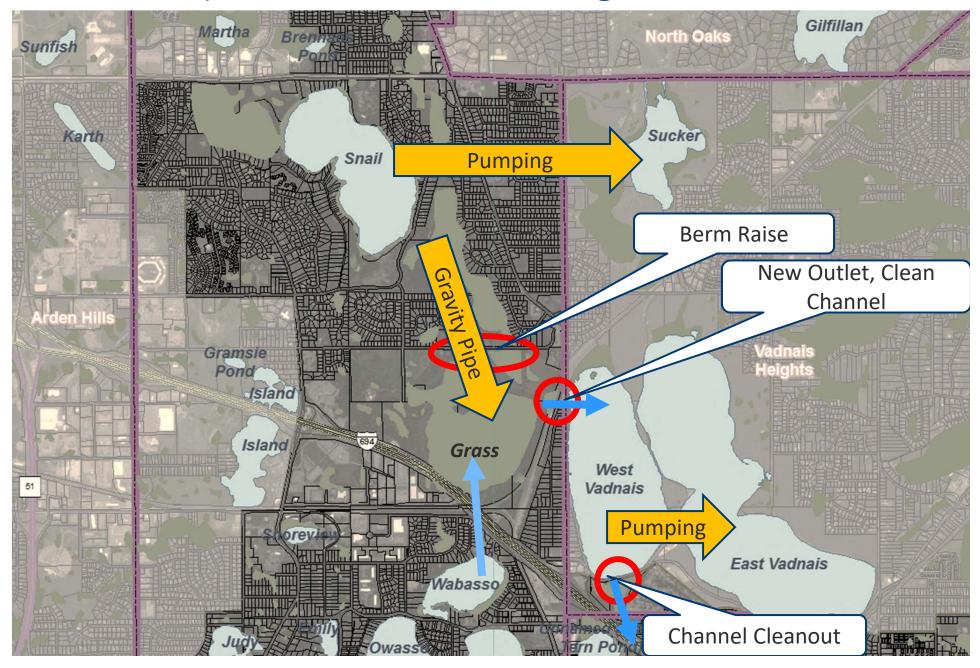
Snail Lake Overflow/Grass Lake Optimization Study Phase II(b)

West Vadnais Lake to East Vadnais Lake Discharge Study



What option(s) will best manage lake levels?



West Vadnais to East Vadnais Lake Pumping Evaluation

One option among several

	Alternative Responses to Mitigating Flood Risk	Benefits
Study complete	Raise Berm and Trail along Gramsie Road	Lessens risk of Grass overflows and increase flood storage
/	Lower Grass Lake Outlet, cleanout flow path	Optimize Flow to West Vadnais and increase flood storage
—	Cleanout channel to West Vadnais Outlet 15-Inch at 694	Optimize Flow Capacity out of and storage in West Vadnais
In progress	Snail Lake to Grass Lake 15" Gravity Pipe and Lower West Vadnais 15" Outlet 881.8 to 881.0	More flood storage, provide outflow
Study Complete	Pump Snail Lake Water to Sucker Lake	More flood storage, active management of high lake levels
In -progress	Pump West Vadnais Water to East Vadnais	More flood storage
In -progress	Emergency Flood Response Plan	Protect homes & infrastructure

Goals of Study

- Lower the flood level in Grass Lake
- Reduce the draw down time in Grass Lake

Secondary benefit

"Make room" for Snail Lake discharge to better manage its flood levels



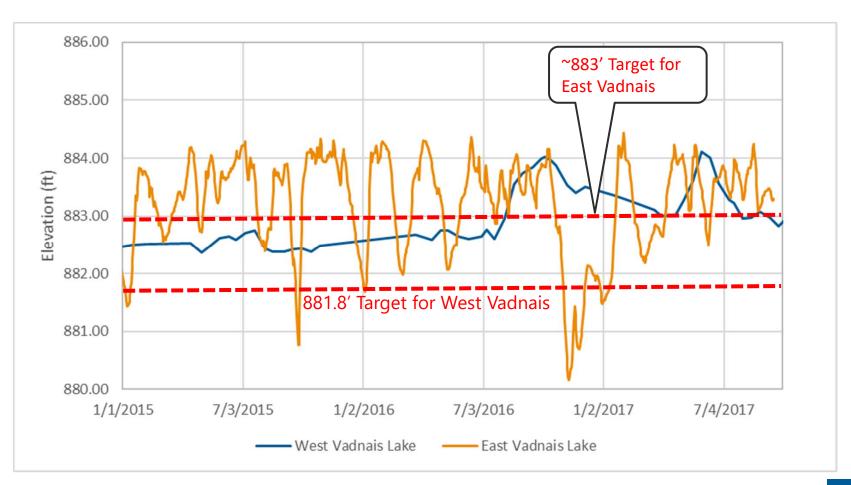
- Consider discharging to East Vadnais Lake
 - How do existing conditions compare?
 - How will we discharge (i.e. by gravity or pumping)
 - How much water do we need to discharge?
 - What permitting concerns?
 - Water quality considerations
 - Invasive Species
 - Other?



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West Vadnais Lake to East Vadnais Lake How do existing lake level conditions compare?







West Vadnais Lake to East Vadnais Lake Pumping Evaluation

Critical Event 100-yr, 96-hour

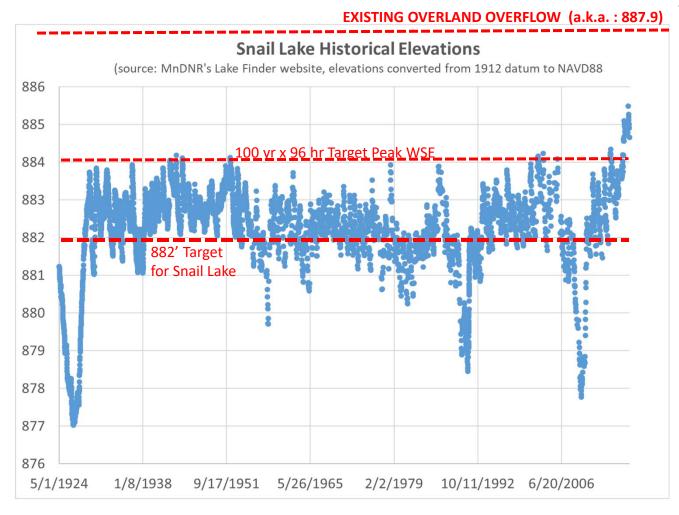


Table 1 – Summary of 2017 Survey of Low Habitable Structures at Snail Lake

Snail Lake Habitable Structure	Unofficial 2017 Survey of Low Elevation at Habitable Structure (NAVD88)			
4322 Lake Point	893.65			
668 Highway 96	891.32			
4154 Reiland Lane	889.66			
4324 Lake Point	889.26			
4320 Lake Point	888.80			
4380 Reiland Lane	886.01			



Update with new figure Tyler Olsen, 3/6/2018 **TAO22**

- Consider discharging to East Vadnais Lake
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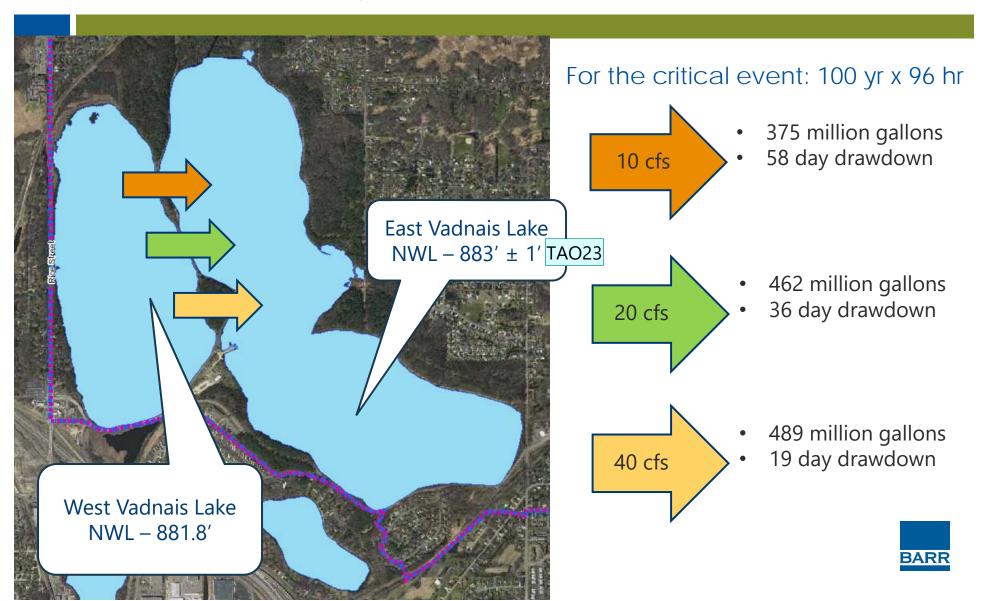
Vadnais Lake Pumping Evaluation Model estimated Grass Lake Drawdown

Summary of Grass Lake Drawdown Time for Pumping Alternatives 100-year X 96-hour Critical Event

Alternative	No Pumping	Pumping and 15" West Vadnais Lake Outlet Pipe Capacity 10 cfs	Pumping + 20 cfs	Pumping+ 40 cfs
Estimated No. of Grass Lake Drawdown Days	137	59	63	72



West Vadnais Lake and East Vadnais Lake System Pumping and Related drawdown times



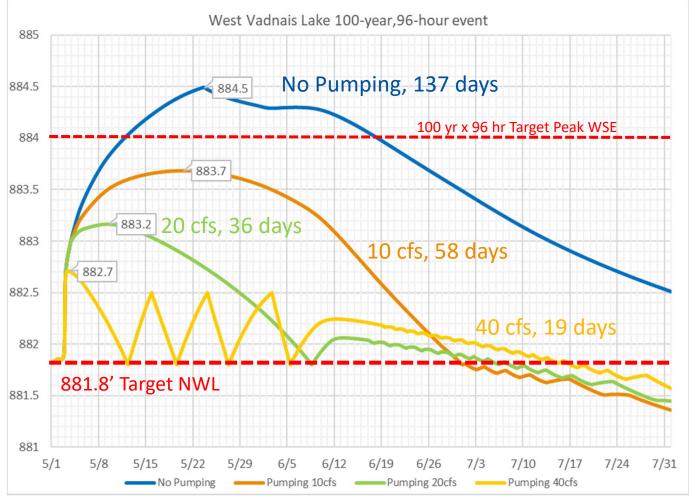
TAO23 Based on historical lake level data, we do not have a NWL

Tyler Olsen, 3/6/2018

West Vadnais Lake to East Vadnais Lake Pumping Evaluation

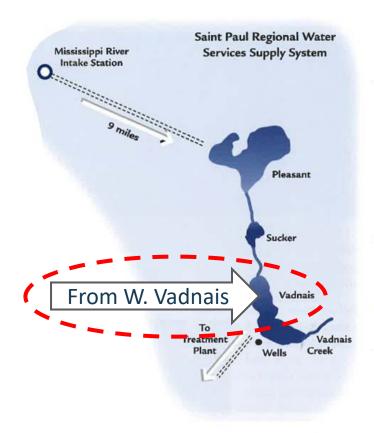
Model estimated West Vadnais Lake Drawdown

Note: the WSE of Grass Lake and West Vadnais Lake equalize





Can we pump West Vadnais Lake water to Saint Paul Regional Water Services (SPRWS) ?





38 million gallons (SPRWS avg. daily use)

375 million gallons (10 cfs critical event drawdown, 58 days)

462 million gallons (20 cfs critical event drawdown, 36 days)

489 million gallons (40 cfs critical event drawdown, 19 days)

Figure 3 - Overview: SPRWS Supply System and Service Area

Image courtesy of Saint Paul Regional Water Services. The Saint Paul Regional Water System 2016 average annual water use was 14,603 million gallons with a maximum pumping capacity of 144 million gallons per day for an average 2016 daily water use of 38.2 million gallons (59 cfs).



- Consider discharging to East Vadnais Lake
 - How do existing conditions compare?
 - How will we discharge (i.e. by gravity or pumping)
 - How much water do we need to discharge?
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 - Other?



West Vadnais Lake to East Vadnais Lake Pumping Evaluation Permitting needs

Table 4: Permitting considerations

Approval entity	Permit/approval	Justification			
U.S. Army Corps of	Section 404 permit	Required for work activities below the ordinary high water			
Engineers (USACE)		level of waters/wetlands under agency jurisdiction			
U.S. Fish and Wildlife Section 7 (Endangered Species Act)		Required as part of the USACE's Section 404 permitting			
Service compliance		process			
Minnesota DNR	Work in public waters permit	Required for work activities below the OHWL of a			
	Water appropriations permit	designated public water			
		 Required for withdrawing more than 10,000 gallons of water per day or 1 million gallons per year; also required 			
		to appropriate or transport any amount of infested			
		water			
Minnesota Pollution	General stormwater permit for	Required for projects that result in more than 1 acre of			
Control Agency	construction	ground disturbance			
Minnesota Wetland	Project compliance	 Required for impacts to wetlands that are not under 			
Conservation Act		jurisdiction of the USACE or DNR.			
		Administered by the VLAWMO and RWMWD in their jurisdiction			
State Historic	Section 106 (National Historic	Required as part of the USACE's Section 404 permitting			
Preservation Office	Preservation Act) compliance	process			
City of Shoreview	Erosion/excavating/grading	Project activities are expected to require movement of			
(Snail Lake is in	permit	more than 10 cubic yards of soil and disturb an area of			
Shoreview)	Right-of-way excavation permit	more than 1,000 square feet			
	Floodplain management special	Construction would occur in a City of Shoreview right-			
	district compliance Shoreland management special	of-way Required for projects in floodplain overlay district			
	district compliance	Applied to all projects within 1.000 feet of a protected			
		water body			
City of Vadnais Heights	Excavation permit	Project activities are expected to require movement of			
(Sucker Lake is in	 Engineering and public works 	over 6 cubic yards of soil			
Vadnais Heights)	approval Utilities approval	 Engineering and Public Works departments typically provide input on significant projects 			
	Floodplain area approval	Project will require modifications to city utilities			
	Shoreland area approval	Required for projects that take place within designated			
		floodplain area			
		Required for all work within 1,000 feet of designated			
		shoreland area			
SPRWS (manages chain	Update source water protection plan	Minnesota Department of Health required to complete source water assessments for public water systems			
of Pleasant, Sucker, and	(SWPP)	SPRWS not required under Safe Drinking Water Act, but			
East Vadnais lakes)		proactive in developing SWPP			
		New source potentially being introduced from West to			
		East Vadnais lakes (West Vadnais Lake outside of			
		Vadnais Lake Source Water Protection Area)			

2 Cities

- Shoreview
- Vadnais Heights

3 Water Jurisdictions

- RWMWD
- VLAWMO
- SPRWS (Drinking Water)

Crossing Two State Aid Roadways

Wetlands at Pumping Inlet & Outlet

Invasives Species

East Vadnais (EWM, ZM)

MnDNR Appropriations

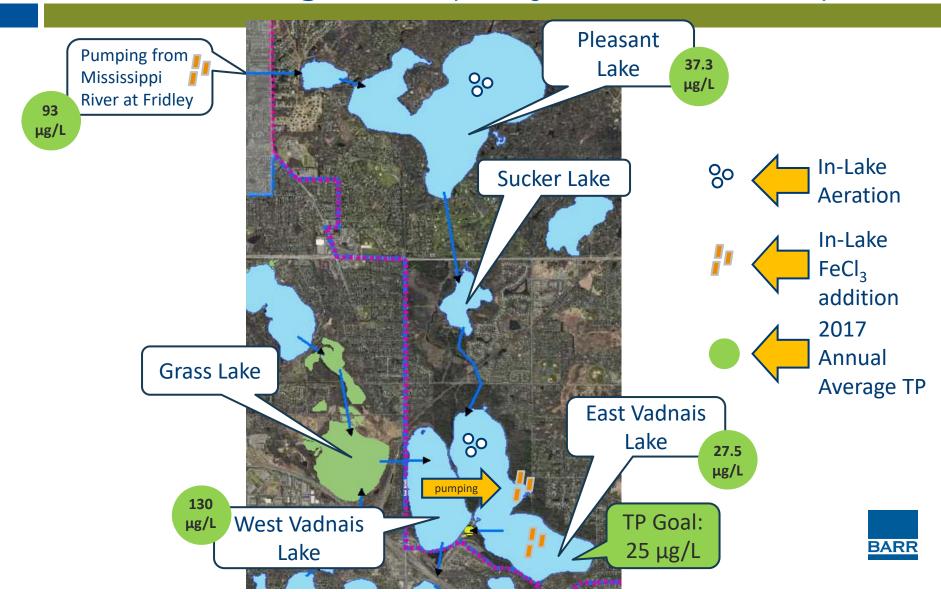


- Consider discharging to East Vadnais Lake
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 - How will we discharge (i.e. by gravity or pumping)
 - How much water do we need to discharge?
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 - Invasive Species
 - Other?



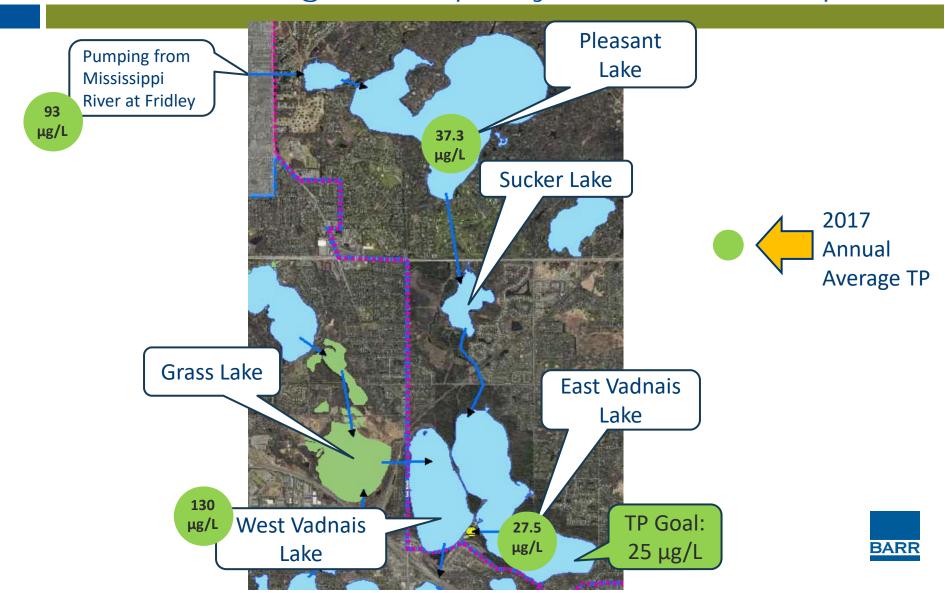
West Vadnais Lake to East Vadnais Lake Pumping Evaluation

How do existing water quality conditions compare?

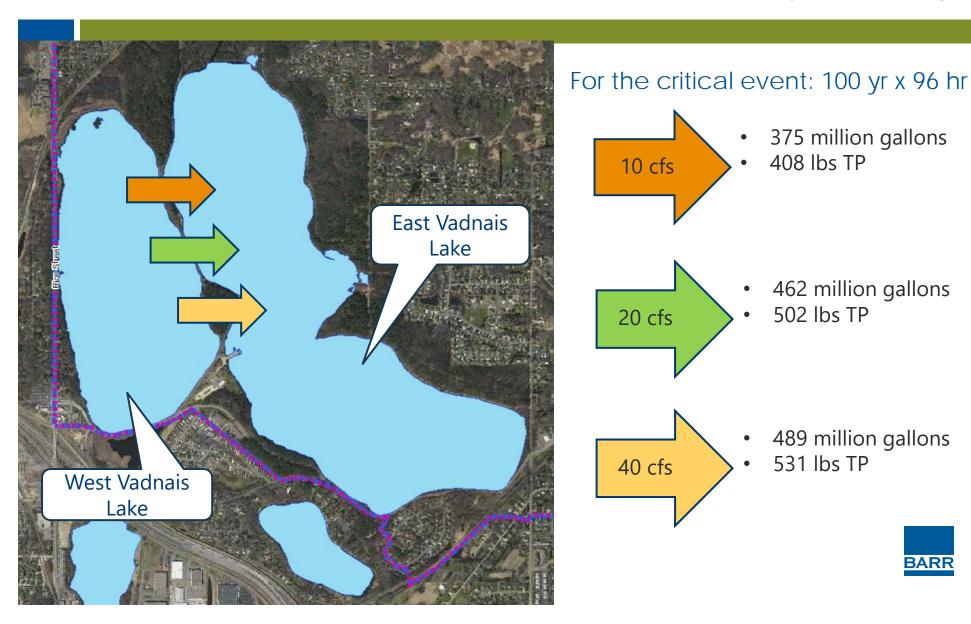


West Vadnais Lake to East Vadnais Lake Pumping Evaluation

How do existing water quality conditions compare?



West Vadnais Lake to East Vadnais Lake West and East Vadnais Lakes Water Quality Loading

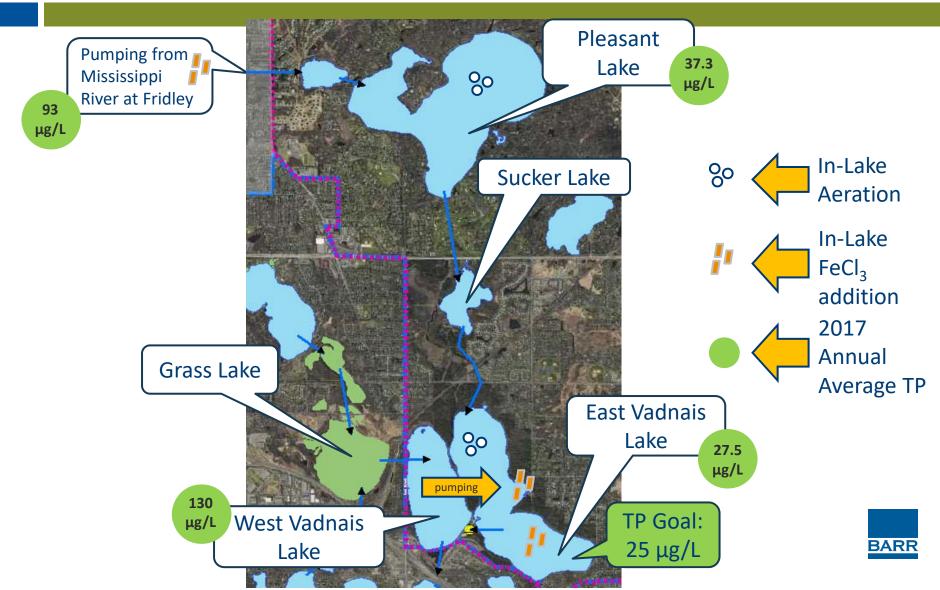


- Consider discharging to East Vadnais Lake
 - How do existing conditions compare?
 - How much water do we need to discharge?
 - How will we discharge and treat water (i.e. by gravity or pumping, chemical treatment)
 - What permitting concerns?
 - Water quality considerations
 - Invasive Species
 - Other?



West Vadnais Lake to East Vadnais Lake Pumping Evaluation

Existing SPRWS Chain of Lakes Treatment



West Vadnais Lake to East Vadnais Lake Pumping Evaluation Proposed Alternative Treatment Options

Alternative Treatment Option	Details	Estimated Construction Cost	Outstanding Considerations	
No treatment, pump West Vadnais to East Vadnais	· · ·		Seasonal variation may change loading	
West Vadnais in-lake chemical treatment	FeCl ₃ or aluminum addition to West Vadnais Lake	≥\$1-2 million + \$150,000 to \$500,000	West Vadnais lake characteristics (depth/pH) suitable for chemical treatment	
Passive treatment (filter) Permeable berm, wetland, or sand filter with enhanced media for P removal		N/A	Lake levels may not drive gravitational flow	
Chemical flocculant addition to West Vadnais flow to East Vadnais FeCl ₃ or aluminum addition to flow from West Vadnais Lake, floc settling in East Vadnais		≥\$1.5-2.5 million	Need land availability for pump and treatment station, settling in East Vadnais would not impact water quality	
Pump water from West Vadnais to upstream lake with direct chemical treatment Similar to previous option, but pump further upstream for maximized settling of flocs		≥\$2-4 million	Can upstream lakes handle additional floc settling, construction permitting and land availability	



Vadnais Lake Pumping Evaluation Model estimated Grass Lake Drawdown

Summary of Grass Lake Drawdown Time for Pumping Alternatives 100-year X 96-hour Critical Event

Alternative	No Pumping	Pumping and 15" West Vadnais Lake Outlet Pipe Capacity 10 cfs	Pumping + 20 cfs	Pumping+ 40 cfs
Estimated No. of Grass Lake Drawdown Days	137	59	63	72
Opinion of Project Planning Cost (O&M excluded)		\$3.9 million	\$6.3 million	\$12.6 million



May 2018 Present RWMWD with Comparative Assessment

Conceptual Alternative	Snail Lake Drawdown Time (Days)	No. of Permits	O&M	Capital Cost	Implementation Timeline	What Else
Emergency Flood Response Plan & Temporary Measures by City of Shoreview						
Snail Lake to Grass Lake 15" Gravity Pipe (1.2 cfs)			'	ted A	Iternatives on Timeling	s /
Snail Lake to Sucker Lake Pumping (1.2 cfs, 10 cfs, 20 cfs)		, Iu	nstruc	entati Nonth	Iternatives on Timeling s or More	
West Vadnais to East Vadnais Pumping - study is underway -			18 1			

The benefits, costs and feasibility issues associated will be evaluated against and compared to the other conceptual options

