Department of Homeland Security Regulatory Impacts on Monetizing Risk for Disinfection Alternatives Analysis

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Outline

- Trends and status of chlorine gas disinfection
- Drivers
  - Safety
  - Regulatory
- Impacts on chlorine disinfection lifecycle analyses
- Example: Joint Water Commission's Fernhill Water Treatment Plant (JWC WTP)

Chlorine Gas Disinfection

- New/pending regulations for storage and handling of Cl_2 gas
- Fewer manufacturers/suppliers of Cl_2 gas
  - Response to more stringent regulations
- Municipalities reconsidering water/wastewater disinfection options
- Cl_2 gas typically the apparent lowest cost chlorine disinfection alternative

Drivers and Regulatory Responses

- Safety Concerns
  - Domestic accidents
  - Potential security risks

- Regulatory
  - Prompted by safety concerns
  - Numerous governing agencies/bodies for Cl_2 gas
  - More regulation on the way?

Safety Drivers

- Events in U.S. (Transportation and Handling)
  - Graniteville, SC – 2005
  - Port of Tacoma, WA – 2007
  - Las Vegas, NV – 2007

Safety Drivers

- Events in Iraq (Used as a weapon)
  - 2007 – over ten events where chlorine was used as a weapon.
  - Targeting trucks that were transporting chlorine gas.

Regulations

What governing bodies have regulations/guidelines for transport, storage and use of chlorine?

- UFC (Uniform Fire Code) and IFC (International Fire Code)
- USEPA (U.S. Environmental Protection Agency)
- USDOT (U.S. Department of Transportation)
- PHMSA (Pipeline and Hazardous Materials Safety Administration)
- The Chlorine Institute
- NFPA (National Fire Protection Association)
- The 10 States Standards
- AWWA (American Water Works Association)
- OSHA (Occupational Safety and Health Administration)
- NIOSH (National Institute of Occupational Safety and Health)
- DHS (Department of Homeland Security)

Department of Homeland Security (DHS)

- Chlorine tank explosion is one of DHS national planning scenarios.
- SAFETY (Support Anti-terrorism by Fostering Effective Technologies) Act.
  - Created in 2002
  - Incentivizes development/deployment of anti-terrorism technologies
  - Establishes Qualified Anti-Terrorism Technology (QATT)

Qualified Anti-Terrorism Technology (QATT)

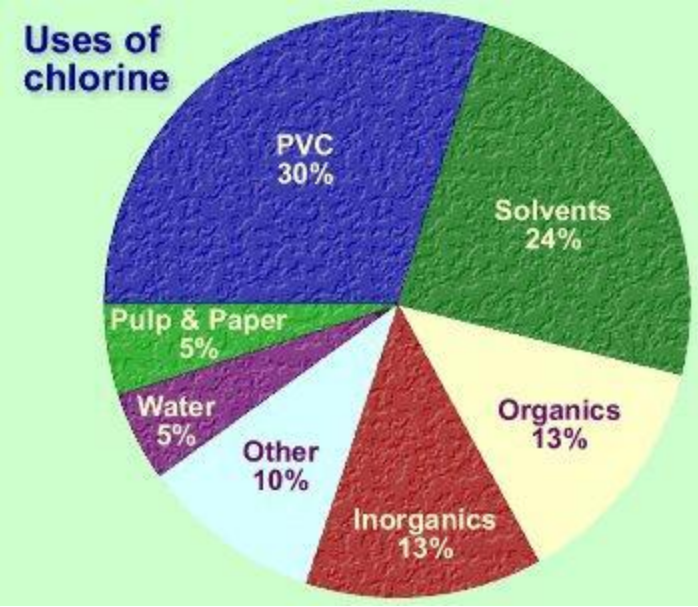
- How to promote development/deployment of anti-terrorism technologies?
  - "Ensure the threat of liability does not deter potential manufacturers…"
    - Limited liability for claims related to an act of terrorism
    - Immune to punitive damages
- QATT Certifications:
  - 2003 – 2005: six designated QATTs
  - Since 2005: approx. 70 more
- Klorigen: Certified QATT in 2010.

Other Proposed Regulations

- Several bills have been proposed addressing storage/use of chlorine that have not been passed into law yet (?)
  - Chemical Facility Anti-Terrorism Act, 2009
  - Drinking Water System Security Act, 2009
  - Secure Water Facilities Act, 2010

Chlorine Gas Availability

- Industrial production in U.S. exceeds 15 million tons/yr
- Fewer than 20 states produce
  - Large quantities must be transported

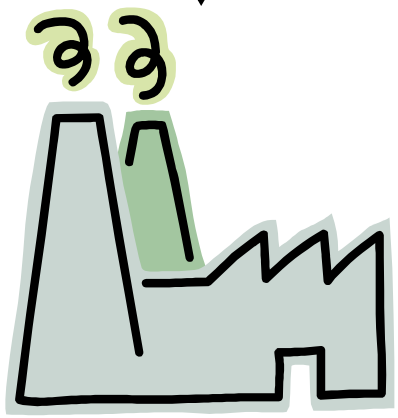


Chlorine Gas Availability

- Pacific Northwest
  - Jones Chemical, Inc – only Cl_2 gas vendor in WA
  - Sierra Chemical Co. Northern CA and Southern OR.
  - Thatcher: MT, ID, and UT
- Hypochlorite also relies on transport of Cl_2 gas
  - Not immune to security regulations on Cl_2 gas transport
  - More numerous suppliers
  - Subject to less regulatory pressure

Chlorine Gas Transport

90-ton
train tanker

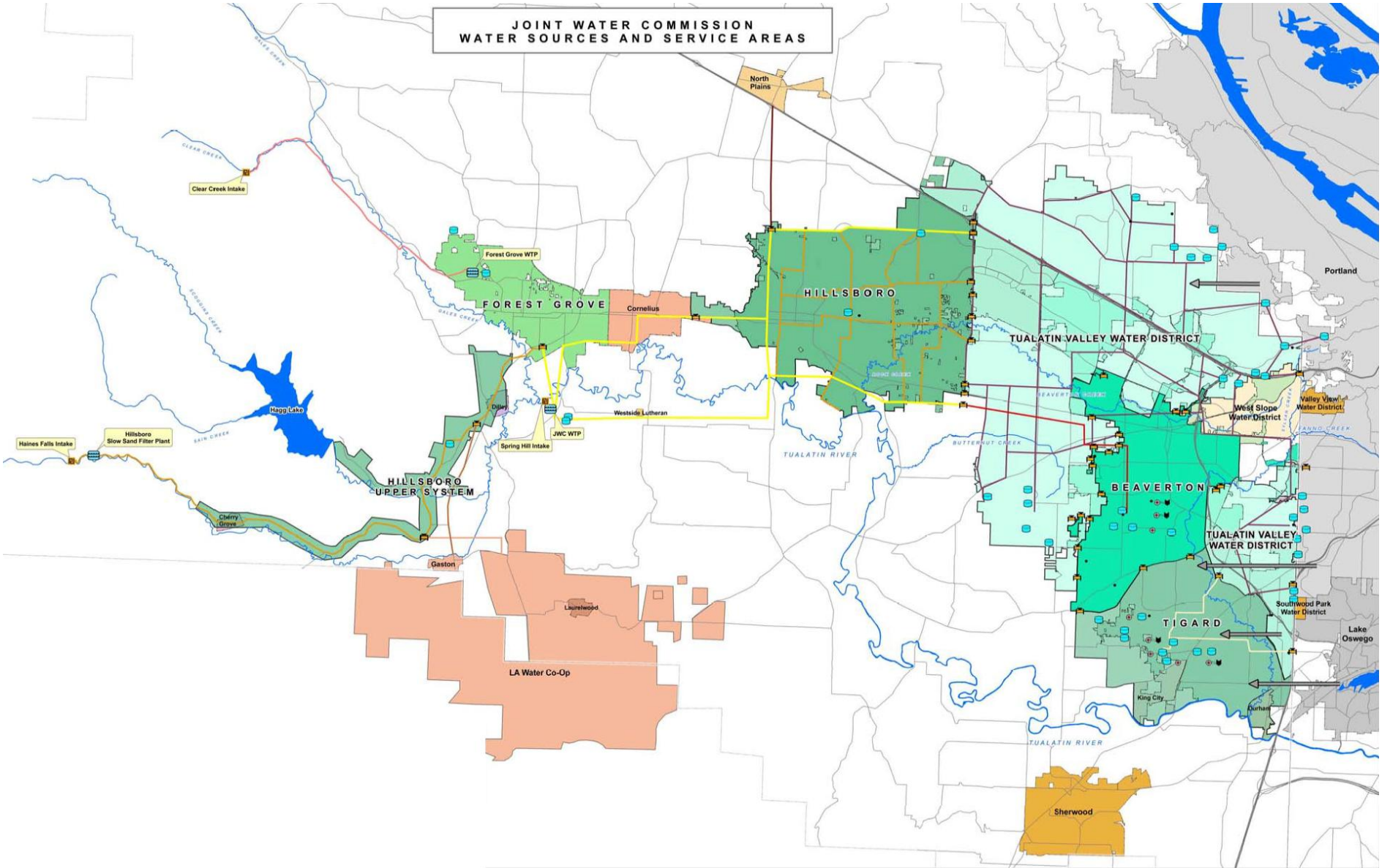


NaOCl

1-ton
cylinder

150-lb
cylinders

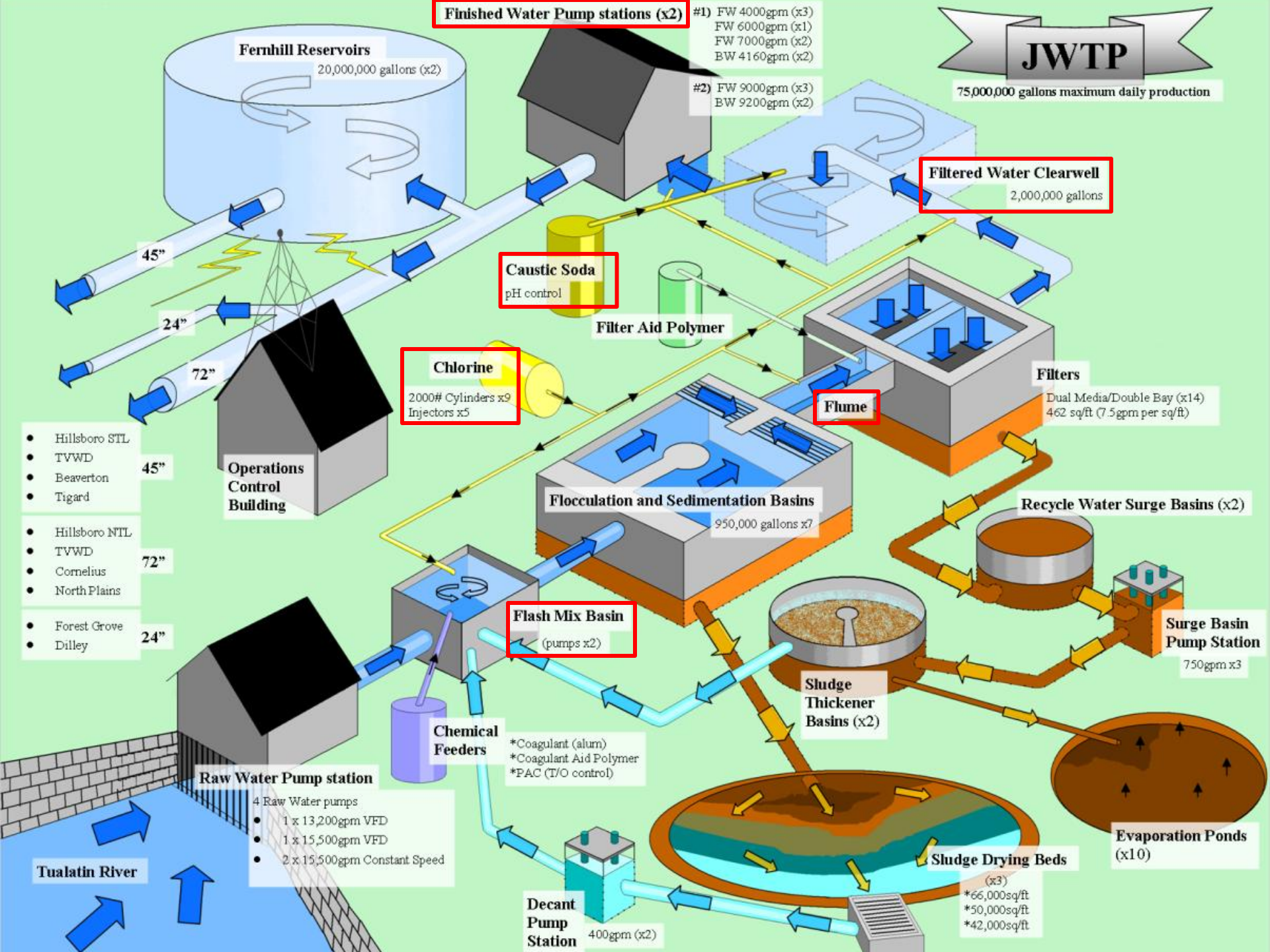
Case Study: Joint Water Commission



Joint Water Commission (JWC)

- Fernhill Water Treatment Plant (JWC WTP)
  - Distributes finished water to Hillsboro, Forest Grove, Tualatin Valley Water District, and Beaverton
  - 75 MGD peak day design capacity
- Chlorine Gas Disinfection:

Existing JWC WTP Chlorinator Sizing and Description			
Unit no.	Capacity, pounds per day (ppd)	Primary application	Control
1	1,000	Post sedimentation basin flume	Flow paced
2	1,000	Clearwell	Flow paced
3	150	FWPB 2	Flow paced
4	150	FWPB 1	Flow paced
5	750	Rapid mix	Flow paced
Total capacity	3,050		
Firm capacity	2,050		


Finished Water Pump stations (x2)
#1) FW 4000gpm (x3)
FW 6000gpm (x1)
FW 7000gpm (x2)
BW 4160gpm (x2)
#2) FW 9000gpm (x3)
BW 9200gpm (x2)
JWTP
75,000,000 gallons maximum daily production
Fernhill Reservoirs
20,000,000 gallons (x2)
Filtered Water Clearwell
2,000,000 gallons
45"
24"
72"
Caustic Soda
pH control
Filter Aid Polymer
Chlorine
2000# Cylinders x9
Injectors x5
Filters
Dual Media/Double Bay (x14)
462 sq/ft (7.5gpm per sq/ft)
Flume
Operations Control Building
Flocculation and Sedimentation Basins
950,000 gallons x7
Recycle Water Surge Basins (x2)
Hillsboro STL
TVWD
Beaverton
Tigard
45"
Hillsboro NTL
TVWD
Cornelius
North Plains
72"
Forest Grove
Dilley
24"
Flash Mix Basin
(pumps x2)
Surge Basin Pump Station
750gpm x3
Sludge Thickener Basins (x2)
Chemical Feeders
*Coagulant (alum)
*Coagulant Aid Polymer
*PAC (T/O control)
Raw Water Pump station
4 Raw Water pumps
1 x 13,200gpm VFD
1 x 15,500gpm VFD
2 x 15,500gpm Constant Speed
Tualatin River
Evaporation Ponds
(x10)
Sludge Drying Beds
(x3)
*66,000sq/ft
*50,000sq/ft
*42,000sq/ft
Decant Pump Station
400gpm (x2)

Alternatives Analysis

Alternative	Type/Strength
Chlorine Gas	Ton containers
Bulk Liquid Sodium Hypochlorite	12% delivered
Onsite Generation (low strength)	0.8%
Onsite Generation (high strength)	12.5%

Level of Service Considerations

- operator safety
- public safety
- ability to meet 2028 design conditions
  - 70 mgd average, 135 mgd peak
- ease of expansion to meet 2047 design conditions
  - 91 mgd average, 175 mgd peak
- maintenance and energy costs
- risk of supply chain interruptions

Lifecycle Cost Analysis

- 20 year analysis
- Components:
  - Capital, O&M, R&R, risk
- Assumptions:
  - Greenfield construction
  - Intermediate ozonation per master plan
  - Existing Cl_2 gas scrubber could be used
  - Caustic savings included for hypochlorite alternatives

Lifecycle Cost Analysis

Major Cost Estimation Components				
	Chlorine Gas	Bulk Liquid Sodium Hypochlorite	Onsite Hypo Generation (0.8%)	Onsite Hypo Generation (12.5%)
Capital	• Chlorinators • New building	• Storage tanks • Metering and transfer pumps • New building	• Onsite generation equipment • New building • Storage tanks • Metering and transfer pumps	• Onsite generation equipment • New building • Storage tanks • Metering and transfer pumps
O&M	• Delivery of ton containers • Caustic • General maintenance	• Delivery of liquid hypo • Caustic • General maintenance	• Salt • Power for electrolyzers • Caustic • General maintenance	• Salt • Power for electrolyzers • Caustic • General maintenance
Assumptions	• \$465/Cl_2 gas ton container • \$414/ton of caustic • Existing Cl_2 scrubber can be used	• \$0.79/gallon delivered liquid sodium hypochlorite • \$414/ton of caustic • 28 percent reduction in caustic per RTW modeling	• \$0.033/lb of salt • \$414/ton of caustic • 28 percent reduction in caustic per RTW modeling • \$0.10/kilowatt hour (kWh)	• \$0.033/lb of salt • \$414/ton of caustic • 28 percent reduction in caustic per RTW modeling • \$0.10/kWh

Monetizing Risk

- Supply chain interruption
  - No access to Cl_2 gas deliveries for 1 week each year
  - Liquid hypochlorite delivered at an inflated rate as emergency measure
  - Truck rental/demurrage and metering pump rental costs

Cost Item	Annual Risk Cost ($/yr)
Inflated Bulk Liquid Hypochlorite	$56,000
Truck Rental/Demurrage	$21,000
Metering Pumps	$5,000
Total	**$82,000**

Net Present Value Results

Chlorine Disinfection Alternatives Net Present Value						
Alternative	Description	Capital cost, present value	O&M cost, present value	R&R cost, present value	Risk cost, present value	NPV
1	Chlorine Gas	$2.77 million	$11.6 million	$265,000	$1.56 million	$16.2 million
2	Bulk Liquid Sodium Hypochlorite (12%)	$2.31 million	$12.1 million	$336,000	-	$14.8 million
3	Onsite Hypo Generation (0.8%)	$7.32 million	$9.76 million	$1.48 million	-	$18.6 million
4	Onsite Hypo Generation (12.5%)	$9.86 million	$11.8 million	$1.84 million	-	$23.5 million

Chlorine Disinfection Alternatives Net Present Value						
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4	Onsite Hypo Generation (12.5%)	$9.86 million	$11.8 million	$1.84 million	-	$23.5 million

Conclusions

- Safety and regulatory drivers are motivating municipalities to reconsider disinfection options.
- Establishment of QATTs by DHS telling example of how regulating bodies are looking at chlorine gas.
- There are significant risk costs to be considered when evaluating chlorine gas as a disinfection alternative.
- Delivered liquid sodium hypochlorite was determined to be the lowest long-term cost solution for the JWC WTP.

Questions?

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