REPORT TO THE LEGISLATURE

DEPARTMENT OF ECOLOGY
State of Washington

Sprague Lake Hydrologic Study
Flood-risk reduction alternatives analysis

Background

Landowners in the city of Sprague (population 450) and around Sprague Lake in Lincoln and Adams counties have experienced high water in recent years that receded very slowly. This includes significant flooding in 2017 that caused damage to 12 properties along Sprague Lake and Negro Creek as well as to city infrastructure.

The level of Sprague Lake is adjudicated and has historically been managed by a water-control structure at the Cow Creek outlet. The constrictions in Cow Creek, both natural (sediment and vegetation) and manmade (bridges), could contribute to the slow release of floodwaters.

Landowners reported frustration with the high water and requested assistance from the state to manage the lake and reduce flooding risks. In Section 302 (52) of the 2022-2023 supplemental budget (ESSB 5693) the Legislature included the following appropriation for the Department of Ecology (Ecology) to study the issue:

> *$100,000 of the general fund—state appropriation for fiscal year 2023 is provided solely for a hydrologic analysis of the causes of flooding on and around Sprague Lake, including stream flows between Sprague Lake and Cow Creek during high water events. The department may contract with a third party to complete the analysis, and the department must collaborate with the department of fish and wildlife in overseeing the analysis. The department must report the results of the analysis to the appropriate committees of the legislature by June 30, 2023.*

Study Approach and Methodology

Ecology and Washington Department of Fish and Wildlife partnered to develop a request for proposals to analyze flooding and potential solutions for minimizing impacts to property using the funding appropriated by the legislature. The team selected Shannon & Wilson (S&W) to complete a hydrologic study by building a model that estimates lake conditions during storm events (Appendix B). The model was built using both existing and new data, including Light Detecting and Ranging (LiDAR), lake elevation levels, and land surveys.

Using this model, S&W analyzed downstream features suspected to cause flow constriction during flood events. The model was also used to assess options to manage flooding without impairing downstream water users, including the feasibility of a bypass channel, channel dredging and widening, and increasing the capacity under the Danekas Road bridge. The consulting team also evaluated multiple large-scale alternatives that combined flood-reducing strategies.

Results

Lake Inflow

Negro Creek is the main tributary of Sprague Lake. Negro Creek drains 215 square miles of lakes, pasture, woodlands, and open range directly east of the city of Sprague. It crosses State Route 23 and transitions into a concrete channel complex within the city. Two unnamed tributaries to the northeast and northwest that collectively drain 47 square miles are dry bed and only saturated during rain events.

As water moves through Negro Creek it switches between surface water and subsurface flow. The study suggests that upwards of 90% of the rainfall in the Negro Creek basin moves to subsurface flow, and only a small portion remains as surface water. The surface water path to Sprague Lake is significantly faster than the groundwater path but is slowed by snow accumulation in winter.

As a result, rainfall in the Negro Creek basin does not have a quick enough effect on lake levels to cause a high tailwater in the concrete drainage channel that runs through the city. It is more likely that long periods of multiple high rain events, or periods with large rates of snowmelt in the spring could cause high groundwater and high lake levels that can lead to flooding.

Lake Outflow Constriction Points

The outlet of Sprague Lake encompasses a relic water-control structure consisting of two concrete curbs positioned about 15 feet apart. These curbs retain a platform of earth and vegetation measuring approximately 1 foot in height that directs water flow into Cow Creek. A small concrete farm access crossing located within Cow Creek is 1,500 feet downstream. About 3,500 feet further downstream, Cow Creek intersects with Danekas Road. At this road crossing, a skewed pipe arch culvert measuring 15 by 6.6 feet has been securely embedded into the footings using mortar, featuring a natural channel bottom. Roughly 1,800 feet downstream from Danekas Road, a prominent bedrock outcrop forms a resilient natural constriction point within the channel.

Evaluation of Potential Structural Changes

Data from modeling runs that removed constriction points, such as the water control structure, and widened the creek channel, suggested little to no functional flood relief for lakeshore property owners. A scenario that widened the culvert under Danekas Road from 15 feet to 30 feet only reduced the estimated time to drain the lake to adjudicated levels from 25 to 23 days.

The hydrologic study also modeled two scenarios for large-scale combinations of various structural changes that consisted of:

- An 80-Foot-Wide Channel from the water control structure to 200-feet downstream of Danekas Road (see Figure 1).
- A Bypass Channel from the water control structure to Danekas Bridge, including the widened culvert from 15 feet to 30 feet (see Figure 2).

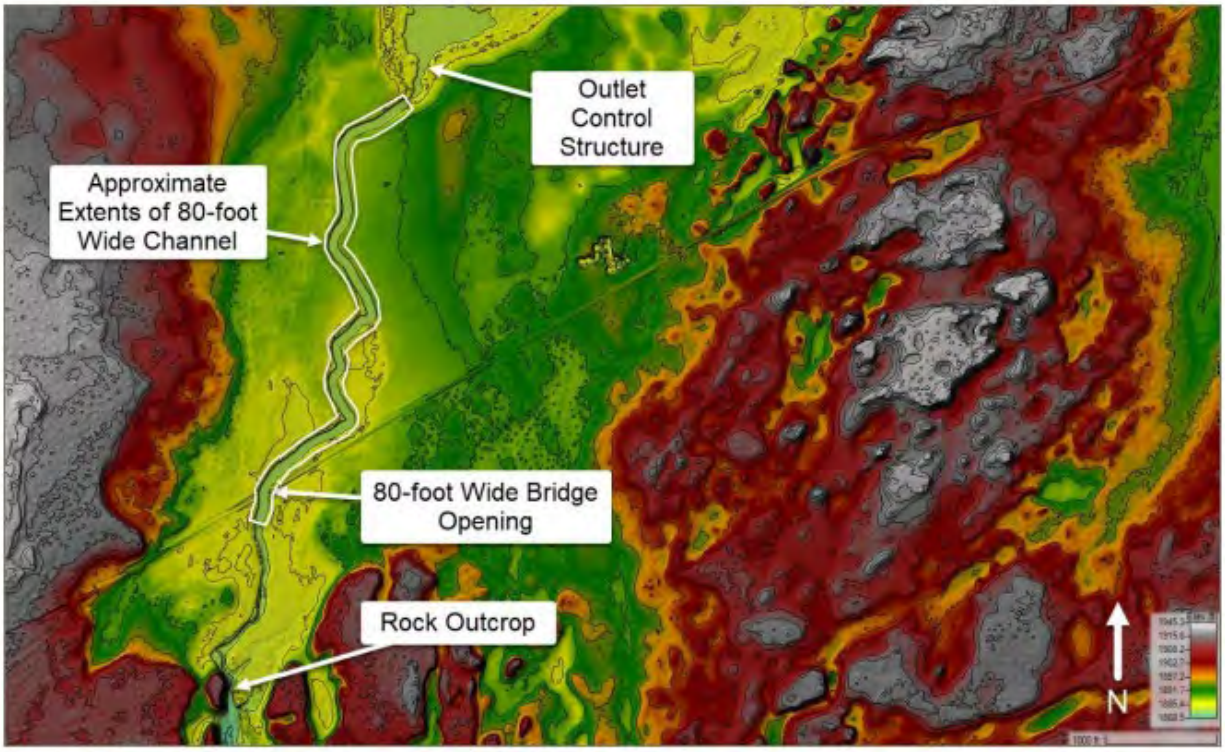

Figure 1 - Large Scale Widened Channel Alternative

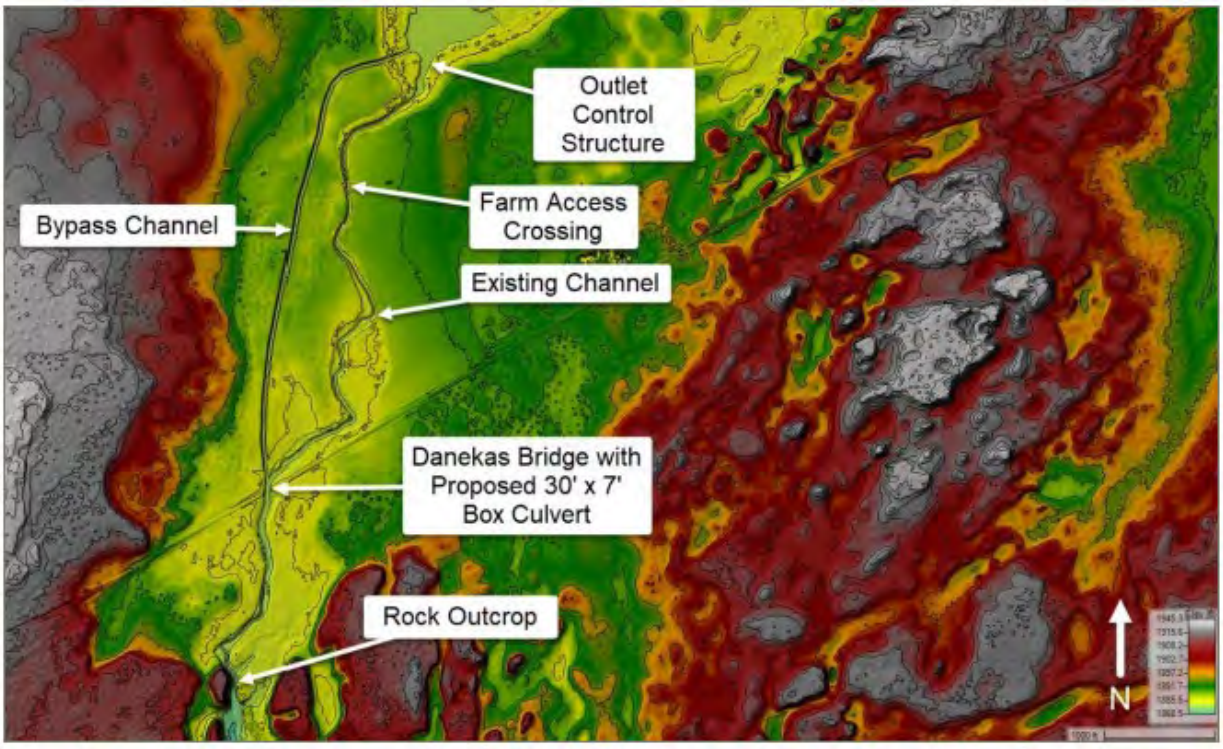

Figure 2 - Large Scale Bypass Channel Alternative

Although these alternatives showed a reduction in lake levels ranging from 1.5 to 2.8 feet within four days of peak levels, according to S&W they would require extensive permitting and environmental mitigation where costs may not outweigh the benefits.

According to the study, all outlet improvements evaluated have low flood risk reduction value for city residents and marginal value to lakeside properties. The long duration hydrology and influence of groundwater and snowmelt make it difficult to reduce flood risk, even with large-scale structural solutions. Additionally, these downstream solutions may impact surrounding wetlands and impair downstream water rights.

Recommendations

Ecology does not recommend altering the lake outlet or advancing a large-scale downstream solution at this time. If community leaders wish to continue to explore these or other structural solutions, further study would be needed including detailed cost-benefit analysis.

To better evaluate flooding within the city, we recommend installing water level loggers (gages) upstream and within the city drainage network to capture valuable data for future design and infrastructure improvements. For a better understanding of lake hydrology, long-term (7 to 10 years) gage installation upstream and downstream of the lake would inform a more detailed analysis of impacts to lakeside properties.

Ecology does encourage the city and counties to further the strategies identified in the U.S. Army Corp of Engineers 2020 report, *City of Sprague Nonstructural Flood Mitigation Assessment*. These include:

- Flood preparedness planning.
- Developing temporary flood fighting techniques.
- Developing and enforcing local zoning and building codes that reduce flood risk.
- Non-structural flood mitigation measures.

Next Steps

Ecology and Washington Department of Fish and Wildlife will host a community meeting to report the results and recommendations identified in the report.

We will also continue to support city and county efforts to plan for and mitigate flood risks.

Conclusion

The hydrologic analysis found that the long duration hydrology and influence of groundwater and snowmelt make it difficult to reduce flood risk around Sprague Lake, even with large-scale structural solutions.

Hydrologic modeling of options for removing individual constriction points for the lake discharge or widening the creek channel found little to no functional flood relief for lakeshore

property owners. Two different alternatives that include large-scale structural changes were also analyzed. While these large-scale alternatives could reduce lake levels, they would require extensive permitting and environmental mitigation where costs may not outweigh the benefits.

Ecology does not recommend altering the lake outlet or advancing a large-scale downstream solution at this time. If community leaders want to continue to pursue structural solutions further evaluation would be needed, including a detailed cost-benefit analysis.

Ecology does recommend longer-term collection of additional data by installing water level gages to help inform better modeling of the flooding impacts and hydrology. We also recommend implementing strategies from the U.S. Army Corp of Engineers 2020 report.

Appendix A – Hydrology Analysis

Appendix B – Flood Report

Publication information

This report is available on the Department of Ecology's website at https://apps.ecology.wa.gov/ecy/publications/SummaryPages/2311018.html

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