

# Improving Chemical Resiliency: Transition from Gas to On-Site Hypochlorite Generation for City of Bellingham

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2023 PNWS-AWWA Conference, Kennewick, WA

Thursday, May 4, 9:45am

# Agenda

- Project Background and Drivers
- Project Summary
- Startup and Commissioning
- Lessons Learned
- Next Steps



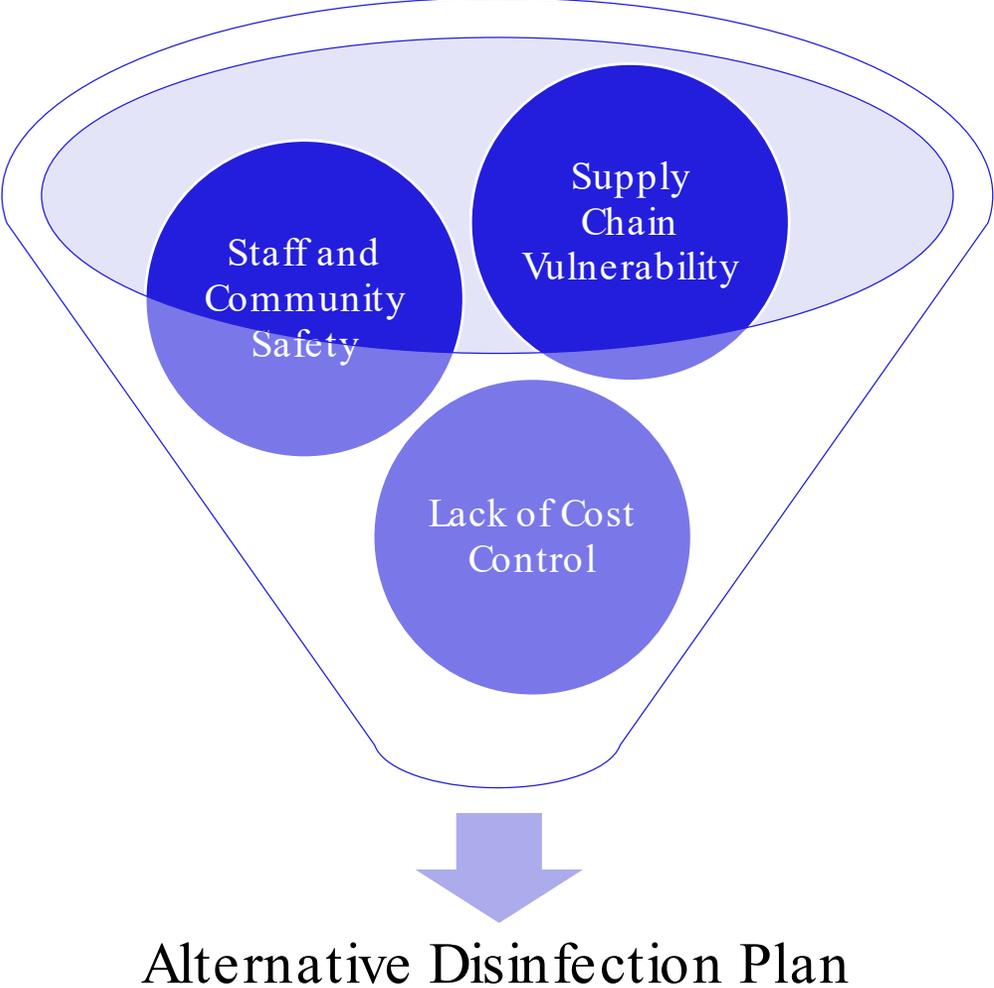
# Background and Drivers

# Background

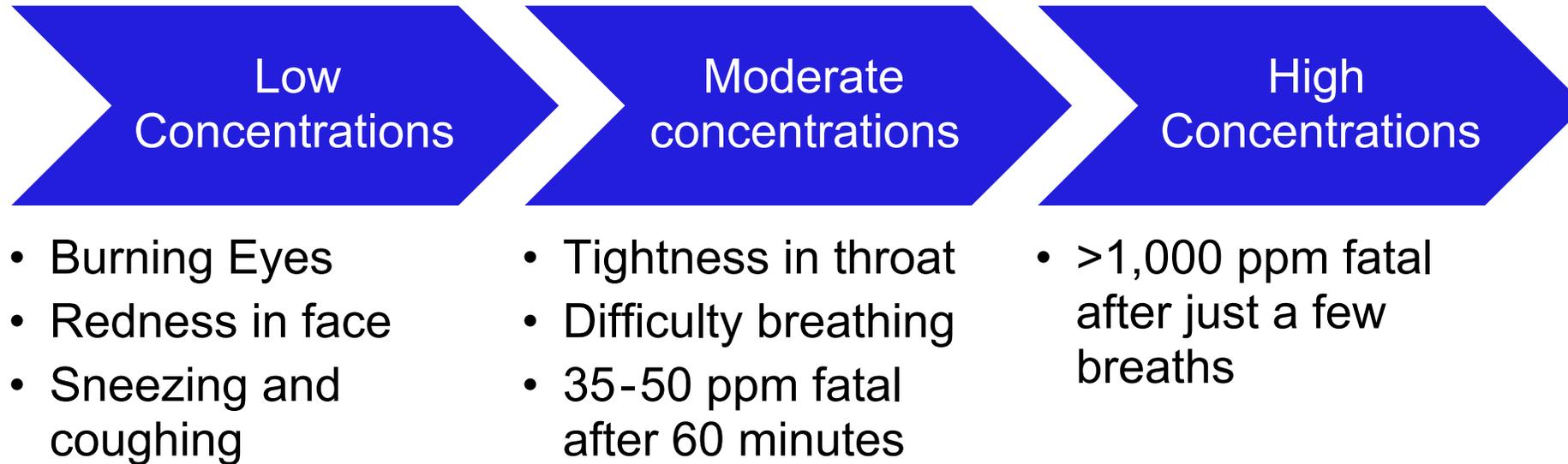
- Long history of chlorine gas use at WTP and WWTP for City of Bellingham
- Water Treatment Plant transition gas → on-site hypochlorite generation in 2018
- Chlorine used for odor control and disinfection at WWTP



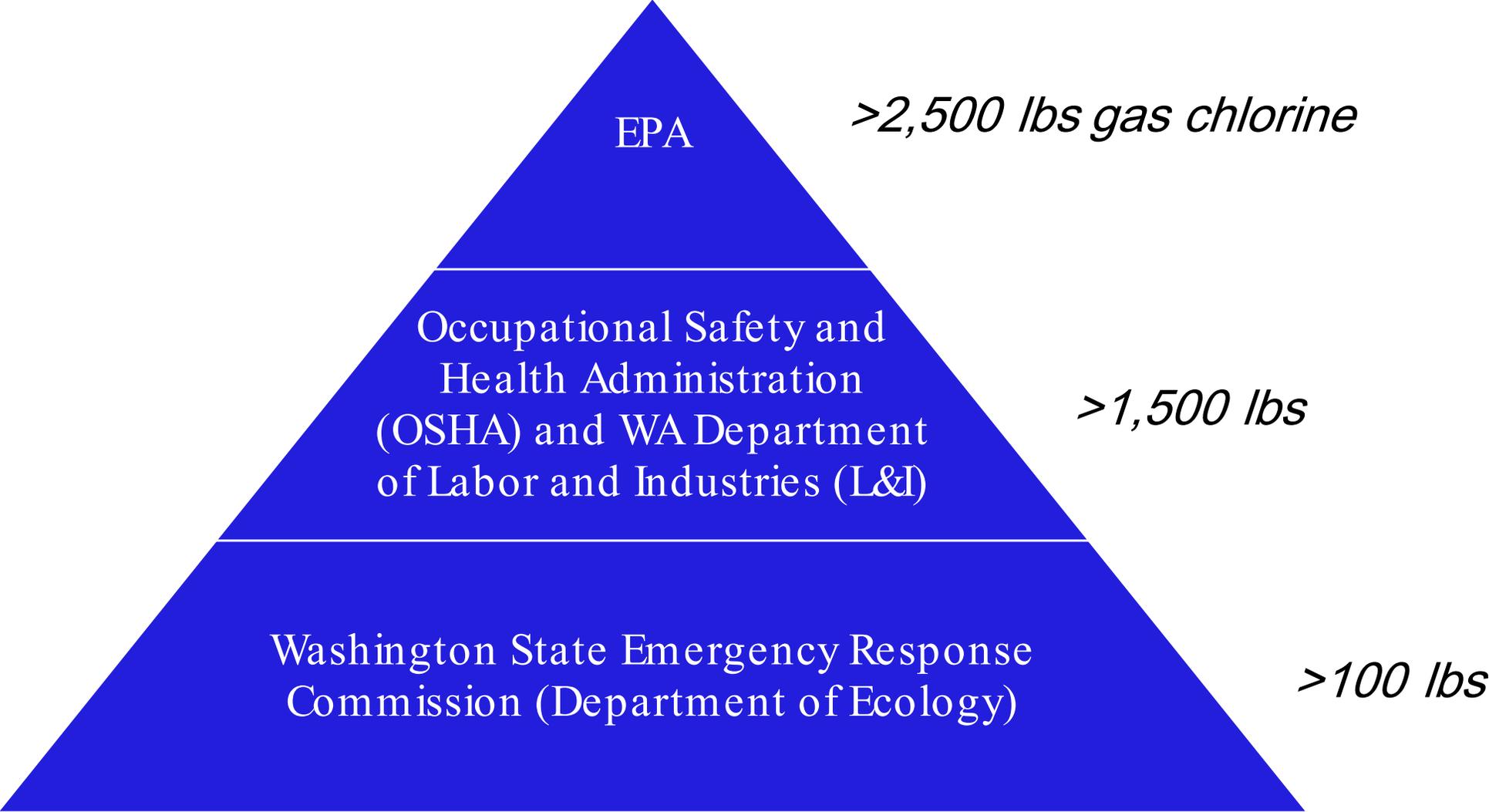
# Alternative Disinfection Drivers



# Staff and Community Safety – Health Hazard



# Staff and Community Safety - Regulations



# Supply Chain Vulnerability

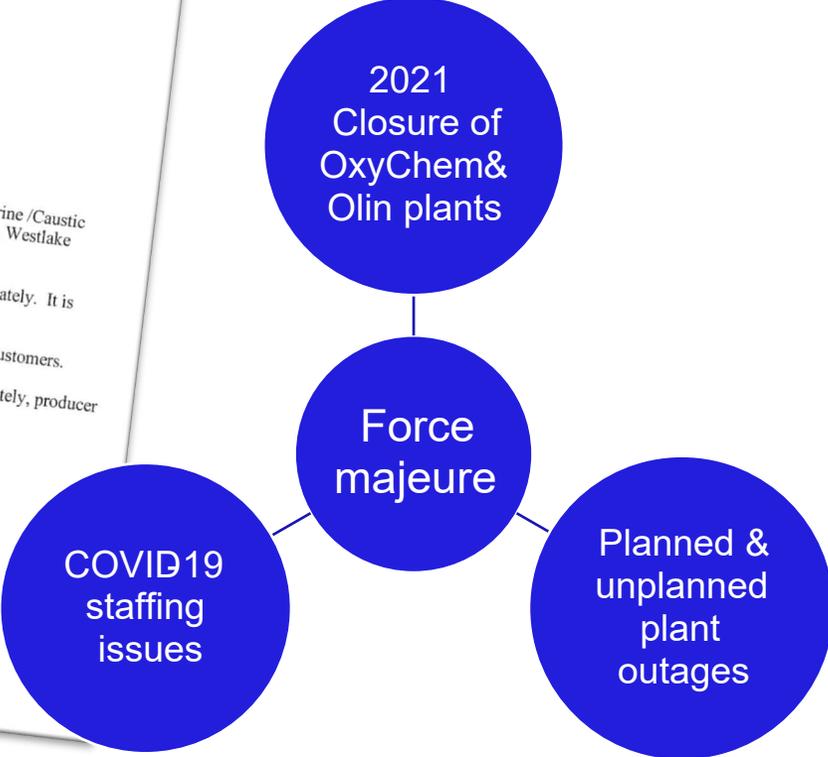
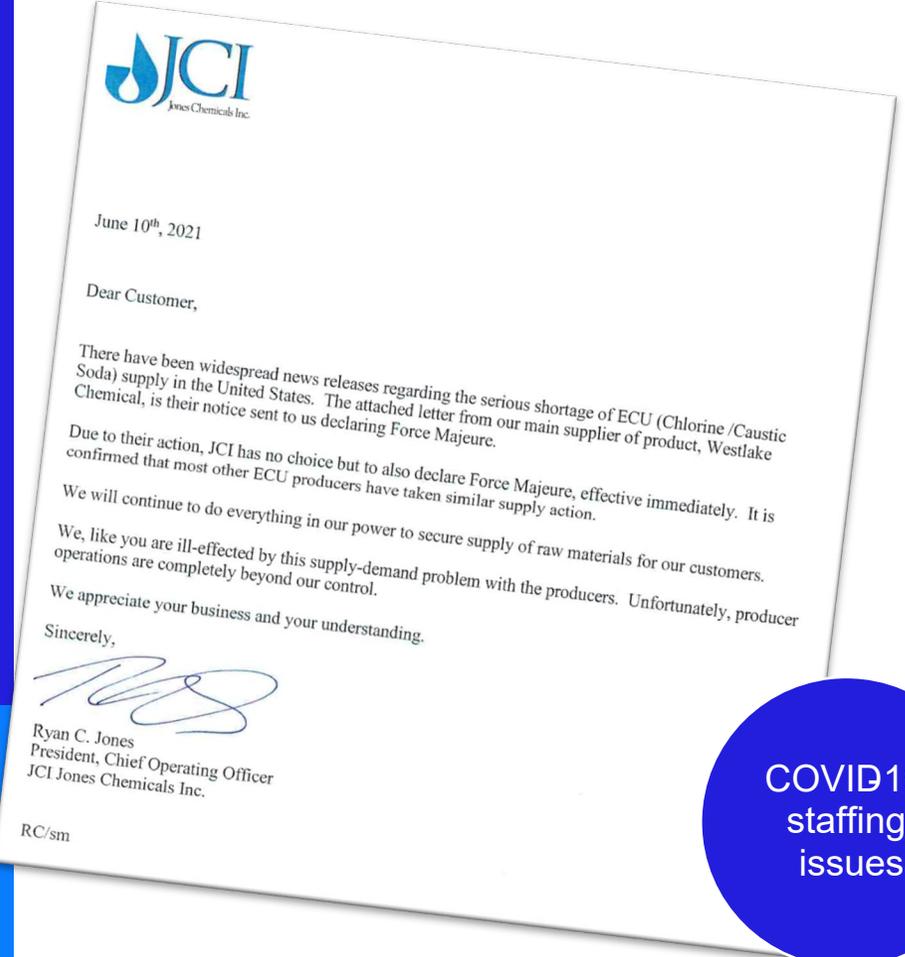


Figure 1: Chlorine gas manufacturing facilities in U.S. as of 5/5/2022

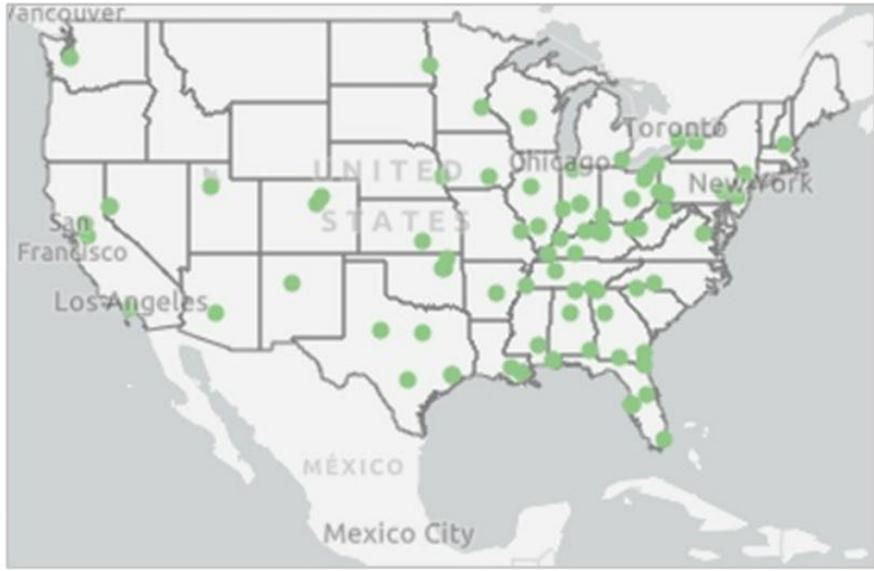
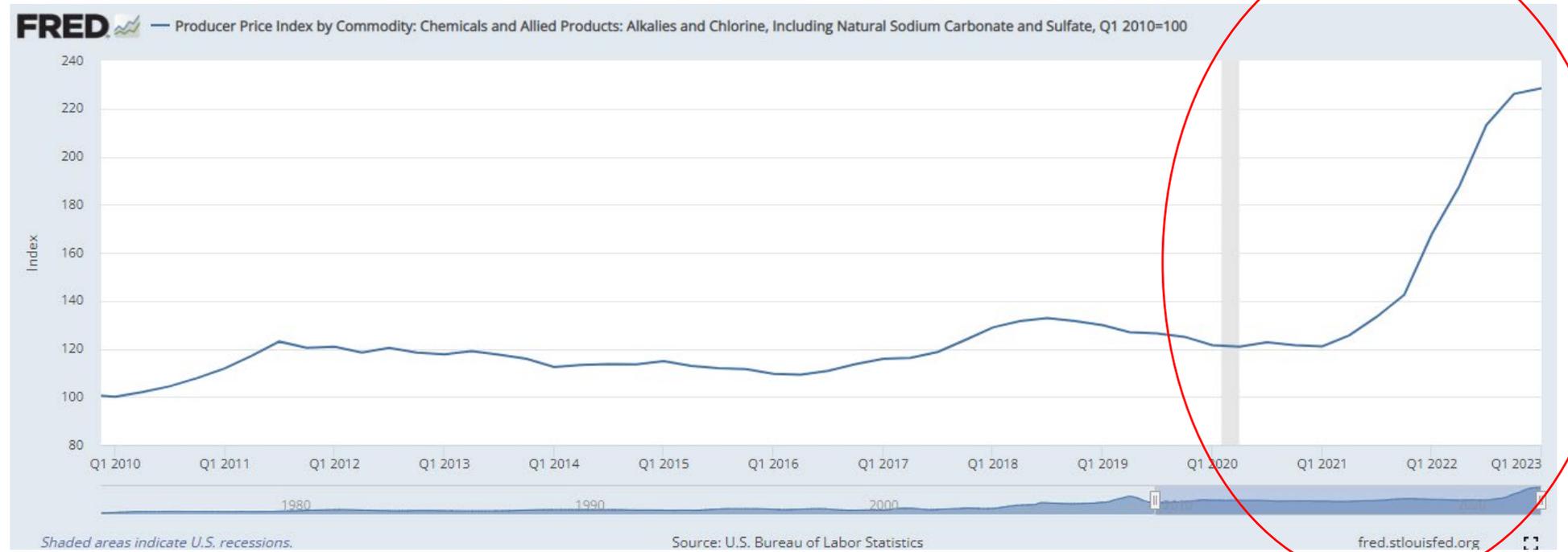


Figure 3: Chlorine gas supplier facilities in U.S. as of 5/5/2022

## Lack of Cost Control

- JCI Chemicals is only supplier in PNW
- Capacity issues and supply chain costs contributing to cost increase
  - Trucking, energy, raw materials, gas prices, railway, etc
- \$680/ton up to \$3,300/ton since 2020



# Project Summary

# Whatcom Falls WTP Upgrades

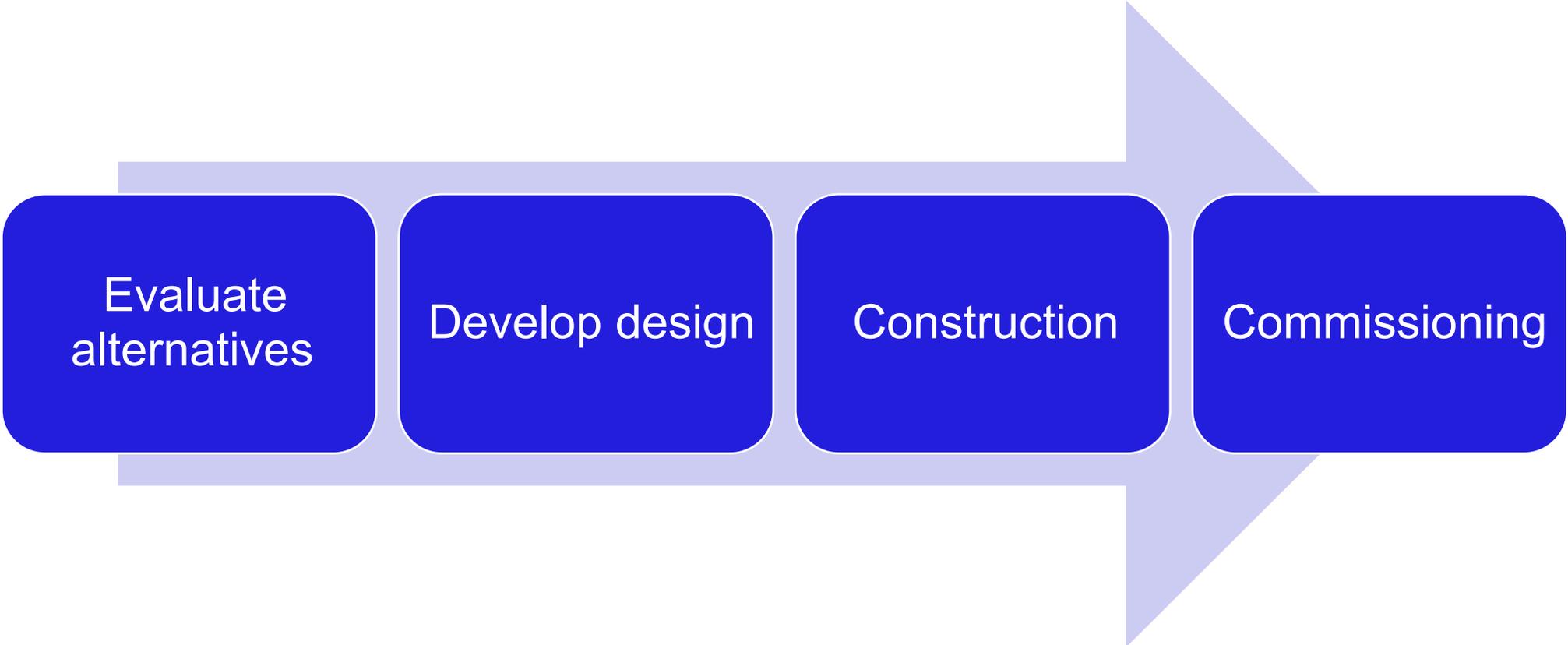
- Chlorine gas replacement
- Construction 2017-2018
- Process details:
  - 2x 450 ppd generators
  - 3x 7,500 gal hypo tanks
  - 1x 36 ton brine tank
  - Three injection points



# Whatcom Falls WTP Upgrades

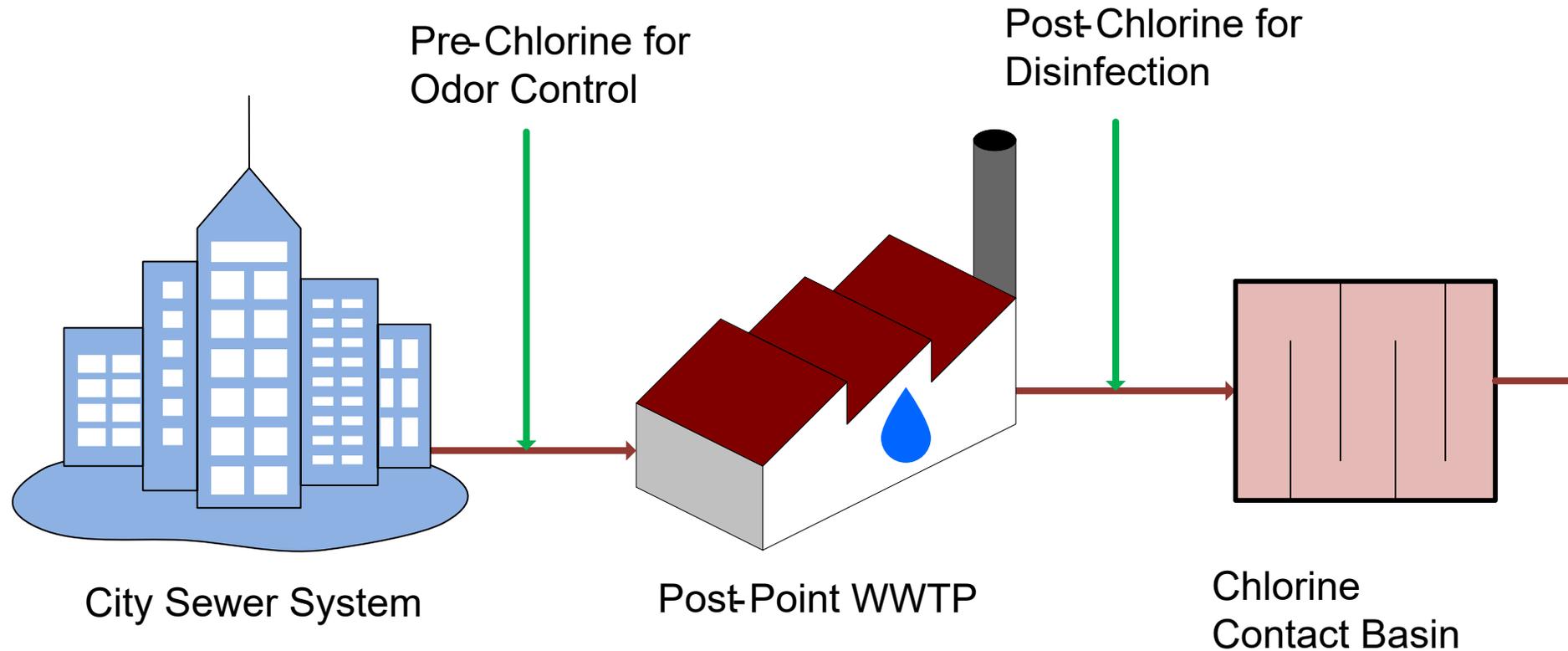


# Post Point WWTP Project Details



# Post Point WWTP

- Pre-chlorine – odor control, flexible
- Post-chlorine – regulatory disinfection, no outage >30 minutes



# Alternatives Considered

	Advantages	Disadvantages
<p>0.8% On-Site Hypo Generation</p> 	<ul style="list-style-type: none"> <li>• Improved operator safety</li> <li>• No special building code requirements</li> <li>• No chemical degradation</li> <li>• Limited supply chain &amp; cost volatility</li> <li>• Less chemical deliveries</li> <li>• Lower O&amp;M costs</li> </ul>	<ul style="list-style-type: none"> <li>• Higher capital cost</li> <li>• Dependency on electricity</li> <li>• More mechanically intensive</li> </ul>
<p>12.5% Bulk Hypochlorite</p> 	<ul style="list-style-type: none"> <li>• Long history in the industry</li> <li>• Simple technology: tanks and pumps</li> <li>• Lower capital cost</li> </ul>	<ul style="list-style-type: none"> <li>• Building improvements required to meet code (sprinklers, containment, ventilation)</li> <li>• High strength chemical presents a safety hazard</li> <li>• Off-gassing can be O&amp;M headache with air binding</li> <li>• Chemical degrades over time</li> <li>• Dependent on supply chain</li> </ul>

# Evaluation and Selection of Alternative

	2019 Construction Cost Estimate	2019 20 -year LCC Estimate
0.8% On-Site Hypo Generation	\$2 M	\$6.5 M
12.5% Bulk Hypochlorite	\$1.7 M	\$8.4 M

- *City selected on-site hypochlorite*

- *Safety* ✓
- *Reliability* ✓
- *Life Cycle Cost* ✓

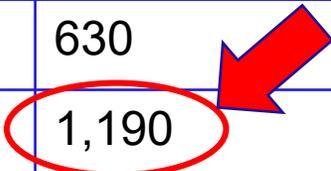
Table 4. Evaluation of Alternatives

Evaluation Criteria	Bulk Hypo	OSHG	Description
Capital Cost	+	-	Similar cost for both alternatives.
Annual O&M	-	+	Lower O&M costs for OSHG.
Life Cycle Cost	-	+	Lower 20-year life cycle cost for OSHG.
Operator Safety	-	+	OSHG is non-hazardous compared to bulk hypo.
Requires Safety Improvements to Building Infrastructure	-	+	No building safety improvements required for OSHG.
Optimized Use of Existing Facilities	+	+	Both systems can fit into existing facility.
Supply Chain Reliability	-	+	Market cost of salt is more stable than bulk hypo.
Overall System Complexity	+	+	Both systems require very little attention and maintenance.
<b>Alternative Selected</b>		✓	

# Post Point WWTP

- Historical chlorine usage (2016-2018)

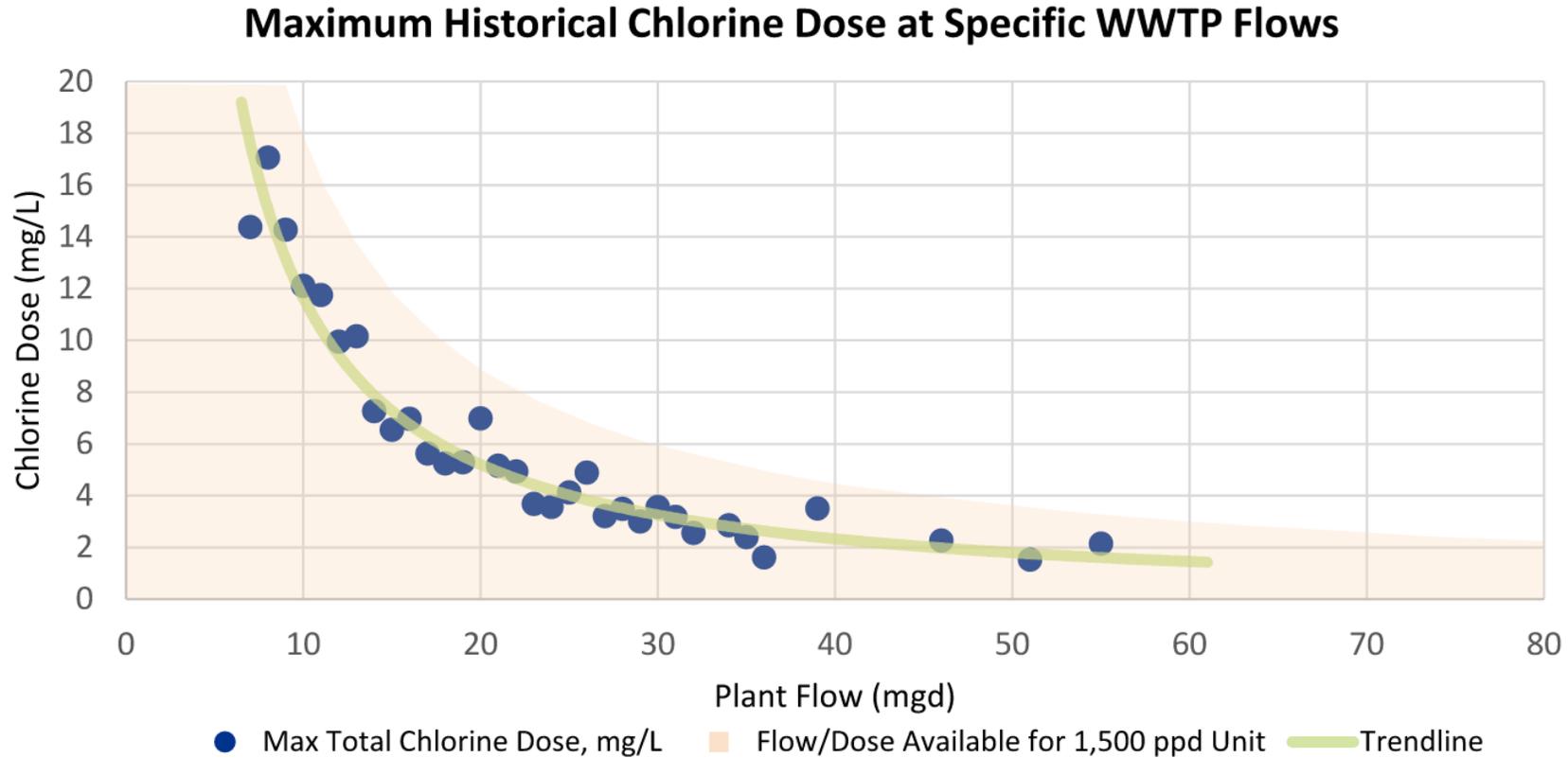
	Flow (mgd)	Pre-Chlorine (ppd)	Post-Chlorine (ppd)	Total Chlorine (ppd)*
Average	12	360	270	630
Peak Day	55	890	820	1,190
Peak Hour	72	1,000	1,000	1,900



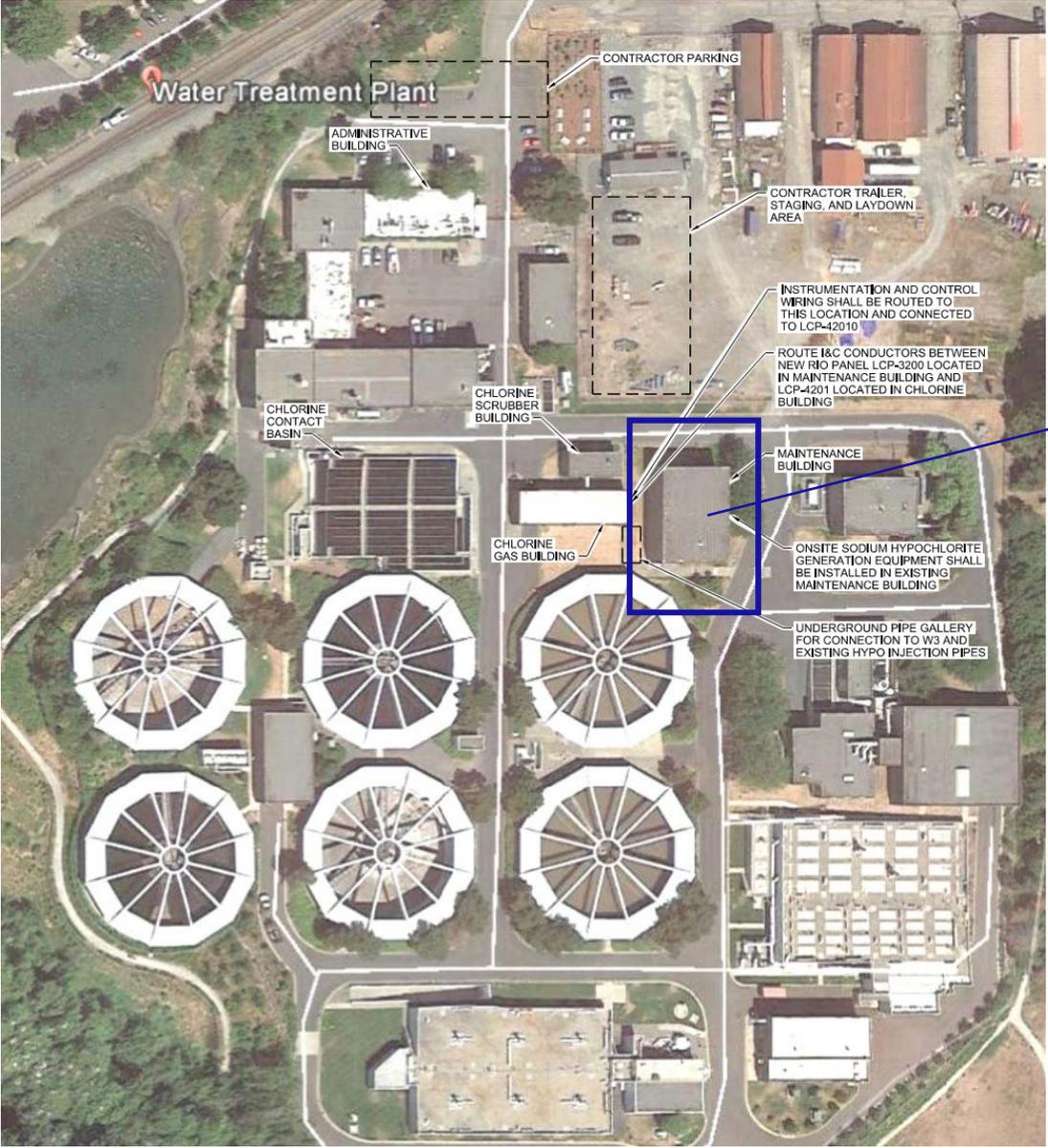
\*Not equal to sum of pre and post as historically the peaks for each injection point do not occur simultaneously

# Design of OSHG System

- 2x 1,500 ppd OSHG units selected to meet future peak day requirements



# Project Location



Existing Maintenance Building

# Design of OSHG System

## ■ OSHG

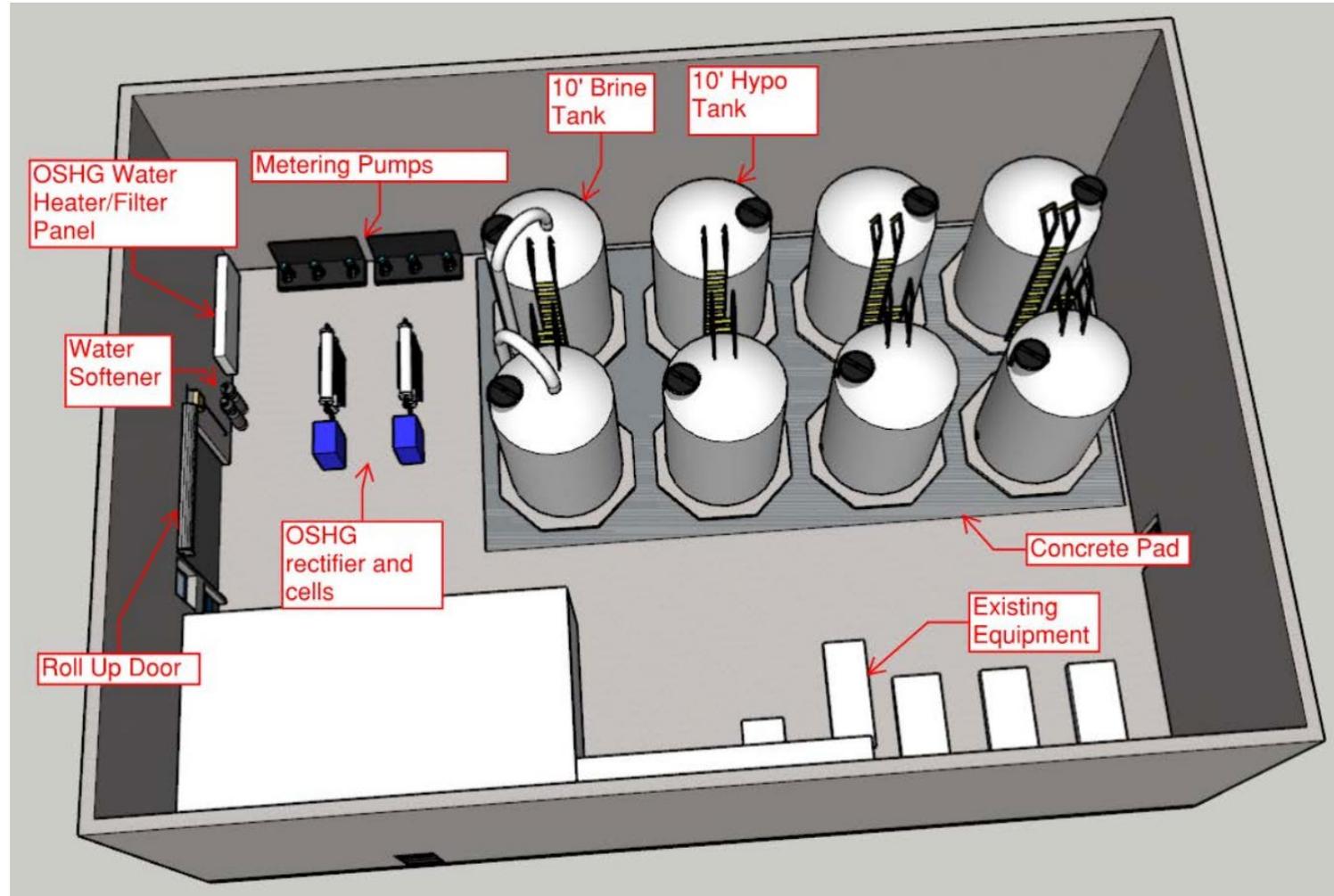
- 2x 1,500 ppd generation systems
- Fully redundant system with control panel, safety devices, etc.

## ■ Hypochlorite Storage

- 3x 8,800 gal tanks
- 3 days of storage at max day

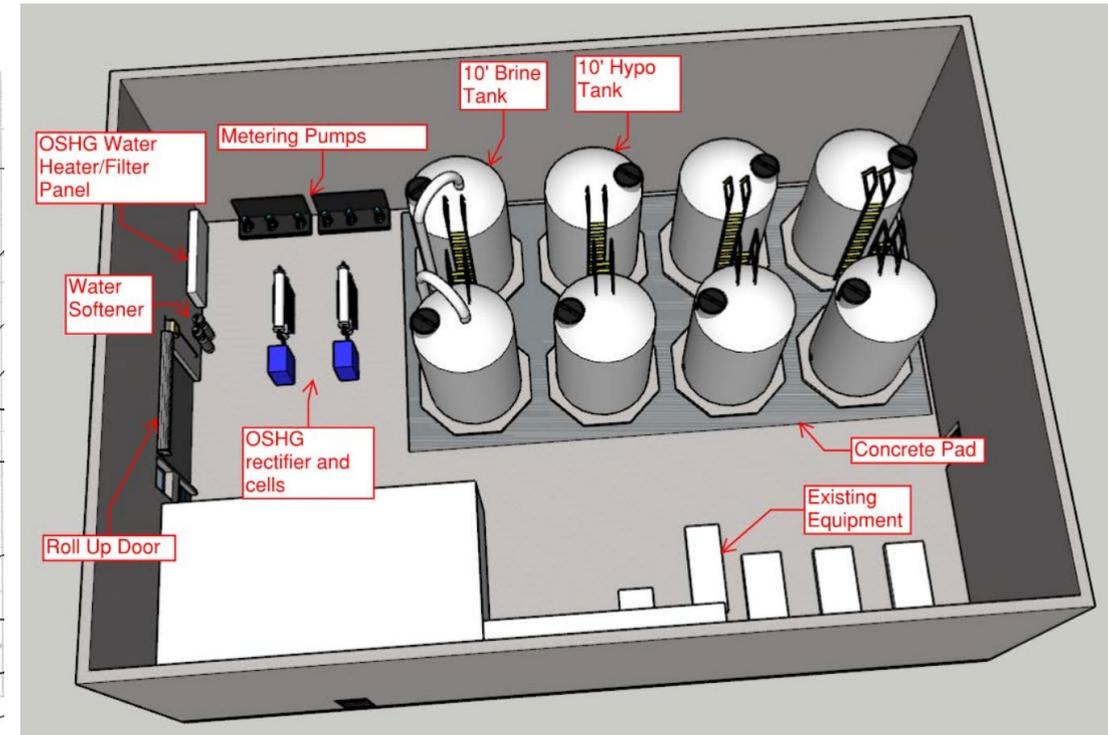
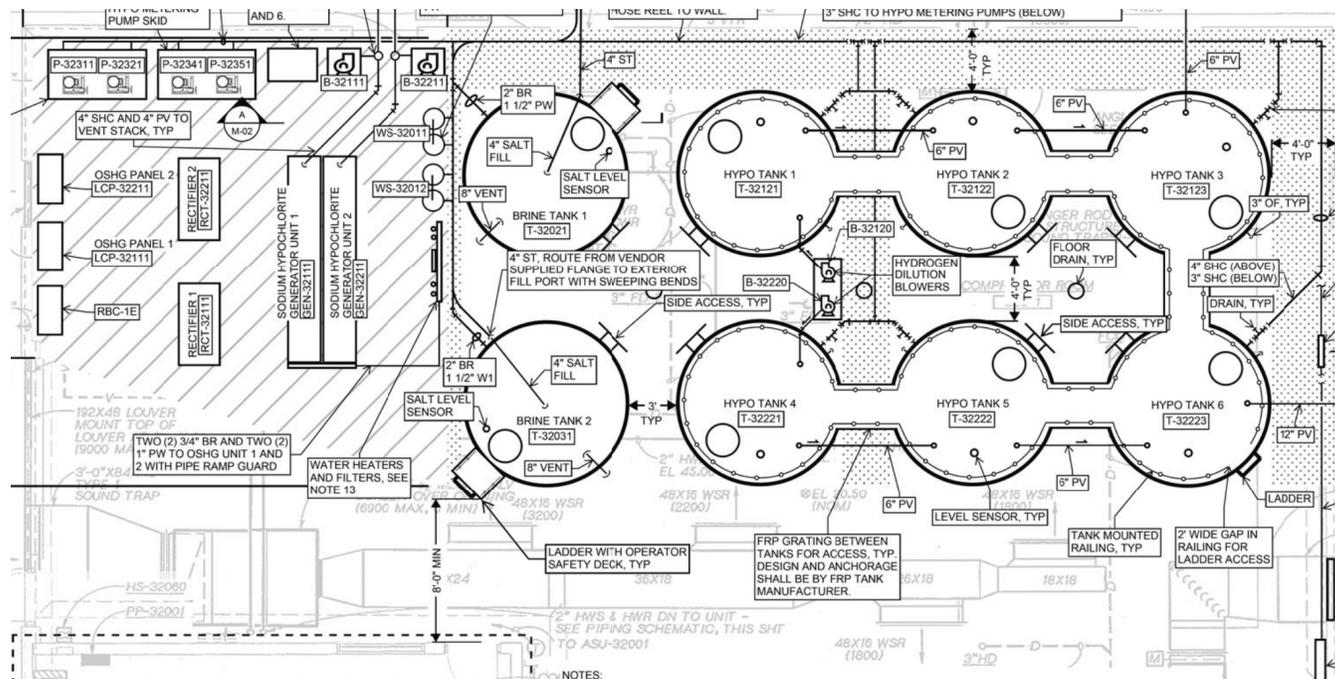
## ■ Metering Pumps

- Duty/ standby for each injection point
- 800 gph hose pumps

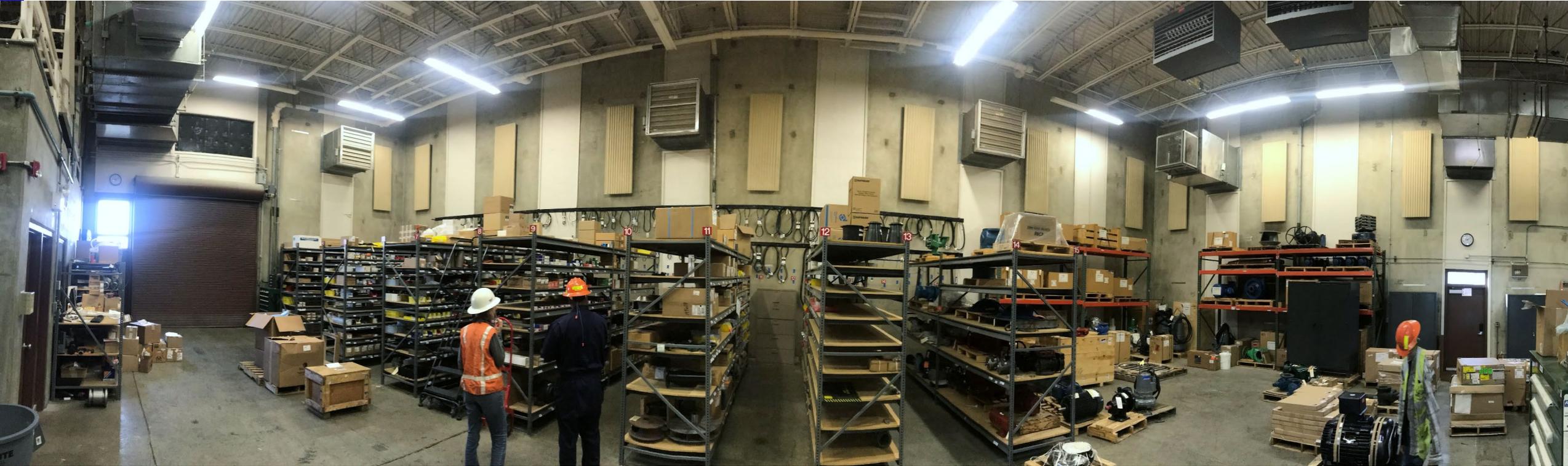


# Design of OSHG System

- Jacobs **Replica Parametric Design™** tool used for early concept development
- Firm up design concepts early for efficient delivery!



# Construction - Before



# Construction – After



# Construction – Progress Photos

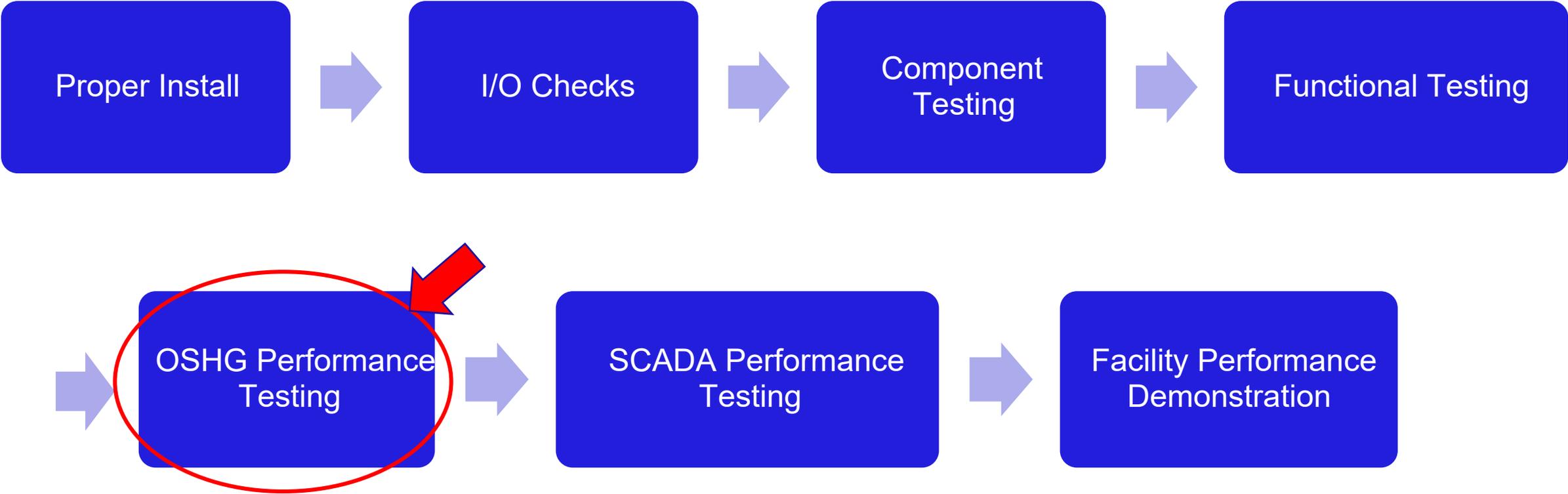


# Construction – Progress Photos



# Startup and Commissioning

# Startup and Commissioning - Process



# Startup and Commissioning – Tips and Challenges

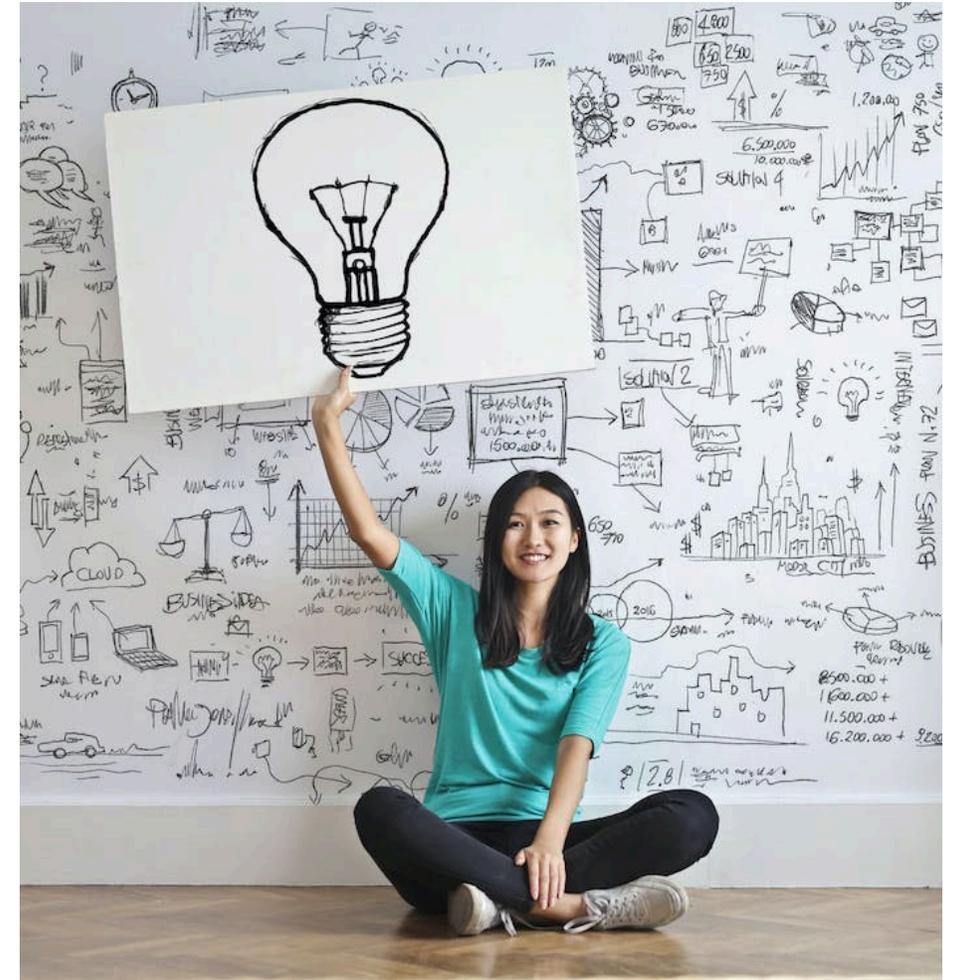
- Begin with the end in mind
- Plan, plan, plan
  - Spend the time/effort on a startup plan
  - Schedule regular coordination meetings
  - Include Contractor, Electrical sub, SCADA sub, and key vendors
- Focus on key sticking points
  - Plant shutdowns
  - Switchover to new system
  - Challenge testing new system – better to break something while everyone is on-site!
  - Where will all the 0.8% hypo go during the testing phase??



# Project Lessons Learned

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- Foundational planning
  - Budgeting, location, power systems
- Cost volatility
  - Difficult to predict project cost, where costs are heading in future
- Long lead equipment
  - May be impossible to predict all the long lead items
  - For this project, FRP tank manufacturer received DoD order which delayed tanks by 6 months
  - Keep track of long lead items, consider pre-purchase, *be flexible*



# Next Steps

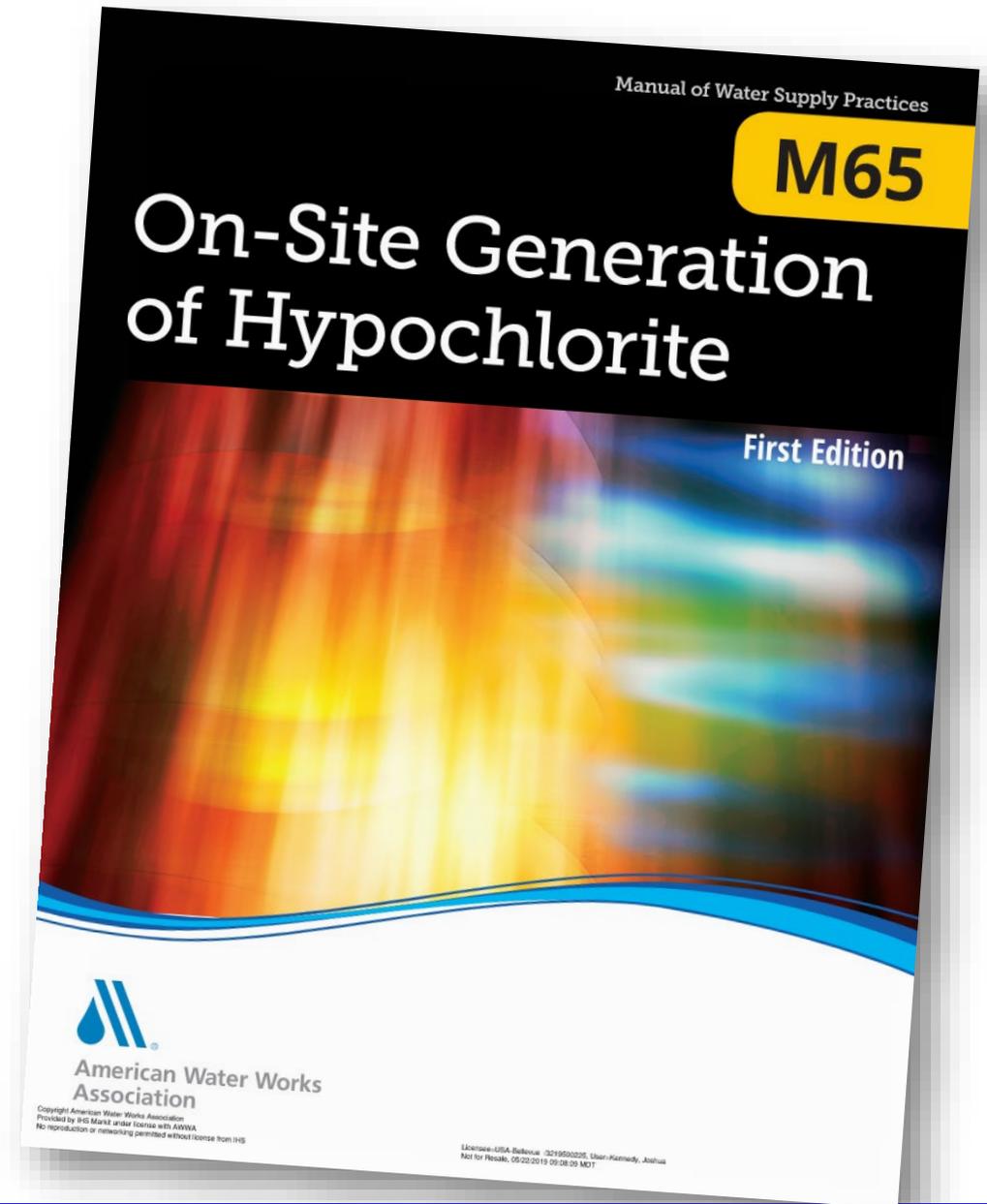
## Project Next Steps

- Performance testing by Denora this week
- SCADA performance testing next week
- Facility performance demonstration by mid-May



## On-Site Hypo in the Industry

- Technology is becoming more and more prevalent as gas chlorine is phased out
- AWWA M65 OnSite Hypo Generation Manual update to reflect the current landscape



# Thank You