

2024 AWWA-PNWS Spring Conference

Small Tank Material Selection Results in a 0.4 MG Prestressed Concrete Tank

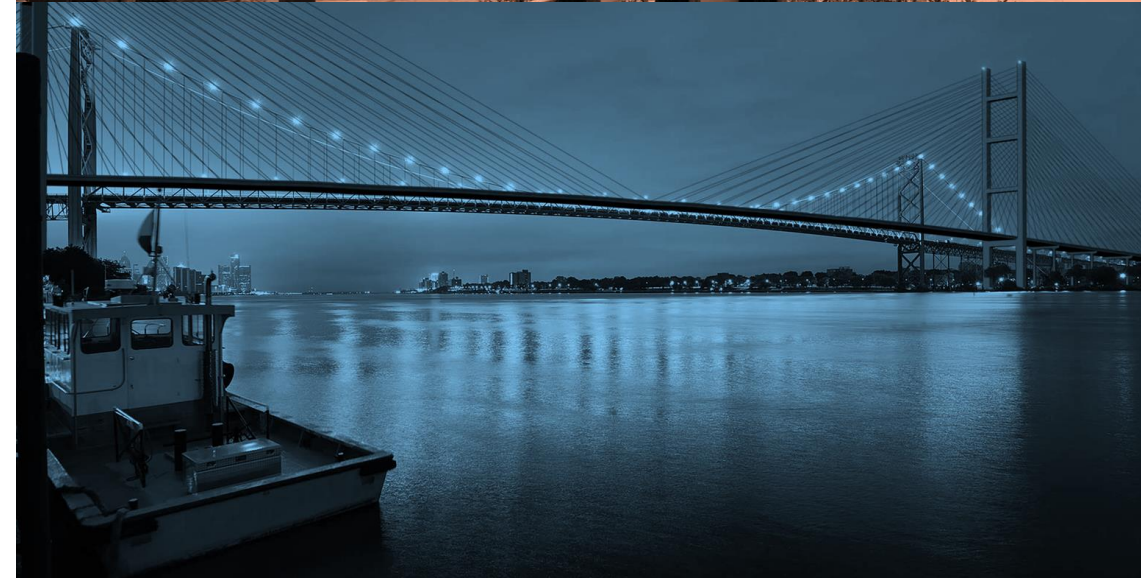
How Considering Multiple Criteria Led to an Unexpected Material Choice

Greg Postlewaite and Nathan Rostad



Agenda

- 01 Background
- 02 Business Case Analysis Process
- 03 Reservoir Material Options
- 04 Alternatives Evaluation Results
- 05 Project Status
- 06 Q&A

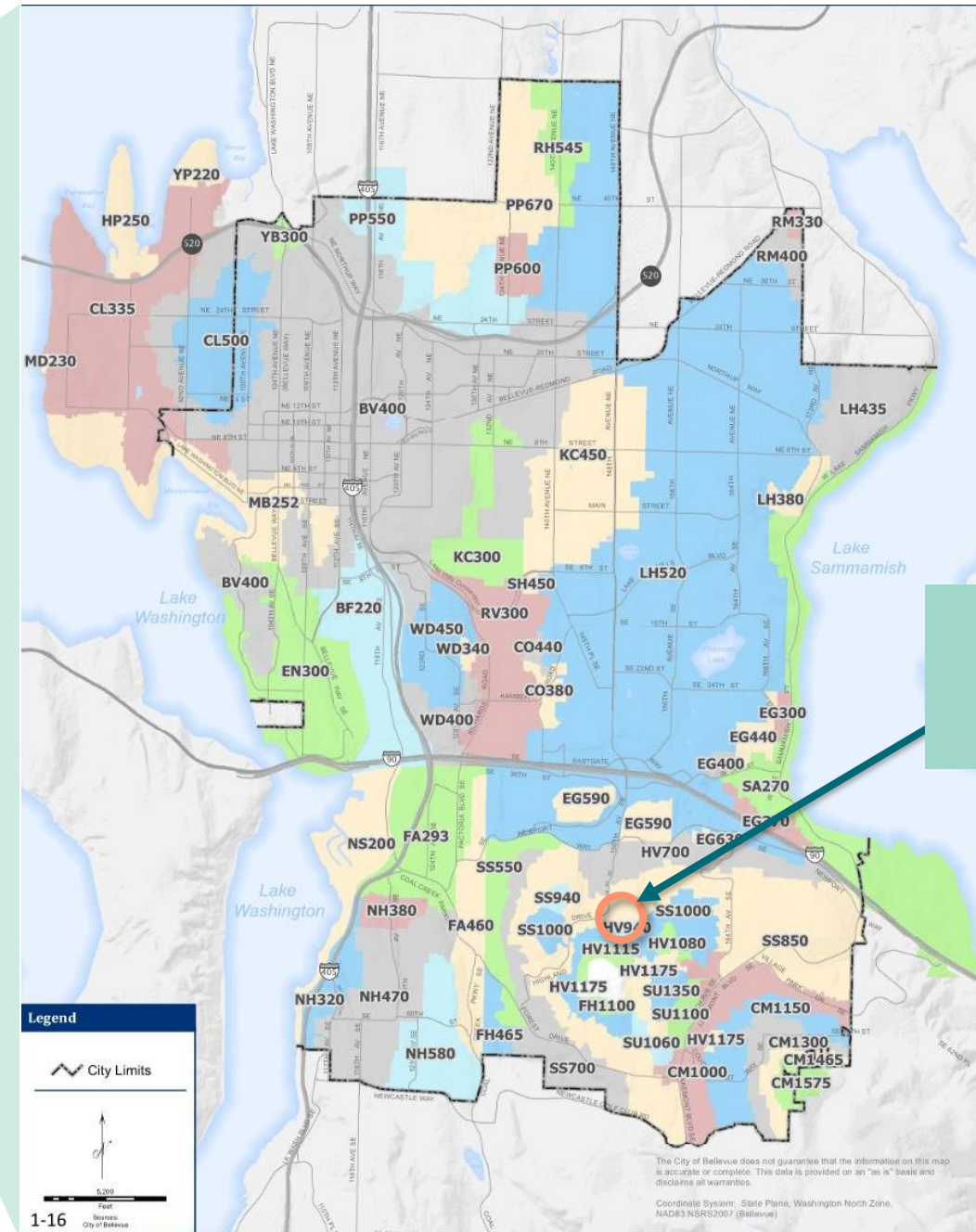
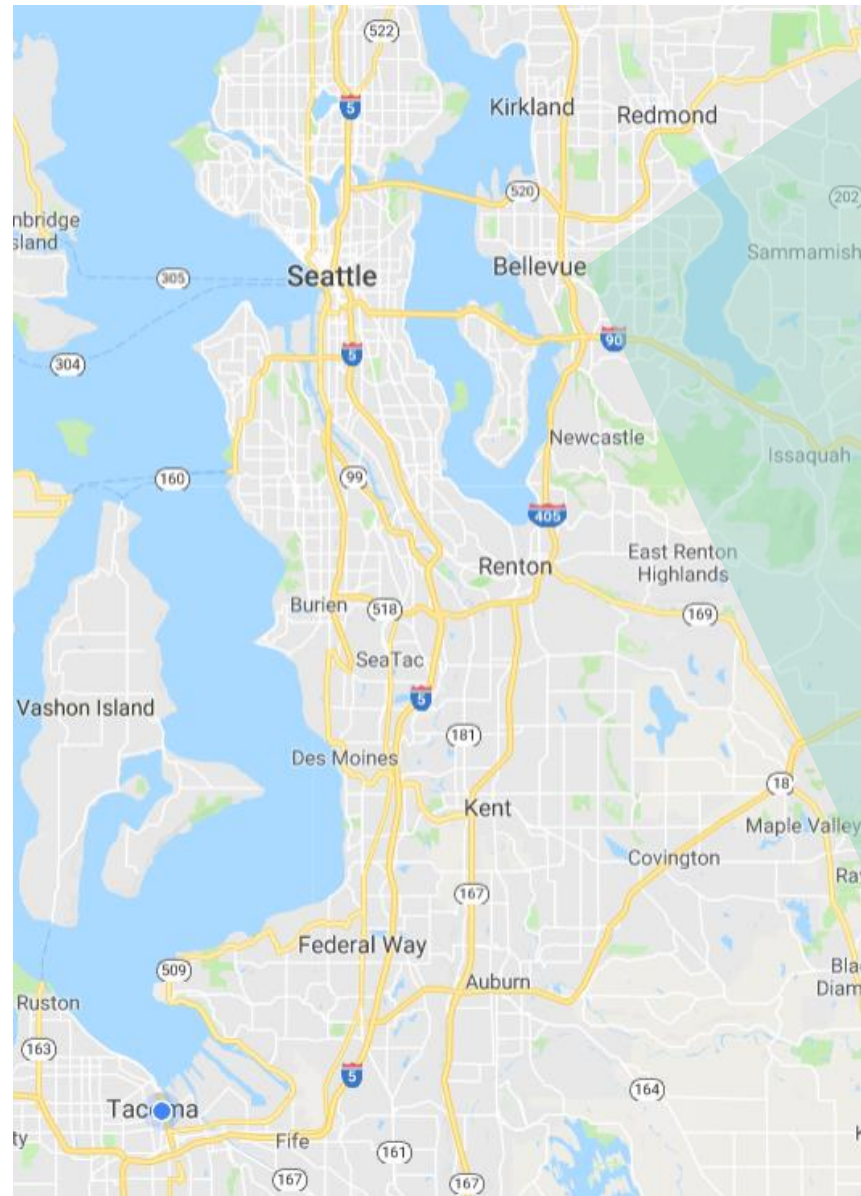




01

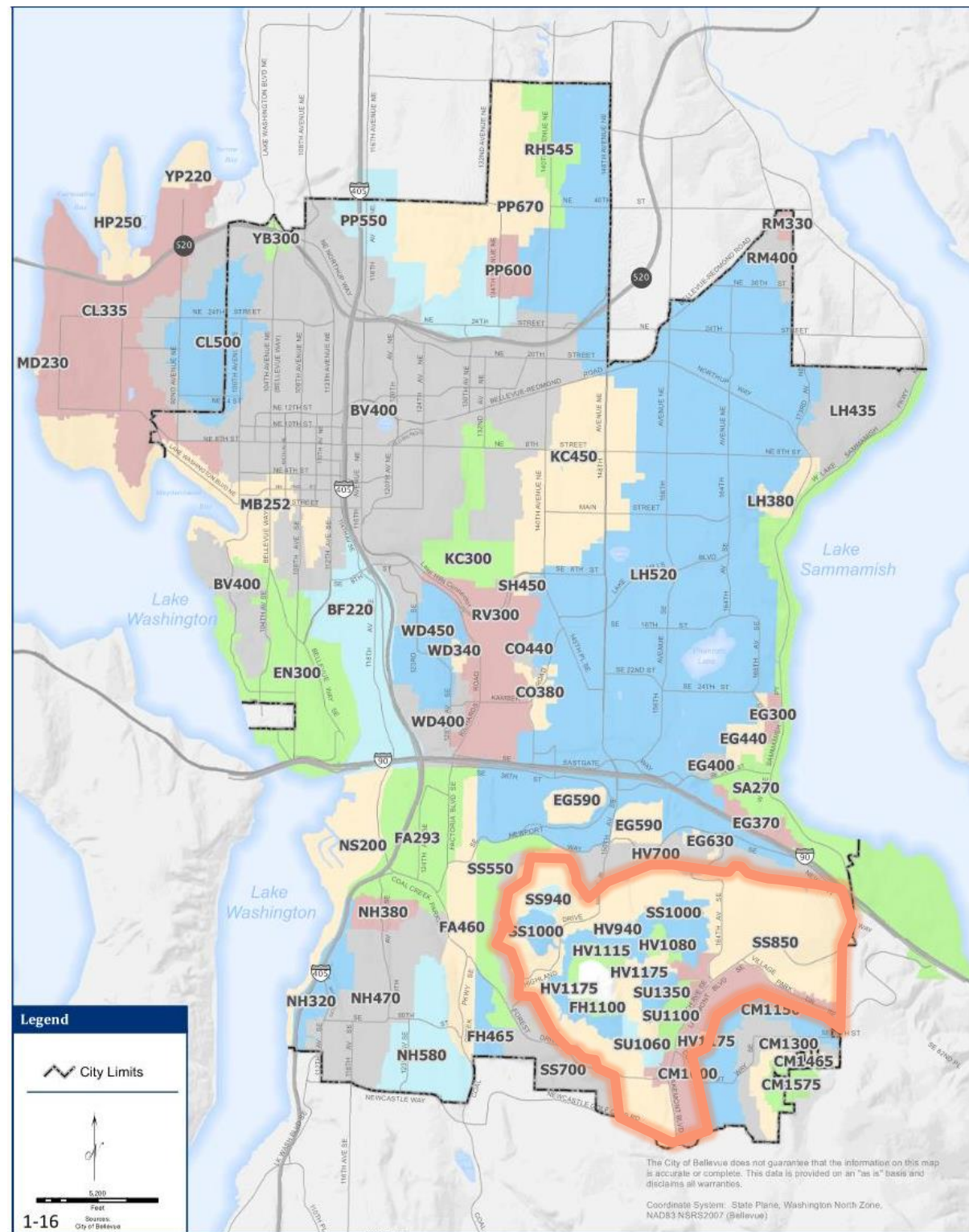
Background

Project Location

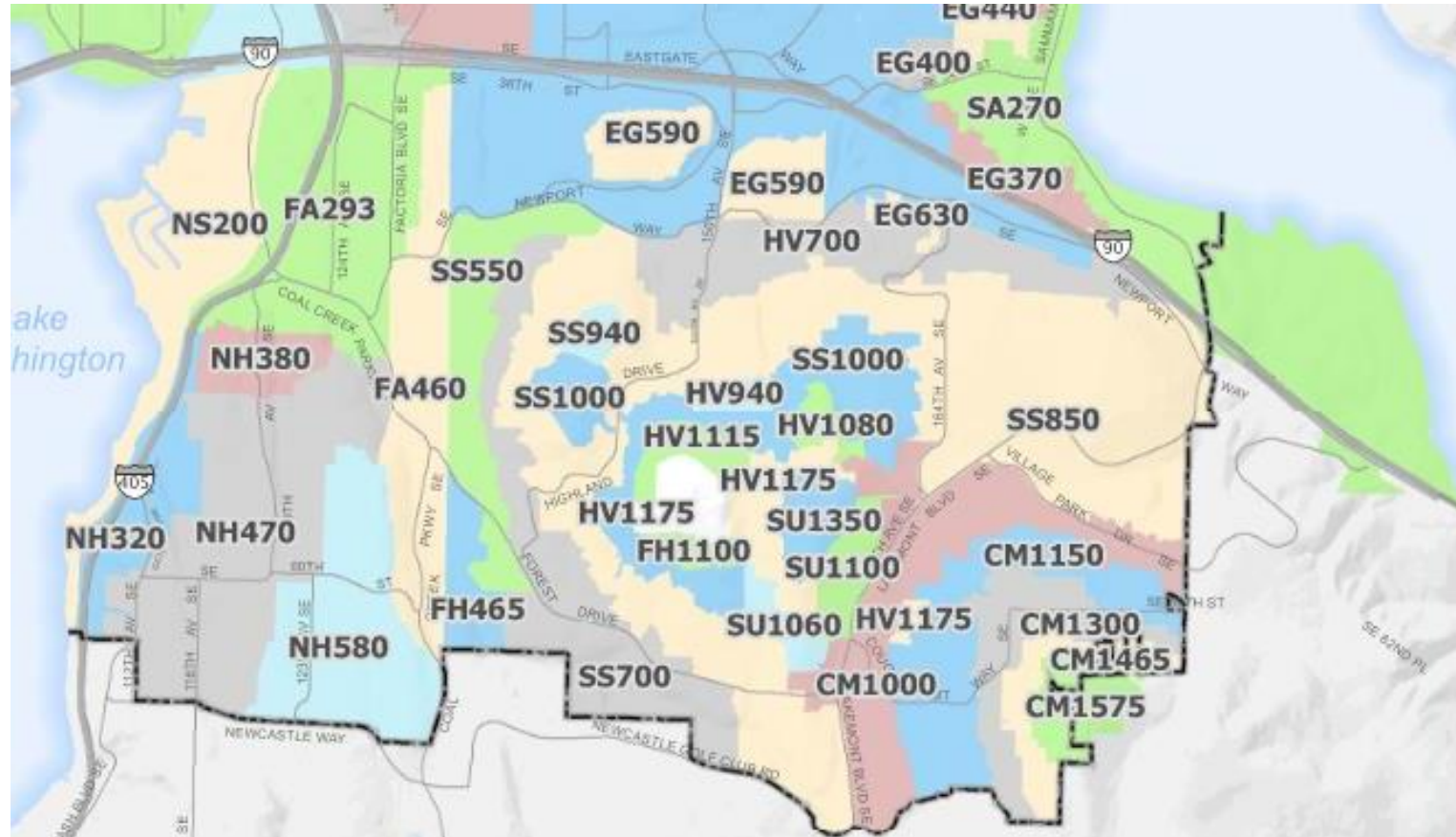


Bellevue Water System

- 41,000 customer meters
- 600+ miles of pipeline
- 60+ pressure zones
- 25 active reservoirs
- 22 pump stations
- 145 pressure reducing stations



Horizon View Service Area



Reservoir Service Area

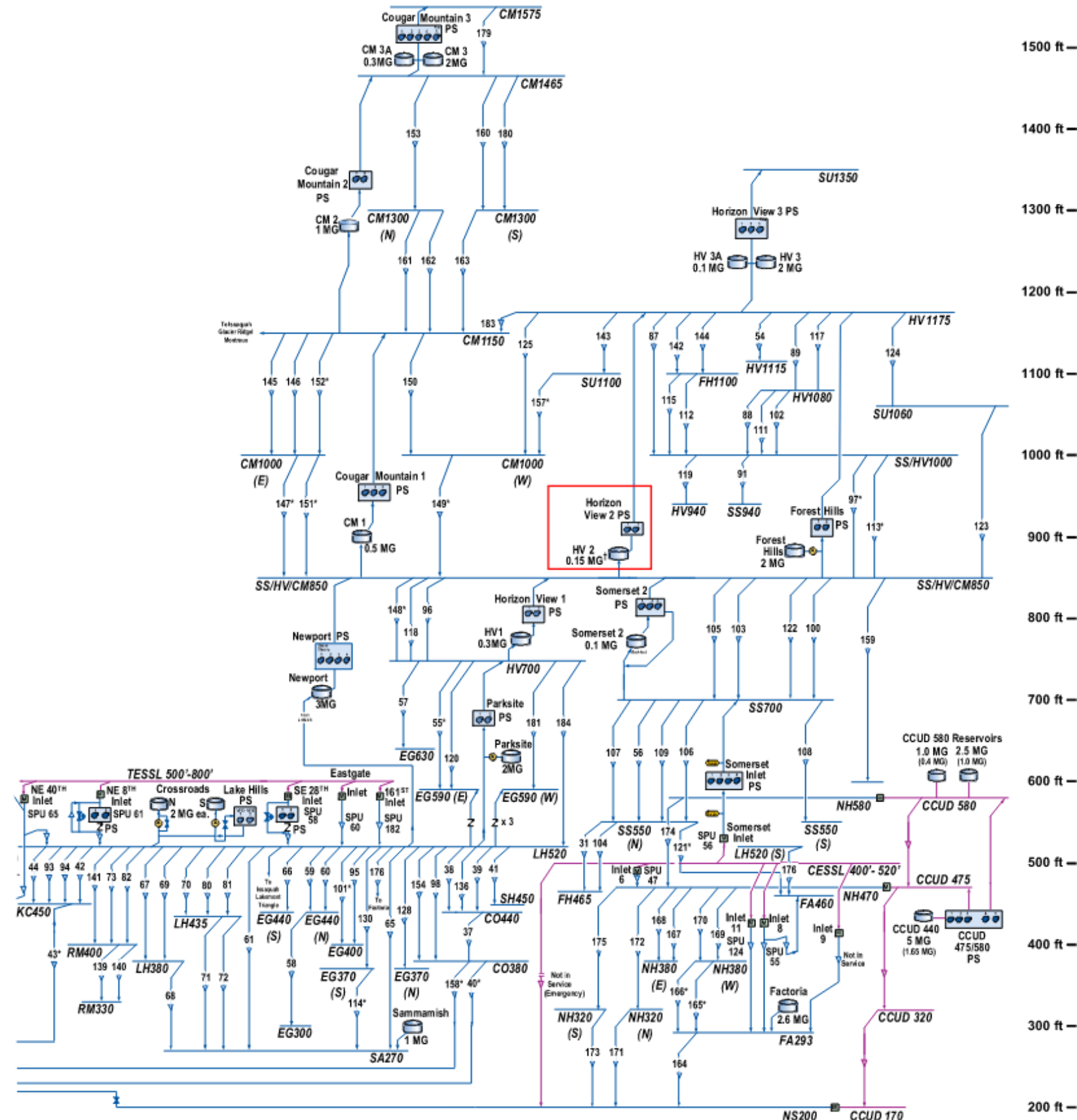
- SS/HV/CM850

Pump Station Service Area

- HV1175
- HV1080
- SS/HV1000
- SS940
- Additional PRV fed sub-zones

System Hydraulics

- City receives water from either SPU Tolt Eastside Supply Line (TESSL) or Cedar Eastside Supply Line (CESSL)
- Both TESSL and CESSL sources available to the Horizon View 2 site
- One of three reservoirs for the large SS/HV/CM 850 Zone
- One of two pump stations supplying the Horizon View 3 reservoir



Existing Facilities

Existing Reservoir



- 0.15 MG Welded Steel
- Relocated to current site in 1963
- Overflow elevation provided zero freeboard
- Small size and lack of inlet control valve have caused operational challenges

Existing Facilities

Existing Pump Station

- Pump station constructed in 1995
- Contains two 150-hp horizontal split-case pumps
- Building was constructed of nonreinforced CMU – inadequate for current seismic code
- Aging electrical and control equipment



Existing Facilities

Existing PRV Stations



Two PRV stations

- PRV 87 – HV1175 to SS/HV1000
- PRV 91 – SS/HV1000 to SS940
- Scheduled to be rehabilitated within 10 years

Relocation into Pump Station building

- Simplify access and maintenance and eliminate confined space entry
- Centralize water system control equipment

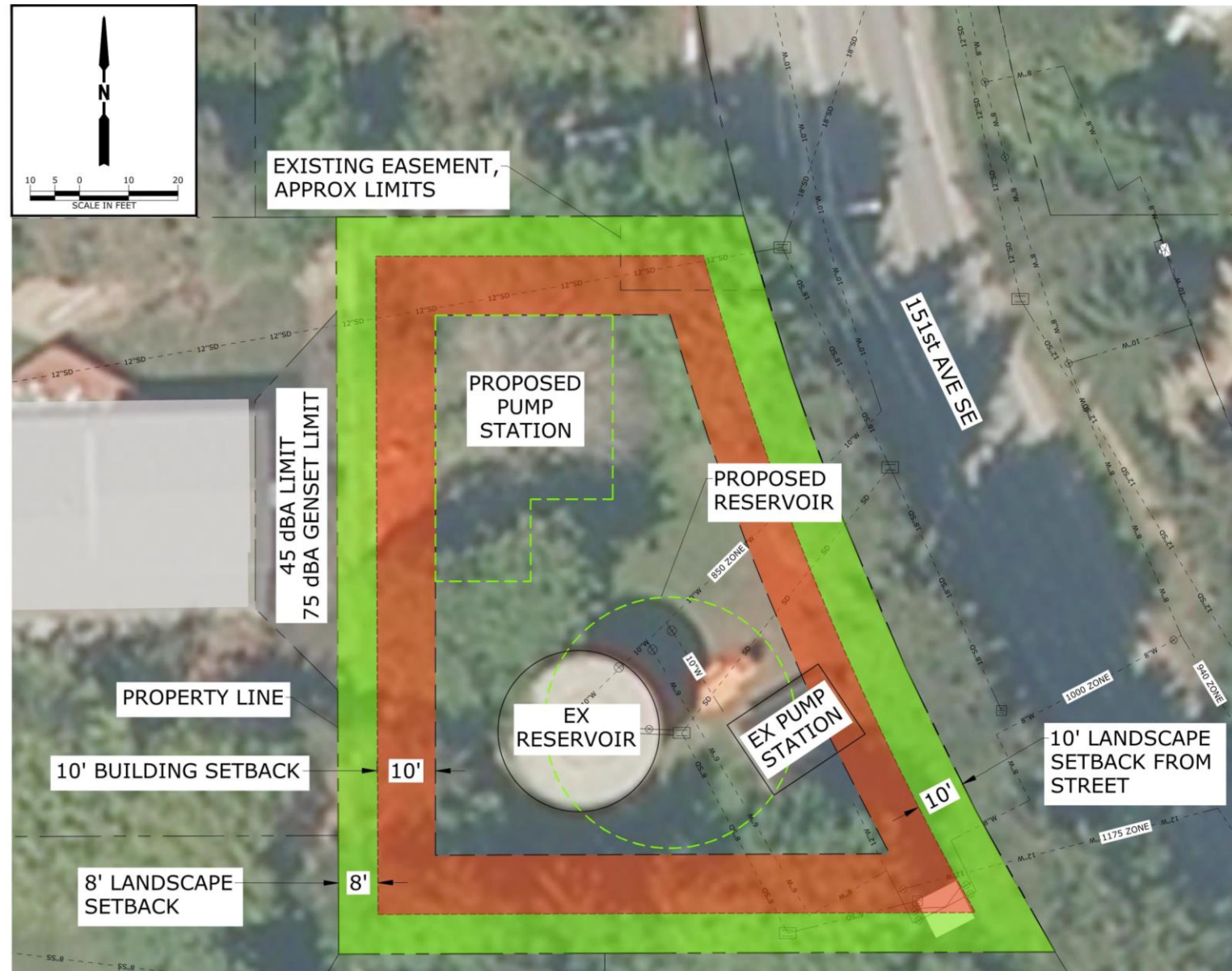


02

Business Case Analysis Process

Alternatives Identification

Site Constraints



Stormwater Management

- Flow Control
- Low Impact Development
- Onsite Conveyance

Zoning and Setbacks

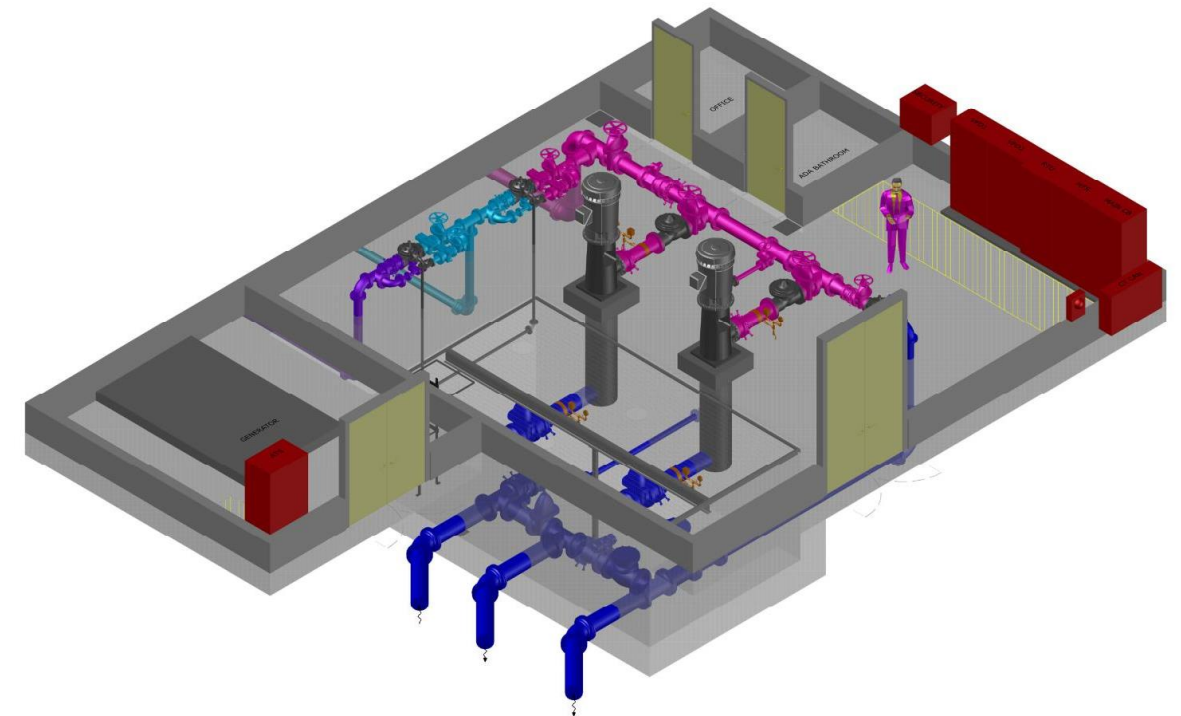
- 20-ft building setbacks
- 8- and 10-foot landscape buffer
- Noise ordinance

Alternatives Identification

Infrastructure Requirements

Reservoir

- 0.3 MG minimum storage
- Seismically resilient
- Minimize O&M Requirements
- Minimize Life Cycle Costs



Pump Station

- 1,200 gpm capacity
- Standby generator
- Minimize Lifecycle and O&M Costs

Triple Bottom Line Process

Considering Every Factor



Financial

- Initial Capital Costs
- Total Life Cycle Costs



Environmental

- Waste Generation
- Use of Local Materials
- Environmental Noise Impacts



Social/Technical

- Operational Requirements
- Service Life
- Risk of Failure
- Visual and Noise Impacts

Alternatives Identification

Multiple Decision Points



Pump Type

Vertical Turbine

Horizontal Multi-Stage

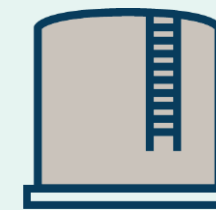
Horizontal Split Case



Site Layout

Two Pump Station Layouts

Reservoir Size



Reservoir Material

Welded Steel

Prestressed Concrete



03

Reservoir Material Options



Welded Steel

Design Considerations

Benefits / Considerations

Lower initial cost

Higher long-term O&M costs (recoating)

Service interruptions during recoating

Plain or artistic finishes possible

Prestressed Concrete

Design Consideration

Benefits / Considerations

Higher initial cost

More space requirements for construction – wire wrapping

Very minor O&M requirements

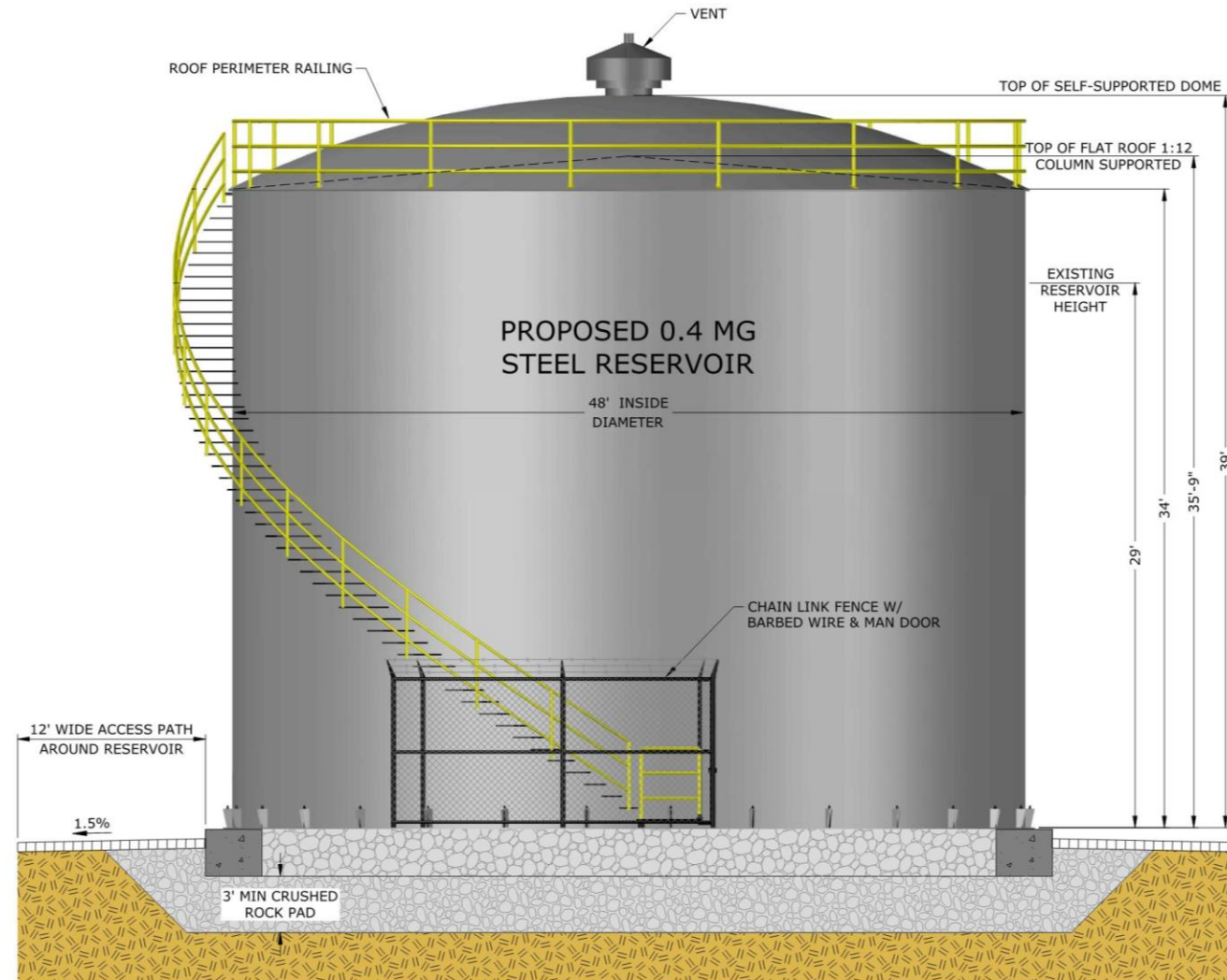
Risk of catastrophic failure is small, even without maintenance

Lower slosh freeboard possible

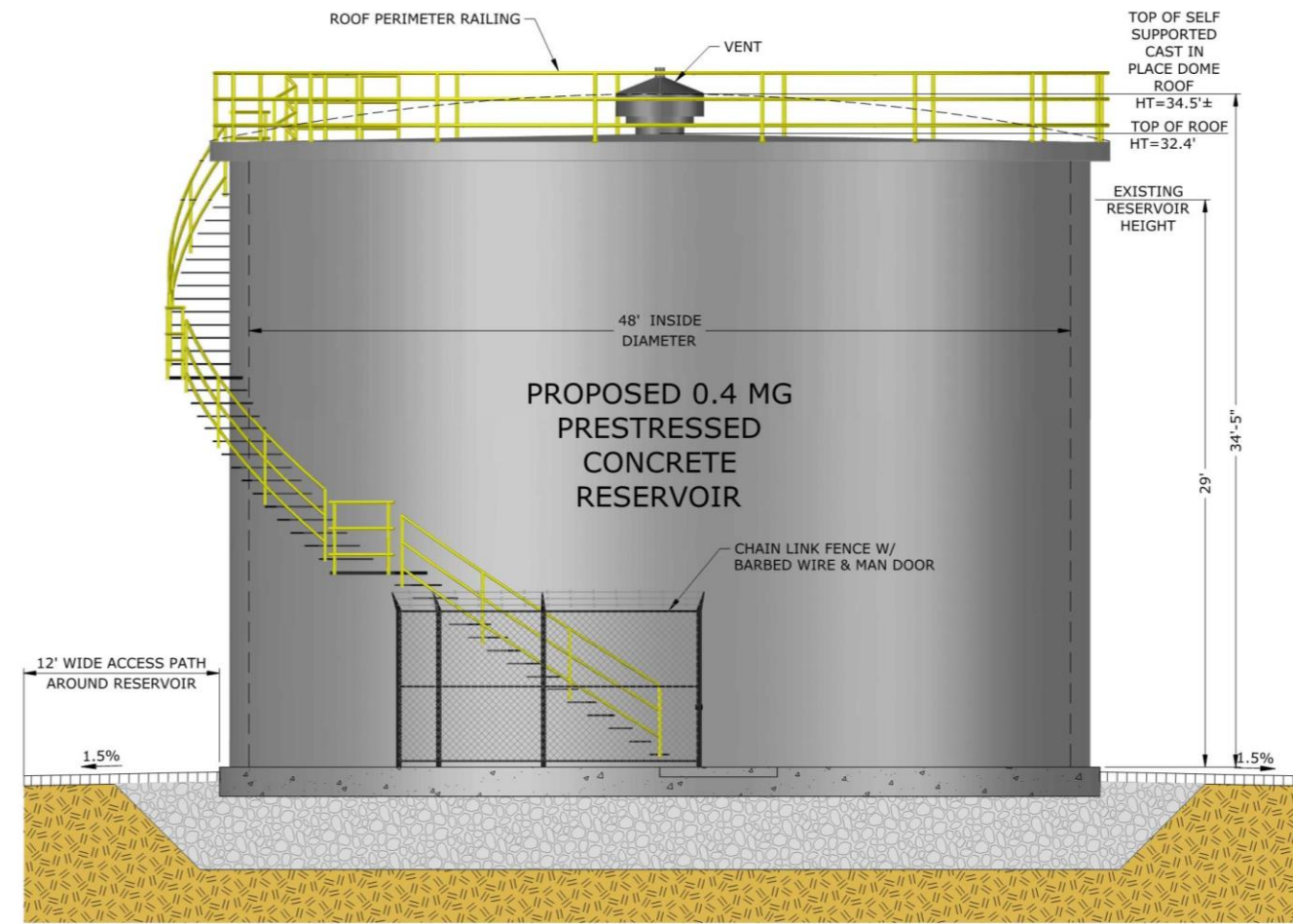
Possible to partially or fully bury the reservoir – providing more site flexibility



Reservoir Cross Sections



STEEL RESERVOIR ELEVATION



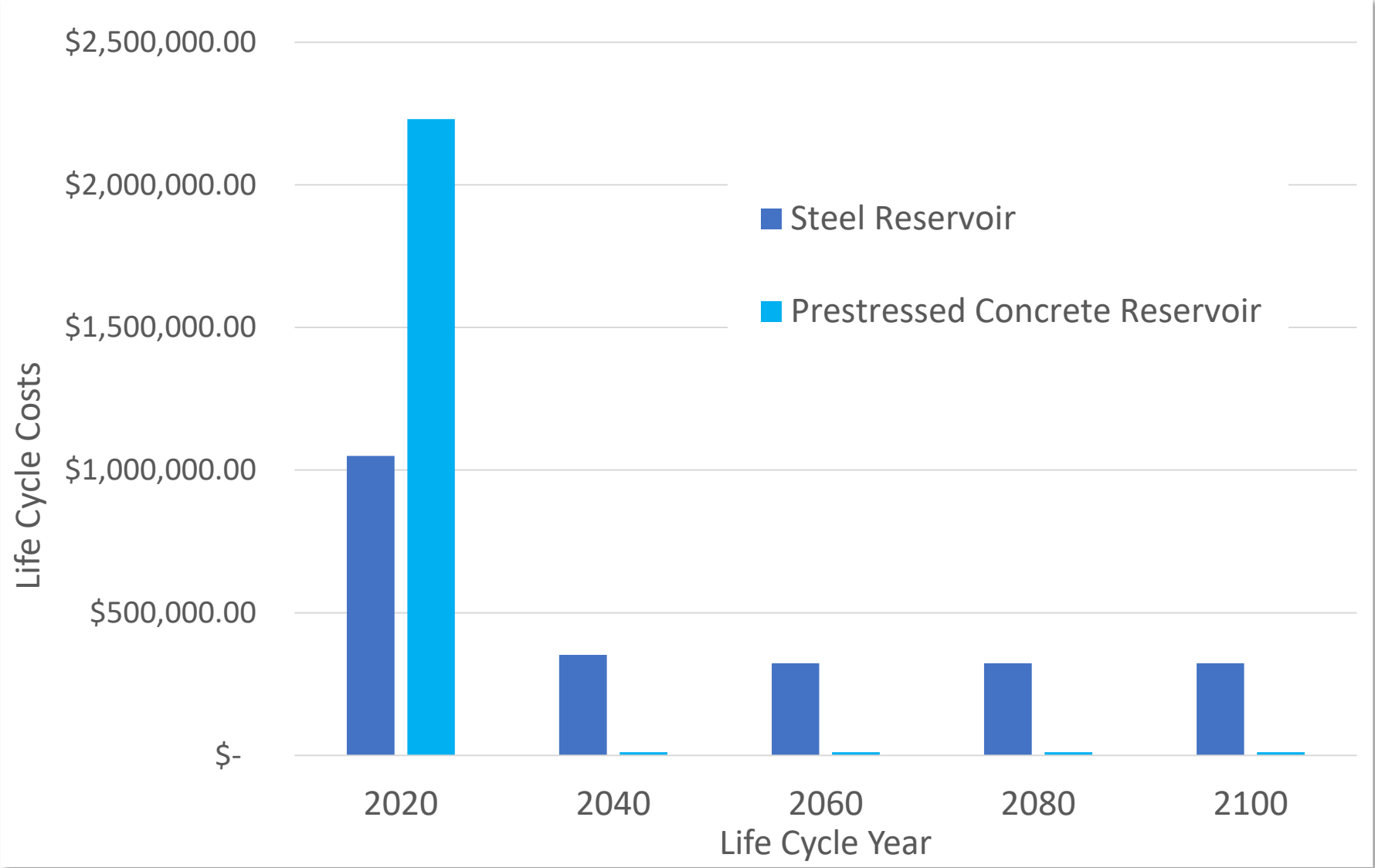
CONCRETE RESERVOIR ELEVATION



04

Alternatives Evaluation Results

Lifecycle Costs Evaluation



Total Life Cycle Costs	
Steel Reservoir	Concrete Reservoir
\$2,371,000	\$2,274,678

Assumptions

- Costs are in 2020 dollars
- Evaluation period is 100 years
- Steel tank O&M assumes recoating every 20 years

Triple Bottom Line Evaluation

Selected Criteria

Financial	Technical/Social	Environmental
Minimize Life Cycle Costs	Minimize Operational & Maintenance Requirements	Minimize Noise Impacts During Construction
Minimize Initial Capital Costs	Maximize Service Life	Maximize Use of Locally Sourced Materials
	Minimize Visual Impacts	Minimize Amount of Waste Disposal During Construction
	Minimize Risk of Reservoir Failure in a Seismic Event	Minimize amount of new materials required
	Minimize Confined Space Entry	
	Minimize Chlorine Decay	
	Minimize Reservoir Leakage	

Triple Bottom Line Evaluation

Criteria Weights and Analysis

Criteria		Short Term or Long Term (S v. L)	(A) Criteria Weight (1 - 3)	Steel		Prestressed Concrete		No Action	
				Alternative RM1		Alternative RM2		Alternative RM3	
				(B) Score (1 - 3)	Weighted Score (1 - 9)	(B) Score (1 - 3)	Weighted Score (1 - 9)	(B) Score (1 - 3)	Weighted Score (1 - 9)
Financial									
F1	Minimize Life Cycle Costs	L	2	1	2	3	6	3	6
F2	Minimize Initial Capital Costs	S	2	3	6	1	2	3	6
Average Financial Score				4		4		6	
Social / Technical									
ST1	Minimize Operat							1	3
ST2	Maximize Servi							1	3
ST3	Minimize Visua							1	3
ST4	Minimize Risk o							1	3
ST5	Minimize Confi							1	1
ST6	Minimize Chlor							1	1
ST7	Minimize Reser							1	2
Average Social / Technical Score				5.0		6.0		2.3	
Environmental									
E1	Minimize Noise Impacts During Construction	S/L	2	2	4	2	4	3	6
E2	Maximize Use of Locally Sourced Materials	S	2	2	4	3	6	1	2
E3	Minimize Amount of Waste Disposal During Construction	S	2	3	6	2	4	3	6
E4	Minimize amount of new materials required	S/L	2	2	4	3	6	3	6
Average Environmental Score				4.5		5		5	
(C) Total Weighted Score				Alt RM1 = 13.5		Alt RM2 = 15.0		Alt RM3 = 13.3	

Evaluation Results



Evaluation Results	
Steel	Concrete
13.5	15.0



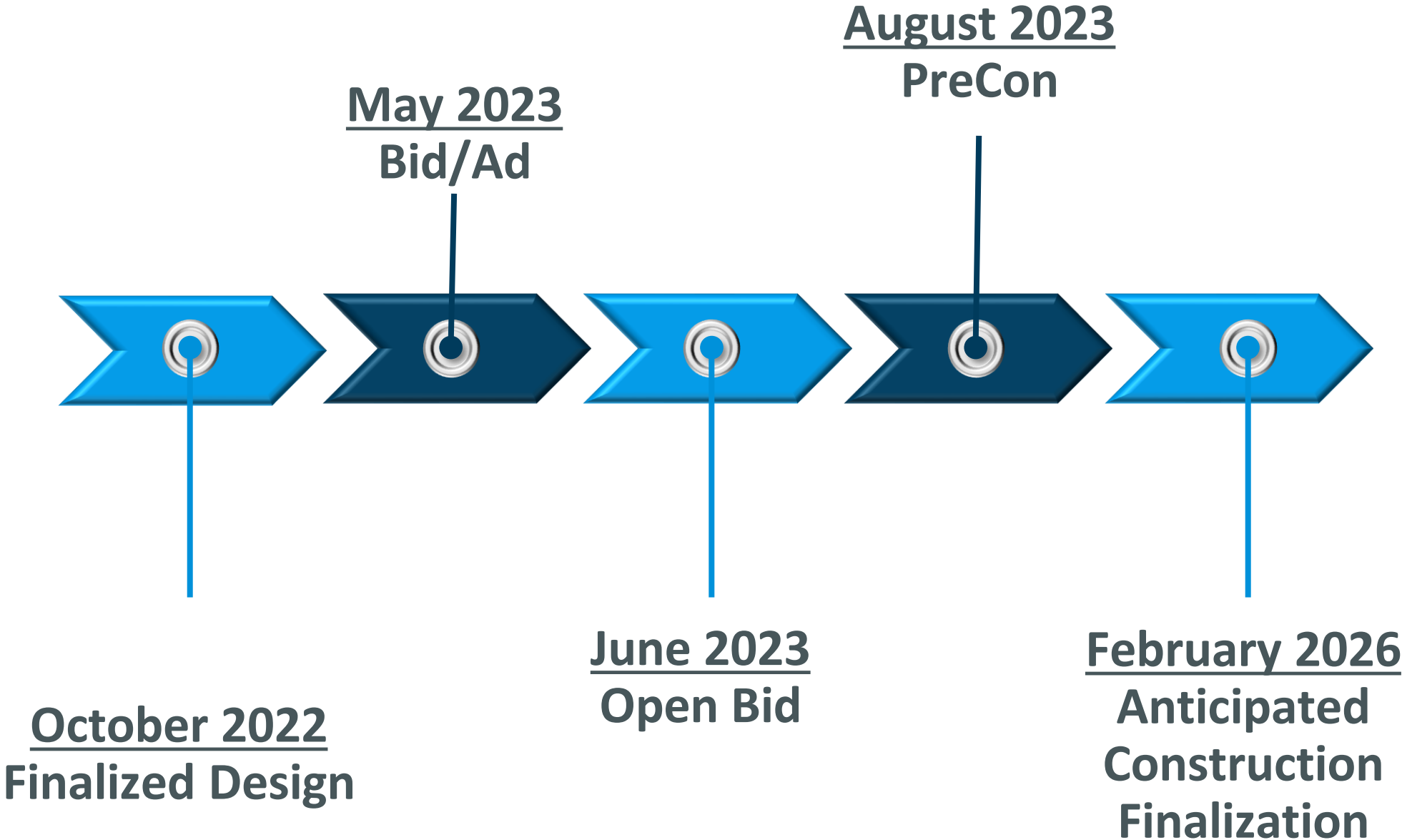
05

Project Status

Final Site



Construction Timeline



Construction Status



Project Team

Owner	City of Bellevue
Prime Consultant	Conсор, Inc
Structural Engineer	Peterson Structural Engineers, Inc.
Electrical Engineer	R&W Engineering, Inc
Instrumentation & Controls	S&B, Inc.
Landscape Design	Osborn Consulting
Geotechnical Engineer	HWA Geosciences
Public Outreach	Envirolssues
Permitting and Environmental	Confluence Environmental Company





06

Q&A

How to add a photo...

1. Click the  icon and browse to the photo on your device

How to change a photo...

1. Right click the image and select **“Change Picture”**
2. Select **“This Device...”**
3. Navigate to the image and click **“Insert”**

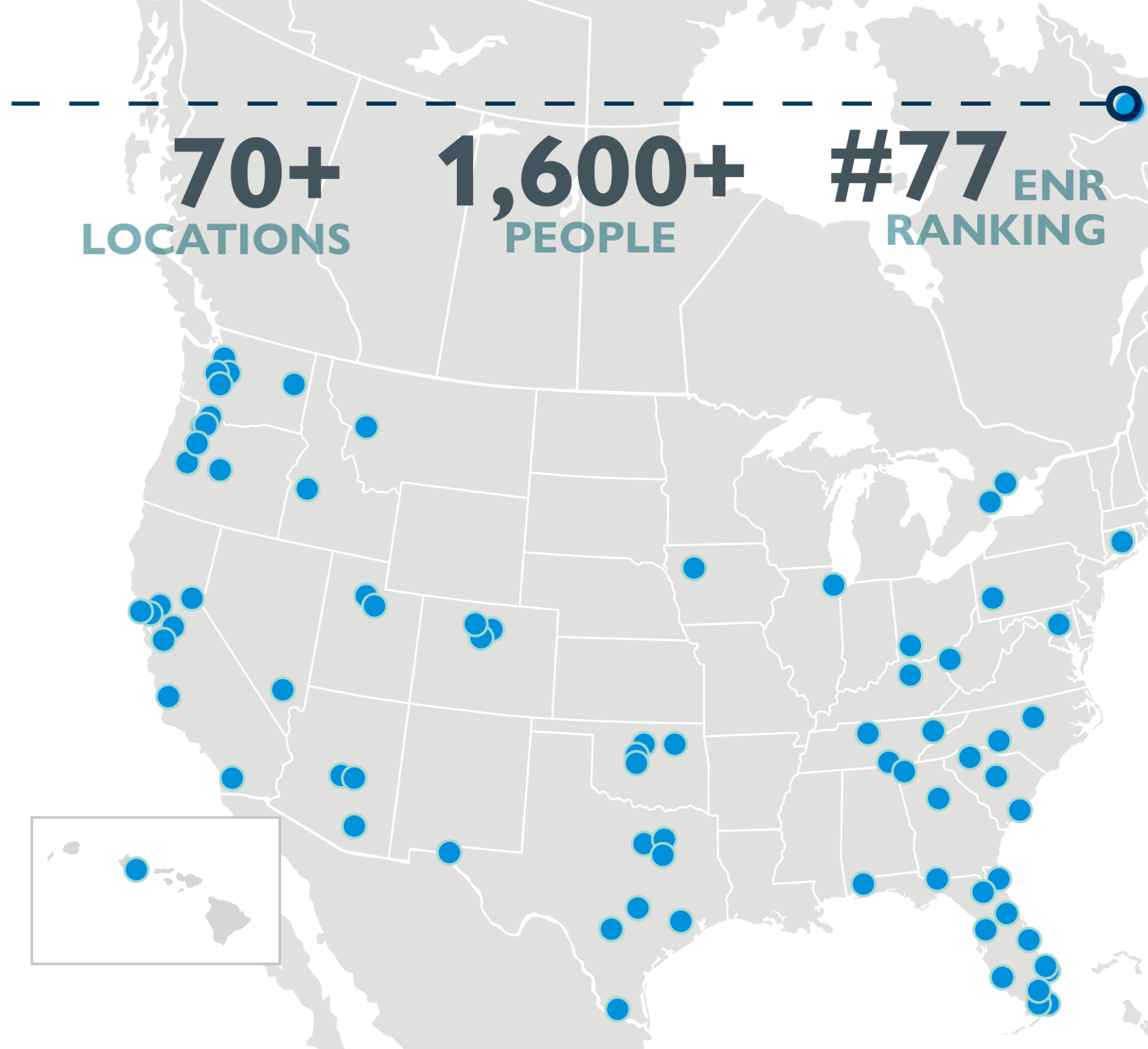
How to change the overlay color...

1. Click the image and select the **“Picture Format”** tab
2. Click the **“Color”** ribbon item
3. Select **“More Variations”** from the menu
4. Select a color from the default **“Theme Colors”**



conSOR

Who we are...



We specialize in...

WATER | TRANSPORTATION



Planning



Design



Construction
Management



Structural
Assessment



Strategic Planning
& Communications



Integrity

**TAKING CARE OF ONE
ANOTHER UNITES US.**

We build trust from individual acts—every day and in everything we do.



Grit

**DETERMINATION
DRIVES US FORWARD.**

Regardless of title, we roll up our sleeves to get the job done well.



Collaboration

**EVERY DROP
MAKES AN IMPACT.**

When we intentionally listen to a wide range of ideas and views, better solutions are created.





What?

This is the text description that will get your point across.



Meet Your Project Manager

Joe Smith | Location

WHY JOE?

- This is the text description. This is the text description. This is the text description.
- This is the text description. This is the text description. This is the text description.
- This is the text description. This is the text description. This is the text description.



FIRST LAST
role



FIRST LAST
role



FIRST LAST
role

The Team



FIRST LAST
role



FIRST LAST
role

Investing in Communities

Project Highlight



TITLE OF PROJECT
Location



Planning



Design



Structural Assessment



Construction Services



Strategic Planning & Communications

KEY POINTS



Key Point #1

HEADING STATEMENT.

Statement



Key Point #2

HEADING STATEMENT.

Statement



Key Point #3

HEADING STATEMENT.

Statement



What?

This is the text description that will get your point across.

Header

Subheader

WHAT?

- This is the text description. This is the text description. This is the text description.
- This is the text description. This is the text description. This is the text description.
- This is the text description. This is the text description. This is the text description.



02

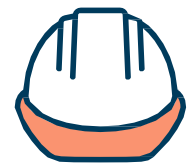
Strategy



Dk. Blue
003b5c



Sea Foam
A1D6CA



Lt. Blue
0091DA



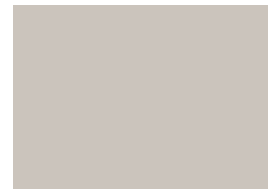
Dark Teal
006975



Dk. Grey
47565A



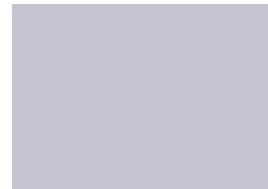
Peach
FA9370



Warm Gray 2 C
CBC4BC



Plum
621244



Periwinkle
C6C4D2