

## Memorandum

**To:** Randy Anhorn, Nine Mile Creek Watershed District  
**From:** Janna Kieffer  
**Subject:** Scoping for Watershed-wide Flood Risk Assessment and Opportunity Identification  
**Date:** December 10, 2020

The Nine Mile Creek Watershed District (NMCWD) has a long history in flood planning and floodplain management going back to the 1960s and seeks to continue to be a leader in flood management. The NMCWD's Water Management Plan identifies several policies and actions related to reducing risk to public safety and permanent structures from flooding, including working with cities to address increased flood potential from Atlas 14 rainfall frequency estimates and understanding and addressing the potential for increased flood risk due to predicted changes in climate.

In February 2020, Barr provided a scope of work to update the NMCWD's watershed-wide hydrologic and hydraulic model to incorporate recent model updates completed by several cities within the watershed and refine other areas of the model (referred to as Phase 1 in the February memo). The memo also identified additional analyses for consideration to further assess flood risk, vulnerability, and mitigation options within the Nine Mile Creek watershed, including a flood risk/vulnerability assessment that includes evaluation of snowmelt and Atlas 14 and mid-21<sup>st</sup> century moderate rainfall estimates (referred to as Phase 2), and conducting a watershed-wide resiliency assessment to identify opportunities to optimize storage and floodplain use throughout the creek system and help alleviate flooding issues (referred to as Phase 3).

In May 2020, the NMCWD board approved Phase 1 of the February 2020 scope of work to update the NMCWD's Xp-SWMM model so as to continue to house the "best available" modeling information on a watershed basis. This memo further describes Phase 2 (*Flood Risk/Vulnerability Assessment- Atlas 14 and Beyond*) and Phase 3 (*Nine Mile Creek Flood Risk Reduction Opportunity Analysis/Resiliency Analysis*) for consideration, including a brief summary of potential tasks and planning-level cost estimates.

## High-level Scope of Work

### Phase 2. Flood Risk/Vulnerability Assessment- Atlas 14 and Beyond

Understanding flood risk includes identifying the likelihood of flooding and the consequences or impacts associated with the flooding. A broader understanding of flood vulnerability can also include consideration of a population's sensitivity to the impacts and their capacity to weather, resist, or recover from the impacts of a flood in the short and long term. A watershed-wide flood risk/vulnerability assessment would help the NMCWD and its communities and other partners gain a better understanding of flood risks throughout the watershed under current precipitation estimates and future climate change

projections. A watershed-wide flood risk/vulnerability assessment could also help identify and characterize the risks of flooding from system failures, such as a failed culvert or clogged pipe along the creek system. Characterizing these risks is a first step in evaluating options to mitigate the risks, where appropriate, to minimize property damage and/or threats to public safety.

The following section summarizes tasks that could be included in a watershed-wide flood risk/vulnerability assessment. Additional scoping for these tasks may be necessary based on discussions with NMCWD staff, board members, and Technical Advisory Committee (TAC) members. Several of the tasks are identified as optional. Although recommended, these tasks could be removed from the overall project or delayed without significant impacts on subsequent tasks presented here.

### **Task 1. Simulate runoff events (100-year snowmelt, Atlas 14 and mid-21<sup>st</sup> century rainfall estimates) and identify flood-prone structures and roadways- \$55,000**

#### **A. Use Model to Simulate Runoff Events (\$23,000)**

The NMCWD's updated model will be used to simulate the following design rainfall events using precipitation estimates from Atlas 14 and from mid-century climate change predictions. The model would also be used to simulate a 100-year, 10-day snowmelt event.

- 1-, 2-, 5-, 10-, 50-, and 100-year, 24-hour events using Atlas 14 data
- 100-year, 24-hour mid-21<sup>st</sup> century moderate estimate (10.2 inches)
- 10-year, 24-hour mid-21<sup>st</sup> century moderate estimate (6.6 inches)
- 100-year, 10 day snowmelt event

#### **B. Flood Mapping (\$13,000)**

- Inundation mapping (level-pool mapping, not including portions of the creek or along roadways with sloped water surfaces) for all of the design events listed above.
- Flood mapping along creek corridor for 100-year Atlas 14 and mid-century predicted events (two events)

#### **C. Identify Flood Prone Areas, Structures and Roadways (\$11,000)**

Flood risk areas, potentially flood prone structures, and overtopping roadways will be identified for the 100-year Atlas 14 event and 100-year, 24-hour mid-21<sup>st</sup> century moderate estimate event.

#### **D. Prepare Figures of Overtopped Roadways and Flood Prone Structures (\$8,000)**

Figures will be prepared in GIS of flood risk areas, potentially flood prone structures, and overtopping roadways for the 100-year Atlas 14 event and 100-year, 24-hour mid-21<sup>st</sup> century moderate estimate event.

## **Task 2. Quantify potential flood damage costs (optional)- \$20,000**

Flood impacts will be quantified in terms of potential damage to structures. The high-level flood damage costs will be approximated using estimated damage curves (\$ as a function of water level per house) and flood probability curves (water level as a function of probability). Information needed for this analysis will include flood elevations for multiple storm recurrence periods (preferably including something greater than a 100-year), building footprints, and topographic information or survey.

## **Task 3. Social vulnerability assessment (optional)- \$5,000**

Flood risk vulnerability includes not only an individual's or community's susceptibility to flooding, but also their sensitivity to the risk and capacity to adapt. Disadvantaged populations are often more vulnerable to flood impacts, with geographic factors such as proximity to waterbodies and social factors such as income level, unemployment, access to a vehicle, and communication-limited English proficiency affecting a community's sensitivity to flood impacts and ability to prepare for, cope with, and recover. To assess social vulnerability, flood inundation areas will be combined with social vulnerability datasets to identify areas of higher flood vulnerability. This cost assumes that social indicator data similar to that recently developed for Hennepin County will be used, based on census tract data.

## **Task 4. Risk analysis for potential pipe failures or clogging at creek crossings (optional)- \$25,000**

The NMCWD's model and corresponding flood management elevations are based on an assumption that the existing infrastructure is in good working condition and flowing at full capacity during a simulated rainfall event. But what happens if a pipe becomes clogged with debris? Or fails entirely? A high-level review of the approximately 70 existing roadway and railroad crossings along the creek system will be completed to identify the creek crossings that pose the greatest risk if clogged or failed. A select number of crossings will be modeled to further evaluate risk of clogging or failure.

### **A. High-level review of risk for existing roadway and railroad crossings- \$10,000**

A high-level review of the approximately 70 existing roadway and railroad crossings along the creek system will be completed to identify the creek crossings that pose the greatest risk (i.e. those with the greatest potential for clogging, failure, and/or greatest consequences of failure).

### **B. Modeling of flood risk- \$15,000**

The NMCWD's model will be used to evaluate the risks of pipe failure for a select number of creek crossings during baseflow and large storm events to identify locations where reduced (or eliminated) capacity could lead to potential damage and/or safety concerns due to creek back-ups. The cost of this task will depend on the number of creek crossings selected for further analysis.

### **Task 5. Meetings and presentations- \$10,000**

Two working meetings will be held with NMCWD staff. Methodology and results will be summarized in a presentation and hand-out materials. The information will be presented at up to two NMCWD TAC meetings and two Board meetings.

### **Task 6. Documentation memo/report- \$10,000 - \$15,000**

A technical memo will be prepared to describe the methodology and summarize the results. Cost will depend on whether all of Tasks 1 – 5 are completed.

## **Phase 3. Nine Mile Creek Flood Risk Reduction Opportunity Analysis (*Resiliency Analysis*)**

Recent discussions with NMCWD board members, staff, and Technical Advisory Committee meetings have indicated interest in a watershed-wide resiliency assessment to identify opportunities within the creek system or upland areas to optimize storage and floodplain use. The goal of the resiliency analysis would be to identify opportunities to reduce flood elevations at some locations along the creek system and/or create or “free up” additional capacity within the system to handle additional inflows from upstream. The analysis could also include identification of projects to alleviate regional flooding issues. Additional scoping for this task may be necessary based on discussions with NMCWD staff, board members, and Technical Advisory Committee (TAC) members.

### **Task 1. Develop framework for evaluating potential flood mitigation and/or resilience projects along Nine Mile Creek corridor or in upland areas- \$10,000**

- Work with NMCWD staff, legal counsel, NMCWD board, and TAC to discuss premises and underlying assumptions for evaluating potential modifications to infrastructure and/or other capital improvements (e.g., creating additional floodplain storage). Also discuss consideration of trade-offs related to potential flood mitigation and/or resilience projects (e.g., potential wetland impacts, tree loss, transfer of flood risk, increasing conveyance to creek corridor).

### **Task 2. Identify potential flood mitigation and/or resilience projects along Nine Mile Creek corridor or in upland areas- \$15,000**

- Identify locations within the creek system (or upstream areas) with potential to store more water.
- Identify potential modifications to the system to provide and/or utilize additional flood storage, including:
  - restricting pipes/culverts sizes to reduce flow and utilize additional flood storage capacity
  - constructing or increasing height of berms to store more water in existing storage areas
  - excavating additional storage

### **Task 3. Evaluate effectiveness of potential system modifications- \$25,000**

- Use model to simulate potential modifications to the creek system (and upland storage)

- Evaluate upstream and downstream impacts to 100-year flood elevations
- High-level identification of trade-offs for potential modifications (e.g., potential wetland impacts, tree loss, transfer of flood risk)

**Task 4. Refine select number of potential system modifications and prepare high level cost estimates- \$15,000**

- Identify select number of potential system modifications for further evaluation, in consultation with NMCWD staff, board, and TAC
- Refine design assumptions and re-run model scenarios
- Prepare concept-level cost estimates for select system modifications

**Task 5. Cost/benefit analysis of select system modifications (optional)- \$5,000**

Cost estimates for select number of potential system modifications will be evaluated in comparison with estimated flood damage costs (developed for Task I.2, above). This task is identified as optional because it is dependent on completion of Task I. 2 (quantifying potential flood damage costs), which was also identified as optional (but recommended).

**Task 6. Develop recommendations- \$10,000**

Recommendations for potential system modifications will be developed, in consultation with NMCWD staff, board, and TAC

**Task 7. Meetings and presentations- \$10,000**

Two working meetings will be held with NMCWD staff. Methodology and results will be summarized in a presentation and hand-out materials. The information will be presented at up to two NMCWD TAC meetings and two Board meetings.

**Task 8. Documentation memo/report- \$10,000**

A summary memo will be prepared to describe the methodology and summarize the results.

## **Cost Summary**

Table 1 summarizes the estimated cost for each task described above. Several of the tasks are identified as optional. Although recommended, these tasks could be removed from the overall project or delayed.

**Table 1. Summary of Estimates Costs, by Task.**

<b>Task ID</b>	<b>Task Description</b>	<b>Estimated Cost</b>
<b>Phase 2. Flood Risk/Vulnerability Assessment- Atlas 14 and Beyond</b>		
1.	Simulate runoff events and identify flood-prone structures and roadways	\$55,000
2.	Quantify potential flood damage costs ( <i>optional</i> )	\$20,000
3.	Social vulnerability assessment ( <i>optional</i> )	\$5,000
4.	Risk analysis for potential pipe failures or clogging at creek crossings ( <i>optional</i> )	\$25,000
5.	Meetings and presentations	\$10,000
6.	Documentation memo/report (note- cost will depend on selected scope from Tasks 1-5)	\$15,000
	Subtotal	\$130,000
<b>Phase 3. Nine Mile Creek Flood Risk Reduction Opportunity Analysis (<i>Resiliency Analysis</i>)</b>		
1.	Develop framework for evaluating potential flood mitigation and/or resilience projects along Nine Mile Creek corridor or in upland areas	\$10,000
2.	Identify potential flood mitigation and/or resilience projects along Nine Mile Creek corridor or in upland areas	\$15,000
3.	Evaluate effectiveness of potential system modifications	\$25,000
4.	Refine select number of potential system modifications and prepare cost estimates	\$15,000
5.	Cost/benefit analysis of select system modifications ( <i>optional</i> )	\$5,000
6.	Develop recommendations	\$10,000
7.	Meetings and presentations	\$10,000
8.	Documentation memo/report	\$10,000
	Subtotal	\$100,000
	Total	\$230,000