Crystal Lake Watershed Initiative
Steering Committee - Meeting #3

To: Steering Committee
From: Michael H. Gunsch, PE, CFM, Senior Project Manager
Josh Loosmore, Peritiacon
Subject: Project Status Update and Presentation Information
Date: ***July 25, 2025 Meeting Summary***
Project: HEI No. 12808-0001-007

The following is a summary of the July 25, 2025 Steering Committee Meeting. These minutes are a tabulation versus a transcript of the discussions.

Those in attendance included Anthoney Roorda (Stutsman County WRD), Levi Taylor (Stutsman County Commission) Les Ressler (Reule Lake), Don Mittleider (Kidder County), Tim Brenner (Crystal Springs Bible Camp), Charlie Dronen, Kidder County Commission, Dan Peltier (BNSF – on Teams). Michael May (Interstate Engineering on Teams), Michael Gunsch (HEI), Josh Loosemore (Peritiacon).

SCOPE AND BUDGET AMENDMENT – SWC COST SHARE AND LOCAL FUNDING

Adequate local funding was secured ($22,000) to match the authorized SWC cost share funding to complete the additional groundwater evaluation. The County Commission authorized the feasibility study to proceed with the additional scope of services if local funding was secured. Total amendment was in the amount of $40,000.

FEASIBILITY STUDY SCHEDULE – SUMMARY

1. Web Grant Approved – DWR Agreement Addendum #1
2. Local Funding secured – for scope revision (checks pending)
3. Evaluation of the watershed and outlet alternatives has been completed
4. Hydrologic and expanded Groundwater Evaluation is underway
5. Joint County Commission and WRD meeting – July 30, 2025
6. Feasibility Study Report (Pending groundwater evaluation and HMGP inquiry)

PROJECT UPDATES:

The following documents were presented and discussed at the meeting are attached.

1. **Crystal Lake – Second Steering Committee Meeting Summary**
    a. This document was reviewed and accepted without comment or objection

2. **Project Status Report and Invoice Description**

3. **Alternative Alignment Hydraulics (1)**

4. **Alignment – USFWS Regulatory (2)**

5. **CWSI Water Balance Equation (3)**

6. **Contributing Areas (4)**

7. **Lake Elevations and Controls (5)**

8. **Historic Lake Elevations (6)**

9. **Area Capacity Data – Removal Requirements (Water Balance) (7)**

10. **CWSI System Components and Opinion of Probable Costs (8)**
    a. Funding Options – HMGP, SWC
    b. Preliminary Engineering Report Cost

11. **Annual - O&M Expenses (9 and 9A) – initial years**

12. **Head loss and System Efficiency in pump system and benefits (10)**

13. **O&M Cost Projections for Alternatives – Supports the Preferred Alternative (11)**

14. **Downstream Impact Sheets (12)**

15. **Economics**
    a. **The total economic benefits were roughly determined for this feasibility study based on a 10-year planning horizon, and in general include the following, which are rough approximations and remain to be finalized.**
        i. BNSF – Grade Raise 3 more at $3.5 Million each = $10.5 million
        ii. Bible Camp Relocation = $11 Million
        iii. NDDOT – Single Grade Raise (3 feet) = $10 million (TBD)
        iv. 500-600 acres of Ag Land ($2,000/ac) = $1.2 million
            1. Land Value of inundated properties - no production recovery
        v. County Roadways ($1.5 million/mile) = $3 million
        vi. Interstate Commerce BNSF Lost Revenue = TBD

    Total Approximation $35.7 million + Lost Revenues

16. **Tributary Discharges – Impact Evaluation**
    a. See comments in Summary of Topics

17. **Joint Stutsman County Commission and Water Resource District Meeting**
    a. July 30, 2025 – 9 am

18. **Public Informational Meeting – Feasibility Study**

SUMMARY OF TOPICS

The preliminary findings supported the conclusion that groundwater is clearly influencing and affecting lake elevations. That portion of the feasibility study remains on going and was delayed by local funding and the conclusion of the SWC Cost Share approval process. A meeting held with the NDDWR on July 23, 2025 to discuss their AEM Groundwater Study, they are not anticipating any further evaluation of the collected data, except for how it is applicable to future water permit allocations. They are supportive of the project and are interested in reviewing the final feasibility study report.

The preferred alternative is clearly the western route along the north side of Interstate #94, with a proposed 20 cfs capacity, based on the hydrologic evaluation – groundwater evaluation continues.

The discharge of waters into the downstream tributary has been evaluated based on both 10 cfs and 15 cfs long term releases. The existing crossings upstream from the Long Lake Refuge discharge all currently comply with the ND Stream Crossing Standards, including with the addition of the project discharges. The only crossing not in compliance is the BNSF Railroad crossing, which can be upgraded by installing an additional 42" culvert.

To accommodate and mitigate for project discharges all crossings would be upgraded with the installation of an additional 24" culvert or equivalent capacity. The needs at each crossing will be evaluated during the preliminary design phase. These improvements will be installed as a project cost at no expense to Kidder County, NDDOT or Townships. The need for easements along this corridor for any channel improvements is a regulatory determination that will be made during the permitting process.

This summary is being provided to the following via email and posted on the County Web Site:

- Crystal Springs Steering Committee
- Stutsman County Commission
- Stutsman County Water Resource District
- Crystal Springs Interested Parties Email Group – Includes doner list

MEETING ACTION ITEMS…

Steering Committee – Third Meeting Summary

Request to the Stutsman County Commission and Water Resource District

- ✓ Funding options for the Preliminary Engineering Report
- ✓ Acceptance of the Feasibility Study Report on completion

NDDOT – provide comments on the draft report when provided.

BNSF – provide comments on the draft report when provided. Note interest in upgrading their stream crossing as part of the project expense or general compliance.

Stutsman County Highway Department – provide comments on the draft report when provided.

Others – Given the local funding provided there is a notable interest and support to proceed and implement a solution to this historic flooding situation.

These minutes were approved by consent by the Steering Committee at their _______ meeting. These minutes are included in the Third Meeting summary.

If there are questions, please contact Michael Gunsch at 701-527-2134 or mgunsch@houstoneng.com.

Project Status and Invoice Description

HoustonEngineering Inc.
3712 Lockport Street
Bismarck, ND 58503
Phone: 701-323-0200
Fax: 701-323-0300

HEI Project No.:	**12808-00001**
Client	**Stutsman County Commission/Water Resource District**
Project Name:	**Crystal Springs Watershed Initiative**

Billing Period: ***through May 31, 2025***

Professional engineering and consulting services related to the Crystal Springs Watershed Initiative and September 2024 agreement with the Stutsman County Commission/Stutsman County Water Resource District. The following is a summary of work completed on each task during this invoice period.

Phase 001 – Hydrologic Watershed Evaluation

- Continued evaluation and expansion of NDRAM 2D BLE model based on field observations to refine contributing watershed area. Additional field evaluations for drainage and culverts were completed as well related to the outfall channel etc.
- Created a landowner listing for the additional PRESEN's stations and coordinated with the NDDWR regarding installation and operation for 2025.
- Expanded contour coverage to 1754-1755 due to continued waters surface increases. This is necessary to evaluate the storage capacity and inflows during the latest runoff season.
- Evaluated Reule Lake cabin lots and elevations for influence of water surface reductions. Provided summary to the HOA for discussion. Contact with developer related this review and Presens Station.
- Review BNSF ROW within the lake system.

Phase 002 – Groundwater Influence Review

- A continued review of available groundwater wells and potential movement within the Central Dakota Aquifer and local groundwater influence.
- *Given the groundwater influence more evaluation is required, which was addressed in a scope and budget amendment, contract extension and determination for additional web grants request to the SWC.*
- NDDWR grant application submitted and in the review process, it was decided for approval on consent at the June 12th meeting. Time related to the expanded services on hold until the funding is approved by the SWC and Stutsman County Commission. It is anticipated the primary review under this task will be over budget given the findings and direction.

Phase 003 – Hydraulic Floodwater Removal Alternatives

- Preferred Alternative was selected for a detailed evaluation and determination regarding the downstream stream conveyance and culvert conditions. This evaluation is underway, with preliminary indications that improvements along this system associated with the project are anticipated.
- Letter response sent to Kidder County Commission to address the questions they raised with the Stutsman County Commission.
- An InfoWater hydraulic pipe and pump system model was created along the selected alignment, with the proposed system and pipe size to be determined. Once the volume and rate of annual lake system inflows are determined the pump and pipeline can be sized.
- Considerable work was completed to evaluate the downstream tributary and system conveyance. This as modeled to determine impacts using the 2D HEC-RAS NDRAM model. Culverts along this system were reviewed and documented for condition and consideration of use. There were multiple crossings that needed to be evaluated, and the final modeling remains to be completed at the time of this invoice.

Phase 004 – Regulatory Considerations

- Limited work on the regulatory issues occurred during this invoice period. Continued contacts with the agencies is ongoing, however most of this will need to be addressed during preliminary design. The specifics related to the influence and impacts to properties and USFW easements are outside the scope of this study. Therefore, they will be more fully documented during preliminary design.

Phase 005 – Water Quality Comparison – Influence Area

- No additional work was completed on this task during this period.

Phase 006 – Economic Analysis (Feasibility Level)

- Limited work continues related to the system installation costs or damage prevention.
- Several cost items were considered, including the BNSF grade raise and County #39 issues.

Phase 007 – Steering Committee and Feasibility Guidance

- Lake Reule HOA meeting update
- Discussion and sharing of groundwater issues
- Sharing of local rainfall event data
- Discussion of committee membership revisions
- Funding email and project status updates
- A third Steering Committee meeting is in the planning stages

Phase 008 – Future Funding Opportunities

- No additional work was completed on this task during this period.

Phase 009 - Feasibility Report

- Started preparing figures for use in report
- Initial drafting for sections and outline.

Comments and Issues:

- The surface water and groundwater assessment has resulted in an indication that groundwater is a greater influence than anticipated.
- <u>*The new targeted completion date is the end of July 2025.*</u> The DWR/SWC costs share approval to be approved June 12th, which will allow additional groundwater review. Until then we continue to evaluate all elements possible within the originally budget.
- Next Steering Committee meeting to be after the SWC funding approval and completion of the outfall evaluation for capacity and conveyance.
- Additional local funding opportunities are under review, with most funds raised that will offset the local share to complete the services under Addendum #1. Stutsman County Commission needs to approve SWC amendment then authorize HEI to proceed with the additional work and complete the draft report.

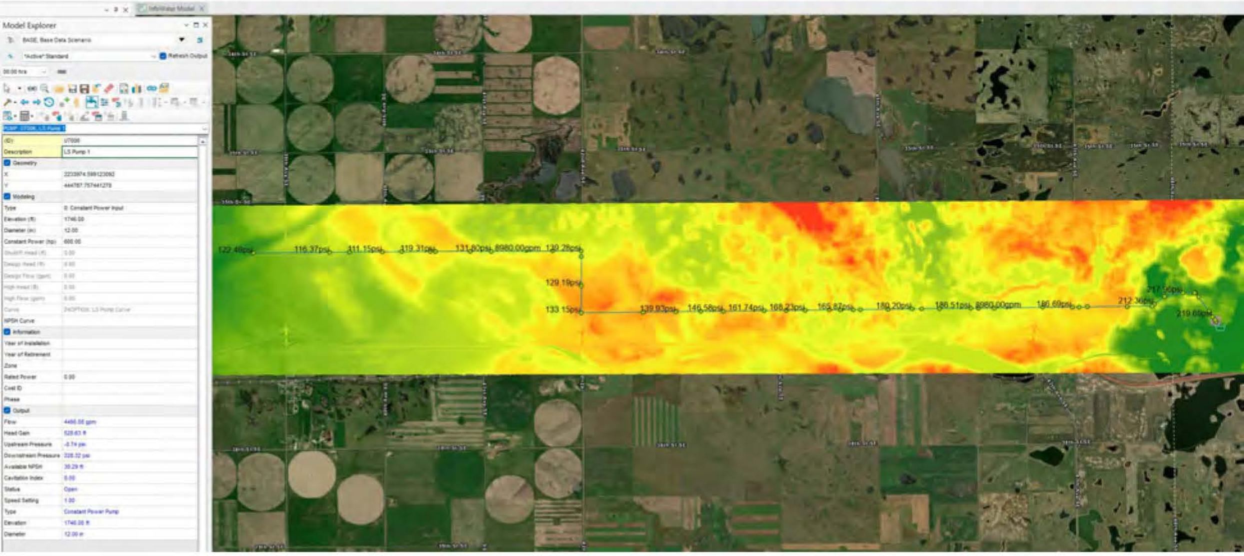
See accompanying invoice for personnel cost breakdown.

HEI Invoice	$ 46,140.75
Peritiacon Invoice	$ 4,410.00
This Invoice	***$ 50,550.75***
Total Budget	***$220,000.00***
Invoice #1	*$ 88,516.00*
Invoice #2	*$ 44,342.50*
This invoice #3	*$ 50,550.75*
Remaining Balance	***$ 38,590.75***

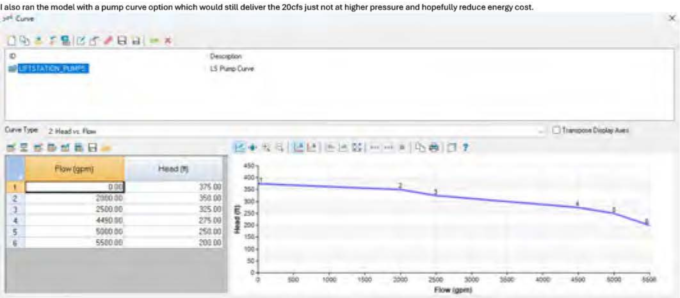
From: Tyler Paul
To: Travis Johnson
Cc: Michael Gunsch
Subject: RE: 12808-0001 Crystal Springs Pipeline Proposed Route
Date: Tuesday, July 8, 2025 5:02:24 PM
Attachments: image002.png
image003.png
image001.png
image004.png

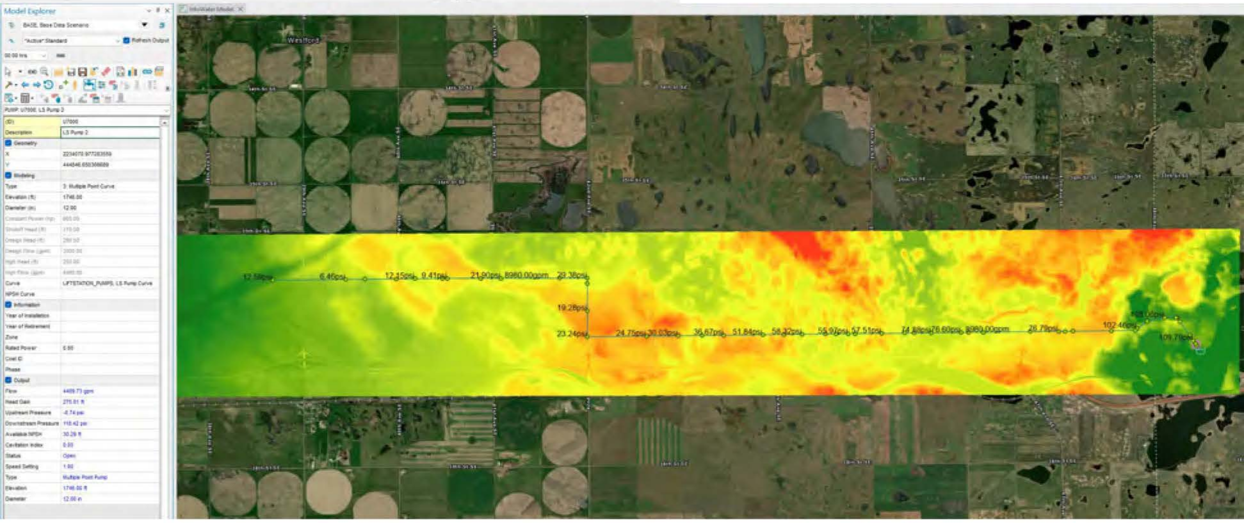
Hi Travis,

I ran it with two 600hp pumps (constant power input option) and a 24in pipeline and am getting the following psi results at the nodes along the pipeline.



I also ran the model with a pump curve option which would still deliver the 20cfs just not at higher pressure and hopefully reduce energy cost.





Sherwin also mentioned that maybe a 30in diameter pipe might allow us to get a more optimal pump size and energy cost as well.

Let me know what your thoughts are and if you need any other options ran on the pipeline/pumps.

Thanks!
Tyler

Tyler Paul
Senior Technician | Civil
Houston Engineering, Inc.
O 701.323.0200 | D 701.751.6288

From: Travis Johnson <travis.johnson@houstoneng.com>
Sent: Wednesday, July 2, 2025 3:22 PM
To: Tyler Paul <tpaul@houstoneng.com>
Cc: Michael Gunsch <mgunsch@houstoneng.com>
Subject: RE: 12808-0001 Crystal Springs Pipeline Proposed Route

I need to double check, but I think to push 10 cfs at 150 psi, we will need a 600 hp pump. Just pro-rating it compared to the pumps at Cottonwood, I came up with 555 horsepower. Will have to run the model and see what that shows for a discharge pressure to make that run and then I can look in the books and see what size of pump gives us those numbers to confirm what I am scratching out here.

Travis Johnson
Senior Civil Engineer
Houston Engineering, Inc.
O 701.323.0200 | D 701.751.6287 | C 701.226.0227

From: Tyler Paul <tpaul@houstoneng.com>
Sent: Wednesday, July 2, 2025 2:52 PM
To: Travis Johnson <travis.johnson@houstoneng.com>
Cc: Michael Gunsch <mgunsch@houstoneng.com>
Subject: 12808-0001 Crystal Springs Pipeline Proposed Route

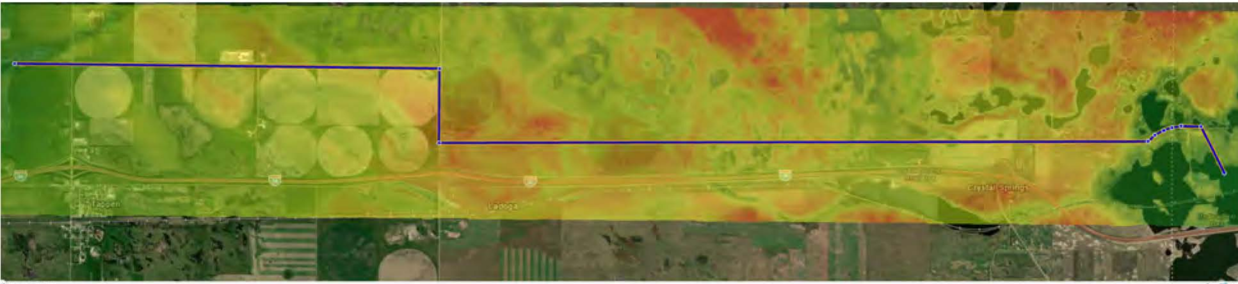
Hi Travis,

Below is a quick profile for the proposed pipeline route at Crystal Springs per our conversation this afternoon.

It looks like the route is currently 83,018 feet long.

If you have any other questions or need any other information, please let me know.

Thanks!
Tyler



Tyler Paul
Senior Technician | Civil
Houston Engineering, Inc.
O 701.323.0200 | D 701.751.6288

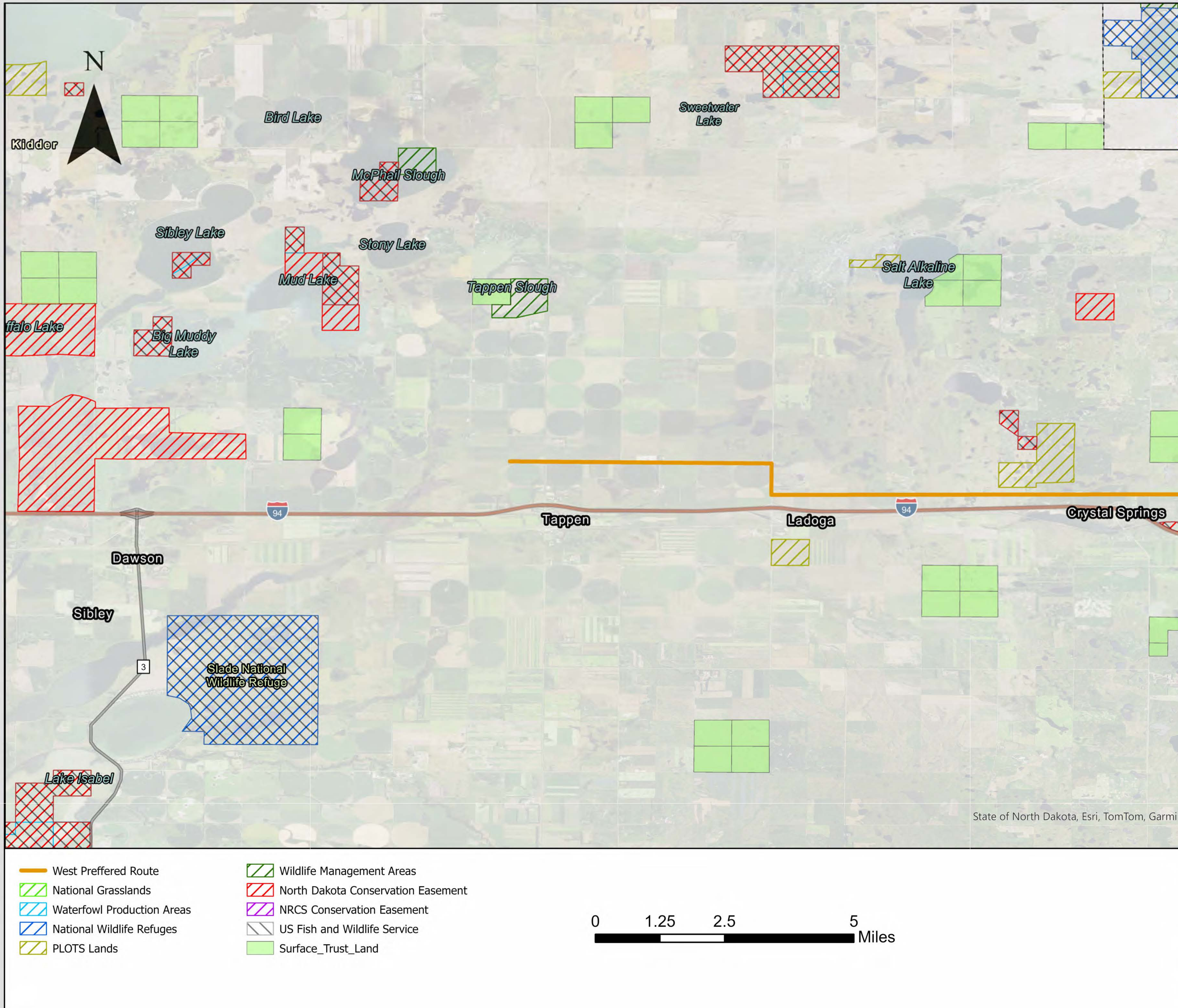


FIGURE 6 - U.S. FISH AND WILDLIFE FACILITIES

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AS SHOWN	JAP	MG	12808-0001	7/24/2025	

HOUSTON engineering, inc.

Crystal Springs Watershed Initiative
System Water Balance Evaluation

The hydrological balance of water in the Crystal Springs lake system is a function of the following factors:

Surface Water (SW) inflows generated by runoff from the watershed including combined surface flows within the tributaries and lake/slough systems. Runoff is affected by soils conditions, land use and precipitation. The total runoff value was approximated using the *USGS Stream Gate at Harvey, North Dakota (09020202)* just north of the study area. Total ac-ft runoff is projected then using a prorated or weighted function of runoff per square mile. This value was approximated for each year utilizing the gage records.

Precipitation (P) from rainfall on the open water. **Direct Rainfall (DR)** contributes to the elevation of each lake system. Simply stated a 2" rainfall generally adds 2" to the water surface elevation. The total ac-ft contribution on the lake is the direct precipitation multiplied by the lake area at the time of rainfall. This value was approximated using the rainfall gage for *Tappen, North Dakota* (______), and the available lake area-capacity information.

Evaporation (E) is generalized as a loss based on the open water area using *the North Dakota Hydrology Manual (NDHM), Chapter 8 Figure 8-3*. There is no available evaporation station data for this area, there the NDHM approximation was utilized. Subsequently, the annual losses were determined, while monthly percentage evaporation data could be applied for subsequent evaluations if necessary. Total evaporative losses in ac-ft are based on the lake area for a given lake elevation.

Groundwater (GW) is a significant factor and has a measurable impact on lake levels, and the inflows are being evaluated. This influence is difficult to directly determine but can be approximated using the other factors, like soils and the AEM data recently acquired by the ND Department of Water Resources (*circa February 2025*). The GW inflows in ac-ft are undetermined; however, it could be approximated using a water balance equation.

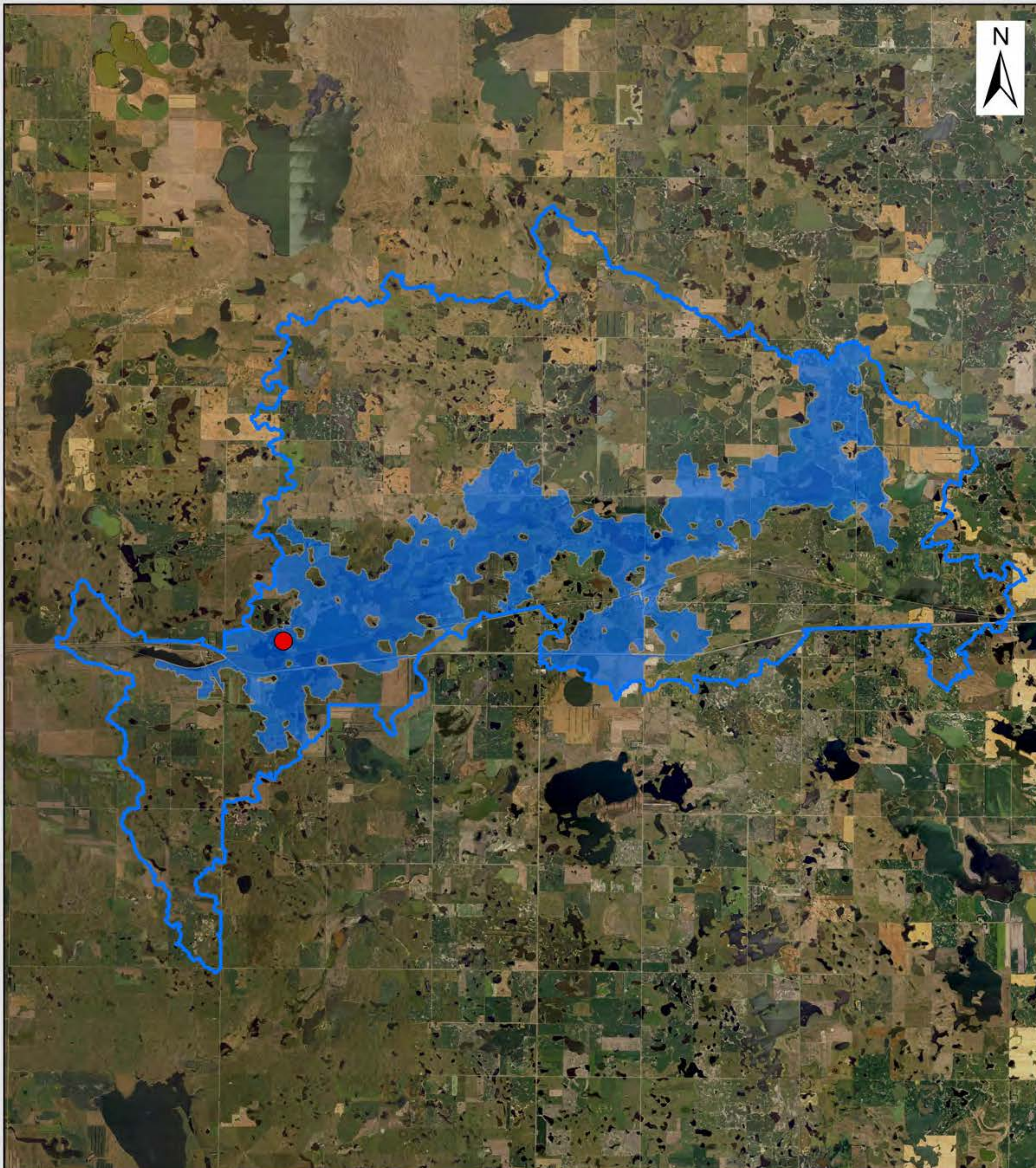
Annual Ac-Ft (AF) of change is determined utilizing the area-storage-capacity curves for each lake and combined lakes system and comparative values from year to year and lake level measurements.

Annual Water Balance Equation in any given year is determined by the following equation.

SW + DR - E + GW = Annual Acre-Feet (change in storage)

The only unknown in this equation is GW, which is projected over the 14+ year study period, based on the other variables. The others can be approximated as noted above.

The feasibility study is being completed to determine the amount of water to be removed to stabilize water levels in the system.



Watersheds

1 (101.3 Square Miles)

Contributing Surface Area

1 (25.8 Square Miles)

0 0.5 1 2 Miles

Figure 2: Contributing Surface Area
(5.3 inch Rain Fall)

Scale:	Drawn by:	Checked by:	Project No.:	Date:	Sheet:
AS SHOWN	KZS	MG	12808-0001	2/14/2025	

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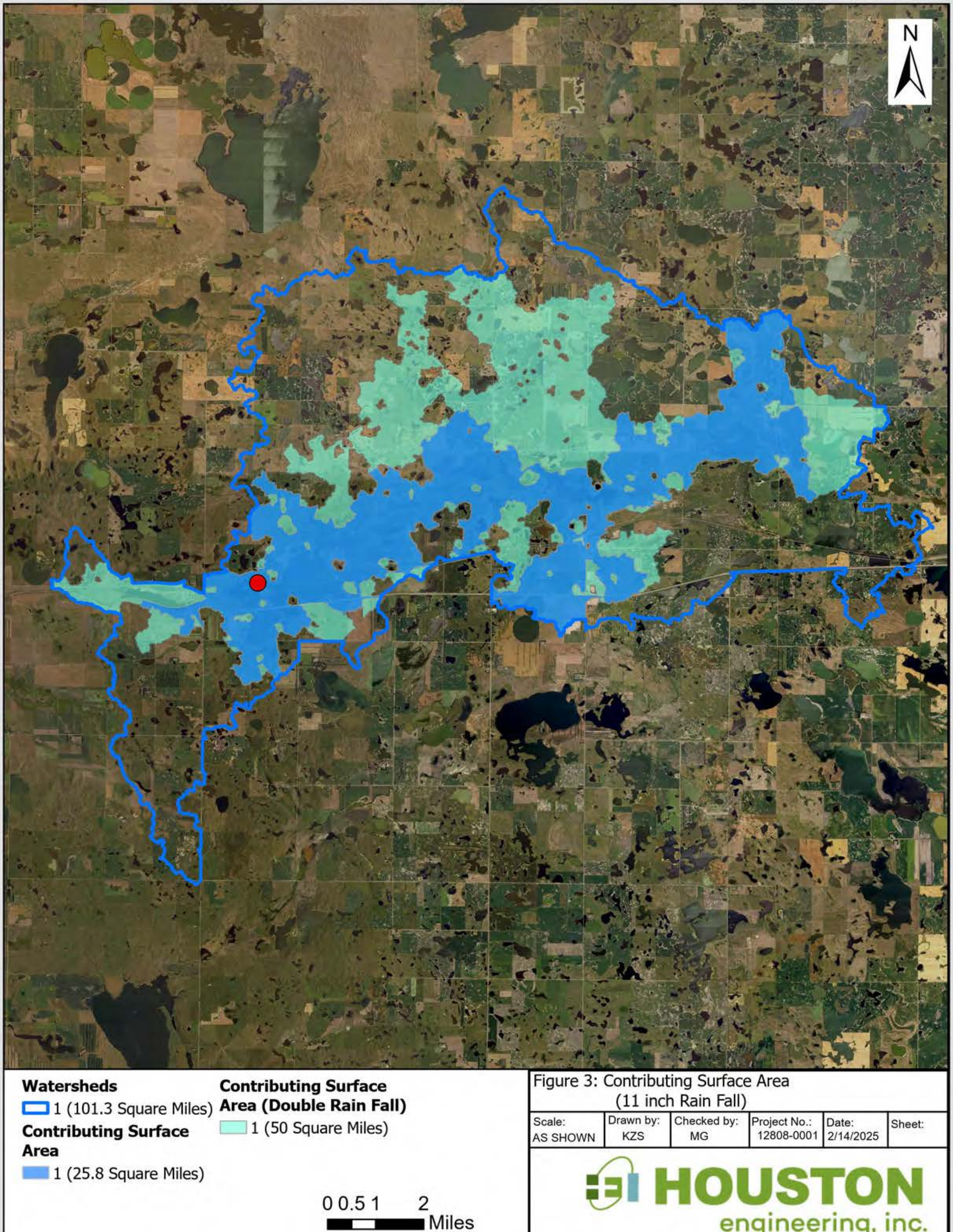

Figure 3: Contributing Surface Area (11 inch Rain Fall)

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AS SHOWN	KZS	MG	12808-0001	2/14/2025	

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Legend

● Culverts

N

0 0.25 0.5 1
Miles

Crystal Springs & Stink Lake Culvert Map					
Scale: AS SHOWN	Drawn by: EN TP	Checked by: MG	Project No.: 9356-0001	Date: 2/11/2025	Sheet: 1

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Crystal Springs Watershed Initiative
Aerial Photo/Lidar/Bathymetry Water Surface Elevations

Lake	*Year*	*Elevation*	*Source*	*Difference*	
Crystal Lake	2024	1752.27	Aerial	0.28	
	2023	1751.99	Aerial	0.48	
	2021	1751.51	Aerial	1.46	
	2015	1750.05	Aerial	1.49	
	2010	1748.56	Aerial	-3.43	Fall in elevation?
	2003	1751.99	Aerial	5.28	
	1980	1746.71	Aerial	0.35	
	1957	1746.37	Aerial	5.90	Rise Since 1957
	Average	**1749.93**			
South Stink Lake	2024	1752.15	Aerial	-0.31	
	2023	1752.46	Aerial	1.82	
	2021	1750.64	Aerial	2.08	
	2015	1748.56	Aerial	2.77	
	2010	1745.79	Aerial	-1.41	Fall in elevation?
	2003	1747.20	Aerial	13.22	
	1980	1733.98	Aerial	-0.81	
	1957	1734.79	Aerial	17.36	Rise Since 1957
	Average	**1745.70**			
Stink Lake	2024	1753.47	Aerial	0.54	
	2023	1752.92	Aerial	2.50	
	2021	1750.43	Aerial	2.84	
	2015	1747.59	Aerial	1.07	
	2010	1746.52	Aerial	3.62	
	2003	1742.90	Aerial	10.55	
	1980	1732.35	Aerial	0.47	
	1957	1731.88	Aerial	21.59	Rise Since 1957
	Average	**1744.76**			
Ruele Lake	2024	1753.27	Aerial	1.12	
	2023	1752.15	Aerial	1.68	
	2021	1750.46	Aerial	3.36	
	2015	1747.10	Aerial	4.12	
	2010	1742.98	Aerial	9.00	
	2003	1733.98	Aerial	0.00	
	1980	1733.98	Aerial	-0.81	
	1957	1734.79	Aerial	18.48	Rise Since 1957
	Average	**1743.59**			

14-Year Historic Record Evaluation - Crystal Springs Watershed Initiative

Year	*Elevation*	*Storage Volume - Area Capacity Curve*	
2024	1755	36,106	Acre-Feet
2010	1746	14,330	Acre-Feet
14	9	21,776	Acre-Feet
	Average	**1,555**	**Acre-Feet/Year**

Aerial Photo Storage Increase	*2010-2024*	
	42,335	Acre-Feet
Approximate ~ 0.5 ft	3,024	**Acre-Feet/Year**
100 Year Event Rainfall	***1,440***	***ac-ft***

		Per Year Removal (180)	
System Size (cfs)	*10*	3,564	**Acre-Feet**
	15	5,346	**Acre-Feet**
	20	7,128	**Acre-Feet**
	1.98	Ac/ft-Day- CFS	
	180	Operational Days	

Time to Remove Inflow - Area Capacity Value

Days	*Years*	*Target Elevation*	**1746**
1100	6.11		
733	4.07		
550	3.06		

Operational Removal	**3,024**	**Annual Ac-Ft (2021-2024)**	
2025 Inflow	**7,900**	**Ac-ft**	**(nearly 2 feet)**

Preliminary Removal Projections

O&M Plan	**Total Lake Storage**	**1755 - 1750**	**15,271**	**Acre-Feet**
	Average Annual Inflow - times 2 years		6,048	**Acre-Feet**
	Retain Waters In Ruele			
	Elevation 1753 - 1750	Reduction in Removal	7,800	**Acre-Feet**
			13,519	**Acre-Feet**

With Ruele Storage (including average inflows)			**Without Ruele Storage (including average inflows)**		
5 feet removed	3.79	Yrs at 10 cfs	5 feet removed	5.98	Yrs at 10 cfs
5 feet removed	2.53	Yrs at 15 cfs	5 feet removed	3.99	Yrs at 15 cfs
5 feet removed	**1.90**	**Yrs at 20 cfs**	**5 feet removed**	**2.99**	**Yrs at 20 cfs**

Period of Record Volume Approximations

Total Inflow USGS gage (SW)	41,455	ac-ft	25.8	Square Miles
Rainfall - Direct Precipitation (P-DR)	60,302	ac-ft	247.65	Total Inches (2010-2024)
Evaporation (E)	(110,790)	ac-ft	32.5	Inches/Surface Area
Total SW+DR-E	**(9,034)**	**ac-ft**		
Lake System Increase	**42,335**	**ac-ft**		
Groundwater (GW) Compnent	**51,369**	**ac-ft**		
	34%	of Total System Inflows		

Lake Surface Area (Acres)	
Elev 1744	2,324
Elev 1755	3,520
Average 2010-2014	***2,922***

Crystal Springs Lake Pump Removal System

Preferred Alternative

24-Jul-25

Construction Cost	**$16,262,000.00**		
Contingency	**$3,252,400.00**	**20%**	**Feasibility Level**
Opinion of Probable Construction Cost	**$19,514,400.00**		

Preliminary Engineering Report (w/operations plan)	$975,720.00	5%
Final Design/CMS Services	$1,951,440.00	10%
Legal and Administration (assessment district, easements, etc.	$1,170,864.00	6%
Regulatory/Environmental	$975,720.00	5%
Draft Preliminary OPC	***$24,588,144.00***	***26%***

Potential Funding Sources - Consideration and Requests

	Full Project OPC		*Preliminary Engineering Report*		
HMGP	$18,441,108.00	Federal	75%	Up To	$731,790.00
	$2,458,814.40	State	10%	of Federal	$97,572.00
	$3,688,221.60	Local	15%	Local	$146,358.00
	$24,588,144.00			***Total***	***$975,720.00***

	Full Project OPC		*Preliminary Engineering Report*		
SWC Rural Flood Control	$11,064,664.80	State	45%		$439,074.00
	$13,523,479.20	Local	55%		$536,646.00
	$24,588,144.00			***Total***	***$975,720.00***

Design Considerations

1. **Utilization of a 30" PVC allows for lower headlosses in the system and smaller pump requirements**
2. **The 30" PVC pipe will lower internal pressures and associated operations and maintenance and maintenace costs**
3. **The 30" PVC allow for the ability to add pump capacity at some point if conditions require.**
4. **Annual Operations and Maintenance Costs for the 24" PVC System $ 266,540**

CSWI Initial 3 phase field pull from source to site:

4-5 miles installation via boring at an estimate of $350k-$400k. The cable cost ($250k) makes up the majority due to the required footage needed. This is according to Northern Plains Electric Cooperative point of contact.

Peritiacon LLC has an estimate of $85k-$100k per mile.

These estimates agree with one another and are constructed with conservative margins.

CSWI Pump House Annual O&M:

Operational – Electric loading on pump (Major Load), auxiliary systems (Minor Loads), operational startup/shutdown/monitoring/system checks/operational control (Operator).

Maintenance – Pump and Auxiliary system maintenance and repair. Maintenance frequency depends on component and tech spec requirements. Quarterly and annual schedules are the most common for lift station systems.

<u>Assumptions</u>: No consideration given to pump/load curves. 600hp is being used as a conservative measure. The 480v Motor Control Center (MCC) may use older DB style breaker schemes or newer Eaton style...shall be sized accordingly for redundancy and amp rated for starting current draws (5 times running current). In the PER, individual component sectional will more closely determine system efficiencies and cost reductions/savings opportunities. Fixed rate is assumed as NPEC has a fixed rural rate.

Operational	**Rate**	**Annual Cost @ 180 days operational**	
Pump Load @ 600hp @ 90% 20hrs/day	Fixed rural rate of $0.098/khw	$142,160.00	Assuming we can secure a fixed rate.
Minor Loads-MCC, lighting, HVAC...etc	8% of total pump load	$11,372.80	
Operator/Mech	55/hr with OT built in	$65,000.00	2 part time cross disciplined operators
Maintenance			
Routine – oil, filters, ventilation, minor leak repairs, valve M&R	$3,000.00/ operational month	$18,000.00	
Non-Routine – vendor service, equipment, unplanned downtime	$30,000.00 Annual	$30,000.00	
		Total O&M	per 1000 acre-feet of water removal @ 20cfs
		$266,532.80	$44,792.32

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Assumptions: No consideration given to pump/load curves. 500hp is being used as a conservative measure. The 480v Motor Control Center (MCC) may use older DB style breaker schemes or newer Eaton style…shall be sized accordingly for redundancy and amp rated for starting current draws (5 times running current). In the PER, individual component sectional will more closely determine system efficiencies and cost reductions/savings opportunities. Fixed rate is assumed as NPEC has a fixed rural rate.

Operational	**Rate**	**Annual Cost @ 180 days operational**	
Pump Load @ 500hp @ 90% 20hrs/day	Fixed rural rate of $0.098/kwh	$118,435.96 (Divide by 2 for single pump operation + 10-20% efficiency gains for single train operations)	Assuming we can secure a fixed rate.
Minor Loads-MCC, lighting, HVAC…etc	8% of total pump load	$9,474.80	No change for single pump OPS
Operator/Mech	$55/hr with OT built in	$65,000.00	2 part time cross-disciplined operators
Maintenance			
Routine – oil, filters, ventilation, minor leak repairs, valve M&R	$3,000.00/ operational month	$18,000.00	
Non-Routine – vendor service, equipment, unplanned downtime	$30,000.00 Annual	$30,000.00	
		Total O&M	per 1000 acre-feet of water removal @ 20cfs
		$240,910.76	$40414.12

Pump Work Note: 33psi is added to each Frictional Head Loss value. This accounts for the Static Head Loss for a suction bell house casing set 20ft below the water surface and a max elevation deviation of 76' (1810'-1734')

Pipe Dia	11.5 miles 58000ft @ 20cfs Frictional Head Loss (psi)	Velocity (ft/s)
	PVC	
24"	99.52	6.39
30"	33.6	4.09

Pipe Dia	15.75 miles 83000ft @ 20cfs Frictional Head Loss (psi)	Velocity (ft/s)
	PVC	
24"	142.22	6.39
30"	48.02	4.09

Pipe Dia	11.5 miles 58000ft @ 10cfs Frictional Head Loss (psi)	Velocity (ft/s)
	PVC	
24"	27.53	3.19
30"	9.3	2.04

Pipe Dia	15.75 miles 83000ft @ 10cfs Frictional Head Loss (psi)	Velocity (ft/s)
	PVC	
24"	39.4	3.19
30"	13.3	2.04

Cost Estimates Based on Known Assumptions

Known:

1. Duplex System of 10 cfs (20cfs total)
2. 600hp electric required (3 phase)
3. Distance of route options – friction losses
4. Head height (elevation change) of the route options
5. System design will remain the same so system minor losses (valves, joints, bends… are assumed constant
6. Piping material to be used is HDPE
7. Estimates are done with 2ft pipe diameter
8. Fixed electric rate of $0.098/kwh

Unknown:

TBD in PER

1. Actual power required in kW (electric) and bhp (hydro hp) required
2. Pump efficiency, required NPSH, pump curves…etc
   a. Pump selection will be benchmarked based on *knowns* and selected for application specific needs as seen fit during the PER

Approach:

What takes WORK? 1)Friction losses due to pipe length and diameter as expressed as Headloss (H_l). 2) Headloss due to height, the water needs to be pumped.

HW Equation in *imperial* units for frictional H_l:

$$H_l = \left(4.52 \times L_{pipe} \times Q^{1.852}\right) \div \left(C^{1.852} \times D^{4.87}\right)$$

$$H_l = \left(4.52 \times L_{pipe} \times \left(\frac{Q}{C}\right)^{1.852}\right) \div \left(D^{4.87}\right)$$

Where:

H_l = Head loss (ft)

L = Pipe length (ft)

Q = Volumetric flow rate (ft^3/sec)

C = Pipe roughness

D = Pipe diameter (ft)

Height of water is divided by 33ft to convert to PSI as 1 ATM ~ 33ft water height. This total then needs to be added to the static head height loss.

Headloss at 20cfs for 2ft diameter HDPE pipe run

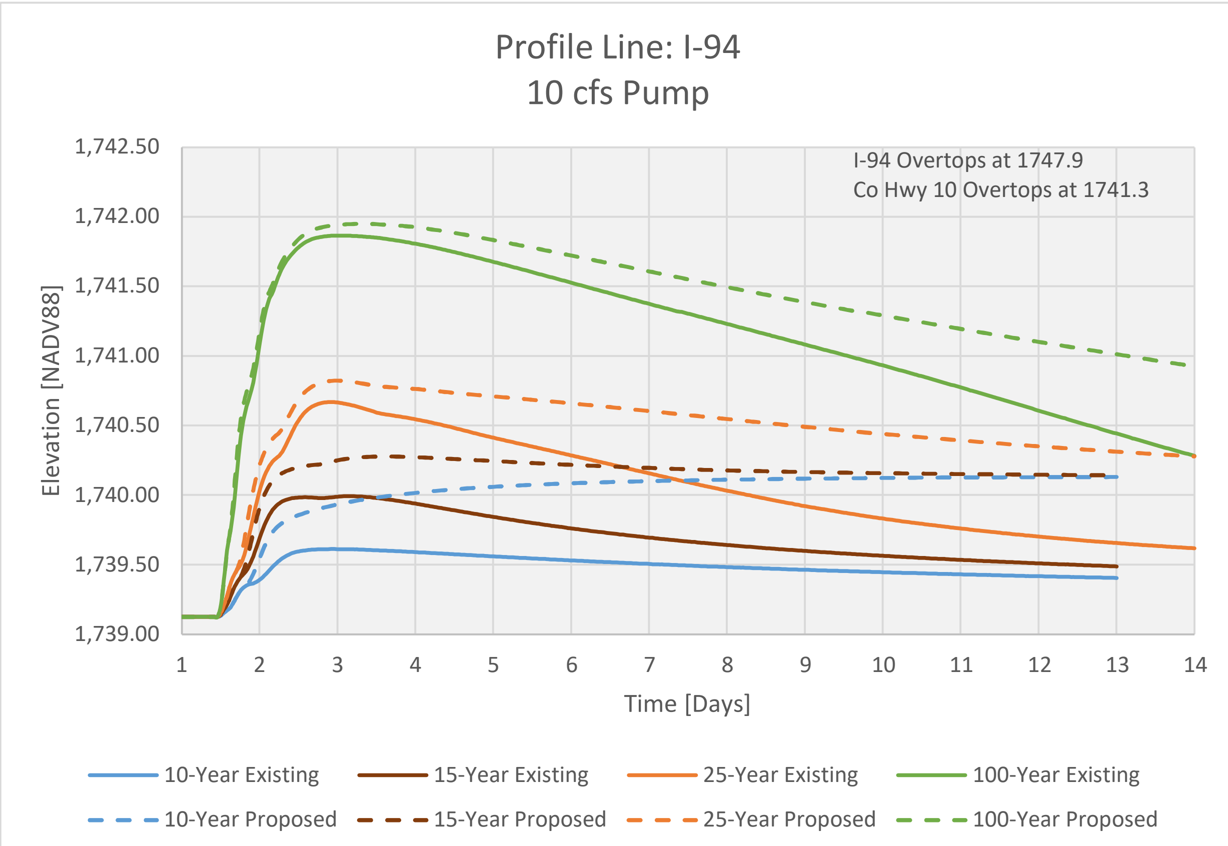
Route	Max Elevation (ft)	Piping Length (ft) Shown in miles	Frictional Headloss (H_l) (psi)	Static Headloss (psi)	Total Headloss (psi)	Cost Factor (CF) (O&M cost for preferred route times CF)
Upper Pipestem	1930	32.6	276.6	78.4	355	2.96
Lower Pipestem	1946	37.8	326.8	82	408.8	3.40
South	2110	17.5	151.3	157.2	308.5	2.57
West RR	1836	13.5	116.4	36.2	152.6	1.27
West North	1810	11.5	95.1	25	120.1	1

Note: This does not consider system losses or minor losses.


I-94
HWY 10 Culvert 3
HWY 10 Culvert 1
HWY 10 Culvert 2
RR 3ft Culvert
Tappen
Dawson Hook 4 Culverts
Dawson
35th Ave SE
HWY 3
Whispering Stream

Crossing Name	Culvert Size [inch]	Culvert type	Invert of Culvert* [NADV88]	Design Event Return Frequency	Allowable Headwater Elevation	Water Surface Elevation for the Design Event [NADV88]			Pass/Fail
						Existing Conditions	Proposed 10 cfs Pump	Proposed 15 cfs Pump	
Highway 10	3-36	RCP	1737.00	25 Year	1742.00	1740.67	1740.82	1740.89	P - P - P
I-94	3-36	RCP	1737.00	50 Year	1742.00	1741.07	1741.19	1741.27	P - P - P
Railroad	36	RCP	1735.00	50 - 100 Year	1738.00 - 1739.50	1740.93 - 1741.71	1741.06 - 1741.79	1741.14 - 1741.84	F - F - F
Dawson Hook	2-30, 2-24	CMP	1731.50	15 Year	1736.00	1733.65	1733.86	1734.02	P - P - P
35th Ave	36	CMP	1723.23	10 Year	1728.23	1726.74	1727.50	1727.86	P - P - P
Highway 3	2-18	vert Unco	1724.5	25 Year	1728.00	1727.12	1727.35	1727.43	P - P - P
Whispering Stream	2-24	CMP	1723.60	10 Year	1727.60	1726.12	1726.12	1726.12	P - P - P

*Values are based on survey data, while HEC-RAS modeling of culvert inverts are based on the lowest LiDAR value near the culvert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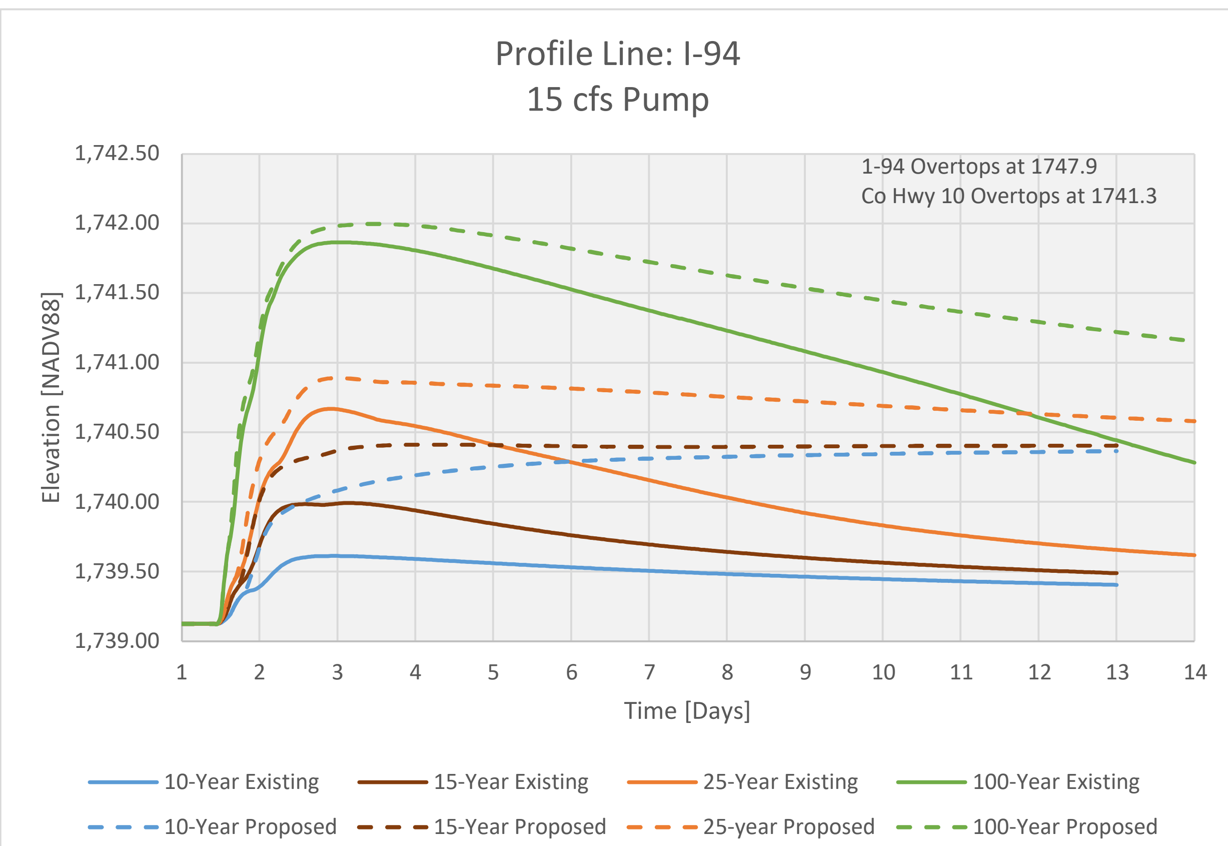
10 cfs Pump
I-94 Overtops at 1747.9
Co Hwy 10 Overtops at 1741.3
1,742.50
1,742.00
1,741.50
1,741.00
1,740.50
1,740.00
1,739.50
1,739.00
Elevation [NADV88]
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed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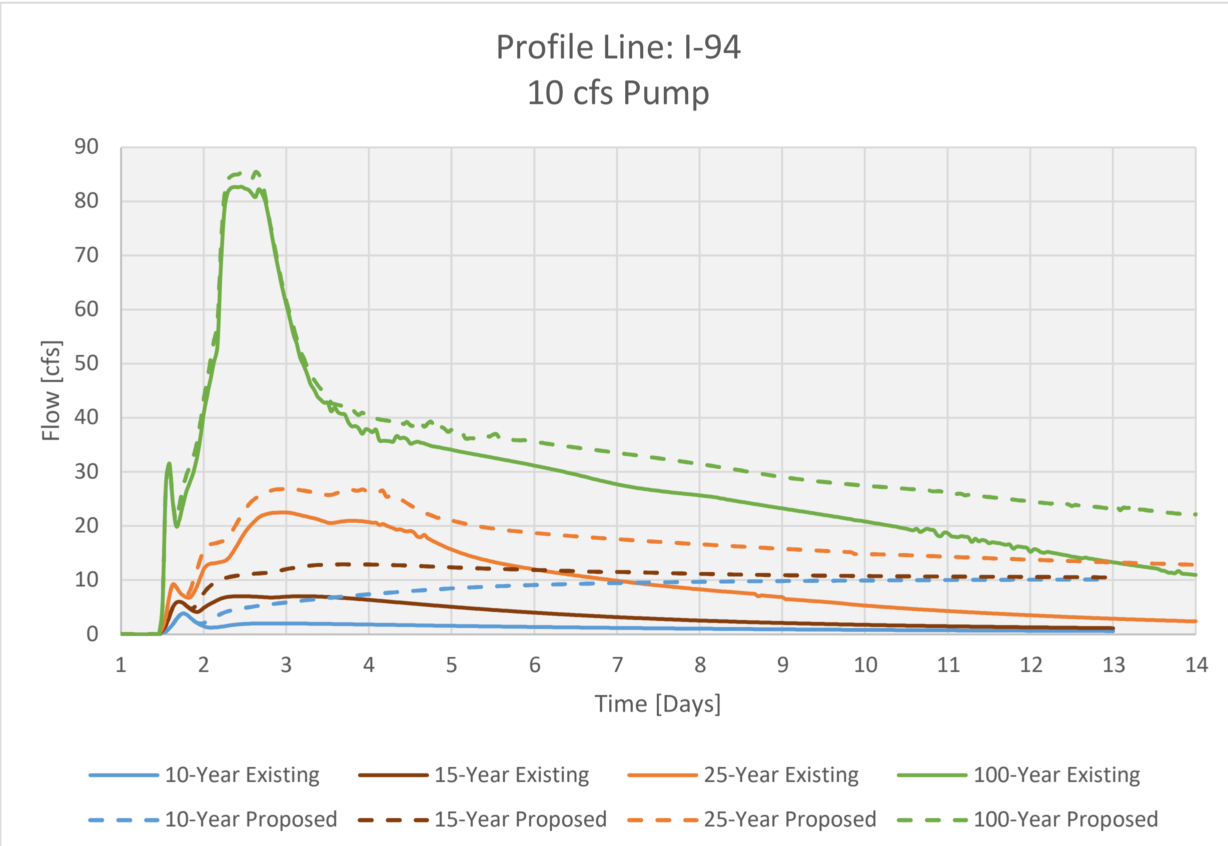
15 cfs Pump
1-94 Overtops at 1747.9
Co Hwy 10 Overtops at 1741.3
1,742.50
1,742.00
1,741.50
1,741.00
1,740.50
1,740.00
1,739.50
1,739.00
Elevation [NADV88]
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-year Proposed
100-Year Proposed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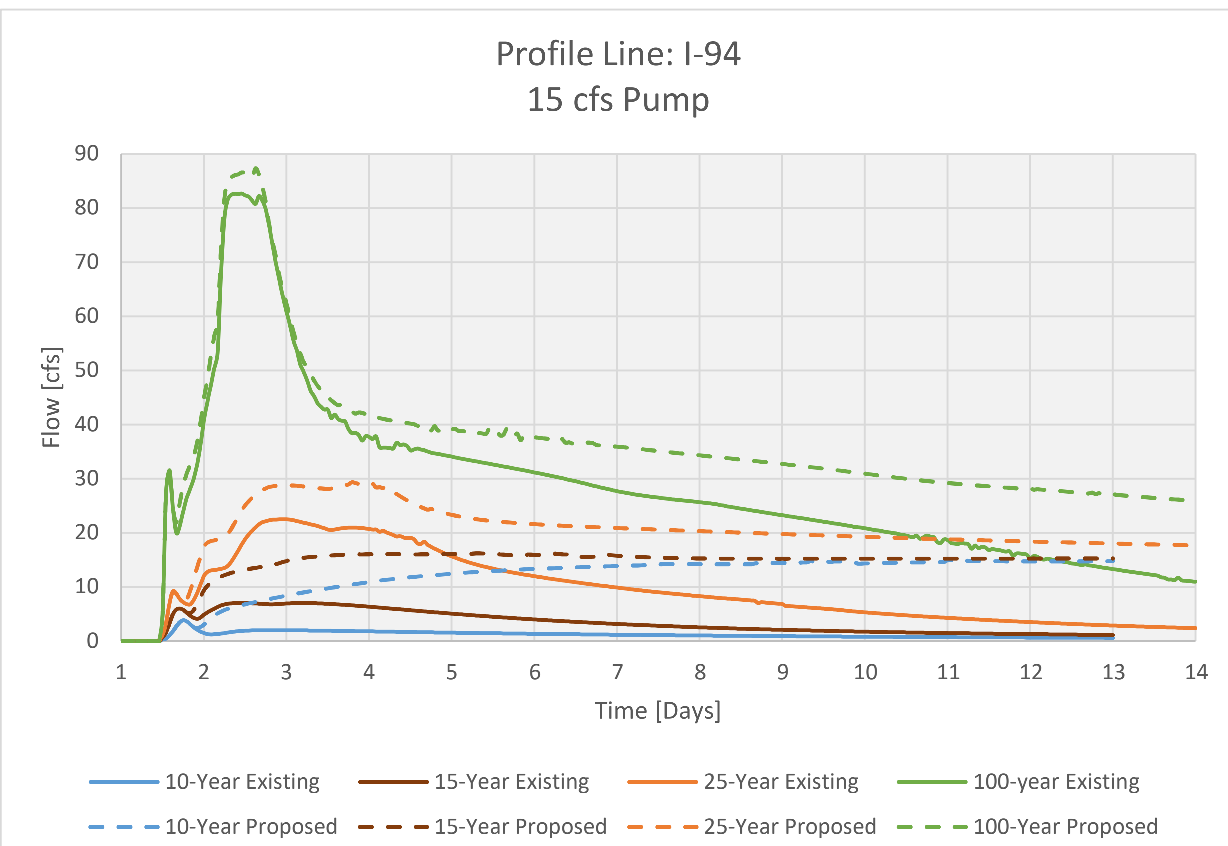
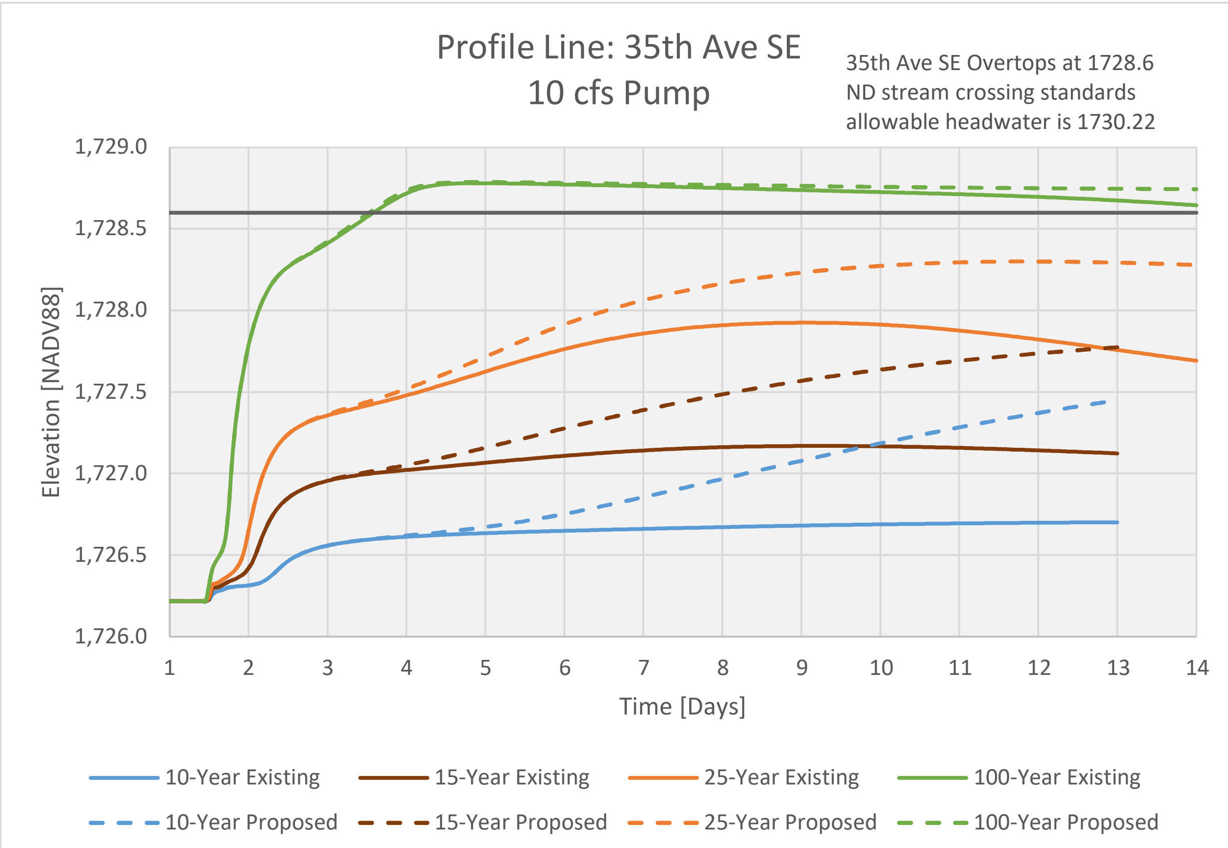
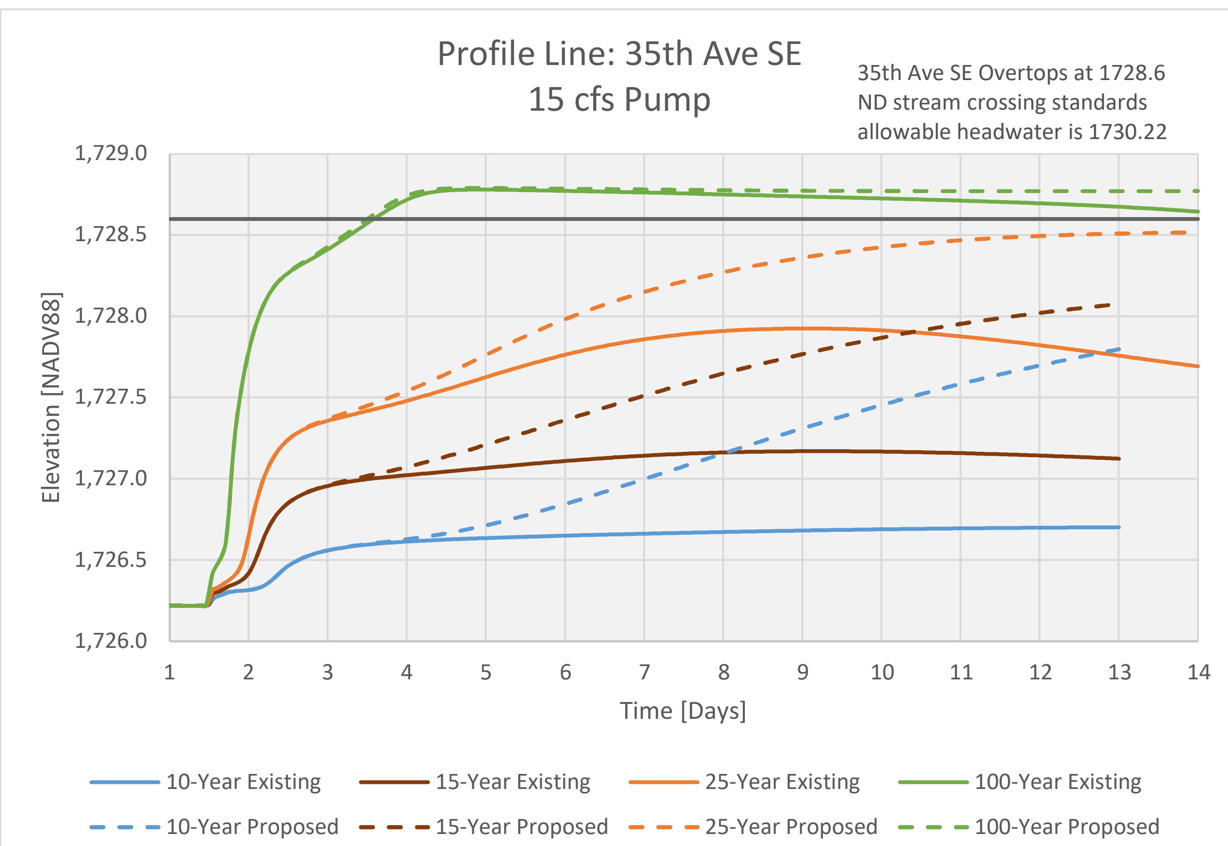
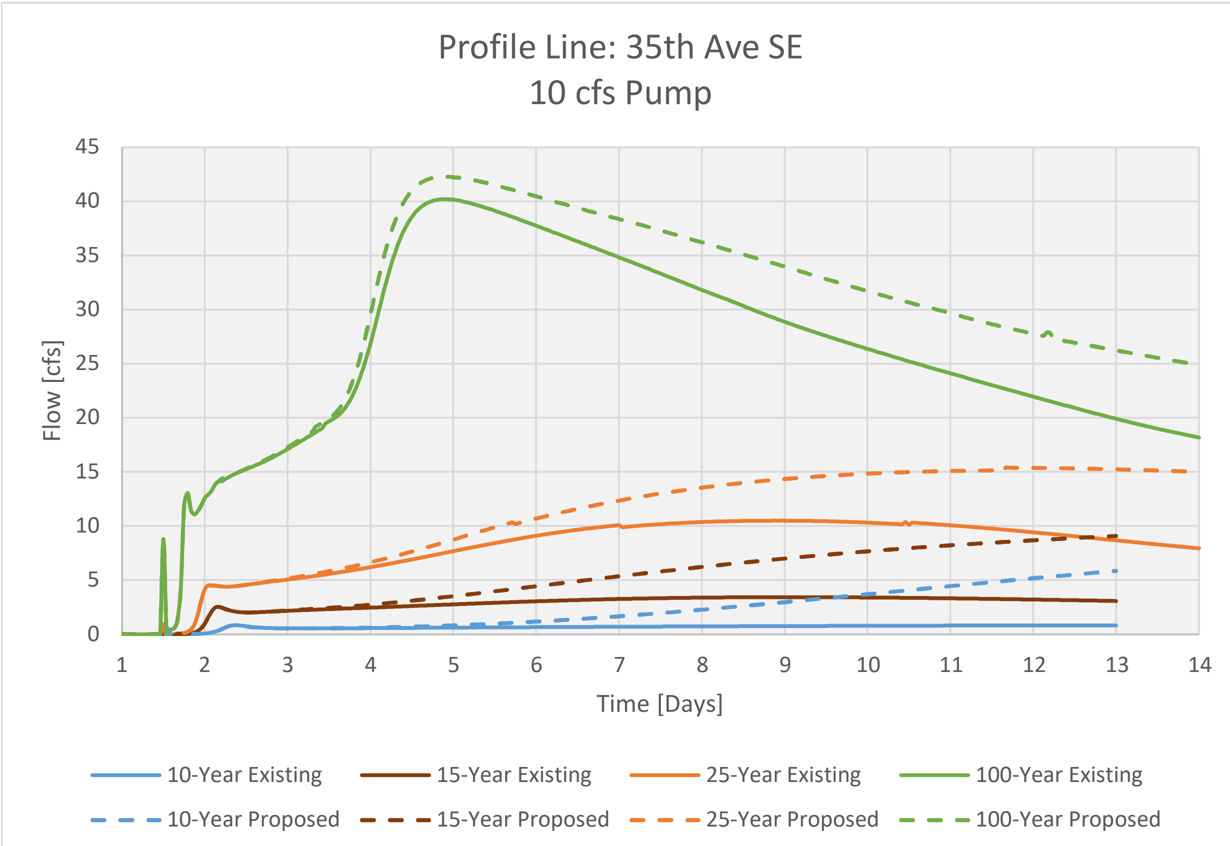
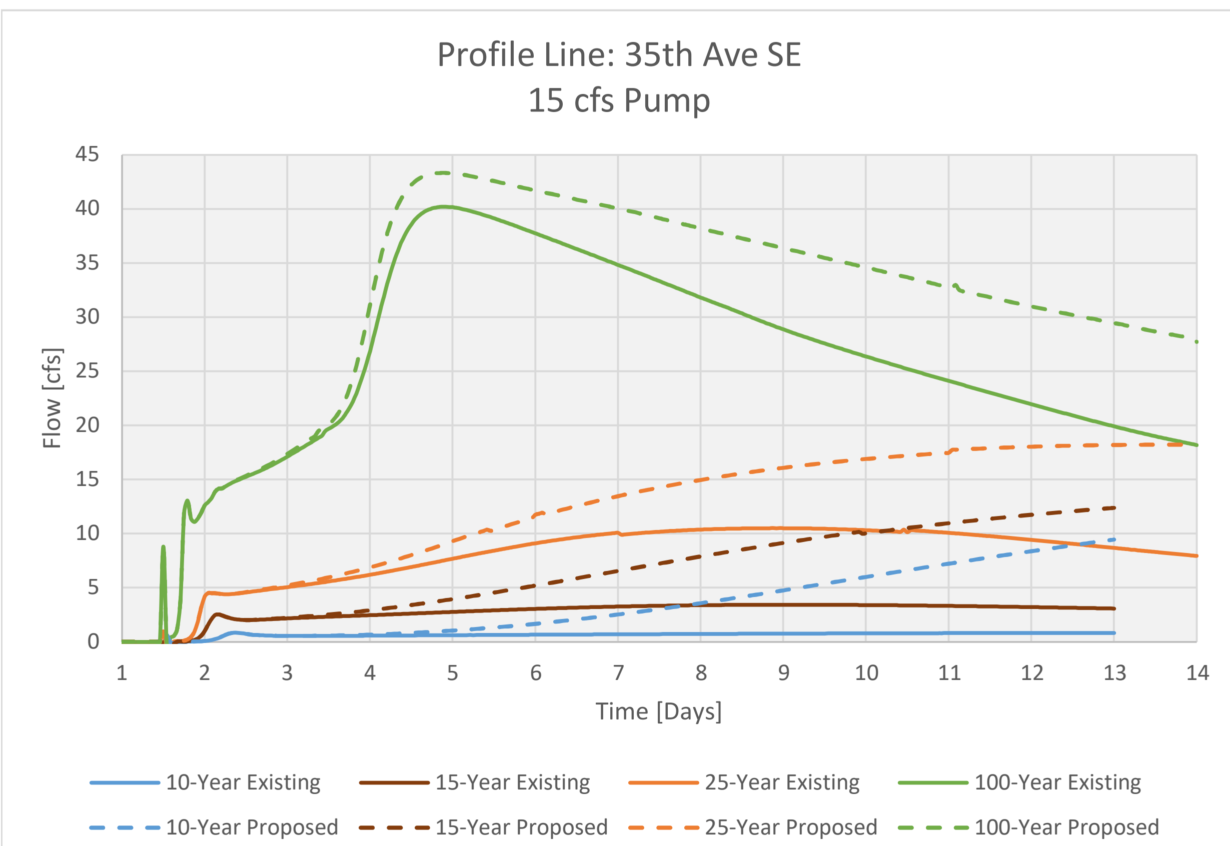
Flow [cfs]
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

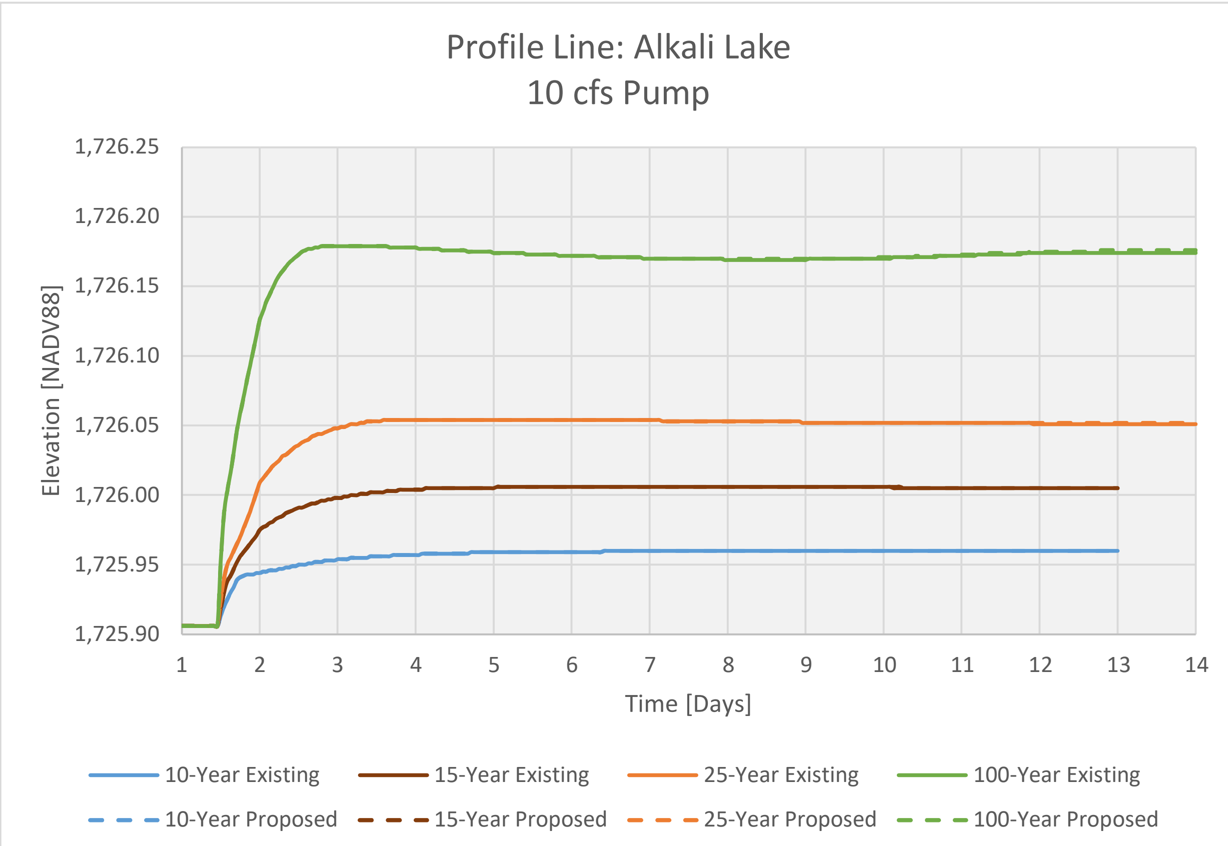

Profile Line: I-94
15 cfs Pump
Flow [cfs]
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


Profile Line: 35th Ave SE
10 cfs Pump
35th Ave SE Overtops at 1728.6
ND stream crossing standards
allowable headwater is 1730.22
Elevation [NADV88]
1,729.0
1,728.5
1,728.0
1,727.5
1,727.0
1,726.5
1,726.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


Profile Line: 35th Ave SE
15 cfs Pump
35th Ave SE Overtops at 1728.6
ND stream crossing standards
allowable headwater is 1730.22
Elevation [NADV88]
1,729.0
1,728.5
1,728.0
1,727.5
1,727.0
1,726.5
1,726.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


Profile Line: 35th Ave SE
10 cfs Pump
Flow [cfs]
Time [Days]
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


Profile Line: 35th Ave SE
15 cfs Pump
Flow [cfs]
Time [Days]
45
40
35
30
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed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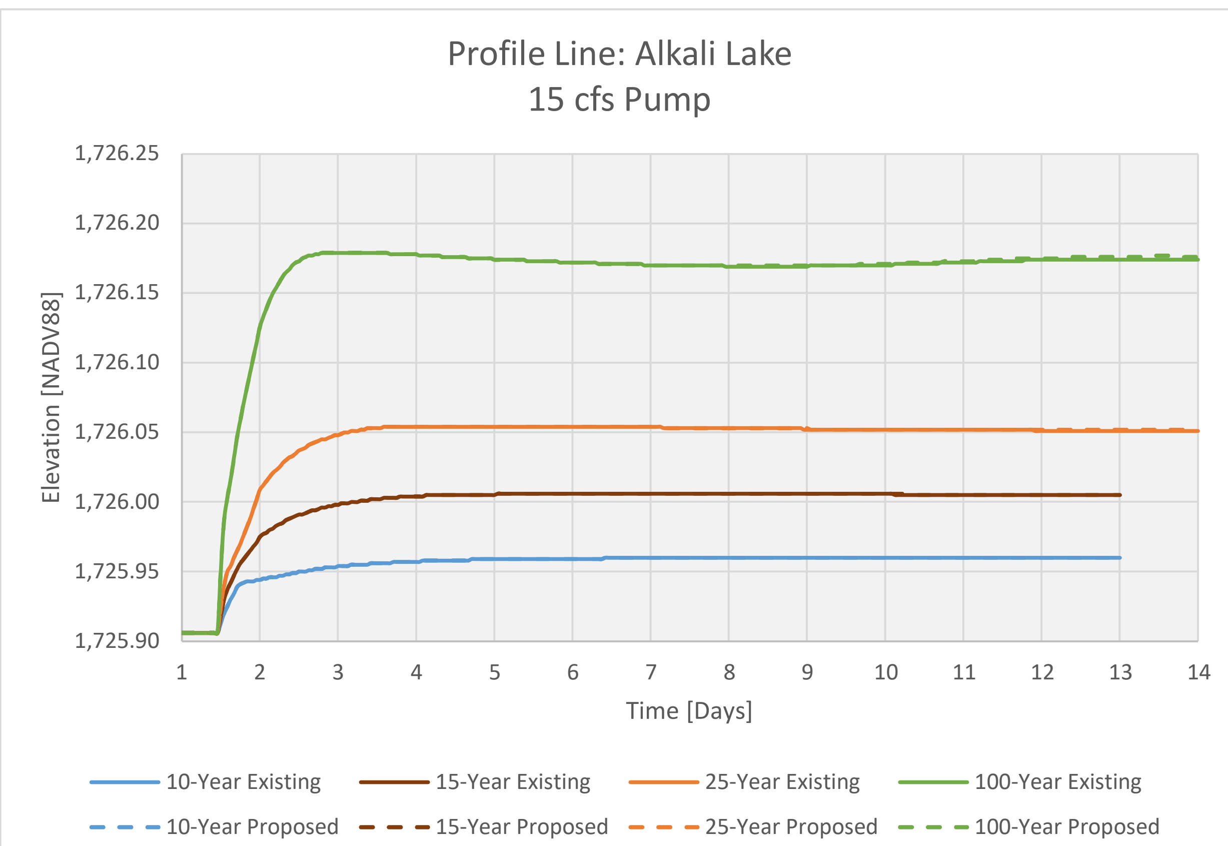
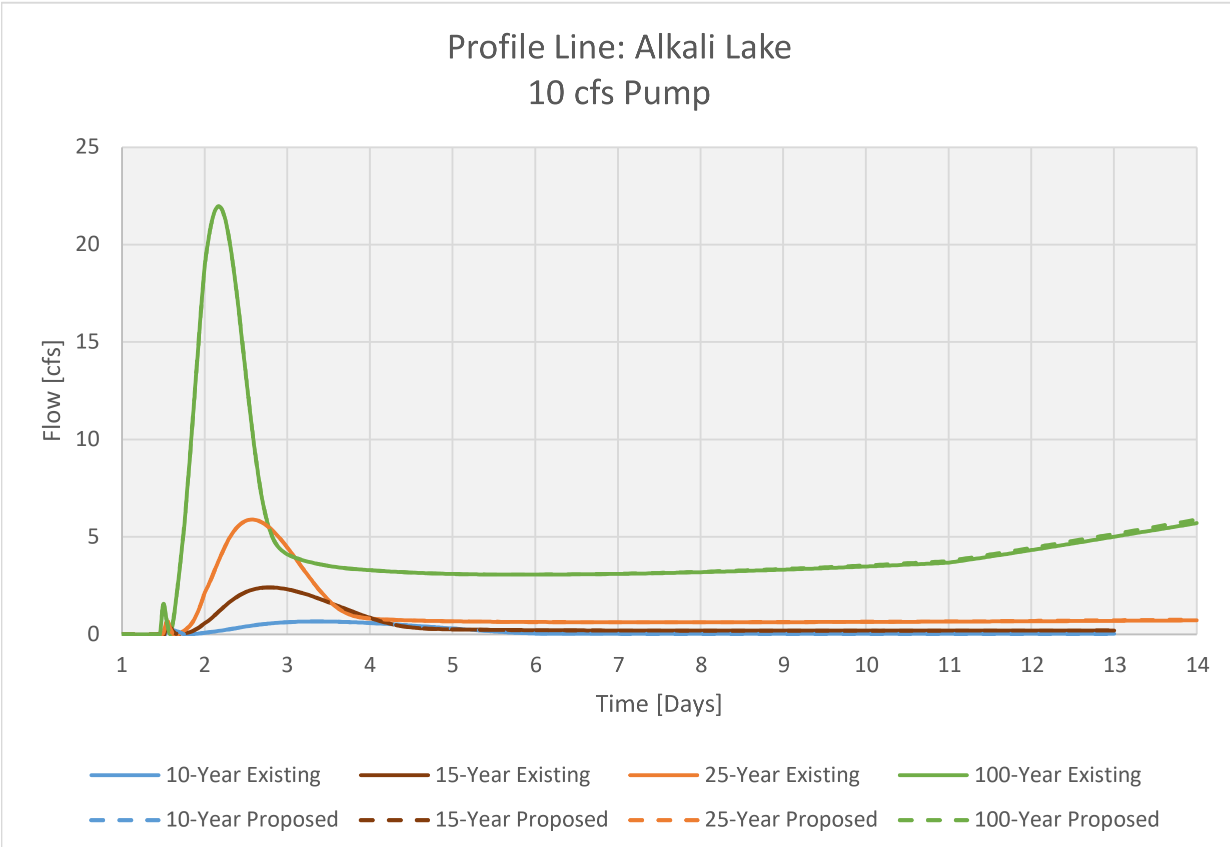
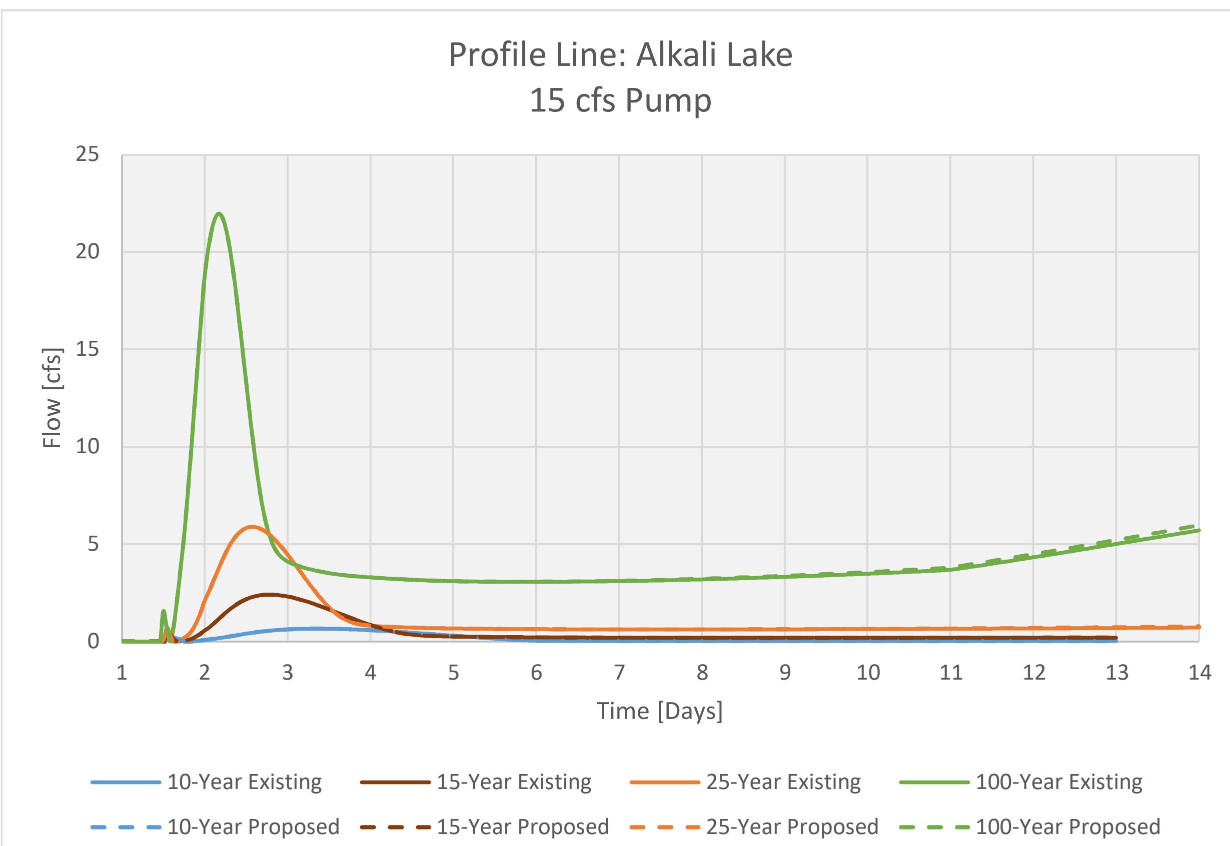
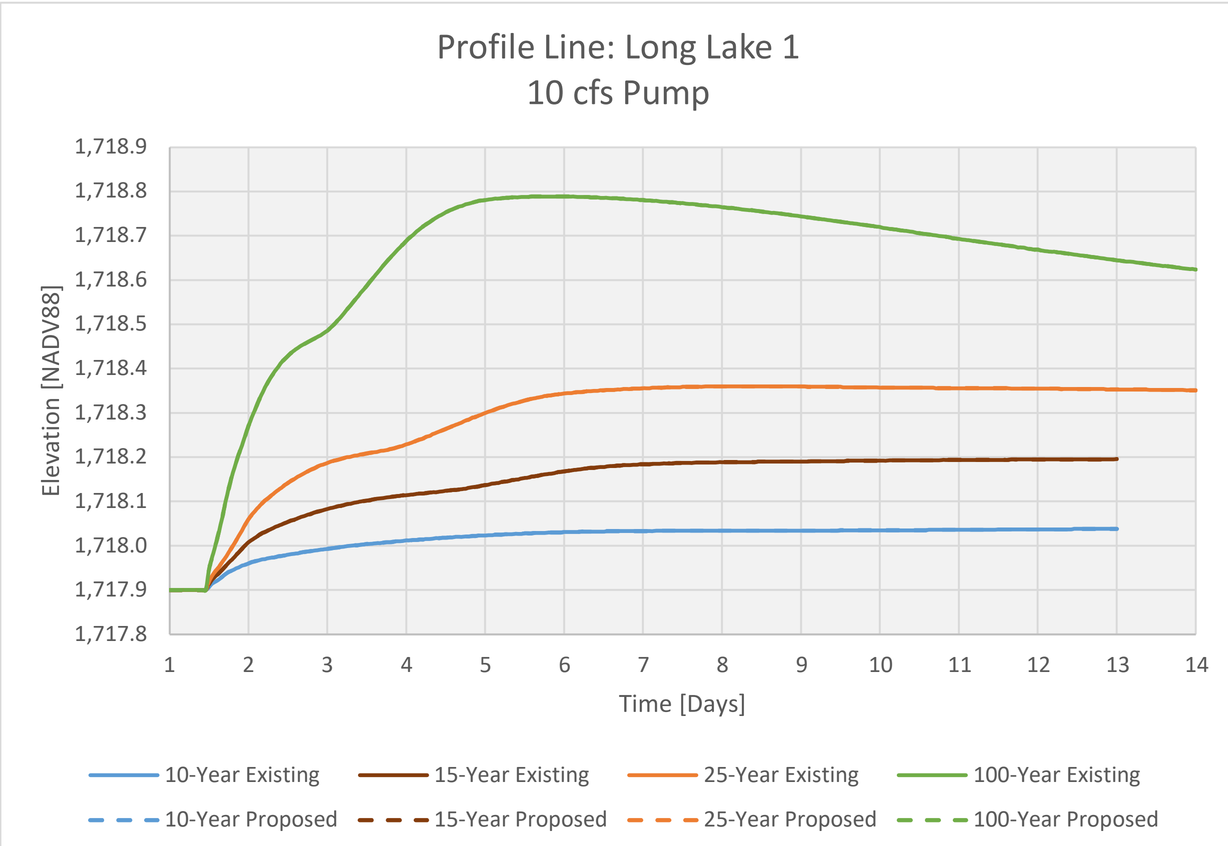
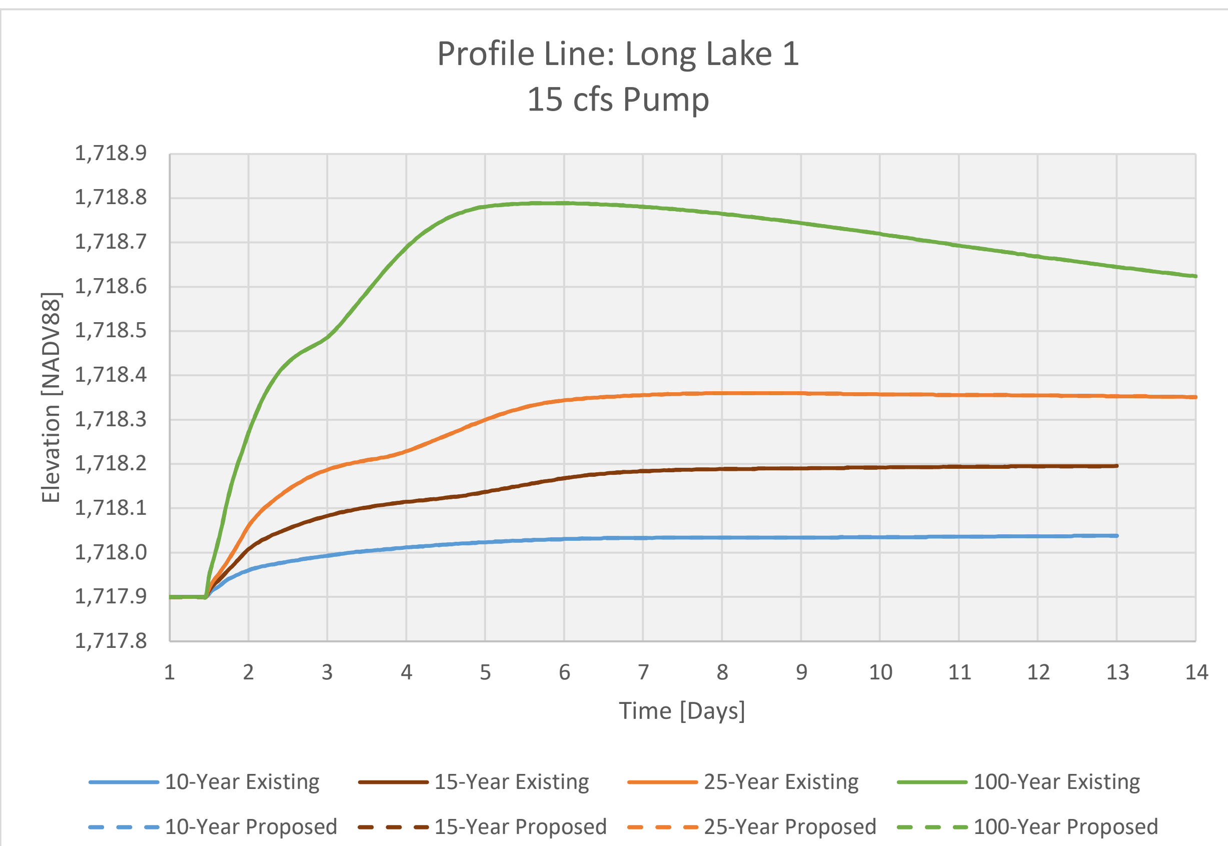
10 cfs Pump
Elevation [NADV88]
1,726.25
1,726.20
1,726.15
1,726.10
1,726.05
1,726.00
1,725.95
1,725.90
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

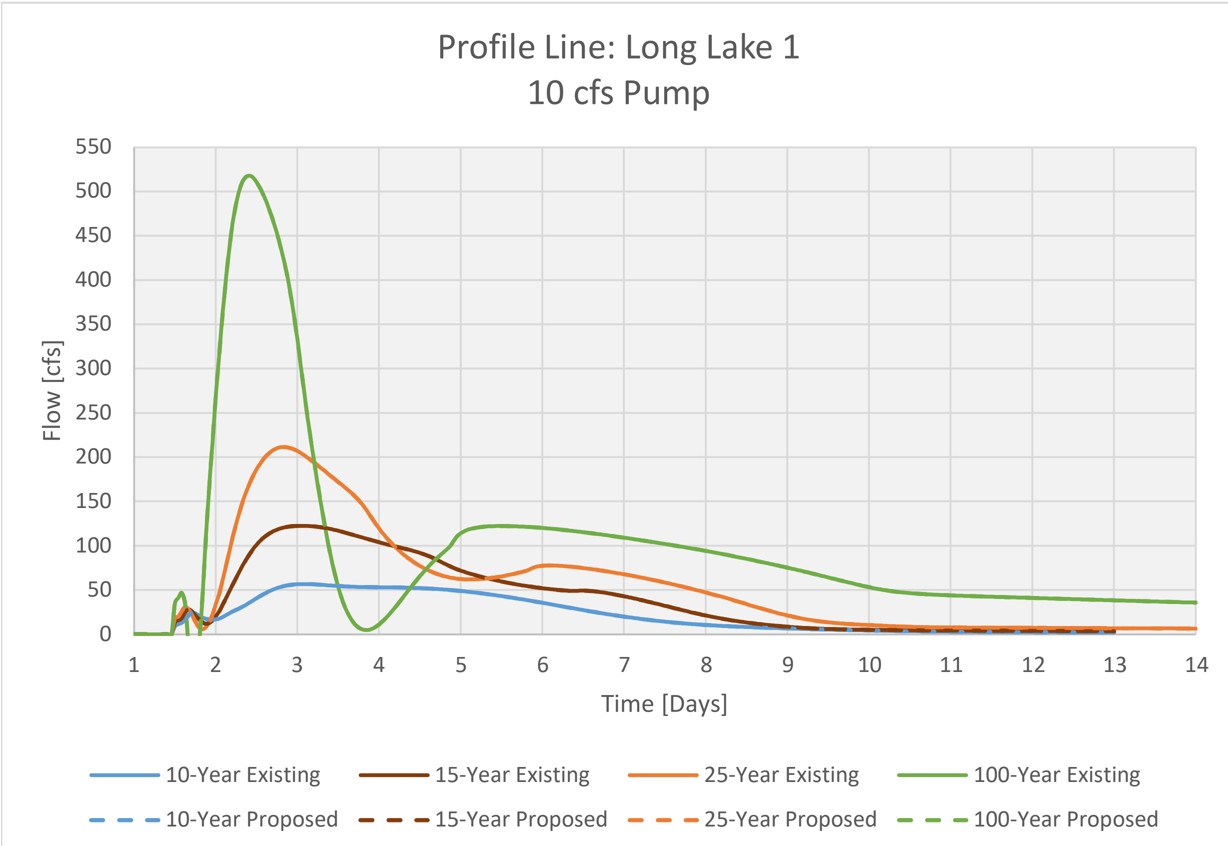

Profile Line: Alkali Lake
15 cfs Pump
Elevation [NADV88]
1,726.25
1,726.20
1,726.15
1,726.10
1,726.05
1,726.00
1,725.95
1,725.90
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

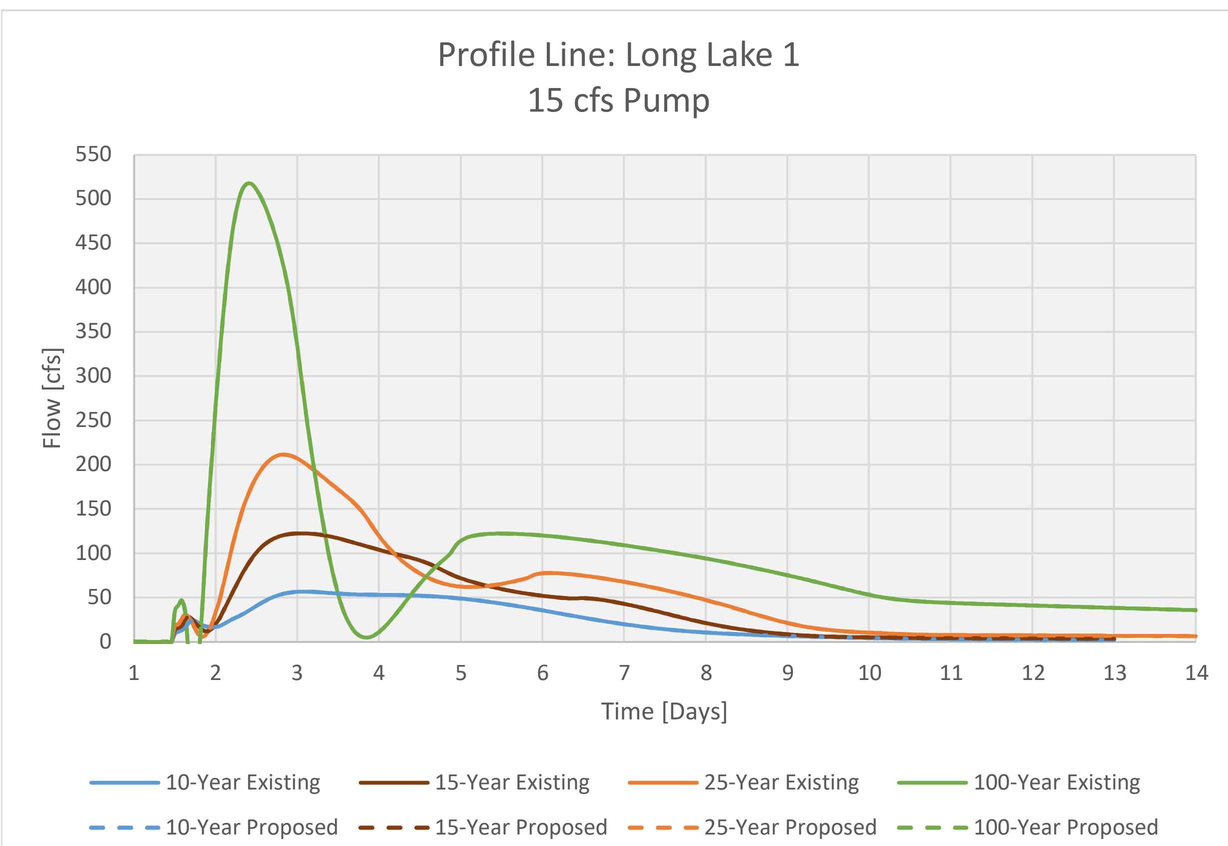

Profile Line: Alkali Lake
10 cfs Pump
Flow [cfs]
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

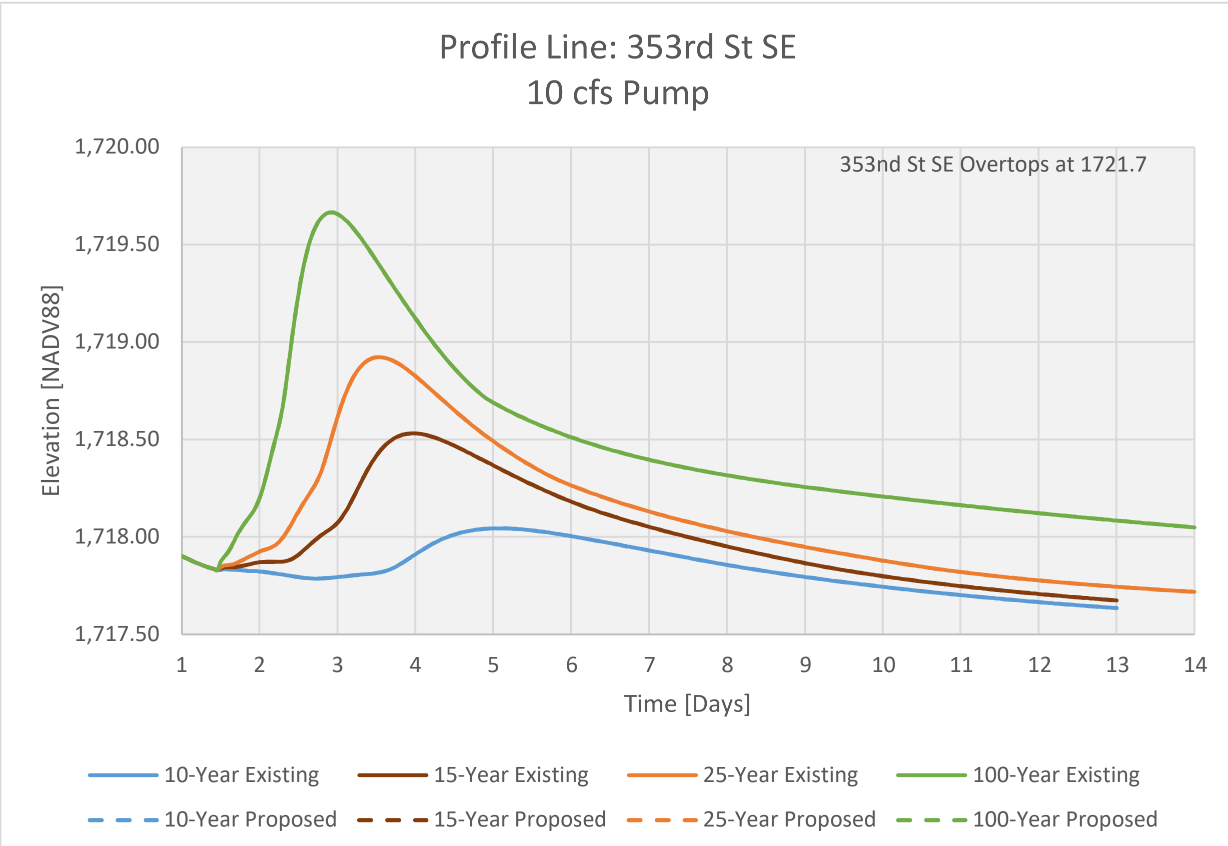

Profile Line: Alkali Lake
15 cfs Pump
Flow [cfs]
25
20
15
10
5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

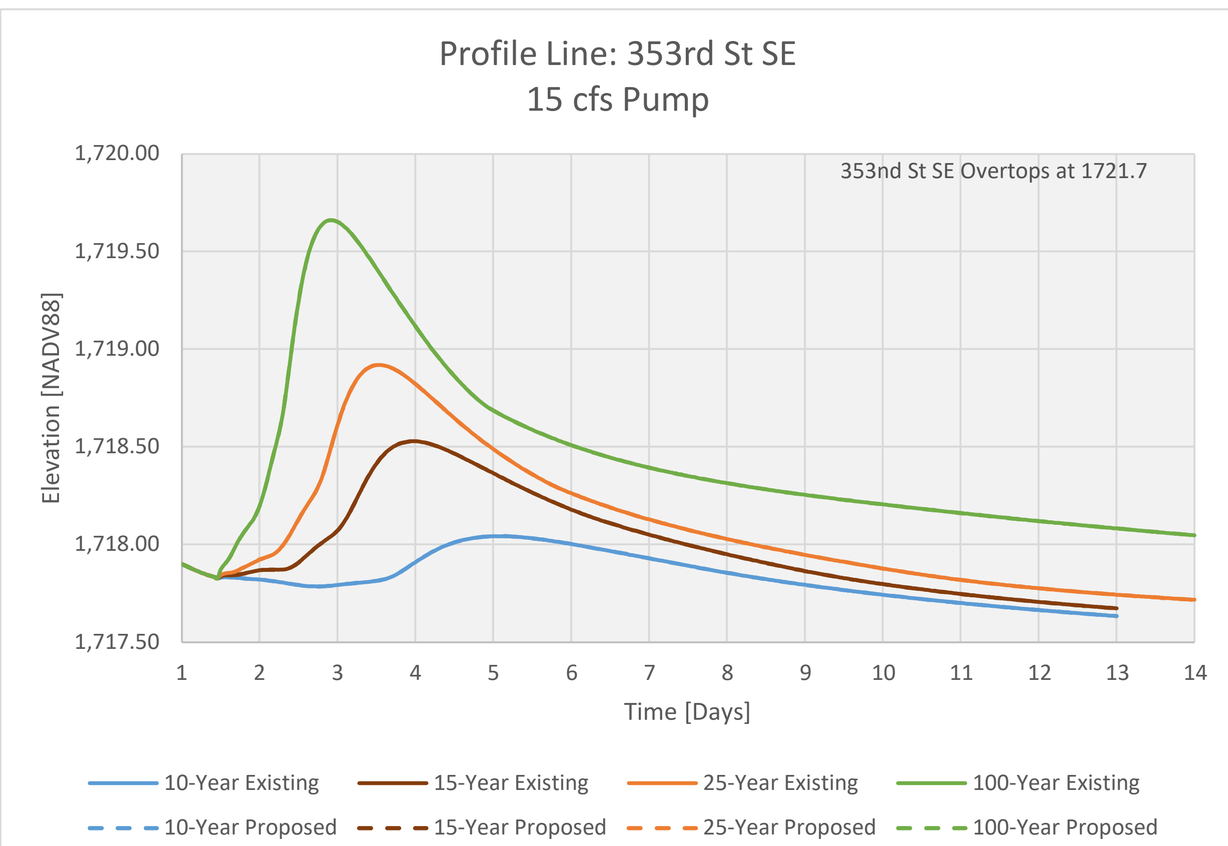

Profile Line: Long Lake 1
10 cfs Pump
1,718.9
1,718.8
1,718.7
1,718.6
1,718.5
1,718.4
1,718.3
1,718.2
1,718.1
1,718.0
1,717.9
1,717.8
Elevation [NADV88]
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

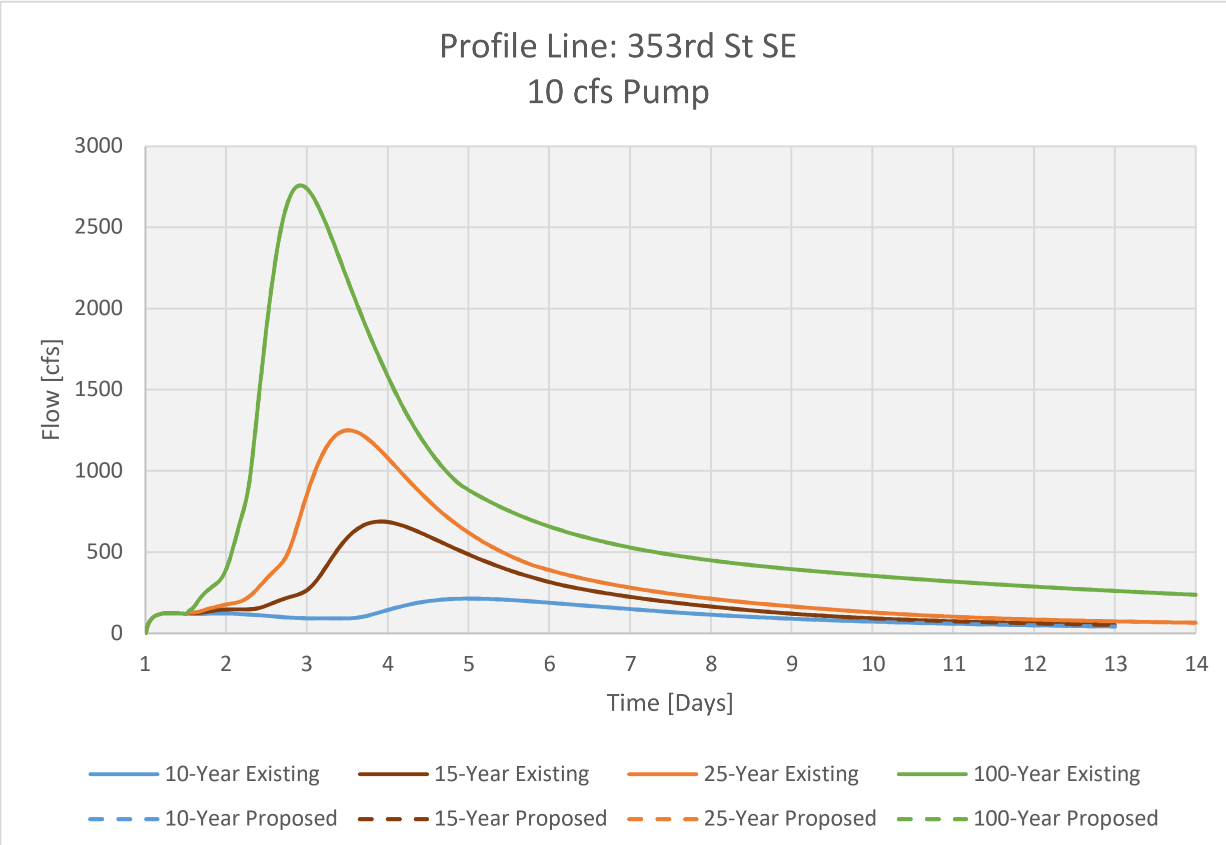

Profile Line: Long Lake 1
15 cfs Pump
1,718.9
1,718.8
1,718.7
1,718.6
1,718.5
1,718.4
1,718.3
1,718.2
1,718.1
1,718.0
1,717.9
1,717.8
Elevation [NADV88]
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

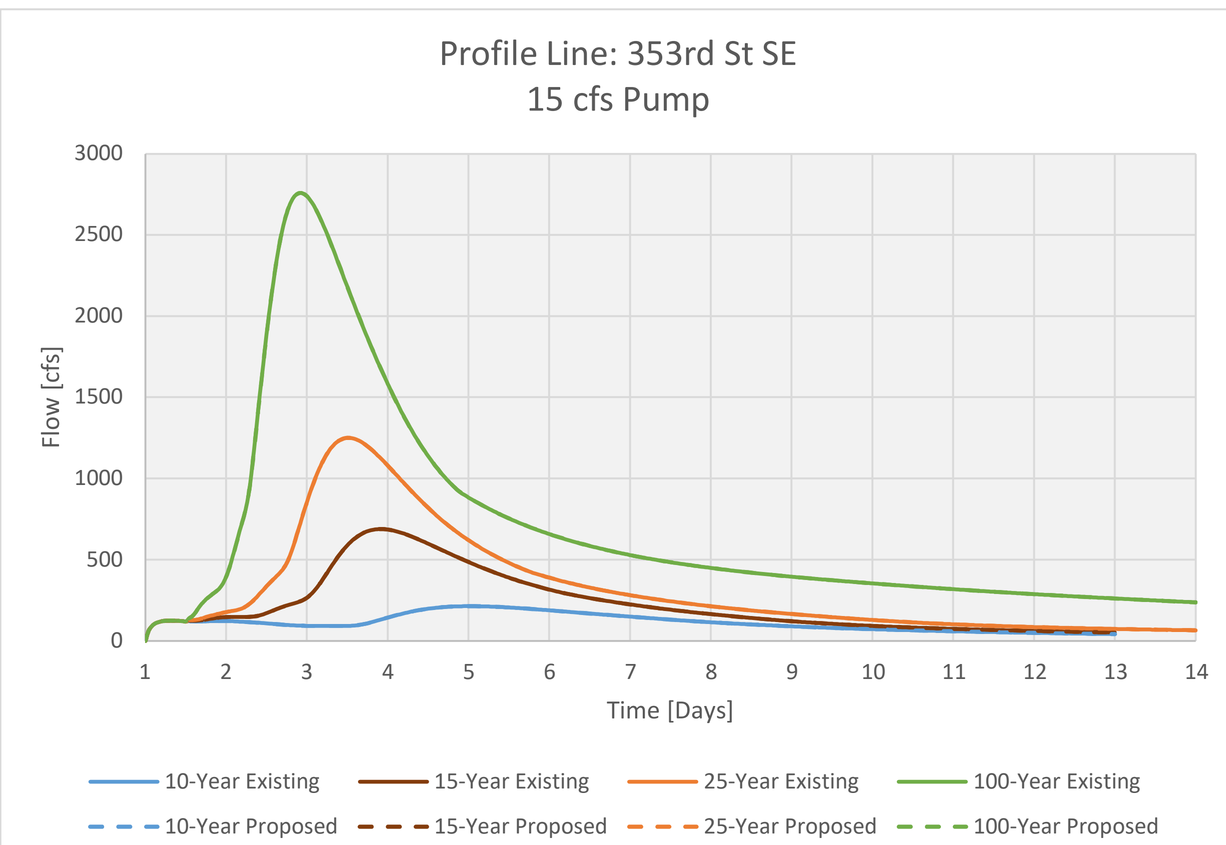

Profile Line: Long Lake 1
10 cfs Pump
Flow [cfs]
550
500
450
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

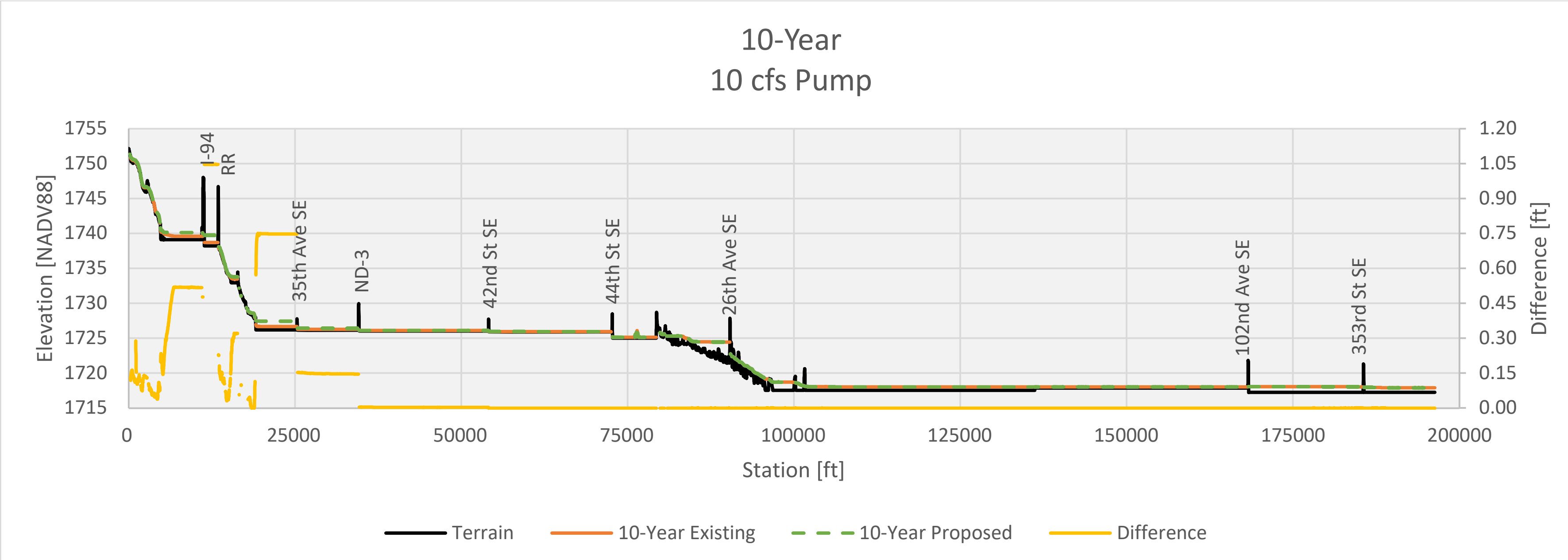

Profile Line: Long Lake 1
15 cfs Pump
Flow [cfs]
550
500
450
400
350
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

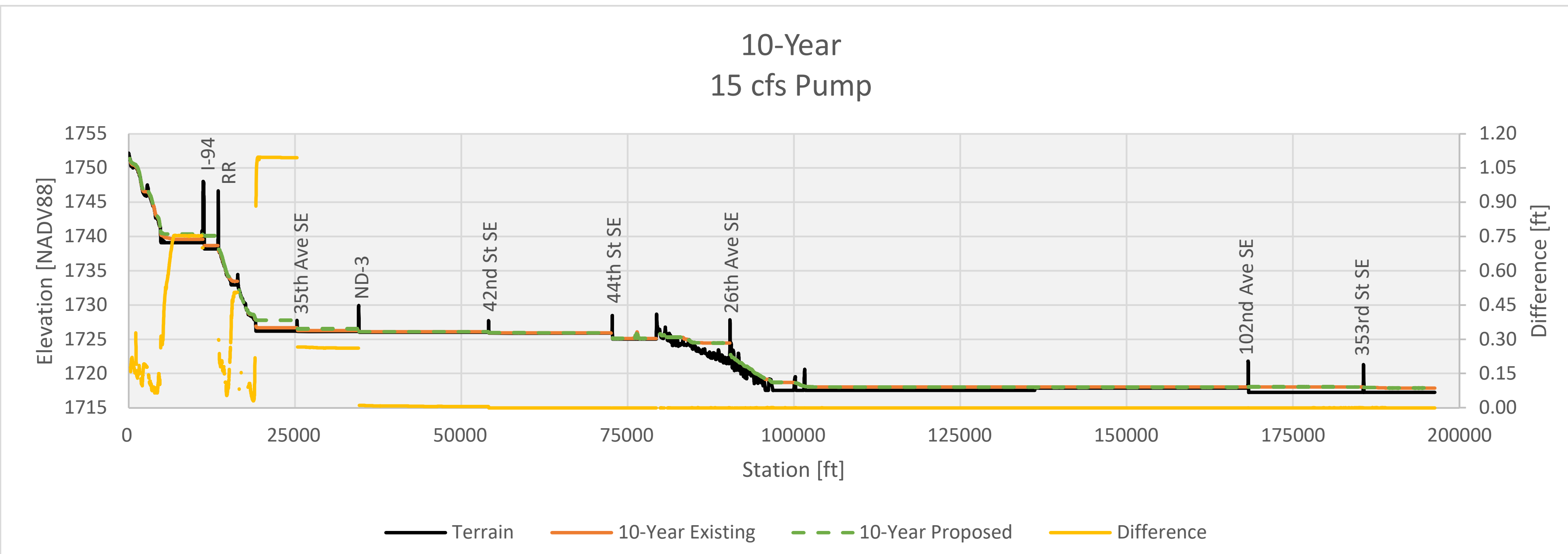

Profile Line: 353rd St SE
10 cfs Pump
353nd St SE Overtops at 1721.7
1,720.00
1,719.50
1,719.00
1,718.50
1,718.00
1,717.50
Elevation [NADV88]
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed

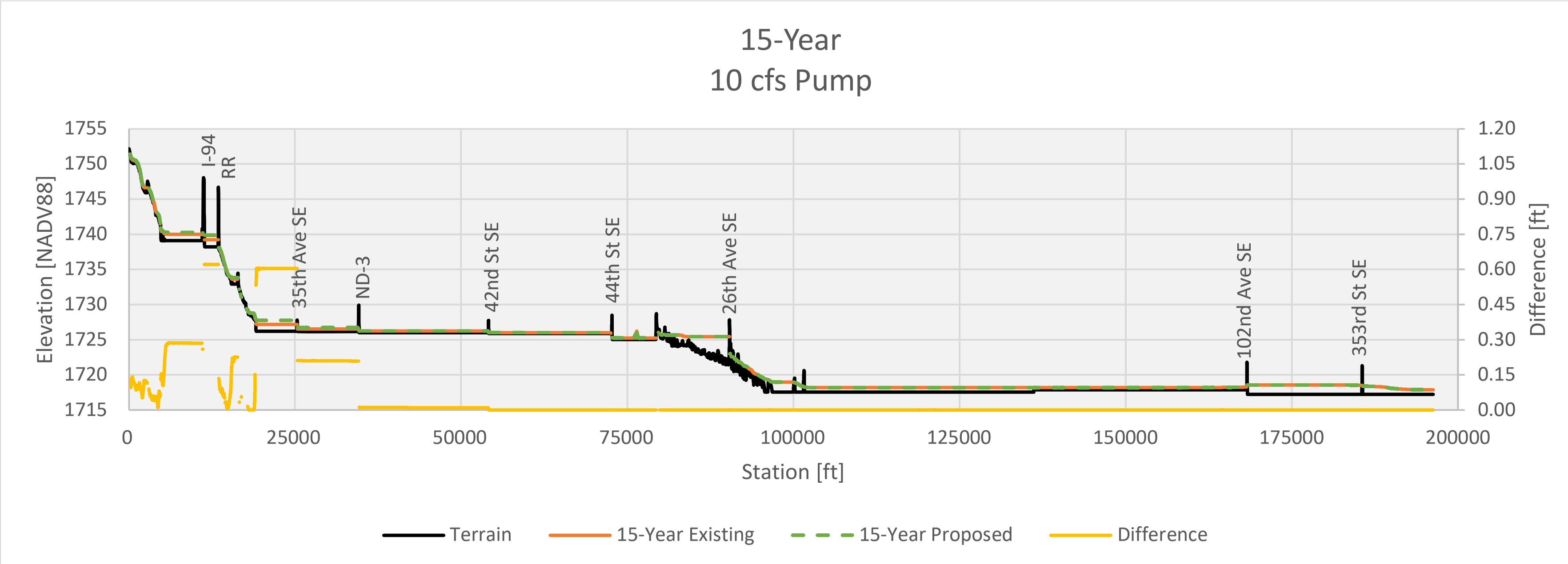

Profile Line: 353rd St SE
15 cfs Pump
353nd St SE Overtops at 1721.7
1,720.00
1,719.50
1,719.00
1,718.50
1,718.00
1,717.50
Elevation [NADV88]
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


Profile Line: 353rd St SE
10 cfs Pump
Flow [cfs]
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


Profile Line: 353rd St SE
15 cfs Pump
Flow [cfs]
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Time [Days]
10-Year Existing
15-Year Existing
25-Year Existing
100-Year Existing
10-Year Proposed
15-Year Proposed
25-Year Proposed
100-Year Proposed


10-Year
10 cfs Pump
Elevation [NADV88]
Difference [ft]
1755
1750
1745
1740
1735
1730
1725
1720
1715
1.20
1.05
0.90
0.75
0.60
0.45
0.30
0.15
0.00
I-94
RR
35th Ave SE
ND-3
42nd St SE
44th St SE
26th Ave SE
102nd Ave SE
353rd St SE
0
25000
50000
75000
100000
125000
150000
175000
200000
Station [ft]
Terrain
10-Year Existing
10-Year Proposed
Difference


10-Year
15 cfs Pump
Elevation [NADV88]
Difference [ft]
1755
1750
1745
1740
1735
1730
1725
1720
1715
1.20
1.05
0.90
0.75
0.60
0.45
0.30
0.15
0.00
I-94
RR
35th Ave SE
ND-3
42nd St SE
44th St SE
26th Ave SE
102nd Ave SE
353rd St SE
0
25000
50000
75000
100000
125000
150000
175000
200000
Station [ft]
Terrain
10-Year Existing
10-Year Proposed
Difference


15-Year
10 cfs Pump
Elevation [NADV88]
1755
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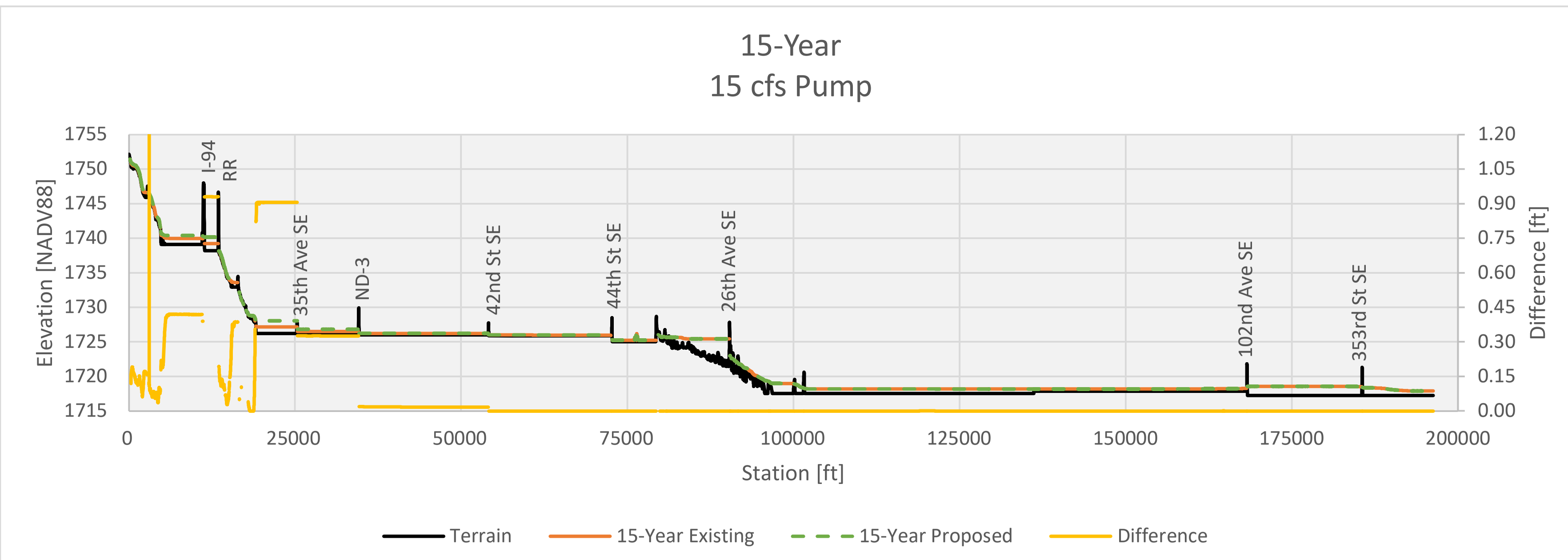
1745
1740
1735
1730
1725
1720
1715
Difference [ft]
1.20
1.05
0.90
0.75
0.60
0.45
0.30
0.15
0.00
I-94
RR
35th Ave SE
ND-3
42nd St SE
44th St SE
26th Ave SE
102nd Ave SE
353rd St SE
0
25000
50000
75000
100000
125000
150000
175000
200000
Station [ft]
Terrain
15-Year Existing
15-Year Proposed
Difference


15-Year
15 cfs Pump
Elevation [NADV88]
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Difference [ft]
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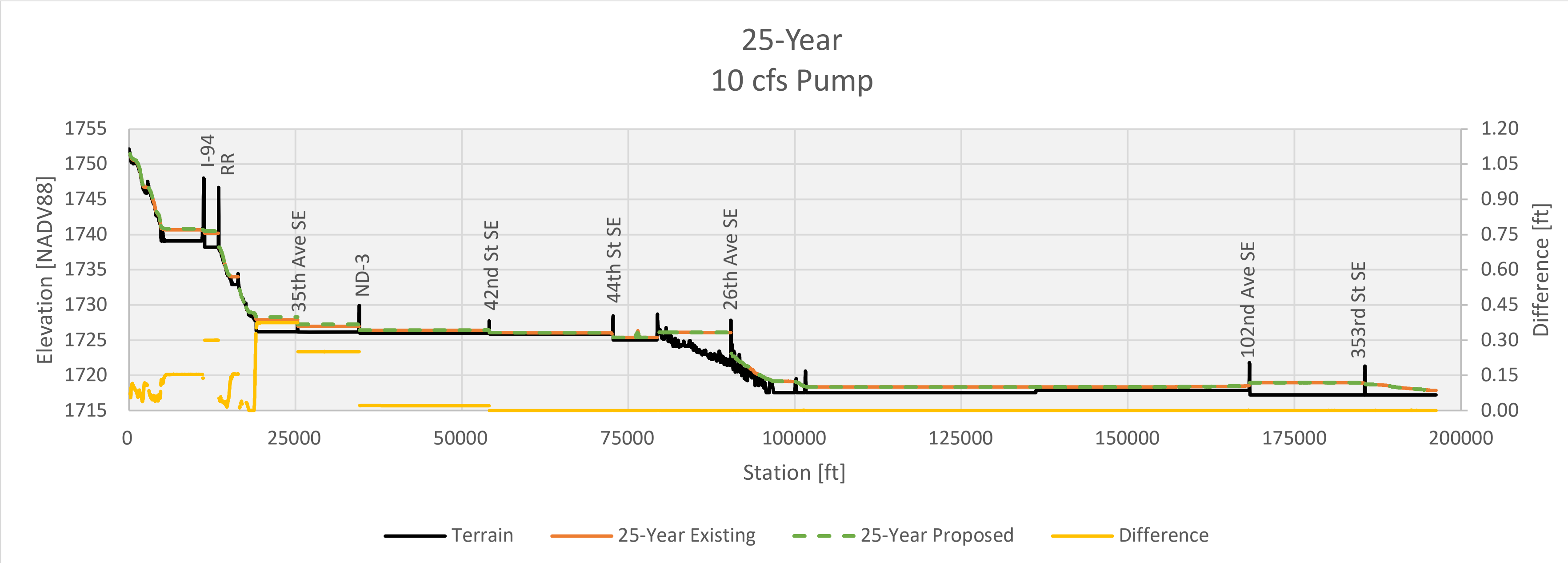
Station [ft]
Terrain
15-Year Existing
15-Year Proposed
Difference


25-Year
10 cfs Pump
Elevation [NADV88]
Difference [ft]
Station [ft]
I-94
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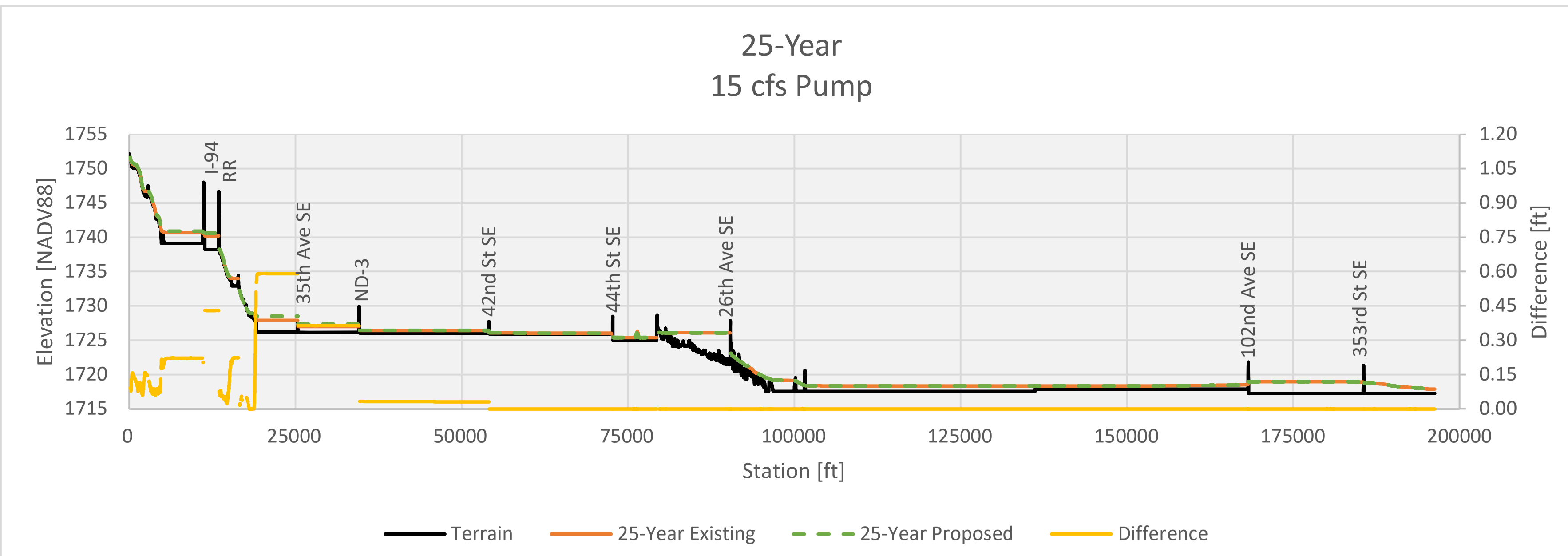
35th Ave SE
ND-3
42nd St SE
44th St SE
26th Ave SE
102nd Ave SE
353rd St SE
Terrain
25-Year Existing
25-Year Proposed
Difference


25-Year
15 cfs Pump
Elevation [NADV88]
Difference [ft]
Station [ft]
I-94
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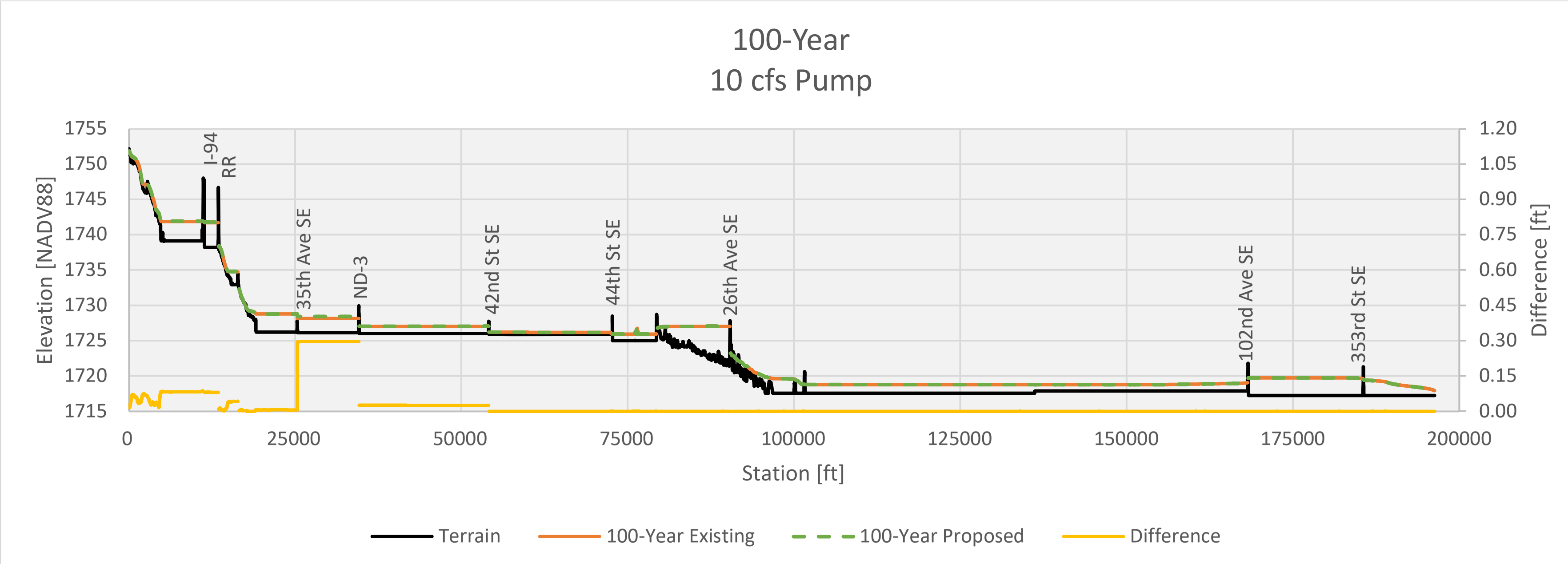
35th Ave SE
ND-3
42nd St SE
44th St SE
26th Ave SE
102nd Ave SE
353rd St SE
Terrain
25-Year Existing
25-Year Proposed
Difference


100-Year
10 cfs Pump
Elevation [NADV88]
Difference [ft]
Station [ft]
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Terrain
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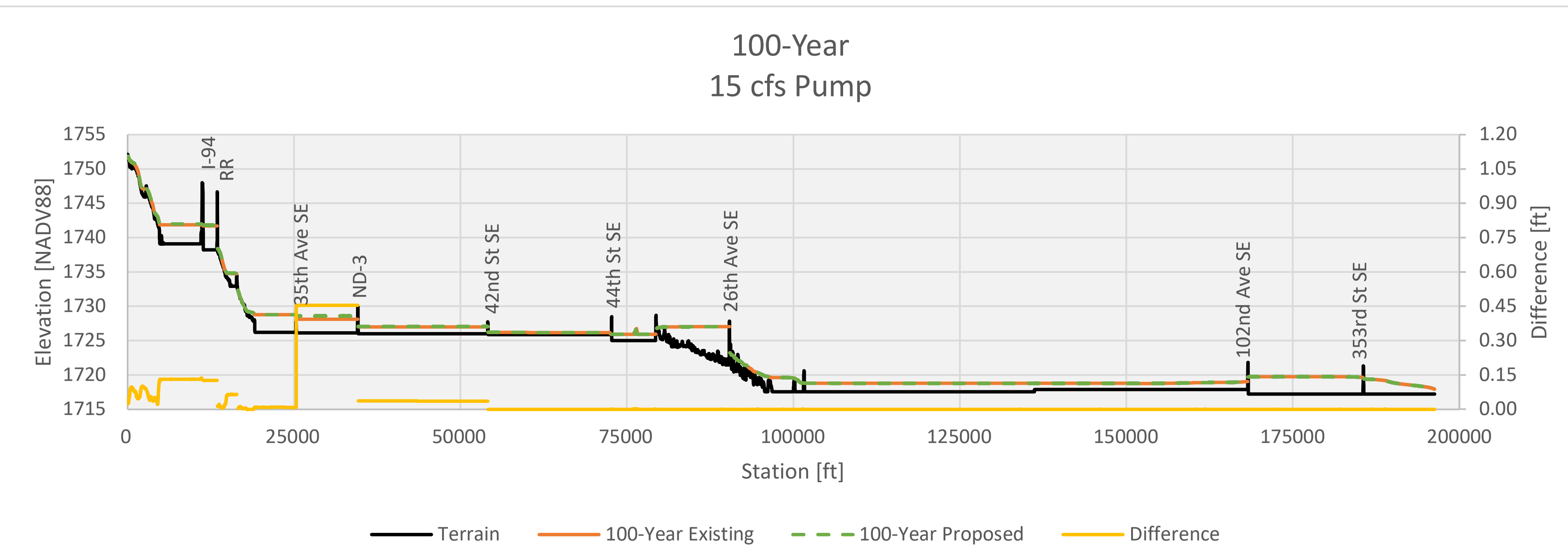
100-Year Proposed
Difference


100-Year
15 cfs Pump
Elevation [NADV88]
Difference [ft]
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Terrain
100-Year Existing
100-Year Proposed
Difference