the level of effort that is chosen for monitoring, this may take 10-30 hours to establish a formal monitoring system and 4-8 hours per year to make observations. For less intensive monitoring, such as qualitative photo monitoring at the site of release, the total time required for monitoring would likely be 1-5 hours, annually. Please see the sections on monitoring below for additional suggestions.

GENERAL COMMENTS ON MONITORING MANAGEMENT ACTIVITIES

Ecological Restoration is a process that involves active management by natural resource professionals. This management often takes place on small, isolated areas of varying quality.

Management activities can influence one or more aspects of the managed community and have lasting, long-term implications. To avert any possible damages and to make sure that the best possible practices are used for restoring natural communities, it is important to monitor chosen aspects of those communities on a regular basis.

Monitoring can be an expensive and labor-intensive process that has the potential to take valuable monetary and human resources away from the process of active management if not exercised judiciously. Deciding what to monitor and how intensively to monitor is always difficult. Some aspects of management can be monitored through visual inspection with field notes recorded and shared between the park and the resource manager. Other aspects may require that quantitative monitoring be undertaken, such as long-term monitoring of rare plants/animals, although rare species are not part of the equation with this restoration project.

As part of the process of visually inspecting areas and assessing management efficacy without quantitative monitoring, it would be recommendable to keep a field journal of management activities, such as one found in the appendices of this report. This could be used by the natural resource manager for the purpose of tracking observations made. These observations may include species noted, fire effects, unusual weather events, human disturbance, activities of work crews in the forest and buffer, and the quality of their work performed, as well as many others.

Although this type of information may not be quantitative, it is crucial to help with adapting management strategies in the future. This is especially true for the long-term, since personnel and policy changes within organizations are inevitable. This information would give future managers the benefit of insight on daily and yearly activities within the forest as they relate to resource management.

PHOTOMONITORING

One method of efficiently monitoring some resource management (especially invasive brush and trees) is photomonitoring. To set up an individual photomonitoring point generally takes about 3 hours, including creating of sampling equipment. Monitoring is an annual event that generally takes less than 30 minutes per plot, including record keeping.

We recommend that for each photomonitoring point that one (or two) permanent posts be installed that would serve as fixed points from which photos would be taken on an annual basis. The photos should be taken in the same direction from the post, with the same camera if possible, and within a week or two of each other each year. This type of monitoring provides a way to track the presence of brush and the changes in character of the area from year to year. Although not quantitative in nature, photomonitoring can help resource managers understand the outcomes of certain management techniques and provide input for adjusting those techniques.

PROBLEM SPECIES MONITORING

Given the typically thin resources of resource management staff, it is probably impractical to carry out quantitative monitoring of changes in nonnative species levels at LRP. Despite this, it is practical to make a yearly walk-through assessment of the site to understand the current status of invasive coverage, the efficacy of treatment, and to determine if additional treatment of nonnatives is warranted. This should include a site visit by an ecologist at least once a year, at approximately the same time. Observational notes should be made on whether there was an increase, decrease or no change in the overall population for a problem species, as well as whether treatment is warranted in the future.

RECORD KEEPING

It is highly recommended that written, electronic, and/or GIS records of management activities be kept. Hard copy and/or electronic records will allow current and future managers to learn from past successes and mistakes and plan for future activities based on this knowledge. Record keeping is particularly important for budgeting, providing a track record of costs, and justification for changes in future budgets.

If time does not allow for detailed documentation, at the very least a diary-like notebook of activities should be kept. Continuity of management requires a knowledge of past management activities as well as future goals.

WATER RESOURCE RECOMMENDATIONS

Following are recommendations related to the management of Pickerel Lake as well as stormwater within the Park.

1. *Conduct a full summer season of monitoring for the lake.* The monitoring would generate data that will provide a solid baseline against which to compare existing lake quality with current MPCA water quality standards for public uses such as fishing and aesthetic enjoyment. The data will also help establish a basis for detecting any significant future changes in lake quality. The sampling would involve collecting water column samples at the deepest part of the lake at least once per month from May through September. The samples should be analyzed for total and dissolved phosphorus and chlorophyll a to assess nutrient enrichment and *E. coli* bacteria to assess bacterial contamination. Testing for chloride could be added if the City is interested in determining whether the lake may be accumulating excessive levels of salt from road maintenance operations. In addition, observations should also be made of the degree of curlyleaf pondweed infestations early in the summer when they are most apparent.

   Estimated cost range: $5,800 - $8,200 ($800 - $1,200 for analytical costs at commercial lab plus $5,000 - $7,000 for sample collection, data analysis and report preparation if this work is done by a consultant)

2. *If lake water quality improvement through decreasing watershed pollutant inputs is desirable, conduct an evaluation of the feasibility and cost of disconnecting Ivy Falls Creek from Pickerel Lake.* Because of its large developed drainage, Ivy Falls Creek appears to be by far the most significant source of phosphorus and sediment loading to Pickerel Lake. Efforts to decrease stormwater runoff-driven pollutant loads from existing developed areas within the watershed will be made as opportunities arise but will probably take place over a period of decades and may not be very effective in achieving significant load reductions from the watershed. One possible remedy is to re-align the Ivy Falls Creek channel below the railroad crossing so that it discharges to the already degraded wetland area south of Pickerel Lake (which is somewhat isolated from Pickerel Lake) instead of Pickerel Lake itself. The approach would be to use a combination of conventional and bio-engineering techniques to create a re-aligned stream channel that is both stable (unlike the existing channel) and natural looking.

   Modifications could be made within the degraded wetland complex itself to enhance treatment of the Creek discharges in a way that blends with the natural environment and improves wildlife habitat. A feasibility study is highly recommended to evaluate hydrologic and hydraulic impacts in further detail, prepare preliminary engineering designs, develop accurate estimates of both costs and benefits of the project, and work with agencies to define and meet regulatory requirements.

   Estimated cost range: $12,000-$18,000 for feasibility assessment and preliminary engineering

3. *Incorporate stormwater mitigation and shoreline habitat protection components into park development features.* In order to protect Pickerel Lake, it will be important to carefully manage stormwater runoff from the Park itself, especially from paved areas. The best way to protect the lake is to minimize the volume of surface runoff that reaches it. Hard surfaces like pavement and rooftops shed much of the water that falls on them and generate significant volumes of surface water runoff. Yet, these features are necessary to serve Park users by providing places to park, gather, and walk. Beyond minimizing the amount of hard surface and keeping the hard surface away from the edge of the lake, there are ways to further reduce or treat stormwater runoff.

   One way to accomplish this is to use rainwater gardens, porous asphalt, pervious pavement systems or other infiltration features in suitable locations to catch and hold runoff, then let it seep into the ground, just like in a natural system. Once in the ground, the water is filtered through the soil and sub-soil system before it reaches either groundwater or the lake. If rainwater gardens are used, the gardens can be planted with aesthetically pleasing grasses and flowering plants that add beauty to otherwise intensively used areas. It is important that the soils at the location of each infiltration feature be tested prior to design to confirm suitability. If soils are too tight to allow adequate infiltration, native soils can be replaced with engineered soils and an under-drain to provide filtration treatment of stormwater.

Rain gardens, such as this one at the University of Minnesota Landscape Arboretum offer opportunities to capture and treat stormwater runoff before it reaches surface waters such as lakes and rivers.

Infiltration features also serve as important opportunities to capture and treat runoff. In this case, permeable pavers also contribute to the aesthetic appeal (Bonestroo headquarters parking lot).

Infiltration features are best designed to treat runoff resulting from small frequent storm events. For example, capture and infiltration of just ½" of runoff depth from a parking lot will be sufficient to reduce average annual runoff volume and phosphorus loading by about 65% from the watershed area served. On average, though, a few events each year will generate more runoff than this, and overflow options need to be installed to safely convey large flows from infrequent, large runoff events to the eventual receiving waters.

Keeping a 30-50- strip of tall dense vegetation between linear impervious features like trails and the lakeshore is also an important-though natural-component of stormwater infrastructure. These "buffer strips" will filter runoff before it reaches the lake. In addition to the water quality benefits, buffers of native grasses and flowers have deep root systems that help stabilize shoreline areas and offer "edge" habitat that many species of birds and other wildlife find attractive.

Estimated cost range: For the less expensive options, costs for installed rainwater gardens designed to infiltrate ½" of runoff range from as low as $4,000 per impervious acre of drainage for gardens which have a simple planting scheme and are seeded to $14,000 per impervious acre of drainage for those with more decorative, planted vegetation. At the high end of the cost scale, pervious pavement systems often range from $55,000 - $70,000 per impervious acre of drainage area served, which includes a rock storage area below the pavement for temporary storage of runoff as it is infiltrating into underlying native soils. Installed buffer costs generally range from $2-4/square foot.

4. *Engage MnDNR in cooperative management of the lake fishery.* One of the main uses of Pickerel Lake after the park is developed is likely to be for fishing. Forging a partnership with MnDNR to better manage the lake for fishing should be a priority for the City. Based on communication with MnDNR East Metro area fisheries staff, it is likely that MnDNR would view more favorably dedication of MnDNR resources to manage the lake if there were more supporting facilities that provided better access to the lake by the general public (Walsh 2008). The park master plans under consideration all appear to have provisions to meet this threshold. Possible areas where DNR could provide management assistance are in supplemental stocking of gamefish and in the development of shoreline fishing sites as well as a fishing pier. MnDNR cooperation on projects is most likely when the projects are consistent with management objectives of that agency's lake management plan, which was last updated several decades ago. Once the City has finalized its master plan for the park, it is recommended that MnDNR be apprised so that they can update their lake management plan to assure the two are consistent.

   Estimated cost range: Initial coordination with MnDNR should require staff time only. Costs for facilities will need to be estimated once the master plan for the park is finalized. In general, fishing piers can be expected to cost between $25,000 and $30,000 and shoreline fishing sites will each cost between $2,000 for a simple on-shore area to $10,000 for those that require supports and footings.

References for Water Resources Section throughout this report

Balaban, N. H. and H. C. Hobbs. 1990. Dakota County Geologic Atlas Series C-6. University of Minnesota

McComas, S. 2008. Curly leaf Pondweed Growth Characteristics (unpublished). Blue Water Science - St. Paul, MN

Minnesota Department of Health. 2009. County Well Index data base for Ramsey and Dakota Counties

State of Minnesota. 2008. Minnesota Rules Chapter 7050-Standards for Protection of Waters of the State as amended – May 2008

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Scheffer, M. Ecology of Shallow Lakes. 357 pgs

ENVIRONMENTAL ISSUES/CONTAMINATED SOILS

The recommendations for environmental issues and contaminated soils should be taken solely in the context of the objectives outlined in "Conceptual Site Plan – Draft", dated June 27, 2008, a copy of which was provided by the city.

At this point there appears to be no regulatory push for any investigation or cleanup of any part of the site. Furthermore, it is our opinion that there is no amount of additional assessment or additional physical investigation or testing of the site that will eliminate, or is even likely to reduce the scope of the comprehensive construction contingency plan that will be required to deal with environmental issues as they present themselves during redevelopment of the site.

KAMISH DEMOLITION

The Kamish Demolition site (visually estimated at 60,000 cubic yards) does not appear to factor into the plans to redevelop the park. One of two proposed canoe routes nominally clips the southeastern corner of the fill area, but it appears that the fill could be avoided entirely with a minor re-route.

The surface of the landfill is moderately to severely uneven with caverns and large chucks of concrete, some pipe and other metal objects protruding randomly from the fill. In its current condition the site presents a minor to moderate physical hazard to park visitors. This hazard could be partially mitigated with a surficial clean up of the more threatening objects and perhaps through the application of additional clean soil to fill some of the voids. The site is heavily wooded however and the placement of a significant amount of fill would likely come at the expense of some or all of the existing trees (depending on the extent of fill required or desired). Furthermore, additional settlement can be expected in this area over time. Alternately, public access to this part of the park could be restricted.

Braun identified petroleum contamination and elevated lead levels in soil samples collected from soil borings they completed at the site in 1988. Braun recommended additional investigation to determine the magnitude and extent of the contamination, but it does not appear that any additional investigation has been completed to date. The petroleum contamination wasn't particularly significant in 1988 and probably hasn't gotten any worse in the past 20 years. If the lead levels detected in the composite soil samples collected by Braun occur at the surface, or if higher lead levels are present in the surface soils, they may present an exposure risk to park visitors. Re-covering the landfill to reduce the physical threats caused by uneven settlement would also address any direct lead exposure concern. Once again, restricting public access to this area would also reduce the lead exposure threat.

This is a low priority site compared to other environmental contamination sites at LRP. Covering this site may be sufficient, along with picking up debris at the surface. We estimate the cost of tree removal, a light surficial cleanup, disposing of the waste, importing two feet of cover soil, and re-vegetating the site to be in the range of $100,000 to $200,000.

Alternately, this site may be a good candidate for wetland restoration and the development of a wetland bank. This process could generate revenue for the city and offset the significant additional cost of debris removal. Although this route would likely not result in a positive ledger for an overall project cost, the wetland bank approach might help in reducing the overall cost. Because other departments in the city and other agencies are often in need of wetland restoration credits to purchase, there is typically a good market for selling credit, which often sells in the Twin Cities metro area for $1 per square foot or more, potentially generating $200,000 to $300,000 in wetland bank credit net sales revenue, depending on design and construction cost for the wetland restoration itself.

LILYDALE MARINA DEMOLITION

The Lilydale Marina site appears to be slated for a dog park. It is our understanding that the existing demo fill material in this area will be removed to allow the placement of engineered fill at another location within the park. This would essentially be a swap of un-constructible fill in the floodplain for constructible fill at another location in the floodplain.

The general objectives for this area of the park as laid out in the concept site plan seem quite achievable. The fill material in this area appeared to be primarily concrete, stone and bituminous pavement all of which could probably be crushed on-site and reused in the park as engineered fill. While it is possible that there were additional waste materials included in this fill area, the incorporation of compressible and/or decomposable wastes wouldn't seem consistent with the goal of creating a stable storage area, which appears to have been the objective of the former site operator. If the demo material is to be removed from this area, contingencies should be developed for the identification and management waste materials that have the potential to harm workers and/or materials that have the potential to pollute the site where the material is deposited.

There was once a marina building on this site and it is not known if the marina stored motor fuel or performed engine service; however both activities would be typical for this type of business. There is also an old petroleum pipeline running through this area that appears to be no longer in use. Although there have been no reports of petroleum leaks or spills at the site, it is possible that Lilydale Marina site has been impacted by petroleum contamination.

Petroleum contaminated soil (if present) should only be a significant issue if excavation extends below the piles of demo material and into the underlying soil. Therefore we recommend removing the demo material down to match the grade of the surrounding land only. Limiting waste removal to a leveling of the land is most likely to avoid encountering and potentially spreading any significant petroleum contamination that may be present.

The Lilydale site offers similar circumstances to the Kamish site. However, there are a number of challenges with this site including a potential petroleum contamination and the larger, more mature floodplain forest trees that occur in this area (potentially an issue for bald eagles).

Based on the Sunde topographic survey provided, we estimate that removal of debris in this area would total approximately 57,000 cubic yards. Depending on the complexity of what lies underground, the oversight required, and the extent of work undertaken, the potential range of estimated costs may vary from as little as $250,000 if the material can be crushed and reused on site to more than $2 million, if significant amounts of materials such as asbestos occur in the debris. The type of investigation that would likely be required should the City choose to enroll the site in the VIC program might help to develop a more accurate number useful in the planning phase.

J.C. White Demolition

It appears that the location of the J.C. White Demolition is slated for canoe tie ups. The simplest way to achieve this goal might be to build an elevated boardwalk and docking system on piles thereby avoiding the challenges presented by the demo fill.

The desire to create a swimming beach in this area, in part, precipitated the 1988 Braun assessment. Although no indications of significant contamination were detected by Braun, no beach was ever built. The 1996 wetland restoration plan prepared by HNTB called for the complete removal of the fill in this area to restore wetland adjacent of Pickerel Lake. Although the HNTB plans appear to have been followed to restore other wetland areas in the park, no wetland was restored in this area. The 2004 Delta Phase I and Phase II studies focused specifically on this area in support of the current plan to improve the park with a picnic area and canoe access on Pickerel Lake. Once again, the Delta investigation failed to identify any significant environmental concern with the material and in general, our recommendation would be to follow the Delta recommendations if this area is going to be excavated.

Specifically, a good contingency plan needs to be developed for the work. This plan should layout how the material will be evaluated as it is removed to identify regulated materials and potential contaminants that would dictate special worker protection, handling and disposal. Indentifying these materials at the source allows them to be segregated as they are removed. Segregation at the source is most likely to reduce the volume of regulated waste, and will help to avoid the cross-contamination of the site(s) where the removed material is ultimately deposited.

Xcel Energy apparently installed a 20-inch diameter, 600 psi natural gas line through this area since Braun completed their borings and Delta dug their tests pits. If this area is going to be excavated, great care will need to be taken to avoid encountering this gas line. We recommend reviewing Xcel's as-built plans to determine the exact location and depth of this line.

Work in this area to accomplish the goals laid out in the concept site master plan may be moderate in level. Development of the canoe tie ups, parking lot, and related built features may involve more coordination for the gas pipeline feature than for the fill itself. Addressing removal or similar activities of the J. C. White fill should be accomplished during the design phase of the proposed park facilities when more details are available regarding how invasive construction would be in this area.

LILYDALE PARK DUMP

The Concept Site Plan for the park indicates a picnic shelter constructed above the regulatory flood protection elevation at the current location of the Lilydale Park Dump. This will probably be one of the more challenging aspects of park development.

At more than 6 acres, the landfill is fairly large. Based on the Sunde topographic survey, we estimate the volume at approximately 45,000 cubic yards. The landfill was built at the former location of an auto salvage yard some time between 1974 and 1980, and appears to be the most recent landfill area of the park. It is possible that solid waste material deposited in the wooded area to the east of this site during the period of the 1940s through the 1960s was incorporated in this landfill area. As this landfill was apparently accumulated in the final years lower Lilydale was occupied, the few remaining structures present at that time may have been accumulated in this area as they were demolished. The Braun assessment detected a slightly elevated concentration of lead and trace concentrations of 4-4,-DDT in composite samples collected from borings completed on this landfill.

It might be possible to cap the landfill and build on top of it. However, the landfill has been settling unevenly and is likely to continue to do so. It is likely that the material wasn't properly broken up or compacted when it was placed, so additional physical settlement is likely. Furthermore, the fact that the landfill is venting gas suggests that decomposition of waste material is ongoing and this decomposition will likely cause additional settlement in the future. If the landfill were to be built upon, provisions would need to be made for the structural stability of the building(s) and for controlling the landfill gas.

Although by no means uncomplicated or inexpensive, it might be a better long term solution to remove the landfill material completely and build up engineered fill for the park shelter. Once again, a contingency plan to identify potential contaminants and properly manage the waste material would be mandatory for this removal activity. If the remaining Lilydale structures were in fact consolidated here, there is the potential for a significant amount of Asbestos-Containing Building Material (ACBM) to be encountered. If it were necessary to temporarily store excavated material while waiting for laboratory analysis for asbestos or any other contaminant, there are approximately 1½ acres of bituminous pavement lying 800 feet east of this landfill at the Armor Coat site where material could be staged and potentially sorted.

Of all the demolition sites at LRP, this one is perhaps most problematic from the standpoint of achieving the current concept site master plan for the park. This also means that estimating potential cost for clean up has a remarkable number of unknowns. We estimate removal costs for this dump to be in the range of about $1.5 to $2.5 million, which would include planning, monitoring, removal, hauling, and related activities.

ARMOR COAT SITE

The plans for the future development of the Armor Coat site appear very minor consisting primarily of surface trails.

The nature of the Armor Coat business is not clear and a search of the Minnesota Secretary of State's web site for a business entity registered in the State of Minnesota by the name of Armor Coat does not produce a match. A Google search yields a number of matches including companies that produce adhesive window glass reinforcement films, epoxy concrete coatings, and protective adhesive films for automobile hoods, but none of these companies appear to be based in Minnesota. A review of St. Paul city directories and/or St. Paul telephone books from the late 1960s and early 1970s might be helpful in determining the nature of this business if development plans change and the past use of this area of the park comes into question.

Nevertheless, given the limited development currently planned for this area, it's not apparent that additional investigation or evaluation of this site is needed at this time. The remnant bituminous pavement could be removed to allow planting of the site with native floodplain forest species, and since there seems to be some concern that the soil lying beneath the pavement is contaminated; the soil could be evaluated at that time.

This site is a relatively low priority for intervention, but would also likely be the least costly to clean up. Based on current available information, we believe potential cost for bituminous removal and restoration of appropriate native vegetation at this site may range from about $20,000 to $45,000, depending on how much testing is desired by the City or required by the MPCA should the City choose to enroll the site in the VIC program.

TWIN CITY BRICK DEMOLITION

The development plans for this portion of the site include the construction of a Fossil Grounds Interpretive building with restrooms and an improved parking lot.

The proposed parking lot appears to replace the exiting parking lot in this area. Without knowing what (if any) grade changes are proposed, the only recommendation we have is to test and appropriately dispose of the two apparently unused pole-mounted electrical transformers in this area.

The location proposed for the Fossil Grounds Interpretive building is the former location of a wetland that (based on a review of historical aerial photographs) appears to have been filled in the 1960s. The fill likely consists at least in part of demolition debris since large concrete chunks are exposed at the surface throughout this area. The surface is very irregular in this area, likely as a result of differential settlement. Based on the topographic survey, the fill in this area is probably 18 feet deep.

Once again, building on top of the debris is an option, but presents some structural challenges. A more geotechnically acceptable solution is probably to remove most if not all of the unsuitable fill material from beneath the building and refill the area with compacted granular borrow. As with each of the other landfills, there remains a degree of uncertainty regarding the nature of the fill material deposited in this area. On the surface, the materials appear primarily inert and unlikely to pose a significant threat to the environment or the health of site workers. However, as with each of the other landfill sites, a contingency plan to identify and manage potential contaminants and regulated wastes should be developed and followed.

The MPCA files make a number of references to an "ash berm" along the east side of the access trail (formerly Joy Street) leading to the former brick yard location. Ash and slag were noted in an exposure along the east side of the trail and at the location of a washout of the former Chicago Milwaukee St. Paul and Pacific Railroad grade. The true extent of ash disposal in this area, the source of the ash, and the threat (if any) posed to public health and the environment is unknown. In internal memos from 1987 and 1988, and in an August 10, 1987, letter to the City of St. Paul, the MPCA recommended testing the ash. Although it does not appear to be factor in the development plans for the park, the ash is exposed at the surface in at least two locations and probably should be tested to see if it needs to be removed from the site or covered with clean soil. If based on this testing it is determined that the ash presents a significant threat, additional investigation to determine the aerial extent of the material may be required.

We estimate the cost of testing the ash berm for a typical suite of contaminants to be in the range of perhaps $2,000 to $5,000 depending on the number of samples required or desired, but once again, there is range of costs associated with achieving the development goals laid out in the LRP concept site master plan. It may be possible to do a partial removal to create a stable building pad which would be a low-end effort with estimated costs in the range of perhaps $100,000 to $300,000. If complete removal is required or desired, costs may well exceed $500,000. A more accurate cost can be arrived at during the initial design phase for fossil grounds facility and may include some historical review and/or additional field investigation.

General Recommendations

It appears that at least one cesspool at the site was not removed or filled and has partially collapsed. This structure and similar structures present a physical threat to park visitors if they are not properly abandoned. We therefore recommend that this and any other cesspool or septic system located at the park be abandon in accordance with the provisions of Minnesota Rules Ch. 7080.

Although none were observed during the site reconnaissance, there may also be unsealed wells at the site. Unsealed and unused wells may act as a conduit for surficial contamination to reach drinking water supplies. If any water wells are discovered at the site during redevelopment, we recommend that they be sealed by a licensed contractor in accordance with the provisions of Minnesota Rules Ch. 4725.

We recommend reviewing a complete copy of the "Environmental Intrusions" map, a portion of which was included in the Delta Phase I report. This 1973-dated map depicts the locations of the wells and cesspools that were to be removed from the park as environmental intrusions and may lead to additional unfilled cesspools and/or unsealed wells. Furthermore, this map also appears to show the location of structures and the occupation of properties throughout lower Lilydale in about 1973. A review of this map may lead to the identification of additional environmental concerns, or to the resolution of some of the uncertainty surrounding the site.

Delta requested a third party search for fire insurance maps covering the J.C. White site as part of their Phase I ESA, and the results of that search indicated that none were available for that area of the park. Fire insurance maps may well be available for the Twin City Brick facility however and may also be available for the development along Joy Street. If additional information is required or desired for this area of the park, we recommend a search for fire insurance maps at the University of Minnesota Wilson Library.

Delta also requested a third party review of St. Paul city directories (reverse directories) for their Phase I ESA of the J.C. White site. Their vendor provided pages from the 1976, 1982, 1987, 1992 and 1997 St. Paul directories that included listings along Lilydale Road. Not surprisingly, there wasn't much listed along Lilydale Road during that period of time since the area went largely vacant some time before 1979. A review of the St. Paul city directories that are available at the Minnesota Historical Society may produce additional information about specific past land uses at the site if this information becomes necessary or is desirable. Specifically, listings along Lilydale Road, West Water Street, Joy Street, and perhaps other cross streets within the community should be available. If these directories are reviewed, more attention should be paid to the period before 1976 when more of the site was actually occupied.

There does not seem to be enough specific information about the 20 plus year history of promiscuous waste disposal at the site to make any specific recommendations. There wasn't much trash or litter observed at the site during the reconnaissance, and certainly nothing was observed that rose to the level of an environmental concern. As a general precaution, contractors working within the area should be aware that waste materials could be encountered almost anywhere at the site and some general contingencies should be put in place in the event that waste materials are encountered in unexpected areas.

Finally, we recommend that a copy of this report and any contingency plans or development response action plans developed for the site be sent to the MPCA for their review.

POTENTIAL FUNDING SOURCES for additional environmental investigation and cleanup do exist and there are a variety of funding sources that could assist with this process. Some of the funding sources most directly applicable to your site include:

- **MPCA** – additional investigation funding may be available through their Targeted Brownfield Assessment program (TBA). This program is freestanding and can be complementary to the VIC program. Wayne Sarappo, TBA Program Administrator, is a good current contact and can be reached at 651.757.2690. Unfortunately however, we are currently aware of no State or local programs that would assist in the physical cleanup or remediation of sites converting brownfields to green space.

- **U.S. Environmental Protection Agency (EPA)** – Has a number of programs that may be suitable to pursue for LRP investigation and clean up. Unlike State and local programs that are generally tied to job creation, property tax value increase and/or targeted housing markets, the EPA administers programs, including recently available funds (stimulus funds) that may be applicable to the LRP redevelopment project. Our current recommended contact for more information regarding funding sources through EPA in Minnesota is: Deborah Orr 312.886.7576.

Other potential funding sources may include the MnDNR (several programs), National Fish & Wildlife Foundation (which also has several grant programs), the National Park Service, and others. These funding sources are less likely to be directly related to the clean up of dump sites and more likely to be for habitat restoration. While grants for clean up and habitat restoration may be complementary to each other, typically, state grants do not allow other state funds to be used as a match. Similarly, federal grants do not typically allow for matching with other federal grants. However, it is worthwhile to investigate the potential of using grants in a complementary manner and instances where state and federal money can be used as a like match.

SUMMARY TABLE OF NATURAL RESOURCE MANAGEMENT RECOMMENDATIONS

The following page includes a prioritized list of recommendations included in this section of the report including those for natural areas, water resources, and contaminated soils/environmental hazards. These are prioritized as High, Medium, and Low.

Overall, protecting and monitoring the water quality of Pickerel Lake is a top priority with bluff stabilization and dump site clean up following. Because Pickerel Lake is a focal point for the park master plan, the need to protect and maintain the water quality of Pickerel Lake is a high priority, along with the role it plays as wildlife habitat and supporting the best quality natural areas in the park. Pickerel Lake is the natural amenity within the park that visitors will be drawn to and the park is designed around with the road being realigned to provide gathering space adjacent to the lakeshore.

Summary Table of Management Recommendations

Priority	Activity	Comments
High	Water quality monitoring in Pickerel Lake	This is an important first step to decision making regarding potential in-lake and in-watershed water quality management activities.
High	Enroll site in MPCA's VIC program	Doing so allows the city to receive technical assistance and/or liability assurance for clean up.
High	Kamish Demolition Site Wetland Restoration	Investigate the potential for developing a wetland mitigation bank on the Kamish Demolition site. Such a project could assist other city departments in finding wetland mitigation sites and may be a source of revenue to help offset the cost of Kamish debris removal. This may also represent an opportune time to reconfigure the outfall of Ivy Falls Creek, should water quality monitoring data and/or other sources of information support.
High	Feasibility and cost study of pretreating Ivy Falls Creek water prior to reaching Pickerel Lake	Conduct feasibility study to evaluate hydrologic and hydraulic impacts in further detail, prepare preliminary engineering designs, develop accurate estimates of both costs and benefits of the project, and work with agencies to define and meet regulatory requirements.
High	Feasibility study of ravine/slope erosion areas	This study will be important to prioritize sites for stabilization of slopes and ravines, important for protecting structures, minimizing nutrient transport to Pickerel Lake and others.
High	Engage MnDNR in cooperative management of the lake fishery	Because Pickerel Lake is widely used for recreational fishing, strengthening a relationship with the MnDNR to manage the fishery will benefit current park users, and potentially increase interest in the park and overall usership. Such an effort could also qualify the city of funding to establish fishing access points and pier(s).
Medium	Nonnative plant management in natural areas	The floodplain forest and bluff forest areas have significant patches of nonnatives, including European buckthorn,Tatarian honeysuckle, Siberian elm, garlic mustard and others. Management of invasive, nonnative plants will help with maintaining or improving the quality of natural areas

Priority	Activity	Comments
Medium	Conduct field survey for curlyleaf pondweed	Field inventory for this report was conducted in late summer when curlyleaf pondweed is at best poorly evident. To better understand the full extent of this invasive species and guide long-term management, a field mapping effort should be conducted in spring and will provide important feedback on what level of management is practical and the potential success of efforts.
Medium	Shoreline restoration and stormwater mitigation	Incorporate stormwater mitigation and shoreline habitat protection features into park development. This activity is listed as "medium" priority primarily due to the fact that park development may occur in a few years. Incorporating these features into new buildings and infrastructure is a high priority when design actually takes place.
Medium	Investigation/clean up J.C. White, Lilydale Park, and Twin City Brick dump sites	This work should occur in advance of or concurrently with design of proposed facilities in these areas (interpretive center, dock, etc.). These three areas may have the most problematic dump materials in the park.
Low	Investigate/clean up Armor Coat site	Although clean up of this area appears to be relatively straight forward, there are no proposed facilities for this area, and it may serve as a materials staging/storage area for clean up activities associated with other dump sites at LRP.
Low	Investigate/clean up Lilydale Marina site	This work should occur in advance of or concurrently with design of proposed facilities in these areas (interpretive center, dock, etc.). This may be a relatively low priority, depending on how important establishing a dog park is.
Low	Conversion of semi-natural areas to natural areas	This includes nonnative, invasive species management, selective tree cutting, overseeding of native grasses, sedges, and forbs, and others. Although important, this is a relatively low priority in relation to some other activities.

Appendix A - Glossary of Technical Terms[1]

Acre-Foot Volume of water that would cover an acre of land to a depth of one foot (43,560 cubic feet).

Alluvium Material, such as sand and gravel, deposited by running water. River terraces and outwash plains are examples of landforms composed of alluvium.

Barrens Usually refers to an area with sparse vegetation or stunted plants, caused by harsh growing conditions such as infertile, droughty, or thin soils; also, a plant community that has very sparse cover or is composed of stunted plants.

Bedrock Any solid rock exposed at the earth's surface or covered by unconsolidated material such as till, gravel, or sand.

Best Management Practices (BMPs) Methods, measures, or practices to prevent or reduce water pollution, including but not limited to structural and non-structural controls, operation and maintenance procedures, and scheduling of specific activities. Acronym is BMPs.

Blowout An area, on a dune or other sand deposit, where wind has eroded a bowl-shaped hollow in the sand. Blowouts generally are sparsely vegetated.

Bluegreen Algae A type of algae whose population often increases dramatically at high nutrient concentrations in lakes. They can form objectionable surface scums, cause taste and odor problems, and secrete toxins poisonous to warm-blooded animals.

Bog A wetland composed of a layer of acidic peat on which grows a specialized group of herbs and low shrubs. Bogs are distinguished from closely related poor fens by extremely nutrient-poor conditions and the absence of most of the minerotrophic species that occur in poor fens.

Bounce In Hydrologic references, the rise in level in a wetland or lake resulting from a rainstorm event. The difference in elevation between the normal water elevation and the peak water elevation of a pond for a given size runoff event.

Brushland An upland plant community composed of shrubs and tree sprouts.

Buffer Strip A band of un-maintained, preferably native, vegetation left along the edge of a stream, lake or wetland to filter runoff and/or stabilize the shoreline.

Calcareous Describes a soil or substrate that contains a significant amount of calcium carbonate.

[1] Many of the definitions used in this section are borrowed from Minnesota's St. Croix River Valley and Anoka Sandplain, Wovcha et al., Minnesota DNR, 1995.

Canopy Aerial branches and leaves of terrestrial plants; generally the tallest layer of foliage in a plant community.

Chlorophyll a The primary photosynthetic pigment in plants, a measure of the algal biomass in lakes.

Colluvium A deposit of rock and soil at the base of a cliff or slope, formed by gravitational action.

Colonial Nesting Birds Species that nest in colonies (groups or aggregations), either with others of the same species or in mixed-species aggregations.

Cover The proportion of the ground shaded when the living plant canopy is projected vertically downward; also a general term used to describe any component of the habitat that conceals animals from view.

DBH (diameter at breast height) A standard measure of tree trunk diameter taken approximately 4.5 feet above the ground level.

Dominant Describes a plant species that shapes the character of a community by virtue of its size, abundance, dense shade, or effects on soils. Dominant species generally influence the presence, growth, and distribution of other plant species in the community.

Degradation A decrease in quality.

Detention Pond A pond designed to catch and temporarily store runoff before discharging the water downstream. The volume of the pool of standing water in the pond is important in determining how effective the pond will be in treating the incoming stormwater.

Dissolved Oxygen (D.O.) Oxygen that is dissolved in water. Fish and other water organisms need oxygen for respiration to survive. Depletion of oxygen from water can occur as a result of chemical and biological processes, including decomposition of organic matter.

Downcutting The process by which a river or stream erodes and lowers its bed, eventually resulting in the formation of a valley or ravine.

Drift (glacial) Rock material, such as boulders, gravel, sand, silt, or clay, removed from one area and deposited in another by glaciers. Drift includes material deposited directly by glacial ice, such as till, as well as material deposited indirectly, such as outwash.

Ecosystem The interacting group of physical elements (such as soils, water, etc.), plants, animals, and human communities that inhabit a particular place.

Emergent Describes a plant capable of surviving indefinitely with its root system and lower stem in water and its upper stem above water (e.g., cattails).

Empirical Based on experiment and observation; used to describe water quality models which are developed from measured data.

End Moraine A typically hilly landform composed of material deposited at the margin of a glacier.

Ephemeral Habitat A temporary habitat created by low intensity, short-lived fluctuations in environmental factors.

Epilimnion Upper warm layer of a lake during thermal stratification.

Esker A long, often serpentine hill or ridge composed of sand and gravel deposited by meltwater streams flowing in a channel in a decaying ice sheet.

Eutrophication A natural process caused by the gradual accumulation of nutrients and consequent increased biological production, and resulting in the slow filling in of a basin with accumulated sediments, silt, and organic matter. Man's activities can increase the rate at which eutrophication occurs.

Eutrophic Lake A nutrient rich lake; usually shallow, green due to excessive algae growth and with limited oxygen in the bottom layer of water.

Exotic Species A species that has been introduced to an area by humans or that is present in the area as a result of human-caused changes. (same as non native species.)

Export Coefficient An estimate of the expected annual amount of a nutrient carried from its source to a lake.

Fen A wetland community composed of sedges, grasses, forbs, and sometimes shrubs, that develops on peat in shallow basins.

Floating-leaved Plants Aquatic plants that root on lake, pond, or river bottoms and have leaves that float on the water surface at the end of long, flexible stems (e.g., water-lilies).

Floodplain A flat area adjacent to a stream or river channel, created by erosion and deposition of sediment during regular flooding. Signs of flooding include debris caught in trees and ice scars at the bases of trees.

Flushing Rate The number of times per year that a volume of water equal to the lake's volume flows through the lake.

Forb A general term for broad-leaved, herbaceous plants.

Forest A plant community with a nearly continuous to continuous canopy (70 to 100% cover) of mature trees.

Forest-grown Tree A tree that matured within a closed-canopy forest. Forest-grown trees tend to have narrow crowns and tall, straight trunks with few lower limbs.

Graminoid An herbaceous plant with linear, "grasslike" leaves that typically are oriented vertically. Graminoids include grasses, sedges, and rushes.

Greenway or Greenway Corridor A linear open space area, usually composed of natural vegetation, or vegetation that is more natural than surrounding land uses. May include paths or recreational trails.

Ground Layer A vegetation layer, mostly less that 3 feet tall, of grasses, forbs, and woody plants.

Ground Moraine A broad and level or gently undulating landform composed of material that was deposited underneath and sometimes at the margin of a glacier as the ice sheet melted; also referred to as a till plain.

Grove A general term for a patch of trees less than 2 acres in area.

Grub A tree or shrub whose aboveground shoots are repeatedly killed by fire or browsing but whose root system survives and continues to send up new shoots. The root system of a grub may be several hundred years old; the above ground shoots are generally much younger.

Habitat The locality, site, and particular type of local environment in which plants, animals, and other organisms live.

Herb A plant lacking a persistent above ground woody stem. Herbs include broad-leaved flowering plants, ferns, grasses, sedges, and others.

High Water Level (HWL) The peak water surface elevation in a ponding area as a result of a specific runoff event. Once the peak is reached, the pond water elevation eventually returns to its normal (standing) water level.

Hydrology The science and study of water in nature, including its circulation, distribution, and its interaction with the environment.

Hydrophyte A plant adapted to growing in water or on wet soils that are periodically saturated and deficient in oxygen.

Hypolimnion Lower cooler layer of a lake during thermal stratification.

Ice Block Lake A lake that occurs in a depression that was formed when a block of glacial ice was buried or surrounded by till or outwash sand, and then melted.

Ice Scar A scar on a floodplain tree caused by abrasion by ice floes during spring flooding.

Impervious Surface A surface that is impermeable to the downward seepage of water; e.g., pavement and roof tops.

Inflorescence An arrangement of flowers on a plant, such as in a cluster or along a stalk.

Lacustrine Refers to features (such as sediments, landforms, plant communities, or animal communities) that were formed by or are associated with a lake.

Landform A land feature, such as plain, plateau, or valley, formed by a particular geologic process.

Life Form Characteristic structural features and growth pattern of plant species (e.g., broad-leaved deciduous shrub).

Litter Layer Relatively undecomposed organic matter and debris on top of soil layer.

Loading The amount of a pollutant or other substance delivered to a lake, usually expressed as a weight per unit time (i.e. pounds per year). The loading of a given constituent to a receiving water is a function of the volume of incoming water and the concentration of the constituent in the incoming water.

Loess Fine material consisting predominantly of silt with fine sand and clay. Loess is often deposited by wind.

Macrophytes Higher plants which grow in water, either submerged, emergent, or floating. Reeds and cattails are examples of emergent macrophytes.

Marsh A plant community of shallow wetland basins, dominated by herbaceous, emergent aquatic plants such as cattails and bulrushes. Marshes usually have standing water throughout the growing season.

Meltwater Water released by melting glacial ice.

Mesic A general term describing upland habitats that are intermediate between wet and dry; also used to describe plants and plant communities that occur in mesic habitats.

Mesotrophic Lake Mid-way in nutrient levels, between eutrophic and oligotrophiclakes.

Microhabitat A small, specialized habitat.

Mineral Soil A soil composed mostly of inorganic matter, including clay, silt, sand, and gravel. Mineral soils usually have less than 20% organic matter but may have organic surface layers up to 12 inches thick.

Minerotrophic A general term describing wetlands with nutrient levels that fall between very low (such as in bogs) and very high (such as in seepage meadows).

Mitigation Actions taken to reduce an impact. Water quality mitigation measures can be non-structural (such as street sweeping, regulation of fertilizer use, and creation/protection of natural buffers to filter runoff) or structural (such as installation of detention basins). Properly designed detention basins are among the most effective and reliable measures for mitigating the water quality impacts of urban developments.

Model A mathematical representation of an event or process.

Moraine Rock and mineral debris deposited directly by glacial ice. Moraines most often consist of unsorted rock and mineral particles.

Muck A dark-colored organic soil of highly decomposed plant material in which the original plant parts are not recognizable.

MUSA (Metropolitan Urban Service Area) The area designated by the Metropolitan Council of the twin cities area to receive urban services such as central sewer, urban streets, etc.

Native Habitat A habitat formed and occupied by native plants and animals and little modified by logging, farming, ditching, flood control, and the like.

Native Species A species that occurs naturally within a given region.

Native Vegetation Vegetation, composed of native plants, that has been little modified by human activities such as logging, farming, ditching, or the introduction of nonnative species.

Natural Area Geographic area in which the dominant plants and animals are native species.

Natural Community An assemblage that tends to recur over space and time of native plants and animals that interact with each other and with their abiotic habitats in ways that have been little modified by nonnative plant and animal species. Natural communities are classified and described according to their vegetation, successional status, topography, hydrologic conditions, landforms, substrates, soils, and natural disturbance regimes (such as wildfires, windstorms, normal flood cycles, and normal infestation by native insects and microorganisms).

Nonnative Species A species that has been introduced to an area by humans or that is present in the area as a result of human-caused changes.

Non-Point Source Pollution Refers to pollution other than that caused by discharge of pollutants through a pipe from a closed system to a receiving water. Pollution caused by runoff from farm fields or paved streets are examples of this non-point pollution.

Normal Water Level (NWL) The elevation of the surface of the standing water pool within a pond or wetland. Generally, the NWL is the elevation of the bottom of the primary outlet pipe or overland flow channel.

Nutrient Budget An itemized estimate of nutrient inputs and outputs (usually for a period of one year), taking into account all sources and losses.

Nutrient Loading The input of nutrients to a lake.

Nutrient Trap A type of pond or wetland that is effective at removing nutrients from water.

Nutrients Elements such as phosphorus and nitrogen that are required for plant growth. When excess amounts are transported in stormwater they may encourage excessive algae or other plant growth in receiving water bodies.

Oligotrophic Lake A relatively nutrient-poor lake, usually clear and deep with bottom waters high in dissolved oxygen.

Open-grown Tree A tree that has matured in an open setting, such as a prairie or savanna. Open-grown trees tend to have broad crowns and thick, spreading lower limbs.

Organic Soil A soil in which the upper surface layers contain more than 25% organic matter.

Outcrop Bedrock that projects above the soil.

Outwash Plain A plain formed of sorted and stratified material-such as layers of sand and gravel-carried from an ice sheet and deposited by glacial meltwater.

pH A measure of the acidic or basic nature of the water; it is defined as the logarithm of the reciprocal of the hydrogen-ion concentration in moles/liter.

Parent Material The weathered rock or partly weathered soil material from which topsoil develops.

Parts Per Billion (ppb) A unit of concentration, sometimes expressed as micrograms per liter (ug/l).

Parts Per Million (ppm) A unit of concentration, sometimes expressed as milligrams per liter (mg/l).

Peat Soil A dark brown or black organic soil consisting largely of undecomposed or slightly decomposed plants. Peat soils usually form where persistent excessive moisture slows or inhibits the decay of plant material.

Persistent Vegetation Wetland vegetation formed by emergent hydrophytic plants with stems that normally remain standing until the beginning of the following growing season (e.g., cattails and bulrushes).

Phosphorus A nutrient essential to plant growth. Phosphorus is the nutrient most commonly limiting plant growth in lakes.

Phosphorus Export The amount of phosphorus carried off of a given area of land by stormwater.

Phytoplankton Open water algae; it forms the base of the lake's food chain and produces oxygen.

Prairie An upland plant community composed of grasses and forbs. Prairies generally lack trees; shrubs, if present, are not prominent.

Presettlement A term used for convenience to denote the time period before Euro-American settlers moved into the Region. The Region was actually settled by American Indians for thousands of years before European-Americans arrived.

Range (geographic) The limits of the geographic distribution of a species or group.

Rate Control A term that refers to controlling the rate at which water is discharged from a watershed. Rate control is often accomplished by creating ponds-either by excavation or berming- to temporarily store runoff, then discharging the stored water at a slower rate to downstream areas. Further reductions in the rate at which water is released from a pond can be accomplished by reducing the size of the outlet, such as through installation of a wall in the outlet structure with a hole (orifice) through it.

Reintroduced Species Species that had been eliminated from areas where they occurred historically and were later released back into the area by humans.

Remnant A portion or fragment of a natural community that has survived while the rest of the community has been destroyed by logging, urban development, clearing of land for cultivation, and other human activities.

Residence Time The amount of time it takes for water flowing into a lake to equal the lake volume. The shorter the residence time, the more incoming water the lake is receiving relative to its volume.

Rhizome A horizontal underground plant stem.

Savanna An upland plant community formed of prairie herbs with scattered trees or groves of trees. The canopy cover of trees in a savanna is generally between 10 and 70%.

Secchi Disk A device measuring the depth of light penetration in water, typically a 9-inch, white circular plate attached to a rope. Used to measure water transparency.

Sedge Any of a number of grass-like plants of the family Cyperaceae.

Sedimentation The process by which matter (usually soil particles) settles on a substrate following transport by water, wind, or ice.

Seepage The slow, diffuse oozing of groundwater onto the earth's surface.

Shallow Lake Lakes with mean depth of less than 10 feet.

Shrub Layer A vegetation layer, usually less that 6 feet high, of shrubs and tree seedlings.

Shrub Swamp A wetland community dominated by a nearly continuous to continuous canopy (70 to 100% cover) of shrubs, such as willows and alders.

Subcanopy A vegetation layer, composed of patches of individuals of approximately equal height that is lower than the canopy layer; often refers to a layer of saplings, tall shrubs, or small trees between 6 and 35 feet high.

Submergent Describes an aquatic plant that grows entirely under water.

Substrate The surface layer of organic or mineral material-such as till, outwash, or bedrock- from which the soil is formed.

Succession The change in vegetation over time.

Swale A broad, shallow depression in a till plain or broad river plain.

Swamp A wetland community with a fairly continuous to continuous canopy of shrubs or trees, such as speckled alder, black ash, or tamarack. Swamps generally occur in shallow basins or wet depressions.

Talus Rocks and other coarse mineral debris that accumulate at the base of a cliff or steep slope.

Terrace A sandy and gravelly alluvial plain bordering a river. Terraces represent former river floodplains, left stranded when the river level dropped because of channel downcutting or decreased flow. Terraces are ordinarily level or nearly level and are seldom flooded.

Till Unstratified and unsorted material deposited directly by a glacier. Till consists of clay, sand, gravel, or boulders mixed in any proportion.

Till Plain A broad and level or gently undulating landform composed of material that was deposited underneath and at the margin of a glacier as the ice sheet melted; also referred to as a ground moraine.

Total Phosphorus (TP) A measure of all of the different forms of phosphorus in water. Includes phosphorus dissolved in the water, suspended or incorporated in algae or other organisms.

Total Suspended Solids (TSS) Particulate material which floats in or is carried along in water (e.g., algae, soil particles).

Transitional Habitat A habitat present between two adjacent natural communities (for example, the edge of a forest along a wet meadow). Transitional habitats often have features that set them apart from the habitats formed by either of the adjacent communities.

Trophic State The level of growth or productivity of a lake as measured by phosphorus content, algae abundance, or depth of light penetration.

Understory The vegetation occurring below the canopy in a plant community.

Vine A plant with a long, weak stem that grows along the ground or climbs on other vegetation for support.

Watershed The area of land draining into a specific body of water.

Water Transparency A measure of the clarity of water. The depth at which an object can be seen in water.

Wetland Habitats where the soil is saturated or covered with water for part of the year.

Woodland A wooded habitat characterized by an interrupted tree canopy; also used as a general term to describe any tract of land with trees growing on it.

Woodland-brushland An upland plant community composed of a patchy canopy (10 to 70% cover) of mature trees and a dense understory of shrubs, tree shoots, and saplings. Usually the trees occur in scattered groves with dense thickets of brush between them.

Appendix B - Plant Species List

Natural Resources Inventory

By-Community Species

Area LRP-1

MLCCS Code	Qualitative Rank
32210	C to D

Floodplain Forest

Canopy		Shrub		Forbs		Graminoid	
Acer saccharinum	Silver maple	*Salix exigua*	Sandbar willow	*Solidago canadensis*	Canada goldenrod	*Poa pratensis*	Kentucky bluegrass
		Rubus idaeus var. strigosus	Red raspberry	*Artemisia absinthium*	Absinthe wormwood	*Muhlenbergia cuspidata*	Plains muhly
Populus deltoides var. occidentalis	Cottonwood	*Rubus occidentalis*	Black raspberry	*Artemisia absinthium*	Absinthe wormwood	*Muhlenbergia cuspidata*	Plains muhly
		Rubus occidentalis	Black raspberry	*Centaurea maculosa*	Spotted knapweed	*Elytrigia repens*	Quackgrass
		Rhamnus cathartica	Common buckthorn	*Aster lateriflorus*	Side-flowering aster	*Carex tribuloides*	Blunt broom sedge
Ulmus americana	American elm	*Lonicera tatarica*	Tartarian honeysuckle				
				Laportea canadensis	Wood nettle	*Agrostis stolonifera*	Redtop
		Catalpa speciosa	Cigar tree				
Salix nigra	Black willow			*Glechoma hederacea*	Creeping Charlie	*Carex blanda*	Charming sedge
		Amorpha fruticosa	False indigo	*Glechoma hederacea*	Creeping Charlie	*Carex blanda*	Charming sedge
Robinia pseudoacacia	Black locust			*Alliaria petiolata*	Garlic mustard	*Elymus virginicus*	Virginia wild rye
				Menispermum canadense	Canada moonseed	*Leersia virginica*	White grass
Ulmus pumila	Siberian elm			*Arctium minus*	Common burdock	*Phalaris arundinacea*	Reed canary grass
Sagina nodosa ssp. borealis	Knotty pearlwort			*Rudbeckia laciniata var.*	Tall coneflower	*Parthenocissus vitacea*	Virginia creeper
				Eupatorium rugosum	White snakeroot	*Vitis riparia*	Wild grape
				Helenium autumnale var.	Autumn sneezeweed		
				Amphicarpaea bracteata	Hog peanut		
				Anemone canadensis	Canada anemone		
				Cryptotaenia canadensis	Honewort		
				Leonurus cardiaca	Common motherwort		
				Solidago gigantea	Giant goldenrod		
				Carex tribuloides	Blunt broom sedge		
				Aster ontarionis	Ontario aster		
				Impatiens capensis	Spotted touch-me-not		
				Teucrium canadense	Germander		
				Hackelia virginiana	Virginia stickseed		
				Taenidia integerrima	Yellow pimpernel		
				Taraxacum officinale	Dandelion		
				Tanacetum vulgare	Tansey		

Area LRP-2

MLCCS Code	Qualitative Rank
61620, 61720	BC to D

Emergent marsh

Canopy		Shrub		Forbs		Graminoid	
		Salix exigua	Sandbar willow	*Lythrum salicaria*	Purple loosestrife	*Carex lacustris*	Lake sedge
				Helenium autumnale var.	Autumn sneezeweed	*Typha latifolia*	Broad-leaved cattail
				Matteuccia struthiopteris	Ostrich fern	*Phalaris arundinacea*	Reed canary grass
				Impatiens capensis	Spotted touch-me-not	*Scirpus fluviatilis*	River bulrush
				Iris virginica var. shrevei	Southern blue flag		
				Rumex orbiculatus	Great water dock		
		Cornus sericea	Red-osier dogwood	*Aster novae-angliae*	New England aster	*Typha angustifolia*	Narrow-leaved cattail
				Aster lanceolatus var.	Eastern panicled aster	*Scirpus atrovirens*	Dark green bulrush
				Lythrum salicaria	Purple loosestrife	*Juncus torreyi*	Torrey's rush
						Scirpus atrovirens	Dark green bulrush

Area LRP-3 — Maple-basswood forest

MLCCS Code 32150 **Qualitative Rank** C to D

Canopy		Shrub		Forbs		Graminoid	
Acer negundo	Box elder	*Rhamnus cathartica*	Common buckthorn	*Aster cordifolius*	Heart-leaved aster	*Bromus pubescens*	Hairy brome
Quercus macrocarpa	Bur oak	*Celtis occidentalis*	Hackberry	*Aster ontarionis*	Ontario aster	*Carex pedunculata*	Long-stalked sedge
Ulmus americana	American elm	*Prunus virginiana*	Chokecherry				
Quercus rubra	Northern red oak	*Smilax tamnoides*	Greenbrier	*Menispermum canadense*	Canada moonseed	*Carex blanda*	Charming sedge
Fraxinus pennsylvanica	Green ash	*Euonymus atropurpureus*	Wahoo	*Solidago canadensis*	Canada goldenrod	*Elymus virginicus*	Virginia wild rye
var. pennsylvanica		*Celtis occidentalis*	Hackberry				
				Anemone virginiana	Tall thimbleweed		
Celtis occidentalis	Hackberry	*Zanthoxylum americanum*	Prickly ash	*Eupatorium rugosum*	White snakeroot		
Tilia americana	Basswood	*Euonymus atropurpureus*	Wahoo	*Asarum canadense*	Wild ginger	*Elymus wiegandii*	Weigand's wild rye
Acer saccharum	Sugar maple	*Viburnum lentago*	Nannyberry	*Eupatorium purpureum*	Sweet Joe pye weed	*Carex pedunculata*	Long-stalked sedge
		Lonicera tatarica	Tartarian honeysuckle	*Solidago flexicaulis*	Zigzag goldenrod	*Bromus pubescens*	Hairy brome
		Cornus alternifolia	Pagoda dogwood	*Aster cordifolius*	Heart-leaved aster	*Muhlenbergia mexicana*	Mexican muhly grass
		Cornus racemosa	Gray dogwood			*Elymus canadensis*	Nodding wild rye
		Toxicodendron rydbergii	Western poison ivy	*Smilacina racemosa*	Common false Solomon's	*Oryzopsis racemosa*	Black-fruited rice grass
		Prunus virginiana	Chokecherry	*Osmunda claytoniana*	Interrupted fern		
		Rhamnus cathartica	Common buckthorn	*Prenanthes alba*	White rattlesnakeroot		
		Viburnum lentago	Nannyberry	*Smilax ecirrata*	Erect carrion flower		
		Ribes missouriense	Missouri gooseberry	*Galium boreale*	Northern bedstraw		
		Rosa arkansana	Prairie rose	*Actaea rubra*	Red baneberry		
		Rubus occidentalis	Black raspberry	*Desmodium cuspidatum var.*	Big tick trefoil		
		Amelanchier laevis	Smooth juneberry	*Lactuca serriola*	Prickly lettuce		
		Celastrus scandens	Climbing bittersweet	*Boehmeria cylindrica*	False nettle		
		Parthenocissus vitacea	Virginia creeper	*Asarum canadense*	Wild ginger		
		Vitis riparia	Wild grape				
		Parthenocissus vitacea	Virginia creeper				

Area LRP-5 — Mixed hardwood swamp

MLCCS Code 32240 **Qualitative Rank** C

Canopy		Shrub		Forbs		Graminoid	
Fraxinus nigra	Black ash			*Matteuccia struthiopteris*	Ostrich fern	*Calamagrostis canadensis*	Bluejoint
Acer saccharinum	Silver maple			*Eupatorium rugosum*	White snakeroot	*Phalaris arundinacea*	Reed canary grass
				Ranunculus abortivus	Kidney-leaved buttercup	*Elymus virginicus*	Virginia wild rye
				Pilea pumila	Dwarf clearweed	*Leersia virginica*	White grass
				Aster ontarionis	Ontario aster		
				Alliaria petiolata	Garlic mustard		
				Angelica atropurpurea	Angelica		
				Eupatorium maculatum	Spotted Joe pye weed		

Area: Prairie Planting associated with Wetland Mitigation site

Canopy		Shrub		Forbs		Graminoid	
		Amorpha fruticosa	False indigo	*Rudbeckia hirta var.*	Black-eyed Susan	*Sorghastrum nutans*	Indian grass
				Heliopsis helianthoides var.	Ox-eye	*Phalaris arundinacea*	Reed canary grass
				Grindelia squarrosa	Gumweed		
				Desmodium canadense	Canada tick trefoil		
				Arctium minus	Common burdock		
				Verbena urticifolia	White vervain		

Appendix C – Historic Aerial Photos

HISTORICAL INFORMATION GATHERERS, INC.

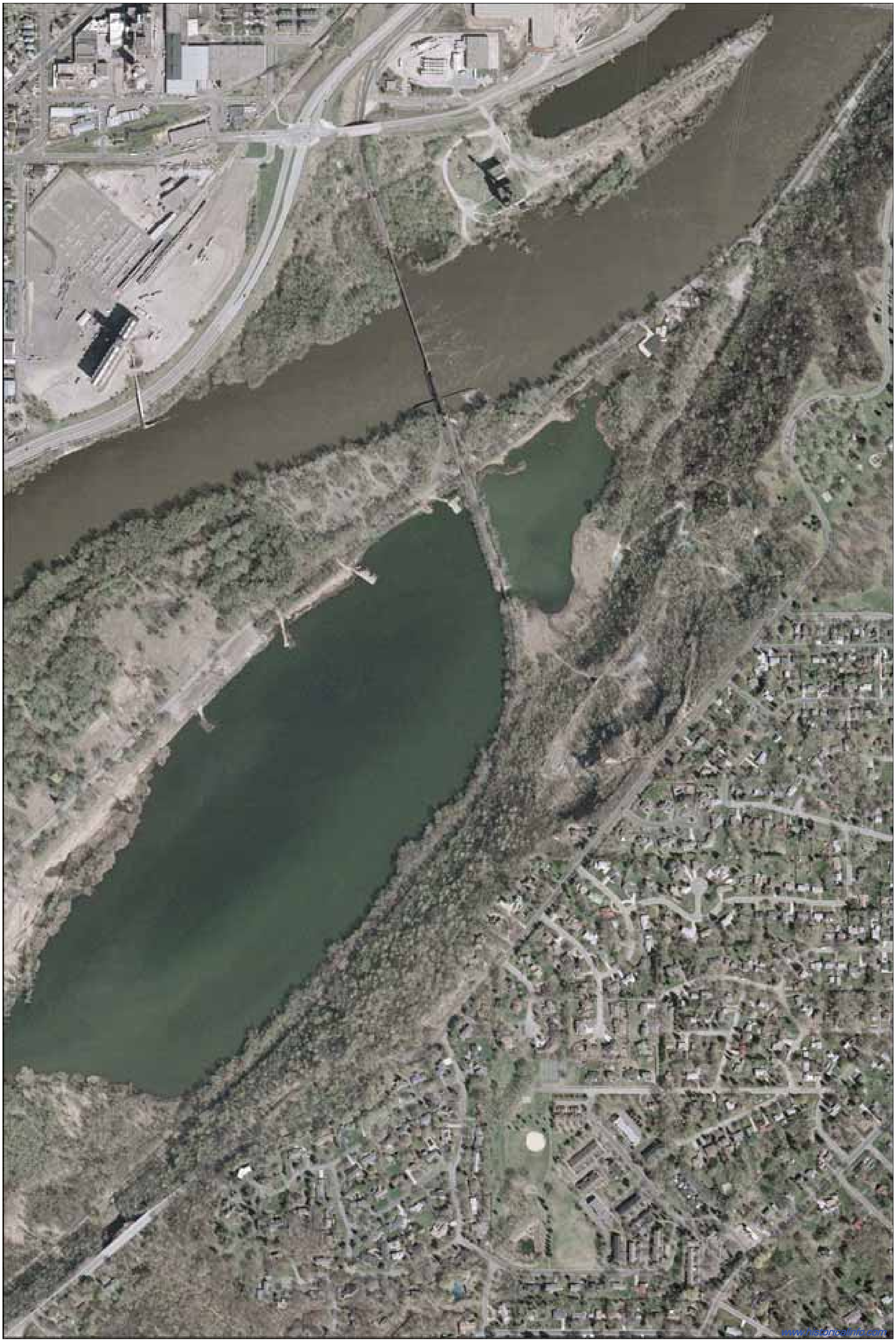
Lilydale Regional Park
Lilydale, Minnesota

2006a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')



HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

2006b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

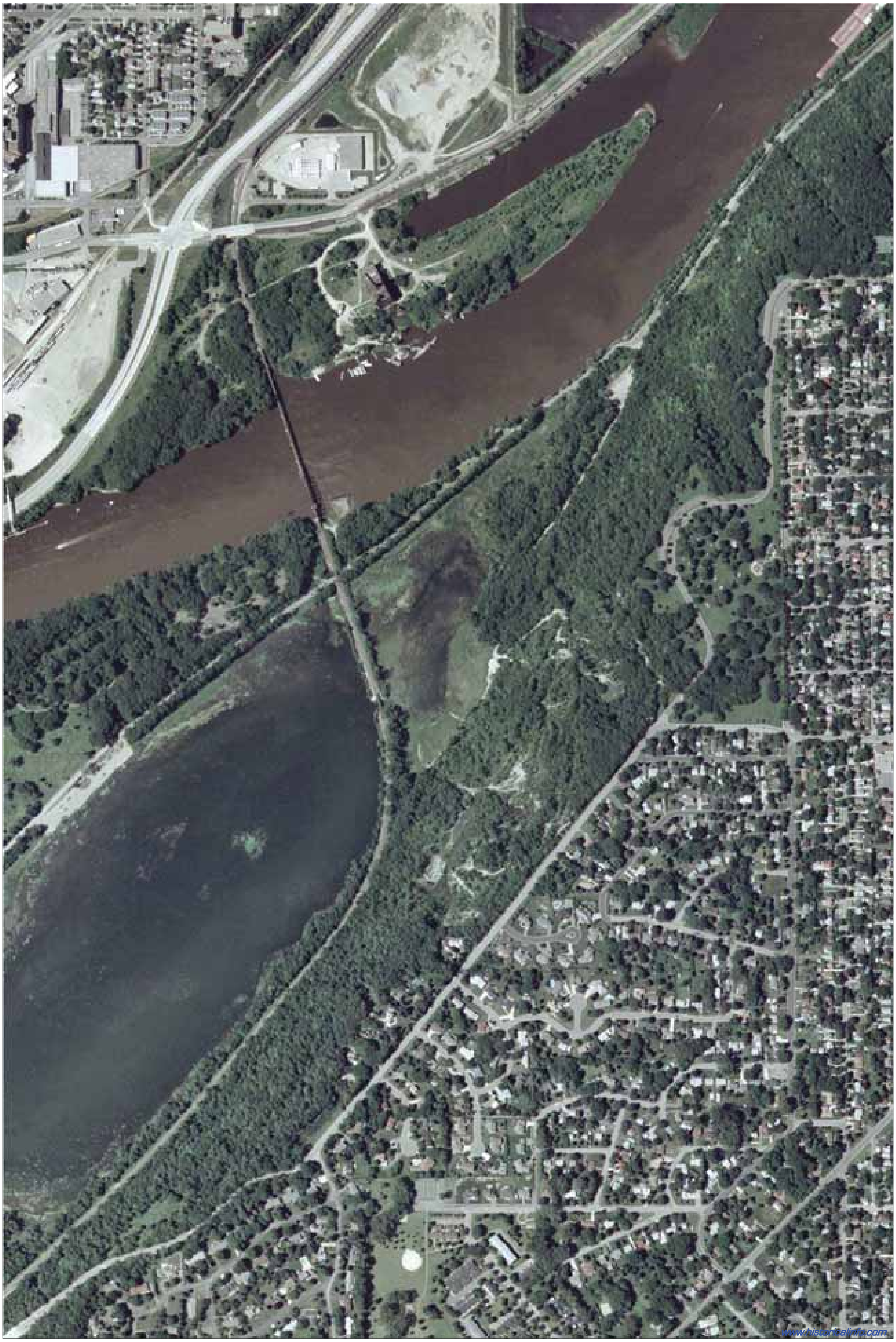
Lilydale Regional Park
Lilydale, Minnesota

2003a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')



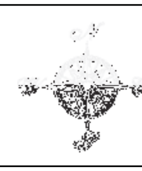
Lilydale Regional Park
Lilydale, Minnesota

2003b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')



Lilydale Regional Park
Lilydale, Minnesota

2002a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG HISTORICAL INFORMATION GATHERERS, INC.	Lilydale Regional Park Lilydale, Minnesota	2002b
		HIG Project Number: MAI-3772
		Client Project Number: 211-08110
		Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

2000a

HIG Project Number:	MAI-3772
Client Project Number:	211-08110
Approximate Scale	1:6000 (1"=500')

HIG HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

2000b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1997a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG HISTORICAL INFORMATION GATHERERS, INC.	Lilydale Regional Park Lilydale, Minnesota	1997b
		HIG Project Number: MAI-3772
		Client Project Number: 211-08110
		Approximate Scale 1:6000 (1"=500')

Lilydale Regional Park
Lilydale, Minnesota

1991a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1991b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1984a	
HIG Project Number: MAI-3772	
Client Project Number: 211-08110	
Approximate Scale 1:6000 (1"=500')	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HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1980a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1980b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG HISTORICAL INFORMATION GATHERERS, INC.	Lilydale Regional Park Lilydale, Minnesota	1979a
		HIG Project Number: MAI-3772
		Client Project Number: 211-08110
		Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1979b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

Lilydale Regional Park
Lilydale, Minnesota

1974a

HIG Project Number: MAI-3772	
Client Project Number: 211-08110	
Approximate Scale 1:6000 (1"=500')	

Lilydale Regional Park
Lilydale, Minnesota

1974b
HIG Project Number: MAI-3772
Client Project Number: 211-08110
Approximate Scale 1:6000 (1"=500')

HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1970a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1970b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

Lilydale Regional Park
Lilydale, Minnesota

1964a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1964b
HIG Project Number: MAI-3772
Client Project Number: 211-08110
Approximate Scale 1:6000 (1"=500')

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1957a
HIG Project Number: MAI-3772
Client Project Number: 211-08110
Approximate Scale 1:6000 (1"=500')

HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1957b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG HISTORICAL INFORMATION GATHERERS, INC.	Lilydale Regional Park Lilydale, Minnesota	1953a
		HIG Project Number: MAI-3772
		Client Project Number: 211-08110
		Approximate Scale 1:6000 (1"=500')

HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park Lilydale, Minnesota	1953b	
	HIG Project Number: MAI-3772	
	Client Project Number: 211-08110	
	Approximate Scale 1:6000 (1"=500')	

HIG
HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1947
HIG Project Number: MAI-3772
Client Project Number: 211-08110
Approximate Scale 1:6000 (1"=500')

HISTORICAL INFORMATION GATHERERS, INC.

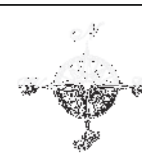
Lilydale Regional Park
Lilydale, Minnesota

1940a

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')



HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1940b

HIG Project Number: MAI-3772

Client Project Number: 211-08110

Approximate Scale 1:6000 (1"=500')

HIG HISTORICAL INFORMATION GATHERERS, INC.	Lilydale Regional Park Lilydale, Minnesota	**1937a**
		HIG Project Number: MAI-3772
		Client Project Number: 211-08110
		Approximate Scale 1:6000 (1"=500')

HIG

HISTORICAL INFORMATION GATHERERS, INC.

Lilydale Regional Park
Lilydale, Minnesota

1937b

HIG Project Number:	MAI-3772
Client Project Number:	211-08110
Approximate Scale	1:6000 (1"=500')