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April 11, 2022

To: Tiffany Schaufler
Project and Land Manager
Minnehaha Creek Watershed District

From: Joe Magner, Ph.D., P.H., P.SS., P.Hg. 
Research Professor

Re: Final technical review of: LAKE NOKOMIS AREA GROUNDWATER & SURFACE WATER EVALUATION, prepared by Stantec, dated April 2022.

This memo summarizes the University of Minnesota's (UMN) final technical review of the Lake Nokomis Area Groundwater & Surface Water Evaluation (Nokomis White Paper) document dated April 2022. The UMN reviewed the multi-agency team's evaluation approach, findings, and the conclusions outlined in the Nokomis White Paper. This technical memo summarizes the UMN's review of the Nokomis White Paper, identifies the UMN's overarching conclusion, and outlines the UMN's next steps.

On the whole, the UMN found that the Nokomis White Paper's approach and findings are sound. The greatest area of uncertainty due to limited geological data will be addressed in our [forthcoming data collection project](#) funded by the State's Environment and Natural Resources Trust Fund, with project support from the City of Minneapolis.

Minnehaha Creek Understanding

During 2012-2013, the UMN partnered with the Minnehaha Creek Watershed District (MCWD) and the Mississippi Water Management Organization to explore opportunities to improve base flow in Minnehaha Creek via stormwater infiltration. This multi-year research project examined the interaction between Minnehaha Creek, hydrologically connected lakes, and shallow groundwater reservoirs to determine hydrologic pathways influencing Minnehaha Creek from Gray's Bay in Minnetonka to Minnehaha Falls in Minneapolis.

Purpose and Scope of the University of Minnesota's Review

As you know, given the UMN's understanding of Minnehaha Creek and its interaction with shallow groundwater, MCWD contracted with the UMN to provide a third-party technical review of the multi-agency team's evaluation of groundwater and surface water concerns in the Lake Nokomis area of Minneapolis.

The UMN (Dr. John Nieber, Kerry Holmberg, and I) provided review of the 50% draft and the final April 2022 Nokomis White Paper. The UMN's review focused on the accuracy of the data and identifying areas of uncertainty. Our review found the data presented in the report (geologic,

land development, precipitation, groundwater, surface water levels) to be reasonably accurate. However, uncertainty regarding the extent and location of peat deposits is present based on the available geologic data sets. Accordingly, the UMN's technical review recommends the collection of additional geotechnical data within the affected areas, to delineate the location of lacustrine/peat soils and potential perched groundwater systems more precisely.

UMN's Overarching Conclusion on the Nokomis White Paper

Page 17 of the April 2022 Nokomis White Paper identifies that the multi-agency team (hereafter referred to as "team") dedicated technical experts to answer the following questions:

- What is causing the high-water issues in these Minneapolis neighborhoods?
- What can be done to help mitigate the water issues?

Based on the data evaluated, the findings revealed, and the next steps outlined, the UMN believes the Nokomis White Paper met the stated objective. The uncertainty presented in the paper was reasonably well constrained and the paper identified how the uncertainty could be reduced – through collecting additional geotechnical data in the affected areas to delineate the location of lacustrine/peat soils and potentially perched groundwater.

Nokomis White Paper Evaluation Approach

Using reported water issue data from the City of Minneapolis, the team identified three separate areas of concern, Nokomis Parkway, West Nokomis, and Solomon Park. Based on the location of these three areas of concern, presented in Figure 6 (page 18) in the Nokomis White Paper, the team's sorting and categorizing of the hypotheses into seven factors make sense. Although many thoughts were presented by a variety of stakeholders including homeowners, the team allowed the most plausible hypothesis to rise to the top as presented in Chapters 2 through 8. The team considered the information available including relatively new data and reports from team members, historical documents, inventories, and information provided by homeowners.

Nokomis White Paper Findings

After reviewing the seven key factors, the UMN identified the following key points during our technical review.

Geologic & Hydrologic History

Hennepin County is fortunate to have revised surficial geology data from the Minnesota Geological Survey (MGS). The 2018 surficial geology atlas for Hennepin County shows lacustrine and organic soils in and around the Lake Nokomis areas of concern. The MGS atlas also records changes to the hydrologic landscape, noting where Lake Nokomis and surrounding wetlands have been drained, excavated, and/or filled.

[Plate 1](#) from the 2018 MGS map for Hennepin County identifies the data used to develop the geology atlas. In reviewing the Lake Nokomis area, the available geology data is sparse. The limitation of the MGS data is that the scale of resolution on the precise location of specific soil types is not fine enough to explain causality of water issues in each area of concern, therefore the resolution of geologic data needs to increase based on water issues reported. This is the basis of the UMN's next step (discussed in more detail below) to collect more granular geotechnical data in the affected areas, in an effort to delineate the location of peat soils and potentially perched groundwater more precisely.

The 1853 land survey data is reasonably accurate for the technology available at the time, and it provides for coarse comparative analysis of how water footprints have changed due to development. There are uncertainties associated with the data because it provides a static understanding of the landscape in 1853. However, the uncertainty is reduced when reviewing the 1853 land survey maps against the 2018 surficial geology atlas, the present-day floodplain, and present-day wetland boundaries. The maps for each area of concern (Figures 14-25 on pages 27-33; and Figures 43-45 on pages 48-50) visually show the relationship of the historic hydrologic landscape against the present-day hydrologic landscape. The UMN finds the data and findings in this section to be sound and the forthcoming UMN geotechnical data collection will improve on the resolution of data in this area.

1910s-1950s Development

Historic Minneapolis Park and Recreation Board (MPRB) records, including Theodore Wirth's personal historic reports, provide important documentation on how the landscape was altered and developed. Wirth documents the transformation of Lake Nokomis, which reduced the footprint of water across the landscape by 100 acres. This MPRB documentation corroborates the MGS surficial geology and 1853 land survey data. The historic infrastructure issues and additional movement of peat soils around the landscape further supports the need for detailed geologic data to reduce the uncertainty with where peat and organic soils may be located, and to identify areas where these soils may be causing perched groundwater.

Precipitation Records

The precipitation data is accurate and shows a clear contrast between the drought in the first half of the 20th century (1920s-1950s) and the 2010s, the wettest decade of both the 20th and 21st centuries, and new precipitation records set throughout the 2010s. Uncertainty within the precipitation factor is well constrained.

Groundwater Recharge & Levels

The modeled groundwater recharge data in Metropolitan Council's Metro Model 3 is reasonable in its estimation of groundwater recharge volumes, but not without uncertainty. The statistical correlation between the shallow well elevations at Lake Nokomis and at Staring Lake helps to constrain some of the uncertainty and demonstrates that local surficial groundwater in the Lake Nokomis area is responding to precipitation, not to land use change or operation of infrastructure.

Given that the elevation of basements experiencing water issues are 5 to 14-feet above the measured regional shallow water table level, this suggests that perched groundwater conditions may exist. However, the correlation between the Nokomis and Staring wells does not prove or disprove perched groundwater conditions, therefore perched groundwater systems will need to be validated by the UMN's forthcoming geotechnical data collection.

Lake Nokomis Water Levels

Lake Nokomis levels are accurate with uncertainty tightly constrained given the measurement methods, and the comparison to similar water level fluctuations at nearby Powderhorn Lake. The Nokomis Parkway area of concern basements experiencing water issues were built below the ordinary high level of Lake Nokomis. The West Nokomis area of concern basements are clearly

above the Lake Nokomis levels thus ruling out the lake, and any affiliated controls, as the source of home/infrastructure wetness.

Minnehaha Creek Water Levels

The 2012-2013 UMN baseflow study was conducted in drier years compared to the later part of the 2010-2019 decade. Nevertheless, we noted the creek was a “losing stream” in the Nokomis area. This means water in the creek will seep out and move vertically downward toward the regional groundwater system and not move laterally toward adjacent homes. Some of Minnehaha Creek’s flood water can be stored in the banks of the creek, but the lateral extent is approximately 250-feet at most. The elevation data showing Minnehaha Creek water levels, relative to homes experiencing water issues, is solid and clearly shows no interconnection.

2010s Land Use Changes and Associated Stormwater Control Measures

Land use data and permit records note little development has occurred in the Lake Nokomis watershed during the 2010s. Land use changes during the 2010s would have required stormwater control measures (SCM). Due to the focused recharge of SCMs, to some extent a groundwater mound may occur. However, the overall volume of water redirected is minuscule, as noted in Chapter 8, relative to groundwater recharge from precipitation (even outside of record-breaking years). The SCM data presented is reasonably accurate enough to eliminate stormwater management as the cause of wet basements.

Nokomis White Paper Area of Concern Conclusions

The Nokomis White Paper draws conclusions about the three identified areas of concern. The UMN’s assessment on each area of concern conclusion is summarized below.

Nokomis Parkway Area of Concern: Given that the lake level is connected to and an expression of the shallow water table, and that basements in this area are built below the normal water level, it is possible that normal water levels in Lake Nokomis impact homeowner basements as suggested in Figure 88 (page 98), but there is uncertainty in this conclusion that should be addressed by the UMN study. The UMN study needs to place piezometers within the area of concern and track water level changes to confirm this conclusion.

West Nokomis Area of Concern: The UMN finds the conclusion that Lake Nokomis and Minnehaha Creek are not contributing the basement water issues to be well documented. The conclusion on the perched groundwater systems will require the UMN to conduct additional testing in this area to eliminate possible links to poor basement waterproofing, poorly placed downspouts, or homeowner soils with large macropores that allow rapid infiltration adjacent to building foundations. UMN will need to conduct small scale hand auger borings and infiltration tests to further prove or disprove possible unique infrastructure features and/or hydrologic pathways and processes.

Solomon Park Area of Concern: The UMN finds this conclusion to be well documented with little uncertainty and the UMN supports the documented conclusion.

UMN's Next Steps

Given that the main uncertainty rests with the surficial geology data, and the presence of perched groundwater, the UMN recommends filling those data gaps. As noted in Chapter 11 of the Nokomis White Paper, the UMN is situated to fill these gaps by leveraging state Environmental Natural Resource Trust Funds, already secured, to quantify and more precisely map the geological features in the Lake Nokomis area. The UMN will do this in partnership with MGS and the U.S. Geological Survey, through the use of soil borings to map peat and wetland soils that are causing perched groundwater conditions. The UMN will assess the potential impacts to properties around Lake Nokomis and develop guidelines to predict areas across the region which may experience similar issues. This work will be done with project support from the City of Minneapolis.

This concludes the UMN's technical review of the Nokomis White Paper. The UMN stands ready to work with the City of Minneapolis and Lake Nokomis area homeowners to gather additional data to improve our understanding of peat soil locations and perched groundwater.