Birch Island Lake
Water Level Investigation

Prepared for
Nine Mile Creek Watershed District

July 2005

BARR

4700 West 77th Street
Minneapolis, MN 55435
Phone: (952) 832-2600
Fax: (952) 832-2601

Birch Island Lake
Water Level Investigation

Prepared for
Nine Mile Creek Watershed District

July 2005

BARR

4700 West 77th Street
Minneapolis, MN 55435
Phone: (952) 832-2600
Fax: (952) 832-2601

Birch Island Lake
Water Level Investigation

Table of Contents

List of Figures

1.0 Problem Description

Birch Island Lake is located in the northeast corner of the City of Eden Prairie. The lake location is shown on Figure 1. A decline in the lake level began in approximately 1987, and it has remained low up to the present time. Several adjacent lakes also experienced a decline and all were studied by the Nine Mile Creek Watershed District in the report Glen Lake, Shady Oak Lake, and Birch Island Lake water level investigation, December 1992. The report concluded the lake level declines were directly related to a lack of precipitation occurring in the preceding years.

Birch Island Lake was an exception as the lake levels did not match the expected water levels based on climatic conditions. The decline was larger than what the water balance analysis concluded.

Since 1992, the water levels of Shady Oak Lake, Glen Lake and Lone Lake have returned to more normal conditions. The water level of Birch Island Lake, however, has not returned to the pre-1987 levels. Since 1992, the Nine Mile Creek Watershed District has been collecting additional water level data on several ponds and wells in the area of Birch Island Lake to supplement the data collected and summarized in the 1996 report.

2.0 Study of 1992

The following is a summary of the 1992 report, Glen Lake, Shady Oak Lake, and Birch Island Lake water level investigation, December 1992.

The elevations of Glen Lake, Shady Oak Lake and Birch Island Lake have experienced a decline in recent years, which has diminished the value of these water resources. This report summarizes this investigation and its conclusions. The lakes have several similarities, which can result in significant fluctuations in water levels. Two most significant similarities are the small watershed drainage area in relation to the surface area of the lake, and the lack of low-level outlets establishing a normal elevation for the lake. Lakes of this type are referred to as landlocked. The analysis to determine the hydrologic system for lakes with these characteristics is referred to as a water balance. A water balance will show the relationship between precipitation, surface water runoff, overflow, groundwater flow, evaporation, and transpiration for each lake. This type of analysis will determine if the elevations are a result of climatic conditions or changes in the hydrologic system of the lake.

Several approaches were pursued in the investigation of water levels of the study lakes. These included: comparison of the lake levels with each other, comparison with other lakes within the general area, the computation of a water balance for each lake, and the potential impacts and urbanization and construction at two activities would have on the Birch Island Lake water levels.

2.1 Lake Level Comparison

The comparison of the water levels of the study lakes with other nearby lakes was intended to determine if the lakes were behaving in a similar manner. The lakes previously listed were used, as well as Lone Lake. Lone Lake, a landlocked lake; was used for additional comparison. The lakes should be expected to respond in a similar matter based on the characteristics of the watersheds. A review of the lake levels indicates that the lakes exhibit similar behavior for the available lake level record. The significant exception is the excessive drop of Birch Island Lake levels in the late-1980s.

2.2 Water Balance

In an attempt to determine changes in the hydrologic systems of the study lakes, a computer model was created to predict lake levels based on the weather records from 1965 to 1992. This model computes long-term watershed yield based on hydrologic watershed factors.

The results of the water balance for Glen Lake and Shady Oak Lake show the computed levels correlate with the measured levels well for the period of record. This indicates that the hydrology has not been significantly altered.

The results of the water balance for Birch Island Lake, however, are different. The computed and recorded levels compared fairly well until the late-1980s. At that time, the lake levels dropped significantly below predicted levels and have remained well below the predicted levels. This is an indication that changes have occurred in the watershed altering the hydrologic system of the lake.

2.3 Highway 62 Construction

In 1985, Hennepin County began placing fill in the wetland north of Birch Island Lake for the proposed T.H. 62 roadway alignment. Because of poor foundation material in the area, granular fill was placed along the proposed roadway alignment to surcharge the existing organic material. Surcharging compacts the organics and provides a stable subbase for the roadway. The construction information indicates that approximately 35 feet of granular surcharge was placed in this area. Soils information obtained from the County indicates the existing organic material is underlain by a sand layer. It is possible that with the placement of the granular material over the organic material, a connection was made with this sand layer. This connection could prevent, intercept, both surface and groundwater from reaching Birch Island Lake.

The current level of Birch Island Lake ranges from 6 to 8 feet below the levels computed using the water balance model. It was speculated that the construction of T.H. 62 had the potential to be the cause of the lowering of the lake level; however, additional investigation was performed to better define the groundwater conditions within the area.

2.4 Sand Point Installation

In order to determine groundwater characteristics along the T.H. 62 roadway embankment, four sand point wells were installed along the shoulder of the roadway. The location of these wells is shown on Figure 2. These wells have been monitored on a monthly basis from 1994 to the present. In addition to these wells, the ponding basins both upstream and downstream were also surveyed. The location of the ponding basins are also shown on Figure 2.

On two occasions, September 1996 and January 1999, the water levels in the roadway embankment, as represented by the sand points, were lower than the elevation of the South Pond. This indicates a

groundwater flow through the roadway embankment flowing easterly to a sand lens, rather than toward South Pond prior to the roadway construction.

The data collected indicates that the North Pond and the piezometers generally correspond with each other. The levels of Birch Island Lake and the South Pond, however, do not seem to correspond with the piezometers. This indicates that the hydraulic connection between the piezometers and the South Pond is not strong, supporting the assumption that groundwater flow has been diverted likely easterly to an existing underlying sand lens.

2.5 Piezometer Installation

In August 2003, two additional piezometers were installed on the south side of T.H. 62 and on the eastern side of the wetland (referred to as B1 and B2). These piezometers were installed within 10 feet of each other, laterally. The upper piezometer (B1) has been installed to a depth of 13.5 feet. The well is screened in a saturated sand lense within peat deposits, that is connected to the existing roadway embankment. The lower piezometer (B2) is 15 feet deeper and is in a more extensive glacial outwash deposit on the east side of the wetland that trends north-south. Data has been collected from these piezometers on a monthly basis since they were installed.

In addition to the new piezometers, elevation data has been collected at the four shallow sand point piezometers installed in the roadway embankment in 1994, the ponds north and south of the road, and Birch Island Lake. Figure 3 shows selected data for the period of record of the piezometer.

A review of the water level data trends indicates three different groupings:

- Birch Island Lake and the South Pond, which have fairly steadily declined throughout the monitoring period.
- The new piezometers and three of the sand point piezometers (NE, NW and SW) which declined through March 2004 and thereafter rose.
- Sand point piezometer SE, which has gone up and down irregularly.

The water level in the lower piezometer (B2) closely parallels the water levels in the shallow sand points, the new shallow piezometer (B1),and the North Pond based on the monthly readings. The water levels in the lower piezometer (B2) are approximately 2 feet lower. This appears to indicate that the lower aquifer is connected with the aquifer within the roadway embankment.

The water levels in the South Pond and Birch Island Lake do not change in concert with the sand points in the embankment and the new piezometers installed in the natural sand lens and glacial outwash deposit on the eastern end of the roadway embankment. This indicates that the hydrologic factors affecting these ponds are not directly connected with the factors affecting the piezometers. Similarly, the SE sand point appears to be in an isolated system, which rises and falls dramatically during rainfall events.

2.6 Installation of Data Level Recorders

The data to date is based on monthly measurements, and shows only broad seasonal changes (dry fall in 2003, winter, and spring 2004 recharge). More detailed data may document the effects related to specific precipitation events. Such detail may provide more proof of the hydrologic groupings identified above.

The data recording devices were installed within the piezometers (B1 and B2) on June 24, 2004 and removed on August 16, 2004. These data recorders were installed to record water levels in each well at one-minute intervals. Plotting the water level in each of the piezometers shows that the aquifers are directly connected. The water level in the lower aquifer responds at the same time as the upper aquifer, but with a slightly smaller magnitude. The Nile Creek Watershed District maintained a rainfall gauge at the Mn/DOT maintenance facility in Eden Prairie. The data from this rainfall gauge was plotted for four rainfall events that occurred during the period of June 24, 2004 through August 16, 2004. Figure 4 shows the relationship between the rainfall and the piezometer elevations and that both piezometers (B1 and B2) react without delay to the rainfall.

A graph (Figure 3) of the water surface elevations in the North Pond the South Pond and the new piezometers (B1 and B2) shows the elevations of the South Pond and Birch Island Lake do not react to the rainfall events as the piezometers do. This indicates that the hydraulic connection between Birch Island Lake and the drainage area upstream of the roadway embankment is no longer functioning. The watershed area north of T.H. 62 is no longer contributing surface and groundwater to Birch Island Lake.

3.0 Conclusions

The results of the data collected indicate that the roadway embankment is directly connected to the lower aquifer and is providing a bypass conduit for the watershed runoff thus preventing it from reaching Birch Island Lake. This has resulted in the low lake levels since the construction of the roadway embankment.

3.1 Construction Options

During the conceptual design of the potential solutions, the location of the primary discharge point into the south pond was found to enter approximately 600 feet to the west. The overall conclusions of the report are still valid. The fill placed for the roadway embankment connected the ponds in the area to the lower aquifer.

There are two options considered to correct the problem. The first is to bypass the road embankment with both surface and groundwater flow, and the second is to seal the flow path that is removing the water from the watershed.

Pipe Bypass System

The first option is to bypass the roadway embankment with both surface and groundwater flow. This would require a pipe, (cross culvert), 12-inch, be installed through the roadway embankment from the North Pond with an upstream invert elevation lower than the existing pipe. This new pipe would extend past the wetland and directly outlet to Birch Island Lake. The bypass would be installed by directional drilling through the roadway embankment and wetland.

To provide a more efficient means to intercept flow, a drain tile system paralleling the roadway embankment to intercept groundwater flow is recommended. The cost of this option is estimated to be $225,000.

This option has the advantage of being straightforward. There is no attempt to pinpoint the exact location where the surface water is leaving the wetland/roadbed. The expectation of success is high.

Flow Path Seal

This second option is to block the current flow path of both surface and groundwater and restore the drainage to its original direction, this would be accomplished by either constructing a sheet pile cutoff paralleling the roadway embankment near the east end of the roadway fill section or sealing

the permeable soils of the embankment with a silicate grout. The grout would be injected into the permeable roadway embankment. The cost of this option is estimated to be $230,000.

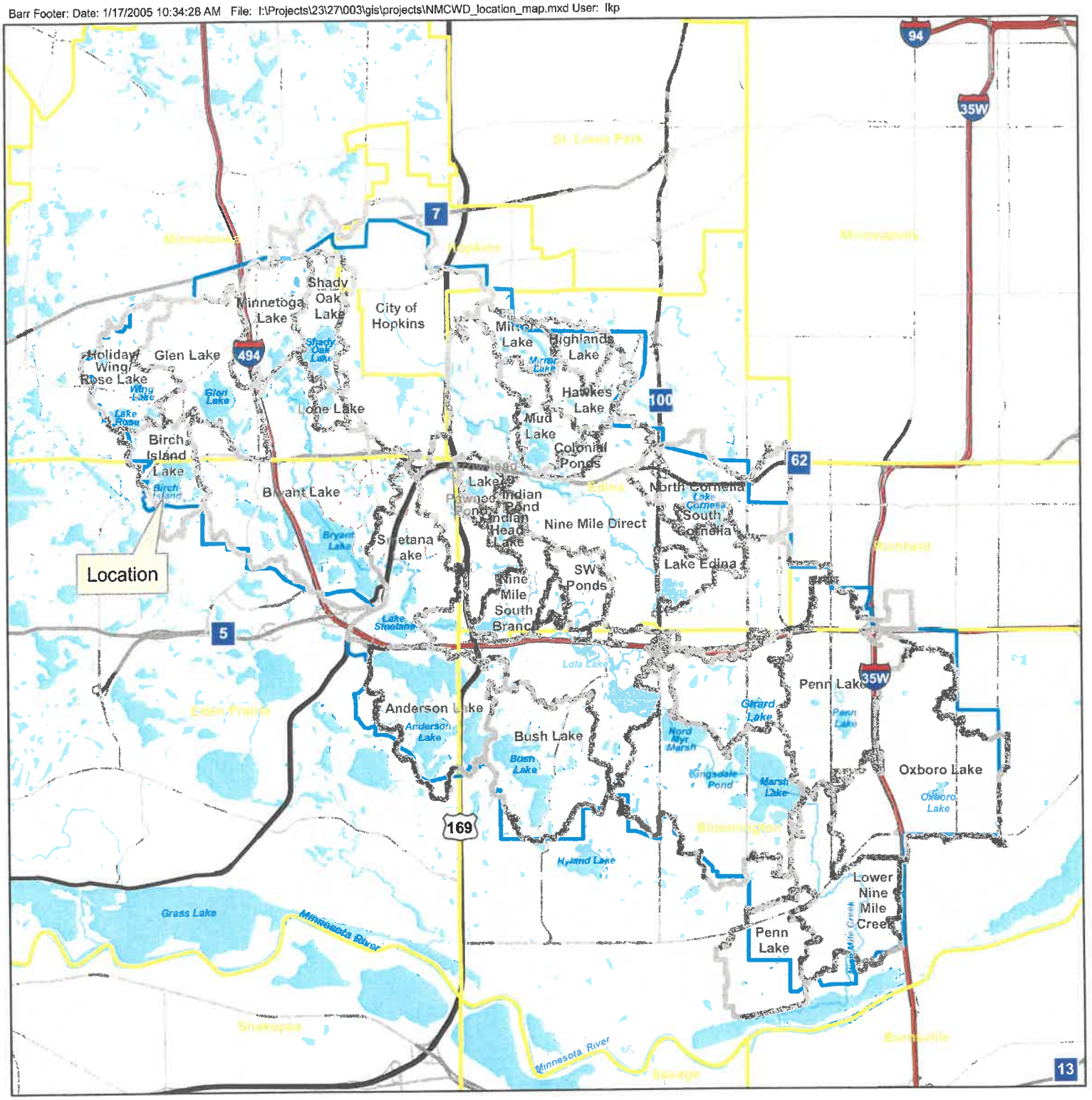
These options have the potential to be less effective than the pipe bypass system. The effectiveness of any geotechnical construction is more variable because the underground conditions can vary between borings.

Recommendation

It is recommended that the pipe/drain tile system be implemented to restore the level of Birch Island Lake to pre-roadway construction conditions. It is estimated that for normal climatic conditions, the lake level will rise between 0.5 and 1.0 feet per year.

Figures

Barr Footer: Date: 1/17/2005 10:34:28 AM File: I:\Projects\23\27\003\gis\projects\NMCWD_location_map.mxd User: lkp



N
W E
S

1 0.5 0 1 2
Miles

Figure 1

LOCATION MAP
BIRCH ISLAND LAKE
Nine Mile Creek Watershed District

Barr Footer: Date: 1/18/2005 2:49:55 PM File: I:\Projects\23\27\003\gis\projects\birch_island_lake.mxd User: lkp

N
W E
S

500 250 0 500 1,000
Feet

Figure 2

FILL AREA
BIRCH ISLAND LAKE
Nine Mile Creek Watershed District

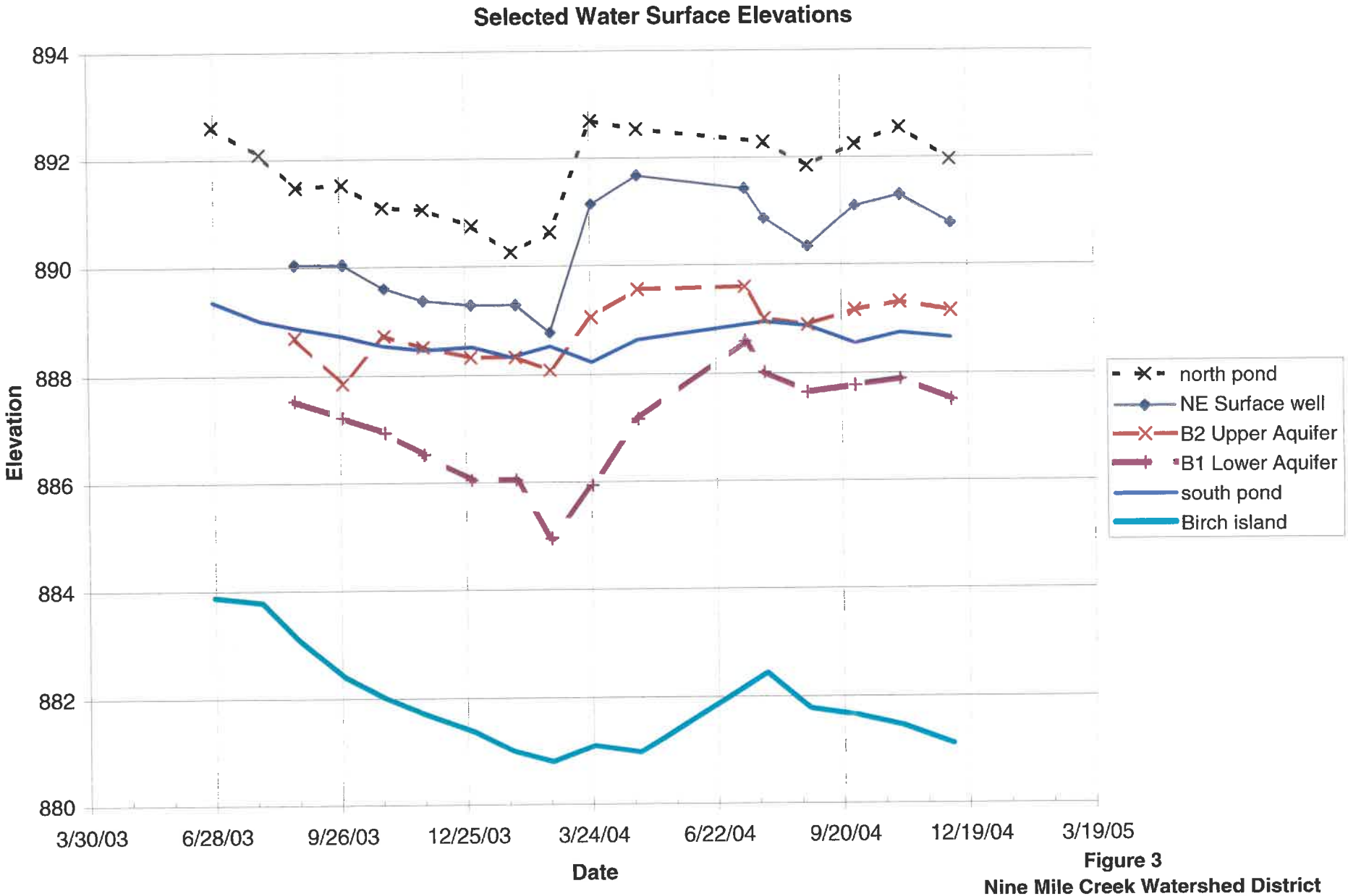


Figure 3
Nine Mile Creek Watershed District
Selected Water Surface Elevations

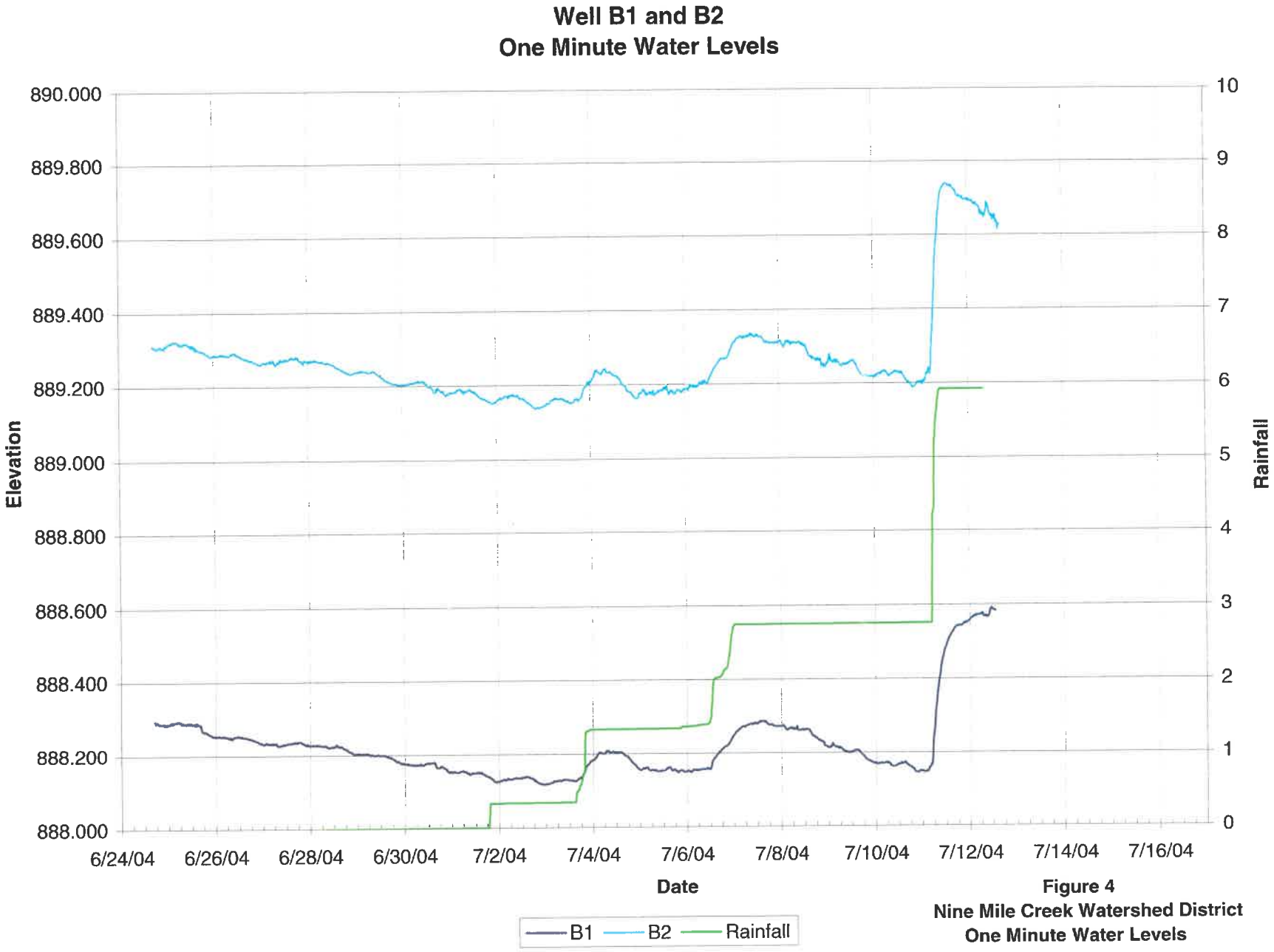


Figure 4
Nine Mile Creek Watershed District
One Minute Water Levels