

# Three lines of thought about Lower Shaker Lake dam

- 1) Downsizing the NEORSD design would meet local needs
- 2) Understanding the dam failure hazards and working towards a non-Class-I project
- 3) The lake and the 15 minute city

Ben Monreal  
Shaker Heights  
Professor of Physics, CWRU

My qualifications:

- a) Taught environmental fluid mechanics at UC Santa Barbara:  
Physics 120 "Physics of California"
- b) Professional experience with complex regulatory systems,  
civil & geotechnical engineering
- c) Live near and enjoy Lower Lake and adjacent parkland

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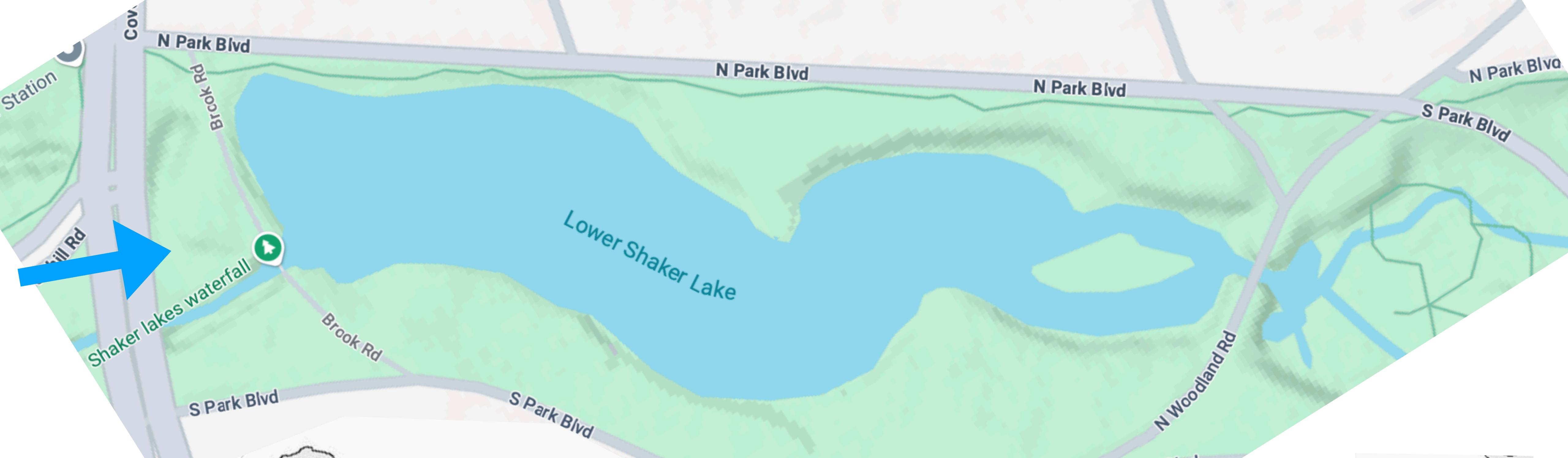
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# Understanding the 2024 NEORSD plan

- NEORSD was interested in the lake mainly because it retains stormwater for them.
- Their 2024 engineering plan was an attempt to repair the dam AT FULL HEIGHT to keep its stormwater-storage function.
- It turns out the full-height plan is expensive (\$43M)
- It turns out NEORSD can meet their Doan Valley stormwater needs without any Lower Lake storage.

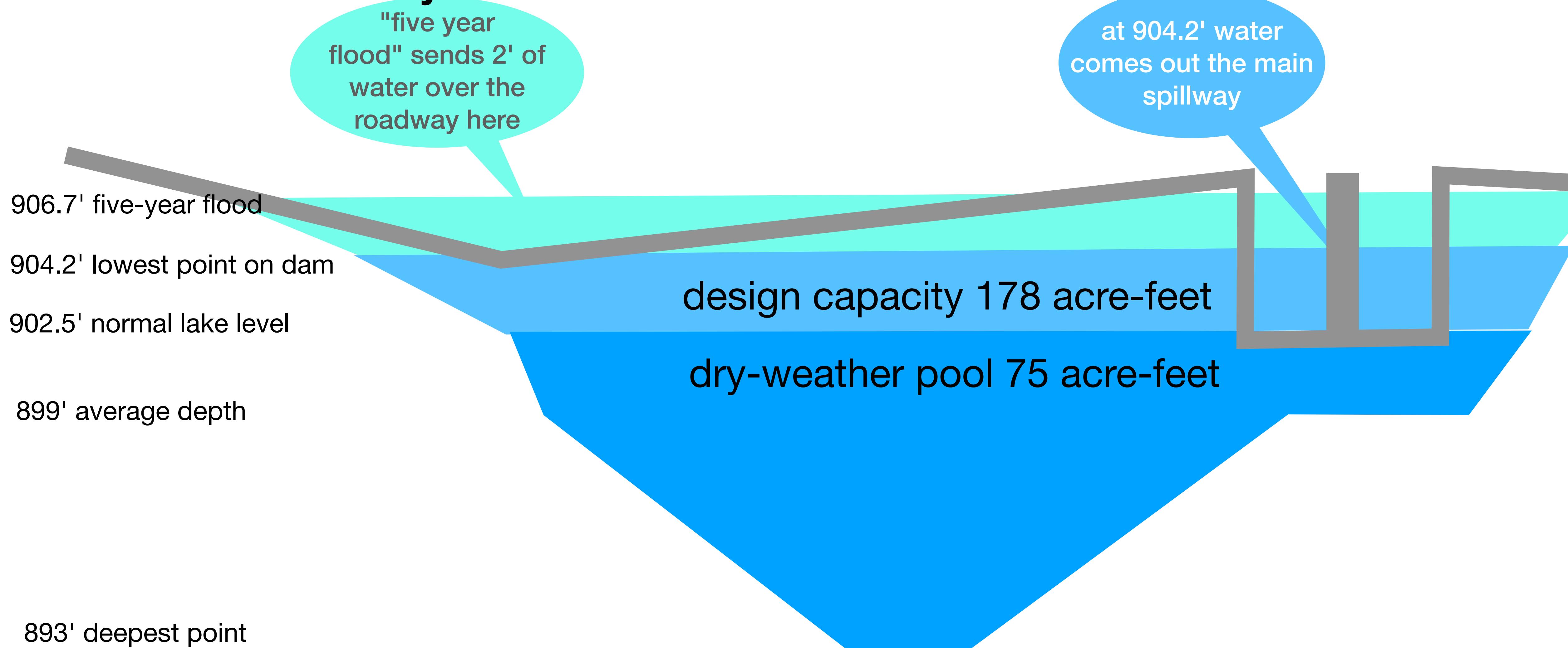
# Why lake users should prepare our own plan

- Shaker/Cleveland Heights and area residents are interested in the lake for recreation and nature value
- Residents/users thought NEORSD's need for a dam would get us a freebie repair; we let them take the lead.
- The full-height \$43M plan was NOT what residents would have chosen.
- If the cities take over dam replacement, we can explore LOWER HEIGHT and LOWER COST designs.



Depth map from: "Modeling sedimentation and scour in small urban lakes", Aaron A. Jennings Environmental Modelling & Software 18 (2003) 281–291

# If we understand the 2024 NEORSD engineering plan we can learn to modify it



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## Overview of units

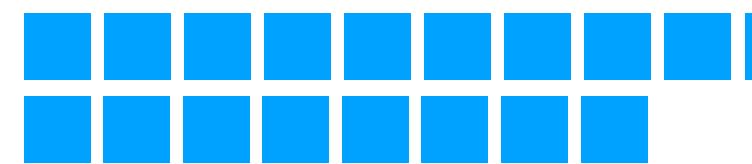
"One acre foot" is a volume of water you get from one-foot-deep flooding of a one-acre area. Lower Lake collects rainfall from 3300 acres.

1. Routine rainstorms (1")



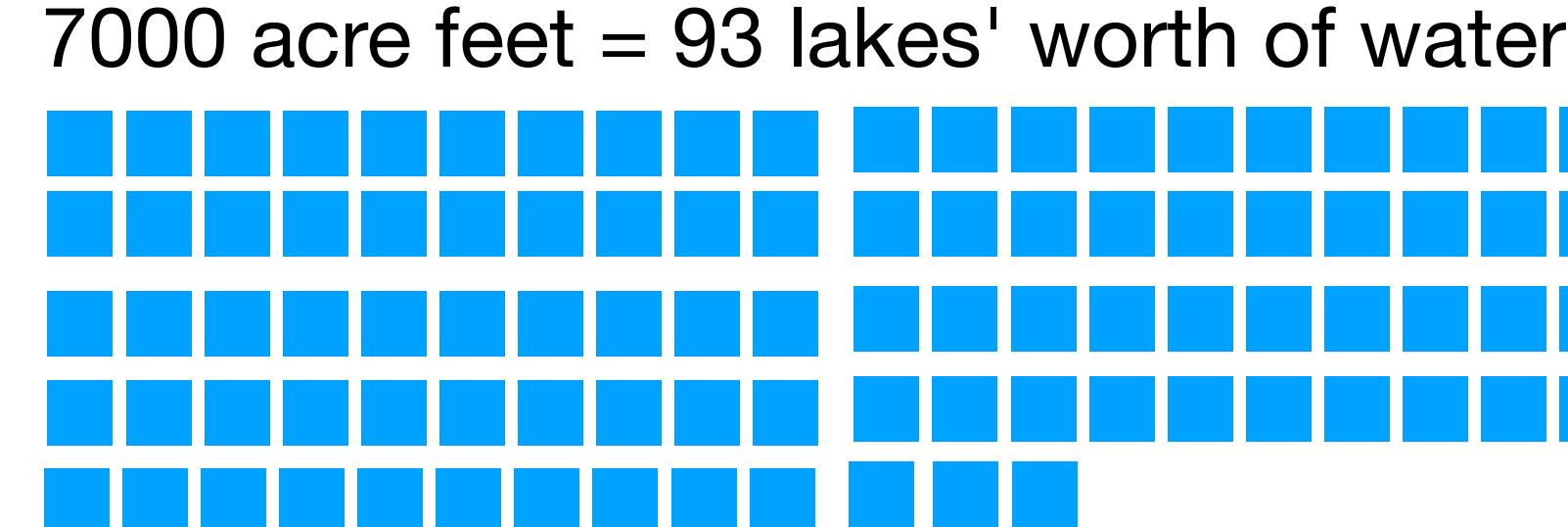
270 acre feet = 3.5 lakes' worth of water

2. The worst storm expected every 1-2 y. Climate change has upped the stakes on this. Consider 5" of rain in 24 (?) hours.

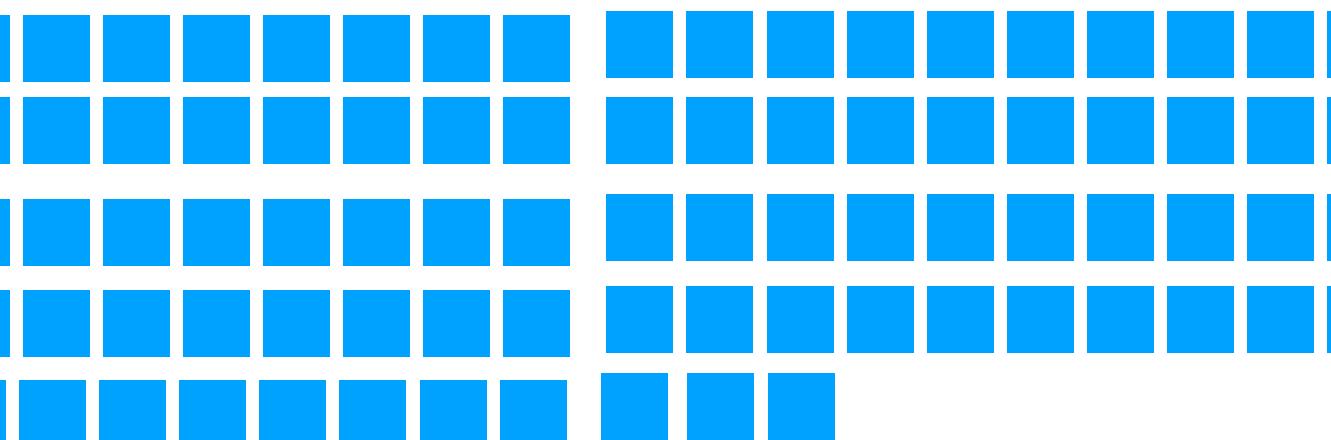


1340 acre feet = 18 lakes' worth of water

3. The "probably maximum flood" (PMF) a one-a-century event. NEORSD analyzed a 17--26" rainfall.



7000 acre feet = 93 lakes' worth of water



Dry weather: The stone spillway is dry when Shaker Lake has 75 acre-feet of water in it.

"storage": you can add 103 more acre-feet to the lake without causing a flood; that's been useful to NEORSD

"lake capacity": if the dam collapses at the worst time, this is what gets released; the number most relevant for safety

■ 75 acre-feet = "one lake"

■■ 103 acre-feet = 1.4 lakes' worth of storage

■■■ 178 acre-feet = Lower Lake capacity = 2.4 lakes' worth

**Even this little storm is more water than the lake can "store" at once. The lake doesn't flood because it doesn't all arrive at once. (Thanks, lawns and gardens!)**

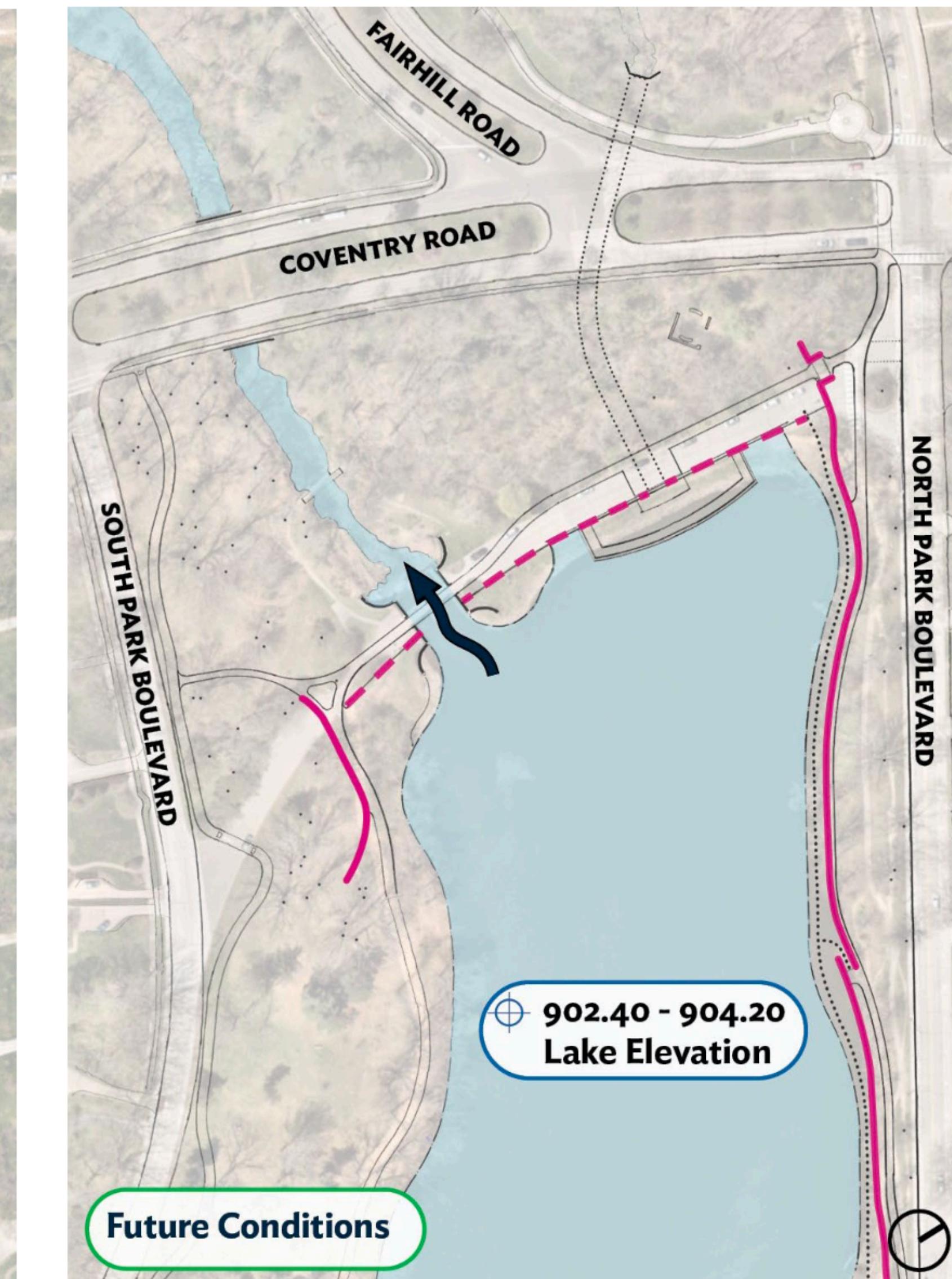
**But big storms involve *many* lakes' worth of water. It arrives quickly and exits as fast as it can. How fast depends what is in the way.**

If we understand the 2024 NEORSD engineering plan we can learn to modify it

This is normal Lower Lake outflow via the spillway.



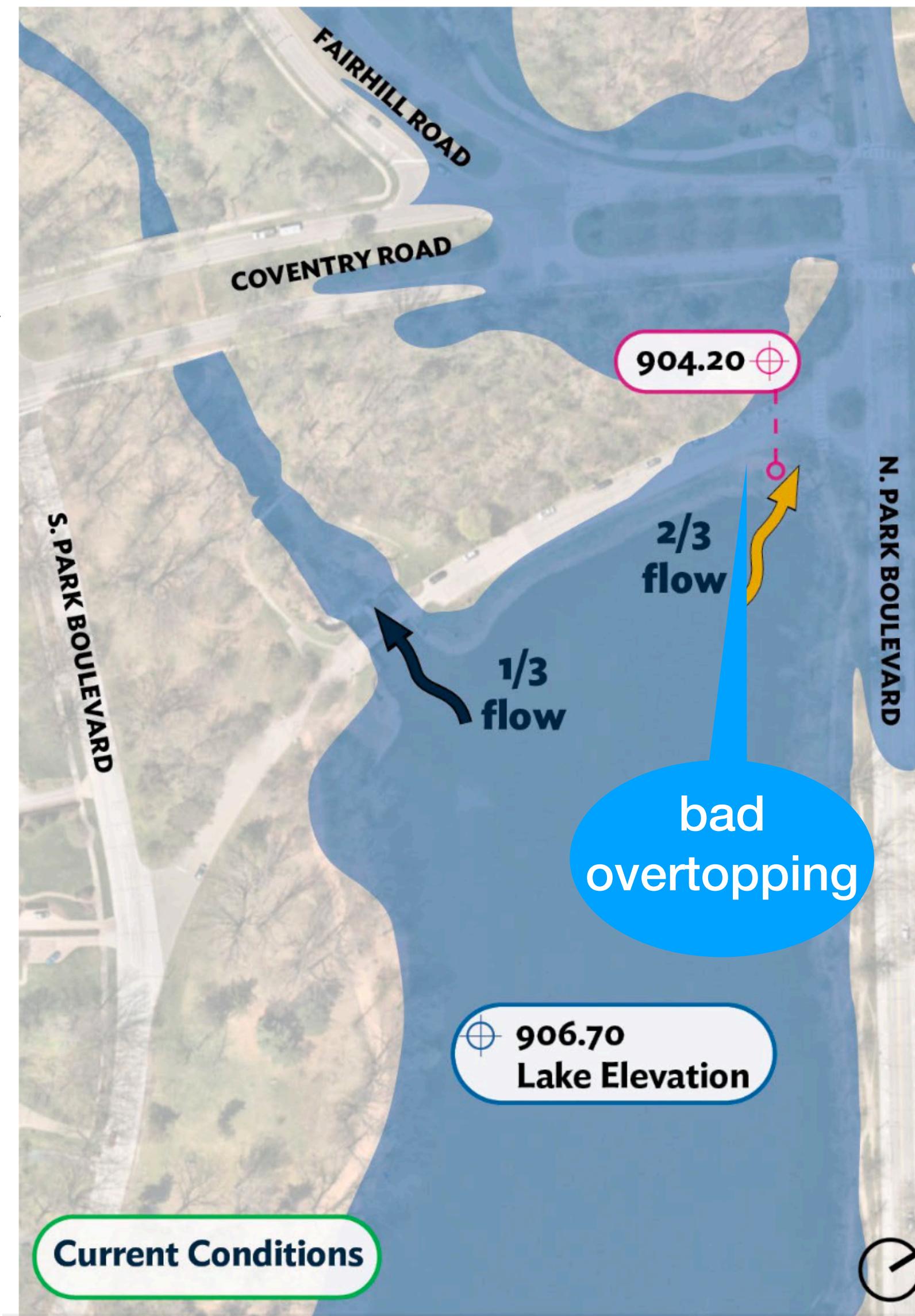
Scenario 1: Normal flow conditions (dry weather, small storms)



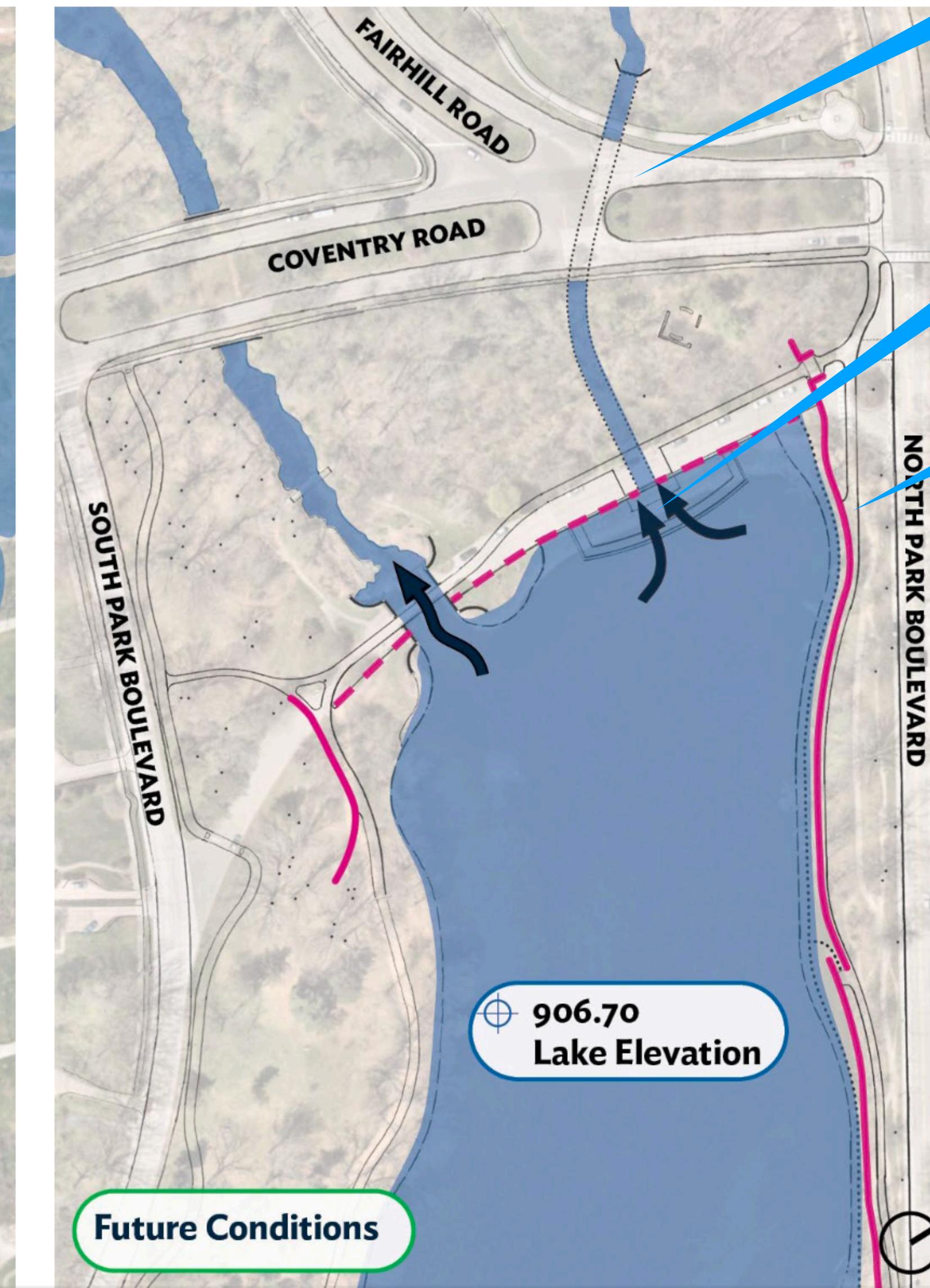
N24 plan doesn't change the normal lake behavior. We will see the modifications relevant to floods.

# If we understand the 2024 NEORSD engineering plan we can learn to modify it

In a 5" rainstorm, the lake level is 4' above the Shaker spillway but also overtaps the dam roadway by 2'. This floods North Park. It may also erode the dam.



## Scenario 2: 5" rainstorm (1-2y)



- new culvert
- new aux spillway
- floodwalls

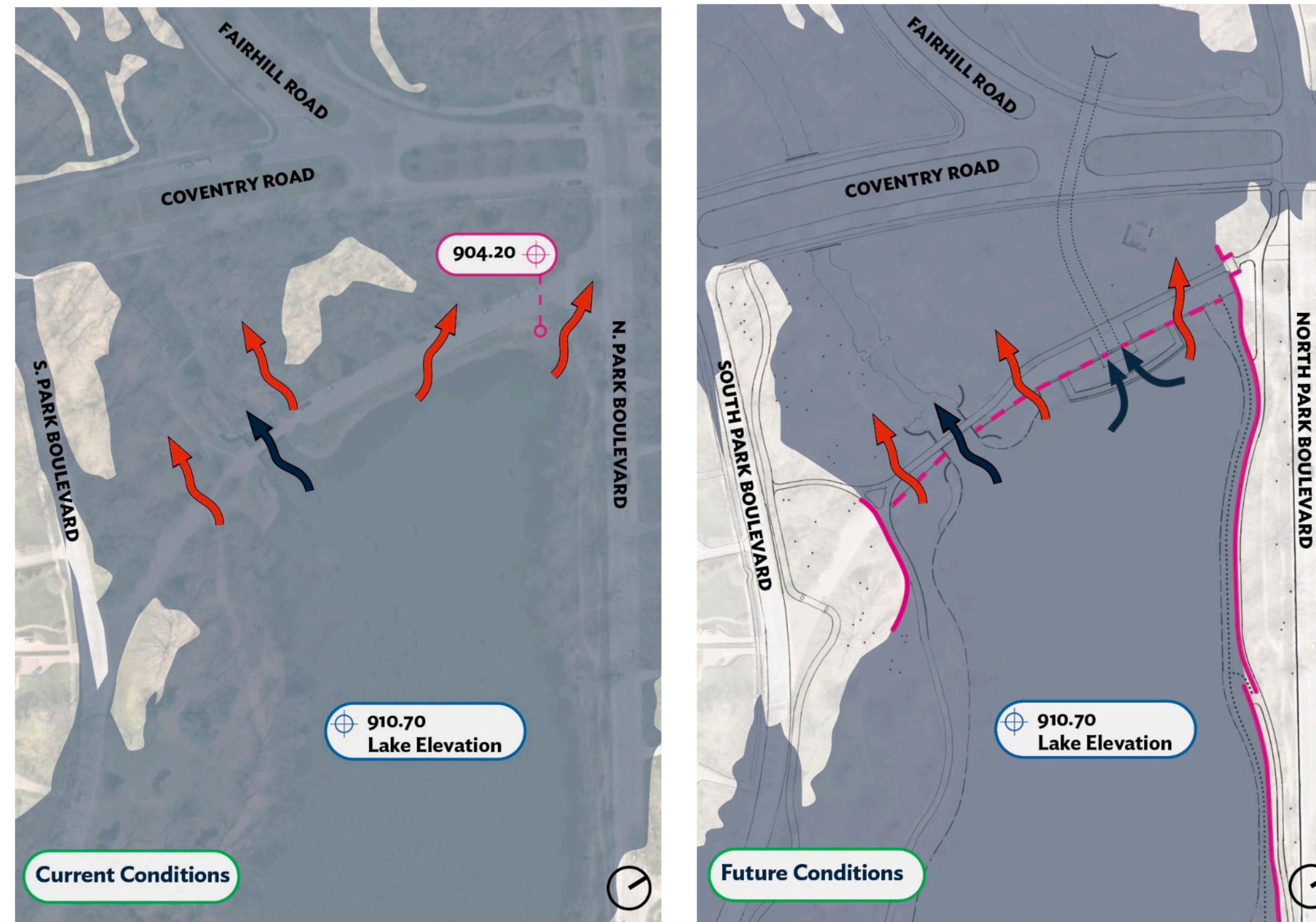
NEORSD-24 plan adds a big auxiliary spillway at 904.2' elevation. In a 5" storm, 2' overtakes the new spillway and escapes under Coventry via a new culvert.

If we understand the 2024 NEORSD engineering plan we can learn to modify it

This flood isn't being caused by the dam at all, it's being caused by Coventry Road and everything downstream.

The dam crest is deep under water.

## Scenario 3: 17"--26" Hurricane Helene-like megaflood



\$43,000,000 worth of Class I dam engineering later, it does not look like it has changed things much?

If we understand the 2024 NEORSD engineering plan we can learn to modify it

### Scenario 3: 17"--26" Hurricane Helene-like megaflood

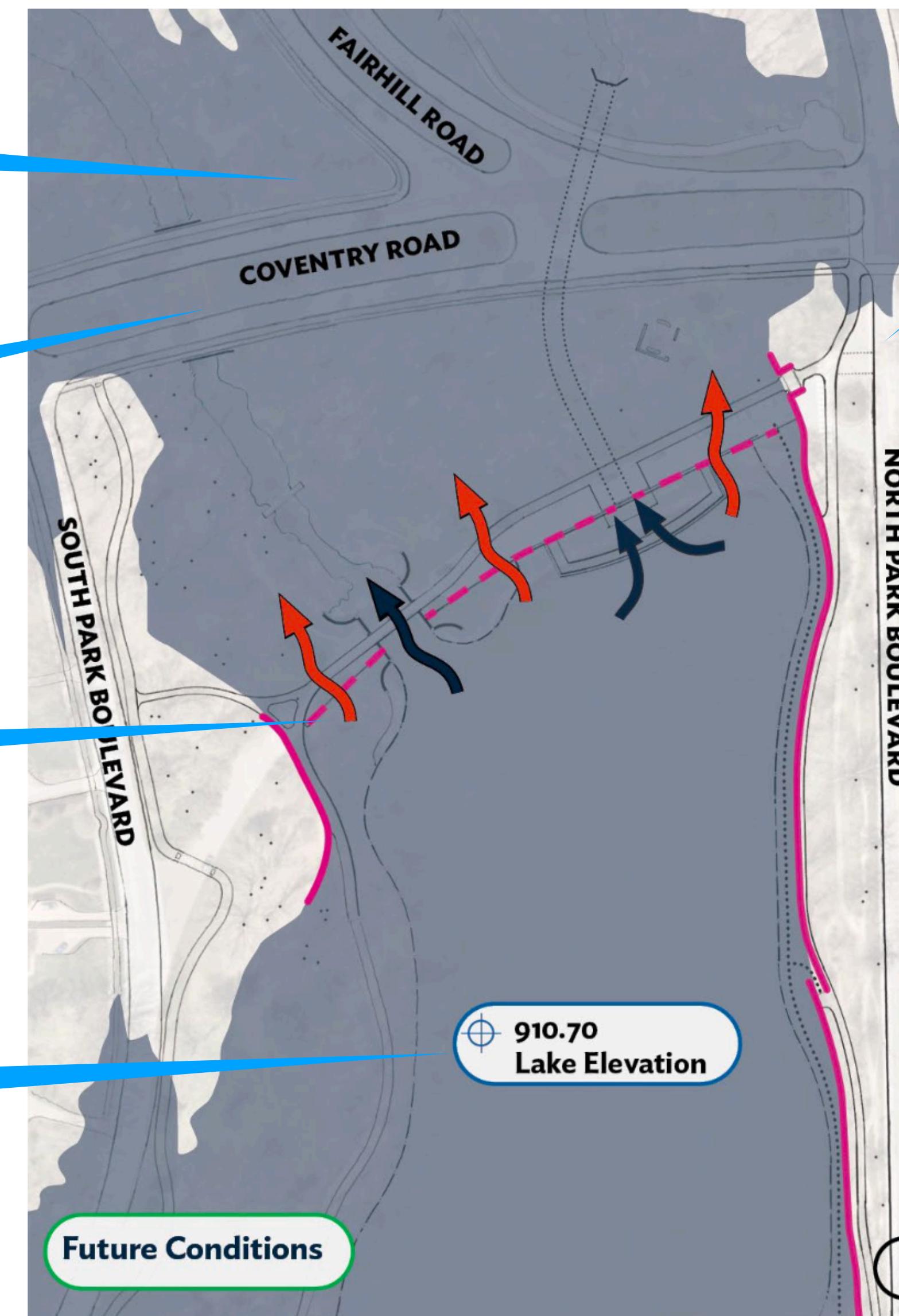
NEORSD's expensive floodwall protects ... the lakeside footpath?

Floodplains and upper canyons backed up, probably as far as N Moreland

Culverts under Coventry are backed up, most flow is over road

Spillways are backed up, most flow is over dam

Water still backs up in lake up to 910.7'; floods basements along South Park



(Won't it just flood with surface runoff from the north?)

My opinion: An 8000 acre-foot storm like this will fill this floodplain in roughly this pattern whether there is a dam there or not.

The water seems to pile up against downstream features, not against the dam itself. NEORSD's stated goals

**Reduce flood risk** downstream of the dam and along Coventry Road and North Park Boulevard

are NOT dam-failure-related goals.

Current dam

Stone  
spillway

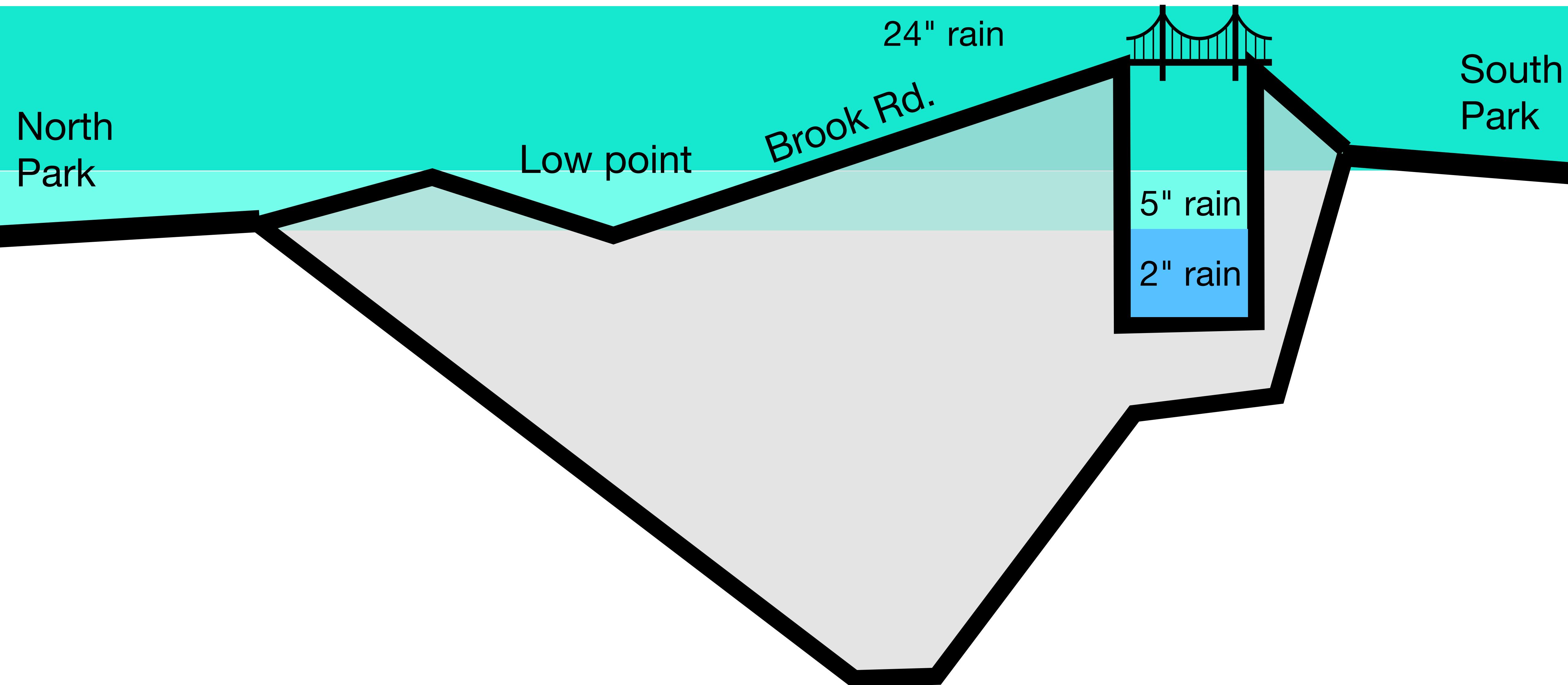
North  
Park

Low point

24" rain  
Brook Rd.

5" rain  
2" rain

South  
Park



Current dam

NEORSD 2024

Stone  
spillway

North  
Park

South  
Park

6' high  
floodwall

new concrete  
spillway at same  
height as previous  
low point

24" rain

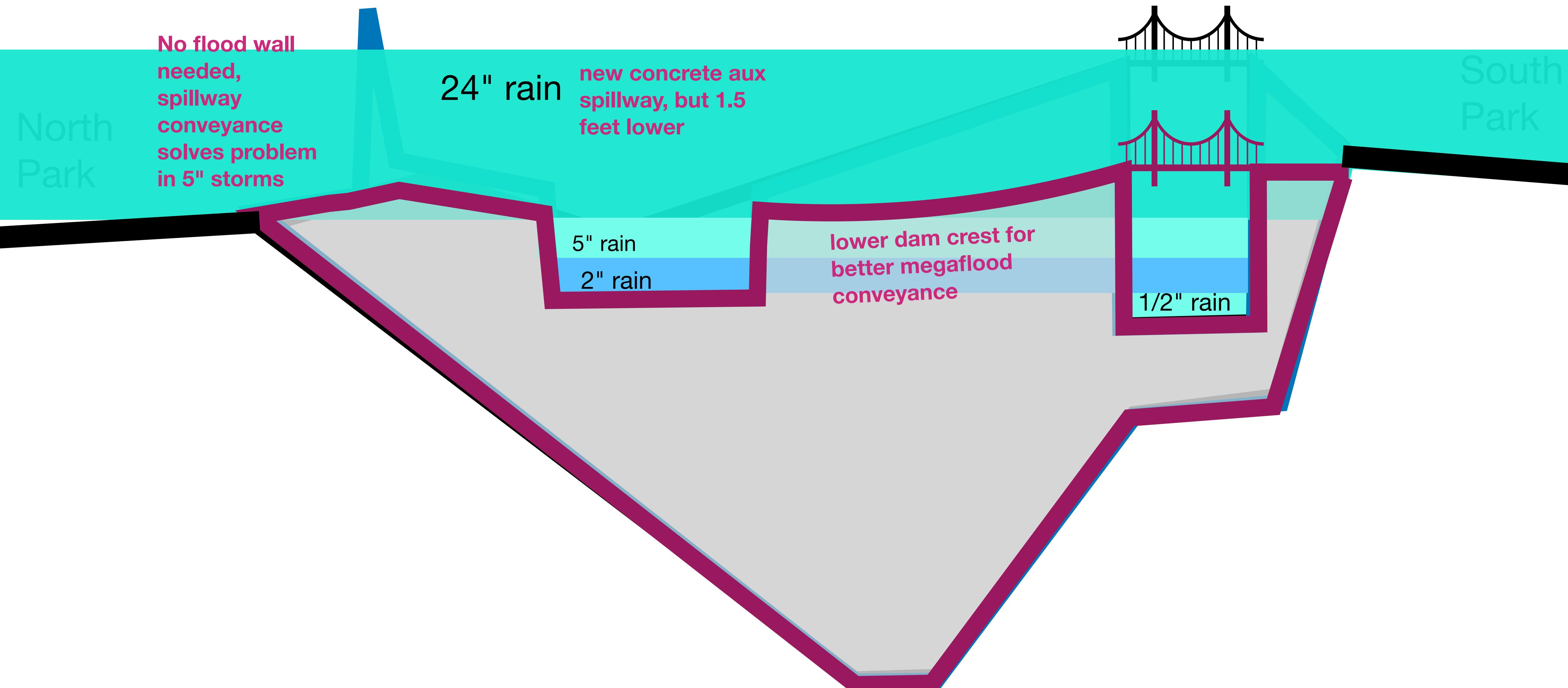
5" rain  
2" rain

Current dam

NEORSD 2024

Lower aux  
option

Stone  
spillway



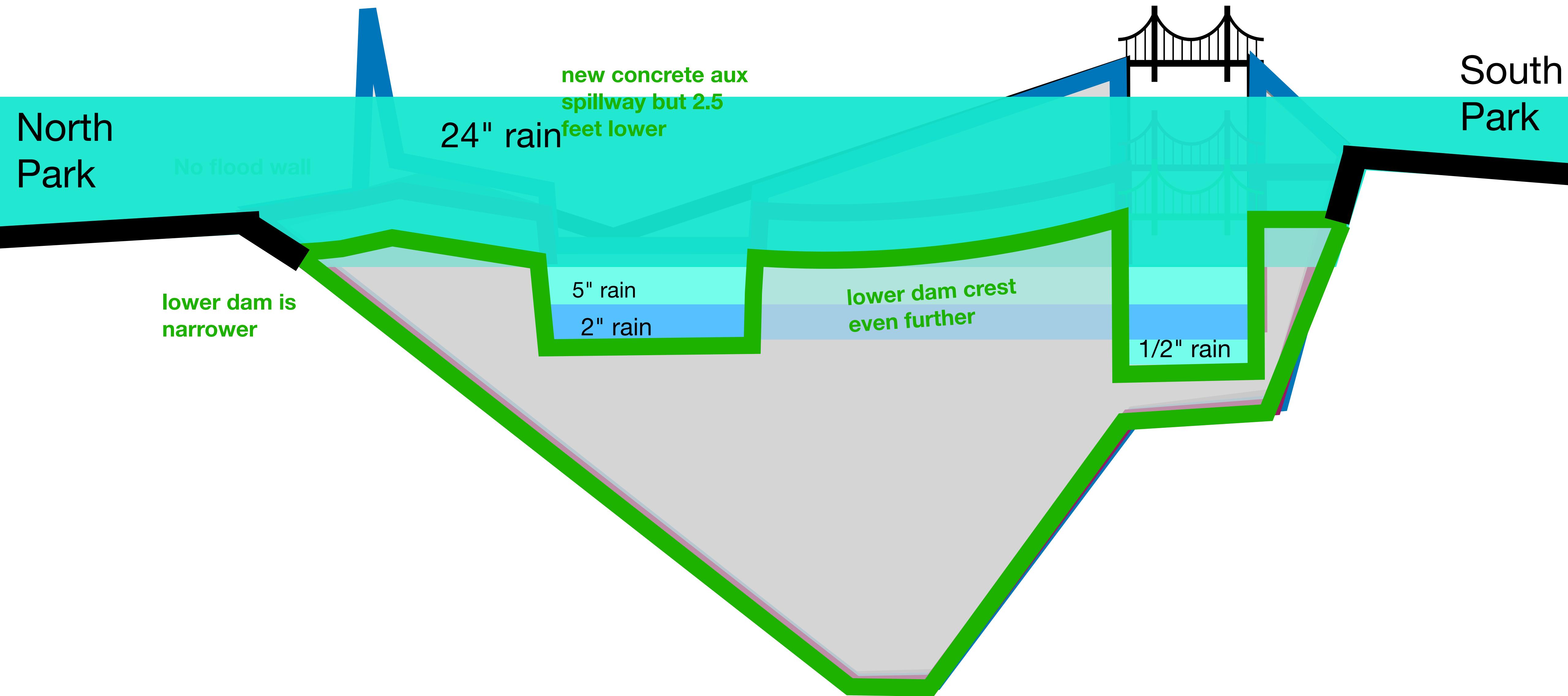
Current dam

NEORSD 2024

Lower aux  
option

Lower main  
level option

Stone  
spillway

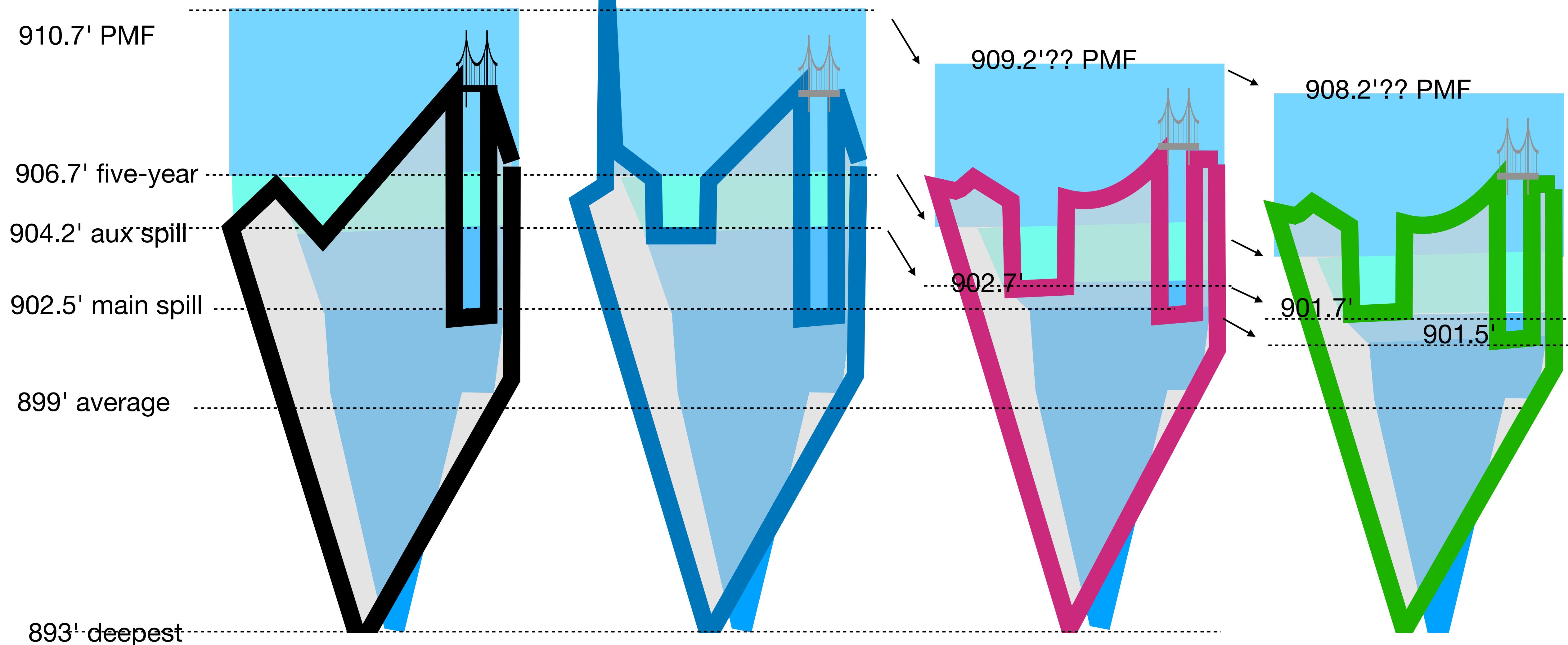


## CURRENT DAM

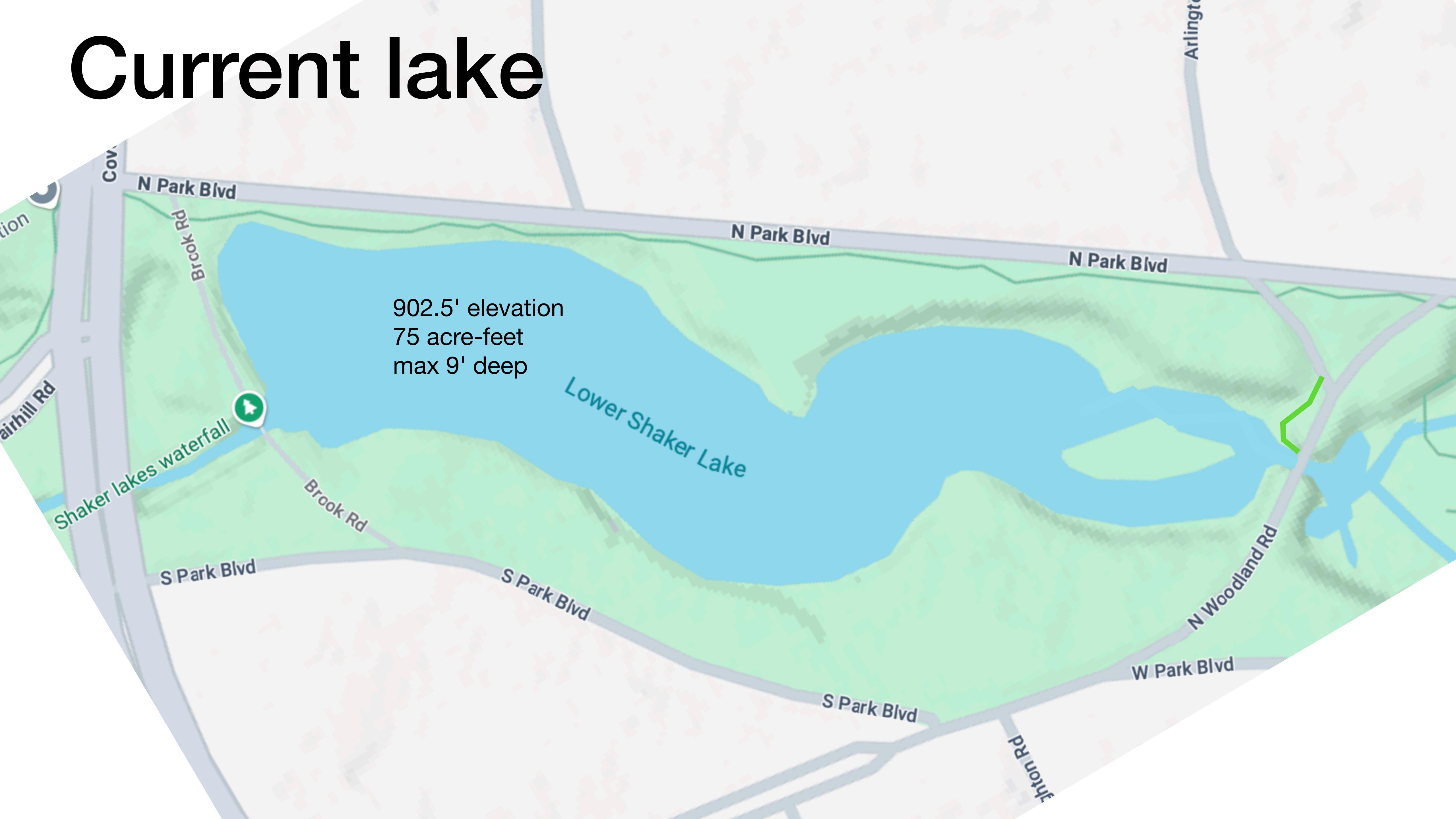
## 2024 NEORSD

## LOWER AUX

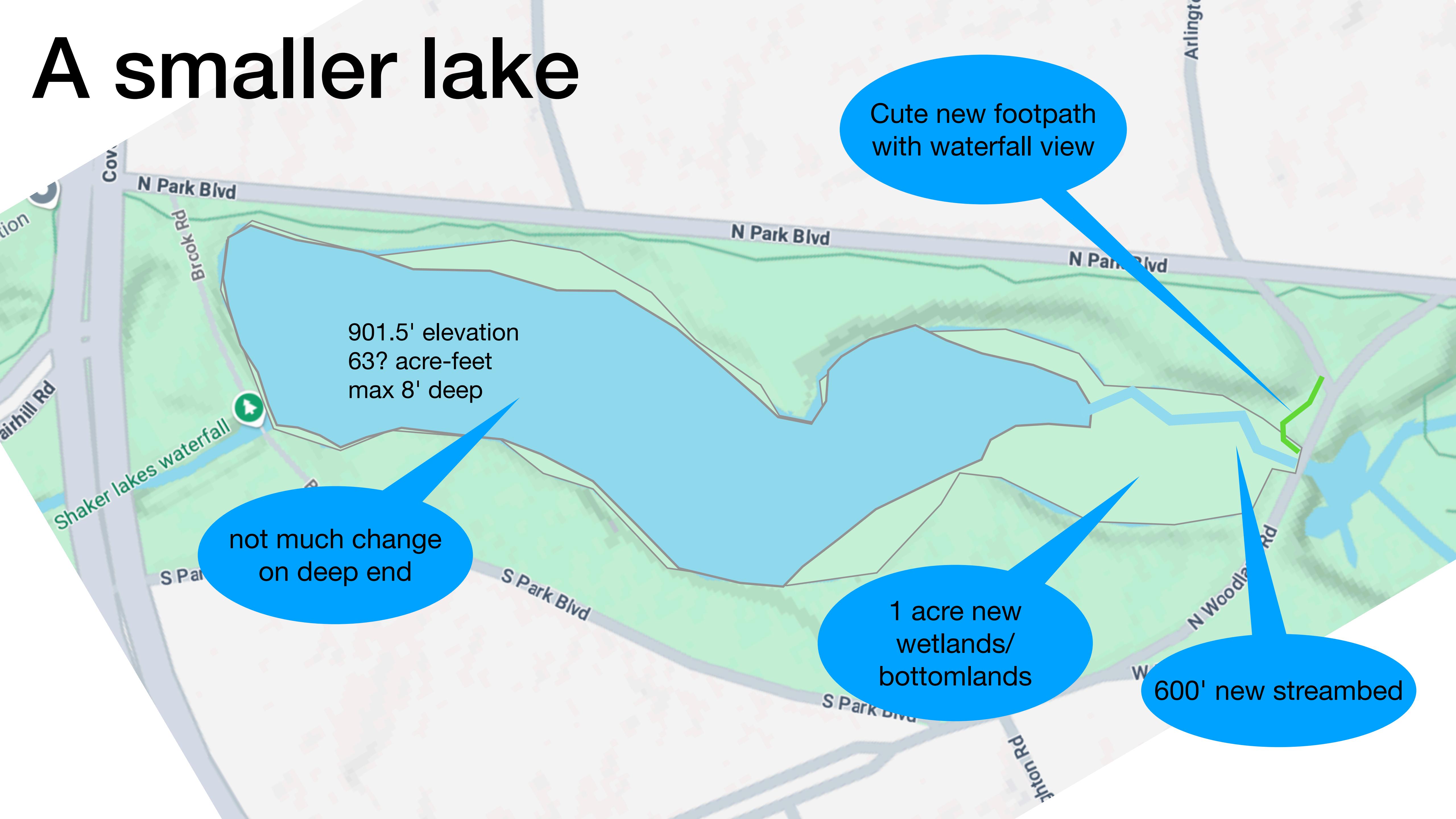
## LOWER MAIN



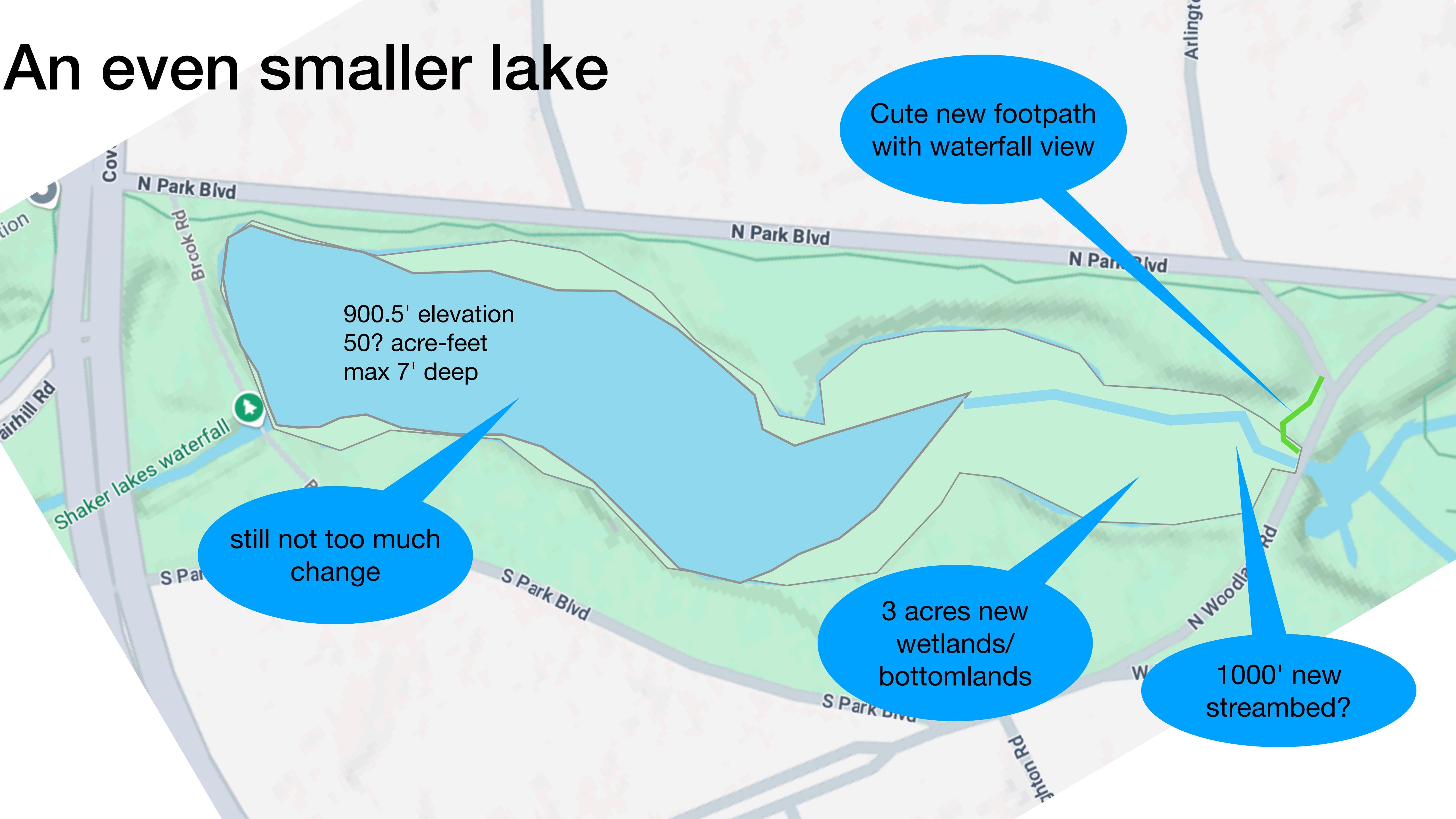
# Current lake



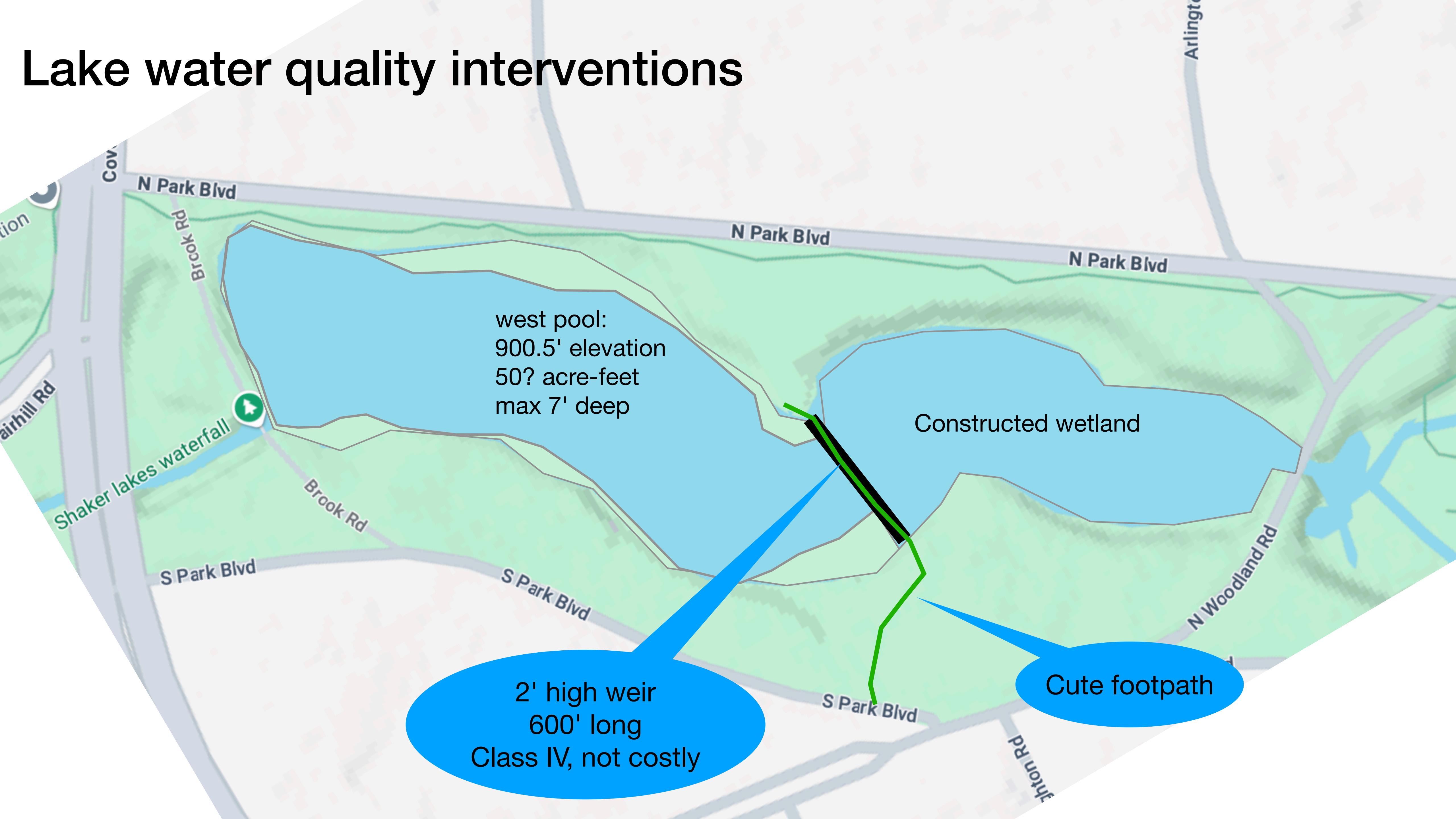
# A smaller lake



# An even smaller lake



# Lake water quality interventions



# How much cheaper is a lower dam?

Extremely guesswork-driven numbers ...

	NEORSD24	Lower	Even lower?	Class II dam?
<b>Concrete gravity dam</b>	20'h x 40' wide x 600' long = 240,000 cuft \$27M?	18' high x 36' wide x 600'? long = 195,000 cuft 81% of NEORSD plan \$22M?	17' high x 34' wide x 540? long = 160,000 cuft 67% of NEORSD plan \$18M?	<i>Earth fill instead of concrete?</i> \$10-15M?
<b>Aux spillway</b>	\$5M?	\$5M?	\$5M	\$5M?
<b>Aux culvert</b>	\$3M?	Fund separately; Coventry Rd conveyance problems are not the dam's fault (NEORSD? ODOT?)		
<b>Main spillway repair</b>	\$3M?	\$3M?	\$3M?	\$3M?
<b>Floodwalls/gates</b>	\$5M?	Exclude OR fund separately; walls are non-lake-related flood control (NEORSD or Cleveland Hts.)		
<b>TOTAL</b>	\$43M	\$30M?	\$27M?	\$18M?

*My opinion: downrating is worth investigating*

- **My opinions:**
  - It *would have* been nice to get a NEORSD-funded dam repair. If that's off the table, let's move on without them. It's our dam and our lake.
  - We should not be trying to change NEORSD's mind.
  - I think Shaker Heights, Cleveland Heights, Cleveland should pay for a *smaller and lower* dam. How much lower? Up for discussion w/ engineers and councils.
  - Some expensive-sounding parts of the NEORSD "dam repair" are actually changes to non-dam/non-lake flood infrastructure (e.g. Coventry Road culverts) and might be NEORSD-fundable.