DEPARTMENT OF NATURAL RESOURCES

Ecological & Water Resources
1200 Warner Road
St. Paul, MN 55106

May 17, 2019

Minneapolis, MN 55417-2607

Dear Resident,

Thank you for your recent inquiries to the Minnesota Department of Natural Resources (DNR). This letter responds to the questions you provided on April 4, 2019 to Scott Pearson, DNR hydrogeologist, regarding monitoring wells at Solomon Park, and to Barb Naramore, DNR Deputy Commissioner, regarding clarification on DNR's role with Nokomis and Hiawatha.

As you are aware, DNR is working in partnership with several agencies/organizations to understand the Nokomis area water issues, including the City of Minneapolis, Minnehaha Creek Watershed District (MCWD), Minneapolis Park and Recreation Board (MPRB), and Hennepin County. Each of these entities brings specific expertise to the partnership, and therefore after receiving your questions, we reached out to them and collaboratively worked to respond below. Graphics that illustrate the points in some of the responses are also included below.

We hope you find this information useful. As you may be aware, the University of Minnesota is currently conducting an independent, third-party review of the information our Nokomis team has gathered, the data we have begun collecting, and the working conclusions we have reached about what is going on in the Nokomis area to cause high water levels. In addition, our team, with the assistance of a consultant retained by the MCWD, is currently preparing a white paper to summarize our work. We anticipate the white paper to be ready by the end of year, and the University of Minnesota's review to be complete by then as well.

Sincerely,

Dan Lais, Central Region Manager
DNR Ecological and Water Resources

CC: Barb Naramore, Deputy Commissioner, Minnesota Department of Natural Resources
Scott Pearson, Hydrogeologist, Minnesota Department of Natural Resources
Kenny Blumenfeld, State Climatologist, Minnesota Department of Natural Resources
Paul Hudalla, Professional Engineer, City of Minneapolis
James Wisker, District Administrator, Minnehaha Creek Watershed District
Michael Schroeder, Assistant Superintendent for Planning Services, Minneapolis Park and Recreation Board
John Evans, Assistant Director of Environment and Energy, Hennepin County

Monitoring Wells at Solomon Park

1. Does the data coming from the wells show an increase in groundwater levels?

   To better understand surface and groundwater interactions in the Nokomis area, the interagency partners installed six groundwater monitoring wells in the area. Data from these wells has allowed us to ascertain both the horizontal and vertical groundwater gradients between the water table observation wells in the vicinity of Lake Nokomis.

   The well data does not indicate unusual or ongoing unexplainable increases in water table levels. The water elevations for the shallow water table wells at Solomon Park and Lake Nokomis Park are shown on Figure 1. At Solomon Park, unique well number 828305 shows a range of water elevations since Nov. 2017 from 818.12 to 817.09 feet, representing seasonal water level changes of 1.03 feet. At Nokomis Park, unique well number 828304 shows a range of water elevations since Nov. 2017 from 817.20 to 815.24 feet, representing seasonal water level changes of 1.96 feet.

   Increases in water levels show synchronization with recharge events from snow melt and precipitation. For example, on September 20, 2018 a 3.28-inch rain event was recorded at the MSP airport which correlates with a measurable water level increase at the Nokomis well and at the Solomon Park well. Correspondingly, periods of low recharge (i.e. winter time) show a relationship with declining water levels.

   For comparison purposes, a review of other Minneapolis area water table observation wells indicate a strong correlation of similar water table conditions as observed near Lake Nokomis. For instance, Eden Prairie observation well 708368, located approximately 11 miles away, exhibits similar water fluctuations from precipitation as the Nokomis and Solomon Park wells. See Figure 2 for a comparison of water table levels which suggest the observed responses are occurring over a larger area beyond the Lake Nokomis area and may be normal given that the area recently experienced the wettest six years on record (2013-2018).

   Water elevations for the well nests (shallow water table wells and deeper observation wells) at Lake Nokomis Park and Solomon Park are shown on Figures 3 and 4, respectively, along with precipitation data.

   Based on information from the new deeper wells installed, there are distinctive differences in the water level elevations between the water table and the buried glacial drift and bedrock aquifers. This tells us the deeper systems are separated from the water table (Figure 5).

2. Where is the groundwater flowing?

   Groundwater is flowing from west to east. Comparison with Lake Nokomis levels indicate the horizontal water table gradient is naturally higher at the observation wells and the water table surface slopes gradually eastward toward the Mississippi River to discharge (Figure 6). Water

table elevations in the Twin Cities metropolitan area are shown on Figure 7, based on an estimated statewide digital model.

3. What will happen with increased precipitation levels, especially in more intense bursts as predicted with climate change?

Our climate will continue to exhibit wet and dry fluctuations, including some periods of significant drought, but the general expectation is that conditions will continue getting wetter with time, with more frequent and sometimes larger heavy precipitation events. The area is currently in the wettest period on record which has included an increase in precipitation in the month of April when soils are usually thawed but vegetation is not growing and cannot take up additional water. This has led to increasing groundwater recharge rates.

4. Can communities do anything to mitigate the changing water?

As the change in groundwater elevations and surface water levels are a function of increased precipitation, communities have little influence over the cause of the change. With regard to mitigation measures, communities can first and foremost communicate data with partners and residents to inform land use decisions at a local or regional scale. For example, if data show that groundwater levels are increasing and a property owner is concerned about risks, groundwater data can inform a decision about whether to install a sump pump or a rain garden to direct groundwater and surface water flow away from structures on their property.

5. Does holding the flow of Nokomis back with the weir, cause groundwater to find other paths, potentially through underground creeks etc.?

In answering this question, the following technical concepts apply:

- Surface water is an expression of groundwater, the systems are connected and can exchange water.
- Horizontal and/or vertical gradients physically drives flow.
- Water seeks lower elevations taking the path of least resistance.
- Water paths and flow are interpreted to follow regional patterns which are mapped as a reflection of topography.

Preferential flow paths have not been identified within the localized water table system. However, the surficial geology indicate that heterogeneities exist. The DNR has presented a theory suggesting the presence of peat and shallow bedrock could impede horizontal flow causing groundwater levels to rise. However, the DNR observation well information indicates significant separations exist between the water table and bedrock systems. Bedrock karst conditions are identified east of Lake Nokomis and Hiawatha. Karst is a result of dissolution of soluble rocks which can include preferential flow paths. Typically, there is high water flow in karst conditions where joints exist and low water flow where there are not voids. There is a wealth of additional research and information available regarding karst bedrock from the

reports related to the Camp Cold Water investigations. For example, see this dye tracing investigation report.

Regarding the Nokomis weir, the amount of water displaced behind the weir appears to be minor. The presence of the weir is not resulting in groundwater flow alteration or forming of alternate flow paths. Figure 8 is a photograph of the weir showing the lake on one side and the creek on the other.

The intention of the Nokomis weir is not to hold back water in Lake Nokomis, but to separate Lake Nokomis from Minnehaha Creek to prevent polluted stormwater (approximately 172 pound of phosphorus per year) and invasive species from entering the lake. Monitoring data for the years 2016 through 2018 shows that Minnehaha Creek remained below 815.1 feet (elevation of the weir runout) for 97.4% of the time, which demonstrates that Minnehaha Creek and Lake Nokomis are not impeding the groundwater gradient in the area.

Both Nokomis and Hiawatha are expressions of the local water table, which has received significant increases in recharge from increased record breaking precipitation. Since 2014 the park surrounding Nokomis has been impacted by high water levels and there has been concern in the neighborhood about increasing water levels. Because of these concerns, the MPRB has been closely working with the MCWD to try to shed as much water as possible out of the lake without allowing backflow from the creek.

The MPRB has collected detailed information on weir operations since 2014. This information may be used by the University of Minnesota in a forthcoming assessment to more quantitatively assess any potential connections between the Nokomis weir, its operation, and groundwater levels in the vicinity. Based upon current information, the weir does not appear to be a significant influence on the regional or localized groundwater table.

In operating the weir for several years, it does not appear that the number of days the weir is open directly correlates with lower water levels. For example, in 2014, due to high creek levels, the weir was open for 30 days spread over the summer, but lake levels still dropped by nearly 4 feet ending the season below the outlet elevation. In the fall of 2018 through the winter of 2019, the weir was open for over 100 consecutive days and the lake level did not fall below the outlet elevation. One potential reason for higher than typical sustained water levels in the lake, is that the regional groundwater level could be higher in recent years than it was in the past.

Another line of evidence that the Nokomis weir is not likely responsible for higher sustained water levels in Lake Nokomis is that other nearby lakes have very similar lake level patterns as Lake Nokomis.

Powderhorn Lake is about 1.7 miles away from Lake Nokomis and Minnehaha Creek, and is not connected to Minnehaha Creek in any way via surface water. Over the past decade, the pattern of rising and falling levels in Powderhorn Lake have been very similar to those in Lake Nokomis,

including sustained high water levels since 2015. Figure 9 shows a graph of Lake Nokomis and Powderhorn Lake levels plotted together. It is likely that the pattern of rising and falling water level is similar in both lakes because both lakes are generally expressions of the water table.

6. Is the geology similar near Hiawatha and would adding more water storage create the same issues?

At a regional scale (zoomed out) the surficial geology in the Lake Hiawatha and Lake Nokomis areas appears to be similar. When the scale is changed to a local scale (zoomed in), more detail is visible and differences are more apparent. Figure 10 shows portions of surface geology maps at a regional and local scale. Additional information is available on the full maps themselves (regional map; local map).

Regarding similarities and differences between the Lake Hiawatha and Lake Nokomis areas:

- At a regional scale, Lake Nokomis and Lake Hiawatha are within the same watershed and exhibit typical surface water drainage patters from high to low elevations (i.e. Lake Minnetonka to the Mississippi River).

- At a regional scale, Lake Nokomis and Lake Hiawatha are connected to the same water table aquifer.

- At a regional scale, high water table levels in the groundwater and surface water flow in Minnehaha Creek correlate with high precipitation events.

- At a local neighborhood scale, vertical and horizontal movement of groundwater is more complex and less predictable. For example, a significant number of impacted basements west of Lake Nokomis are estimated to be at elevations between 825 and 835 feet, which is up to 18 feet above the local water table elevations. This may be indicative of a potentially perched water table that is separate from the shallow groundwater connected to Lake Nokomis. It should be noted that wet basements could also indicate poor drainage around the home. Gutters and other improvements such as sump pumps may resolve some of these issues.

- Additional data collection and analysis from new wells will aid existing studies and groundwater model analysis to improve understanding of local and regional surface and groundwater relationships.

7. Will our community built on wetlands, be able to handle increased volumes of water?

Historically, it appears that the wetland areas were altered to accommodate the needs of a growing community. This area has an established history of flooding problems, and therefore increased volumes of water may continue to be a concern. We note that this situation is not unique to the Nokomis area. Other areas within the Twin Cities metropolitan area and beyond

are experiencing similar issues, due at least in part to the same increase in precipitation we are seeing in some areas across our state.

Adapting to changes in precipitation is a topic being explored by the Interagency Climate Adaptation Team (ICAT), comprised of eleven state agencies (including DNR) and the Metropolitan Council. Please see the ICAT's 2017 report "Adapting to Climate Change in Minnesota" for more information on efforts being made.

Clarification on DNR's role with Nokomis and Hiawatha

1. Who monitors the volume of water coming from Mothers and Taft Lake into Nokomis, and are the lake levels on the DNR website accurate?

   The City of Richfield monitors the flow out of Taft Lake (which includes inflows from Mother Lake and Legion Lake into Taft Lake) into Lake Nokomis. DNR has conducted hydrographic surveys for Taft Lake (Basin ID#27068300) and Mother Lake (Basin ID#27002300). These surveys include field assessments, lake level readings, establishment of elevation benchmarks and ordinary high water level elevations (OHW). The DNR LakeFinder database contains the information DNR has about these two lakes. To the best of our knowledge, the information contained in LakeFinder accurately reflects Mother and Taft Lake levels.

2. Who is deciphering the data with the newest well at Solomon Park on 58th and 12th and where can this be found?

   The DNR presented hydrographs of the well data at Nokomis technical group meetings and at the October, 2018 public meeting – see Figures 1, 3, 4, 5, which show, respectively, water elevation data from the shallow water table wells at Lake Nokomis and Solomon Parks, the Lake Nokomis Park well nest, the Solomon Park well nest, and the Solomon Park well nest with bedrock water elevations.

   There are currently seven instrumented DNR observation wells in the Nokomis area (Figure 11). Data is collected by staff from Hennepin County and electronically transmitted to the DNR. The data is available online using the DNR Cooperative Groundwater Monitoring web page.

3. Is the DNR requiring the Park Board to reduce the pumping at Lake Hiawatha? Is it the DNR's preference to reduce pumping?

   DNR has encouraged the MPRB to go through its process of determining its preferred future plan for the Lake Hiawatha area. Once that preferred plan is identified, DNR will then consider an application for any groundwater pumping needed to support that plan. The DNR is not requiring the MPRB to reduce the current pumping volume. DNR has requested the MPRB submit a permit application, which they have done, for the current level of pumping up to 308 MGY until an alternate plan is developed. DNR anticipates authorizing the interim pumping permit application submitted by the MPRB in early May 2019.

4. How will reducing pumping take the water out of the system and protect homes?

MPRB does not have a final design for an alternative pumping scenario; however, a 2017 study by Barr Engineering determined the feasibility of such an alternative. If a scenario of reduced pumping is selected, a final design including exact dimensions of the system will be determined and final modeling will be completed.

The current pumping system in the golf course creates a cone of depression centered around the ponds in the golf course. This current cone of depression has a second, inadvertent effect, of protecting low basements in the neighborhood from groundwater intrusion by artificially lowering the groundwater over an area larger than the golf course. By moving a system closer to the homes, the system would not need to be sized to dewater the entire golf course and larger surrounding area, but rather could be sized to create a smaller cone of depression in the local area around the targeted homes and protect low basements.

In a new pumping system, just like in the current system, pumped water would be removed from the system by flowing downstream via Lake Hiawatha and Minnehaha Creek.

Additional, detailed information regarding modeling a new pumping system is here: Barr Responses to Modeling Questions.

5. Are current pumping methods hurting the environment?

Based upon the information currently available, DNR has not seen evidence of an aquifer level sustainability issue with current pumping volumes. Additionally, the current level of pumping does not appear to be negatively impacting nearby resources such as Lake Hiawatha, Lake Nokomis, or Minnehaha Creek.

6. Who has jurisdiction over how much water can come into Lake Hiawatha via city outflow and the Minnehaha Creek?

According to the United States Geological Survey, a watershed "is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with drainage basin or catchment." The Minnehaha Creek Watershed encompasses 178 square miles that ultimately drains into Minnehaha Creek. Minnehaha Creek is 22 miles long and flows through Meadowbrook Lake and Lake Hiawatha and ultimately drains into the Mississippi River. Given this understanding water has always flowed though Lake Hiawatha before making its way to the Mississippi River. The amount of water that flows into Minnehaha Creek and through Lake Hiawatha is dependent on how much precipitation falls across the watershed.

Since its establishment in 1967, the MCWD has been operating a permitting program to protect the watershed's natural resources from degradation associated with land use change. In the

beginning, MCWD's permitting rules were not based on how the land was used, but rather on ensuring that regardless of how the land was used, that the water resources were protected from the impacts of that land use. However, there is overlap in MCWD permitting rules with local planning and zoning authority of cities, such as limiting stormwater flow increases from development. Currently MCWD's permitting rules include requirements for development and redevelopment projects to implement water quantity and water quality controls to reduce impacts on downstream resources. All communities within MCWD, including the City of Minneapolis, are subject to MCWD stormwater management rules which prohibit increases in peak discharges as part of land development projects. Additionally, the City of Minneapolis through its Chapter 54 Stormwater Management Ordinance also has similar requirements as MCWD's permitting rules.

The Metropolitan Land Planning Act requires that in order for Metropolitan Council to approve a local comprehensive land use plan for a land use authority within the Minnehaha Creek Watershed, the land use plan must contain a local water plan approved by MCWD. With its most recent Watershed Management Plan in 2018, the MCWD has made a concerted effort to more closely integrate land use planning and water resource management. Land use, and how it is planned and executed, is what most directly determines water quality and quantity conditions within the hydrologic system.

The thrust of the MCWD's current Balanced Urban Ecology approach is to integrate water resource goals into local land use planning, private development and redevelopment intentions, and land use authority development regulation in order to be alert to, and exploit, opportunities to achieve multiple public and private goals with well-timed and efficient investments. This vision stems from the MCWD's 2014 adoption of the Balanced Urban Ecology policy, which now serves as the MCWD's underlying organizational strategy. It prioritizes partnership with the land use community to integrate policy, planning and implementation. The Balanced Urban Ecology policy was developed from a series of policy analyses that identified the governance gap between land use and water resource planning. It responded to state, county, and non-profit assessments calling for increased integration of water resource planning and land use planning to improve the watershed management model in Minnesota and for treating land development and water resource protection as complementary rather than competing interests. Moving forward, MCWD will utilize its permitting program to also partner with local land use and the development community to generate greater natural resource outcomes than those achieved through regulation alone.

7. What is the DNR's involvement in helping local officials plan for more high levels of precipitation with the knowledge that the lower Minnehaha Creek Watershed is built on wetlands, is already saturated, and yet more water storage is needed for a growing and aging community?

DNR maintains a webpage to share information about climate change and Minnesota. The DNR State Climatology Office updates its climate records constantly, stays current on climate change science, and is willing to share data, analyses, and conclusions it has drawn from local data with the Nokomis/Hiawatha community. Upon request and with enough advanced notice, Senior Climatologist Kenny Blumenfeld would be available to present and discuss this information with the community, and/or to participate in a workshop where such information is critical.

The DNR is also part of the Interagency Climate Adaptation Team (ICAT), comprised of eleven state agencies and the Metropolitan Council. The ICAT's 2017 report Adapting to Climate Change in Minnesota highlights how state government is working to adapt to the changing climate, reduce risks and impacts, and increase the resilience of our communities.

Figure 1 – Water elevation hydrograph of the shallow water table wells

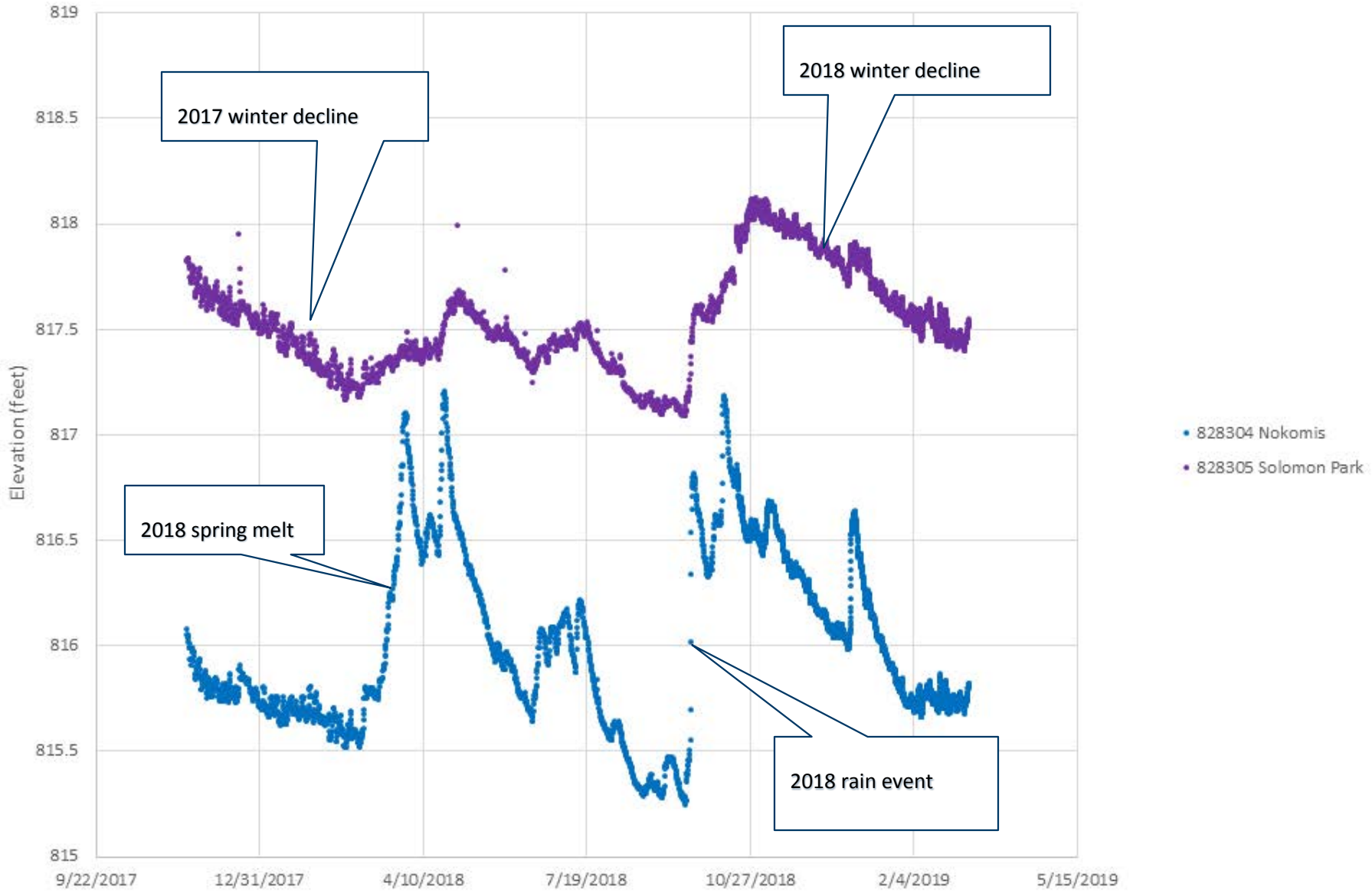


Figure 2 – Comparison of water table wells

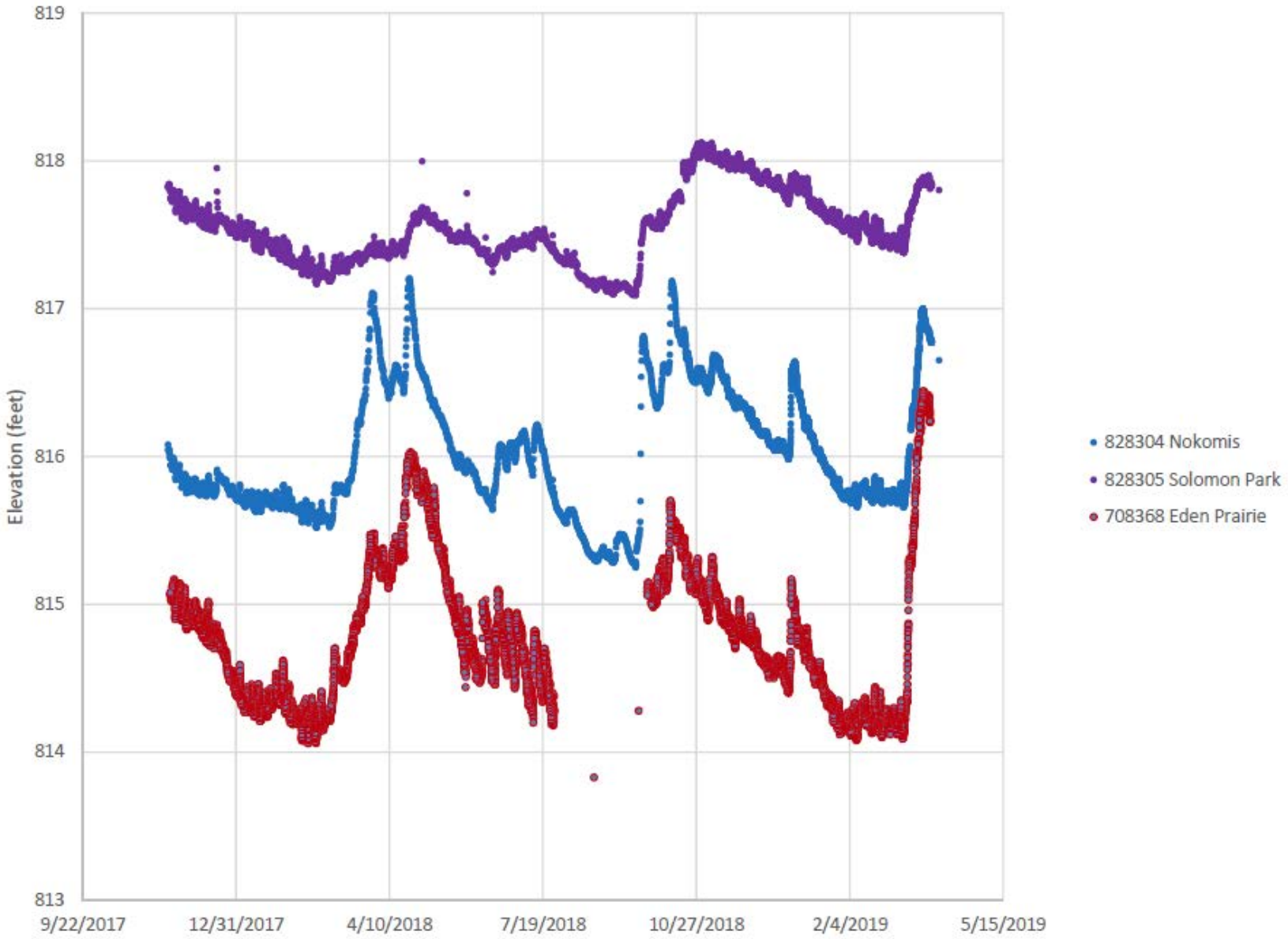
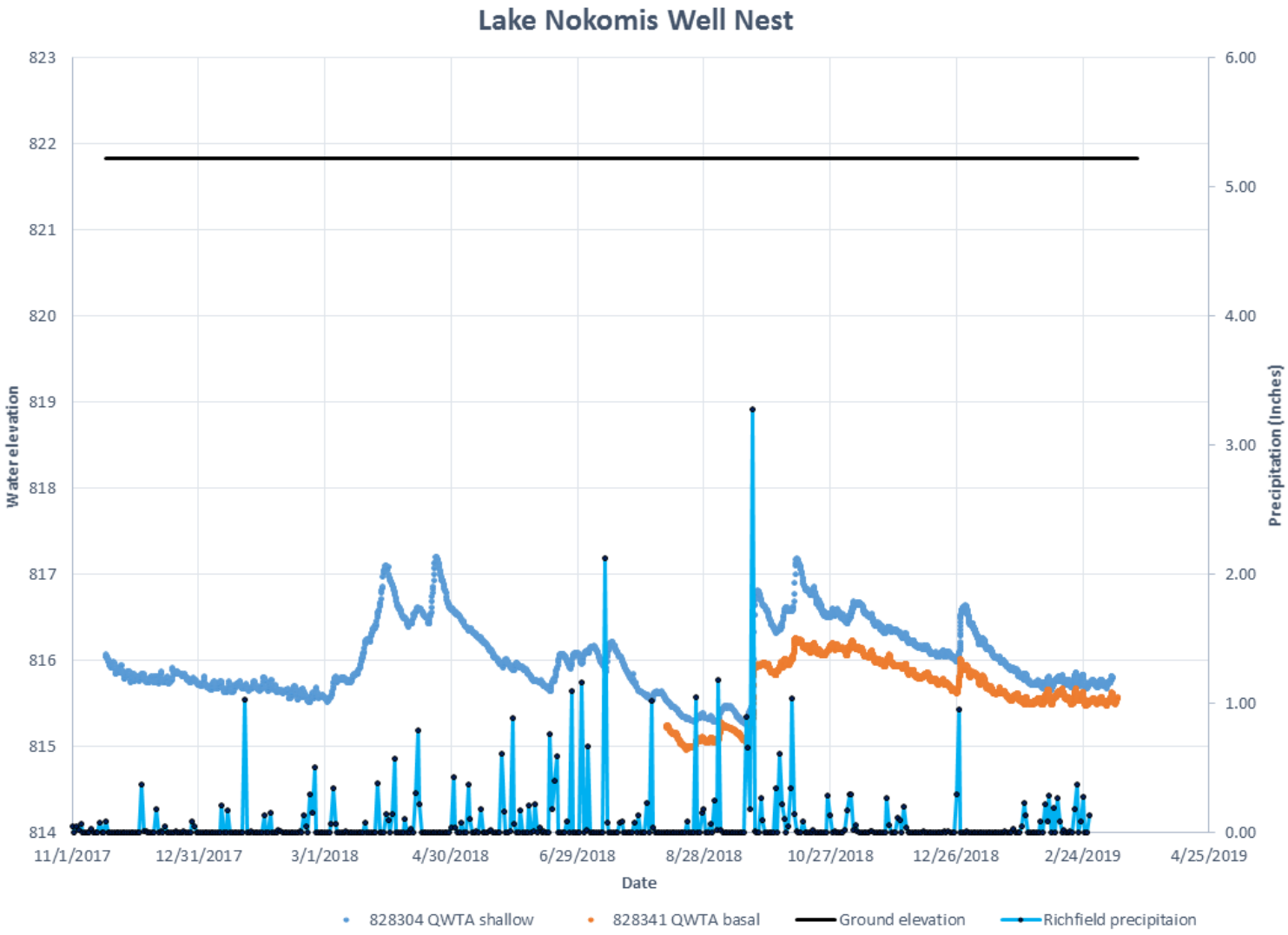
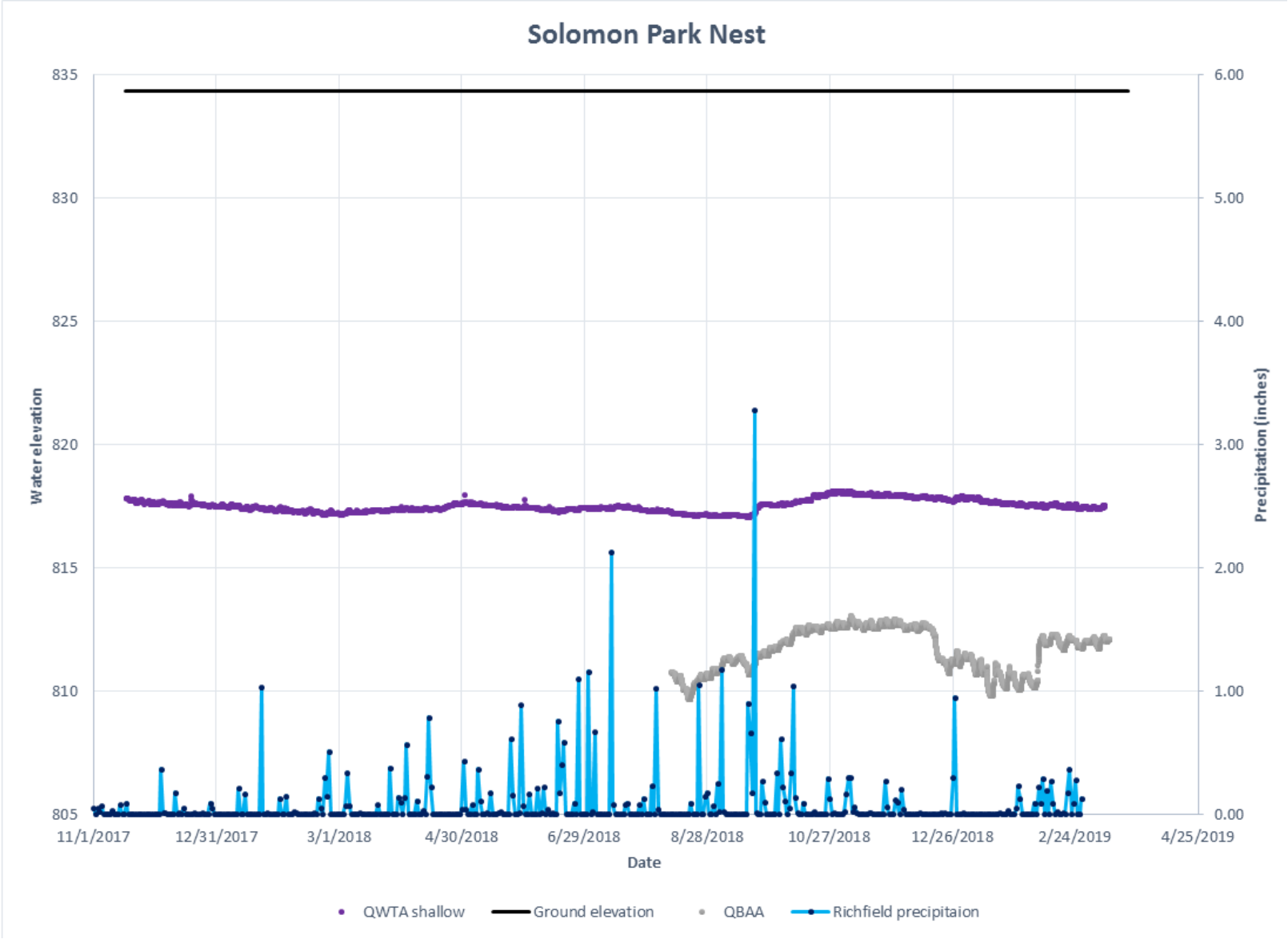


Figure 3 – Lake Nokomis Park well nest



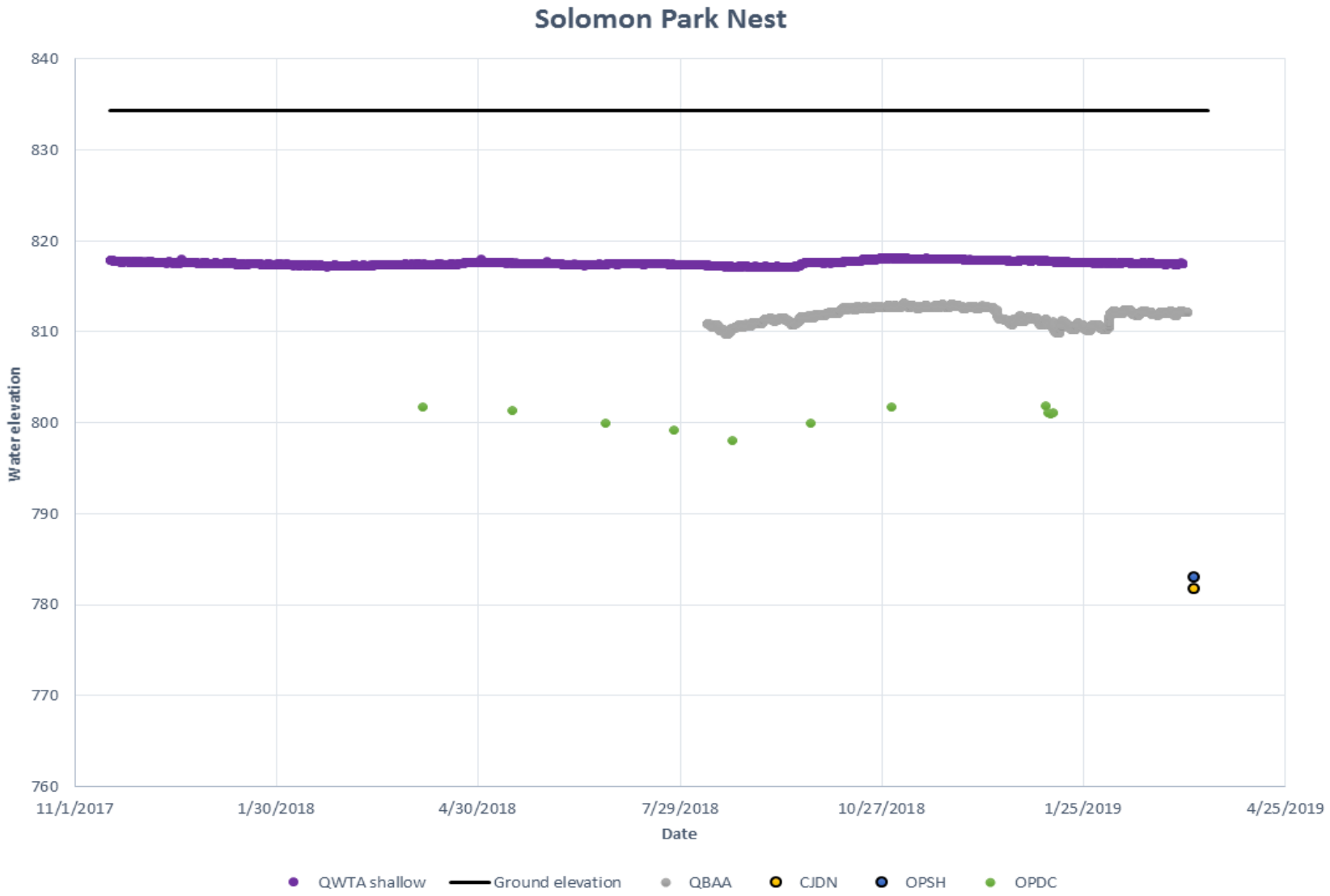
This figure shows water elevations from the two Lake Nokomis Park water table observation wells with a line showing land surface and precipitation information.

Figure 4 – Solomon Park well nest



This figure shows water elevations from the two Solomon Park observation wells with a line showing land surface and precipitation information.

Figure 5 - Solomon Park well nest with bedrock water elevations



This figure shows large differences in the water elevations. This indicates hydraulic separation exists. The Solomon Park bedrock wells are shown as CJDN – Jordan Aquifer and OPSH – Prairie du Chien – Shakopee member. The OPDC well is the Hope Lutheran Church supply well.

Figure 6 – Water Table Estimated Elevation Contours from Hennepin County Geological Atlas (C-4, Plate 5)

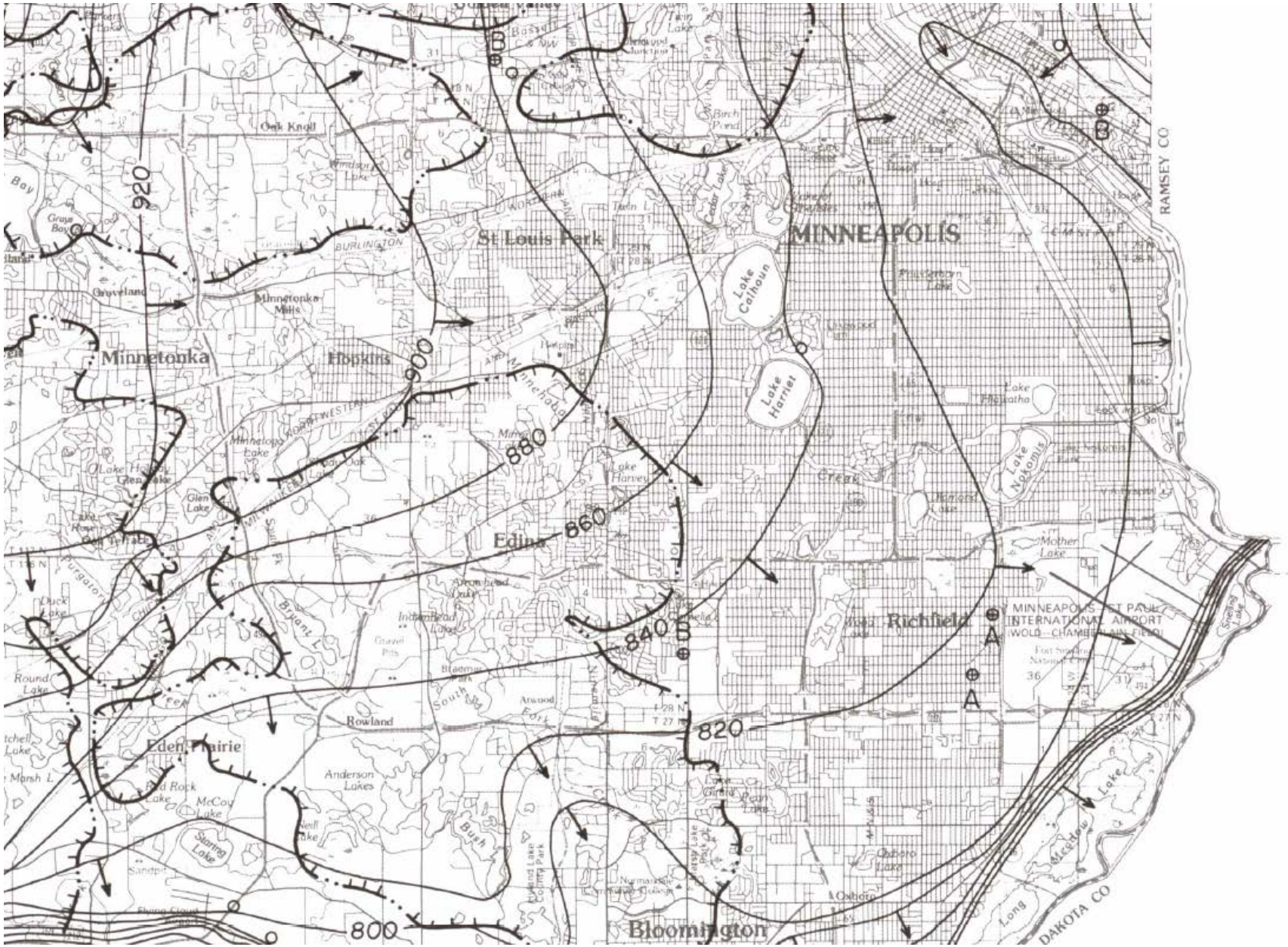
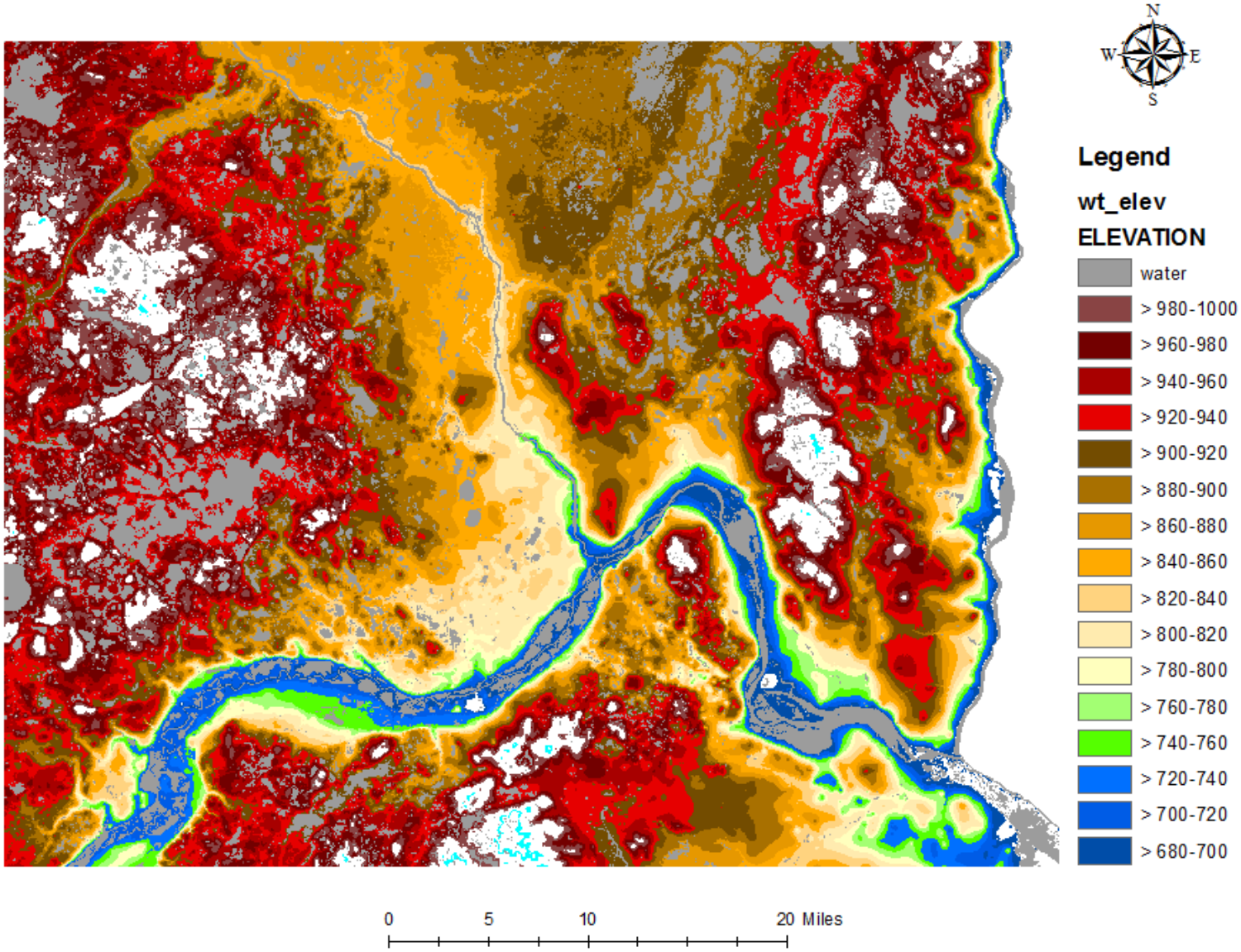


Figure 7 - Water Table Elevations for the Twin City Metro Area



This figure shows estimated digital model of the water table elevations for the Twin City Metro Area

Figure 8 – Weir at Lake Nokomis outlet (lake left, creek right)

Figure 9 – Lake Level Comparison, Nokomis and Powderhorn

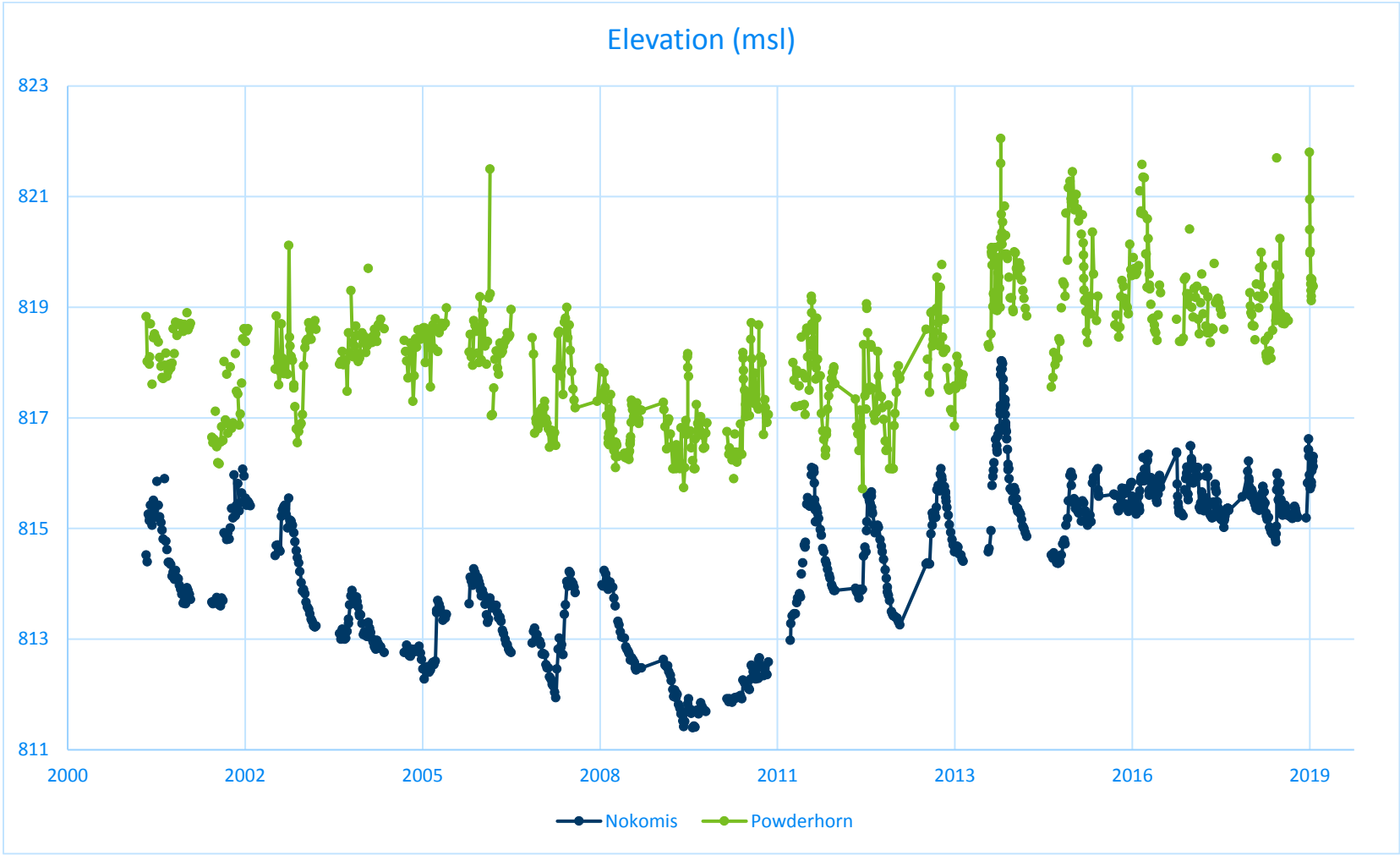


Figure 10 – Surficial Geology Regional versus Local Scales

Zoomed out

Zoomed in

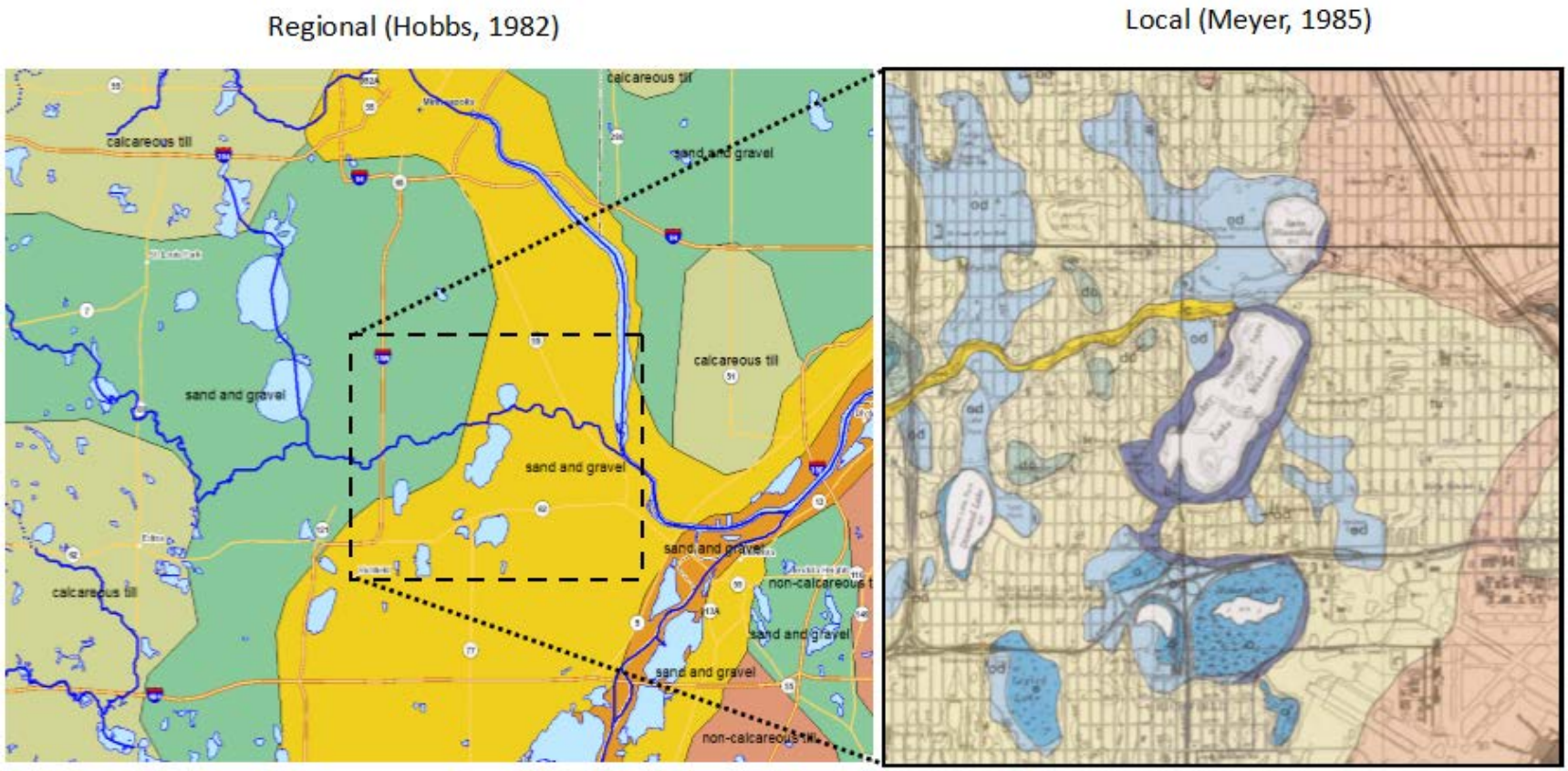
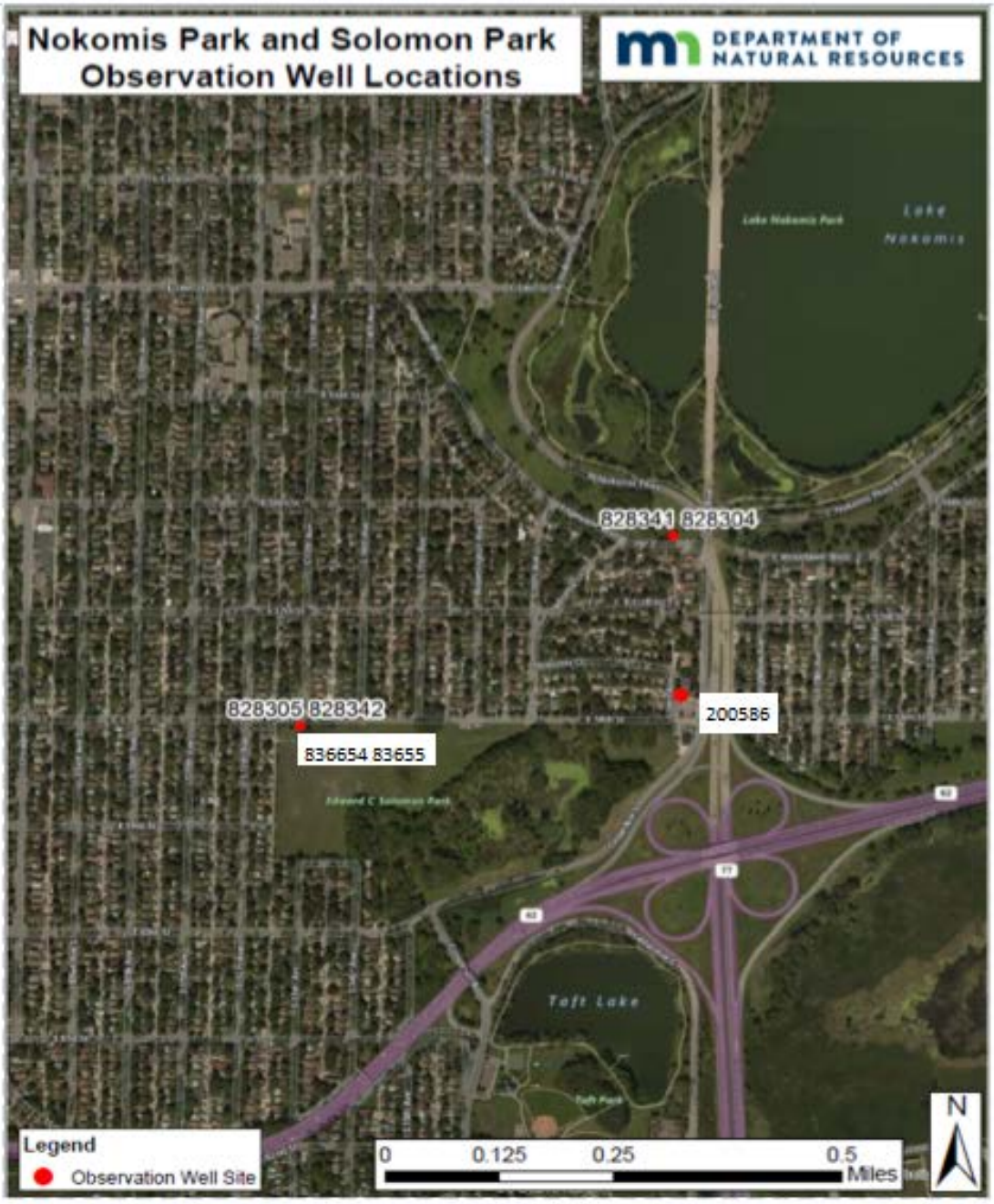


Figure 11 - DNR Observation Well



DNR Observation Well Summary

DNR Obwell Number	MDH Unique Number	measure point elevation	Well depth	Aquifer	Site Name	Formation the well is monitoring
27080	828304	825.37	21	QWTA	Nokomis Park	Shallow Water Table
27081	828341	825.1	82	QWTA	Nokomis Park	Basal Water Table
27082	828305	837.37	21	QWTA	Solomon Park	Shallow Water Table
27083	828342	837.58	105	QBAA	Solomon Park	Buried Artesian
27084	836655	837.48	398	CJDN	Solomon Park	Jordan sandstone
27085	836654	837.28	250	ODPC	Solomon Park	Prairie du Chien Group
27036	200586	832.27	245	ODPC	Hope Lutheran Church	Prairie du Chien Group