1,2,3-Trichloropropane Regulatory Compliance Strategies and Treatment Design Considerations

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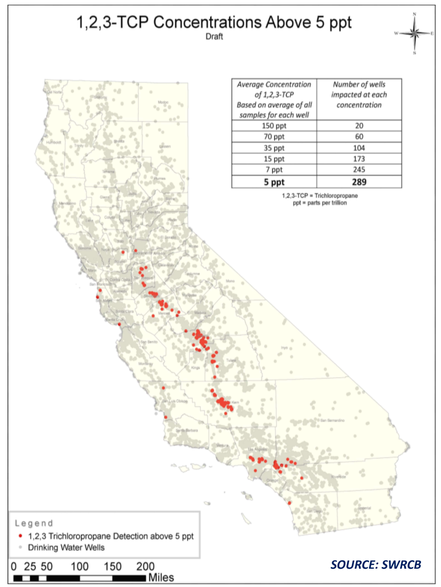
What is 1,2,3- Trichloropropane (TCP)?
- Colorless, chlorinated hydrocarbon
- Man-made, volatile organic compound
- Carcinogen
- Migrates to groundwater with minimal soil adsorption
- Persists in groundwater due to low biotic and abiotic degradation rates

Uses of 1,2,3-TCP
- Industrial solvent/degreaser
- Byproduct of chemical production
- Former ingredient/impurity in soil fumigants

Impacts on California Water Market
- Increased reliance on imported water
- Increased costs of products and to consumers
- Increased in potential violations and lawsuits due to non-compliance



Regulatory Background (*Source: SWRCB)*

As early as 1999, the California State Water Resources Control Board Division of Drinking Water (DDW) identified 1,2,3-trichloropropane (TCP) as an emerging contaminant in groundwater. On July 18, 2017, the DDW changed the status of TCP from an emerging contaminant to a regulated contaminant by adopting a California Maximum Contaminant Level (MCL) in drinking water of 5 parts per trillion (ppt). MCL became effective on Oct 1, 2017.

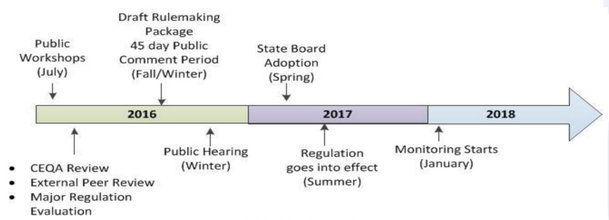
According to DDW, approximately 471 drinking water sources are affected by TCP statewide. In evaluating the economic feasibility of implementing the new regulation, DDW estimated that TCP contamination affects nearly 929,000 people, and the cost to provide treatment for the affected population is approximately $34 million. This presentation will outline regulatory compliance strategies for drinking water suppliers, and if a strategy of treatment is selected, discuss effective and economical design considerations. The State has determined that 471 drinking water sources statewide are impacted with 1,2,3-TCP (refer to the map on this page).

Public Action
- Regulations require that public water systems statewide begin quarterly sampling for TCP in their drinking water sources starting in January 2018.
- Systems will be in or out of compliance with the new drinking water standard based on average of four quarters of sampling.

If 1,2,3-TCP is detected above the MCL of 5 ppt for four quarter average, then the supplier must …
- Notify customers
- Take corrective action to resolve the exceedance and avoid future violations of the standard

Options for compliance include:
- Remove well from use and install new well in area of uncontaminated groundwater
- Purchase water from, or consolidate with, a nearby drinking water supplier
- Blend contaminated water with a clean source.
- Provide treatment either at the well head or at a centralized facility. SWRCB designates Granular Activated Carbon as the "Best available technology (BAT)" for TCP removal. Other treatment include Air Stripping, Advance Oxidation Process and combination of technologies.

1,2,3-TCP MCL DEVELOPMENT SCHEDULE*



* Schedule subject to change.

City of Livingston GAC Treatment System

Lessons Learned:
- Starting the permit modification process with DDW as early as possible
- Using existing monitoring data ("grandfathering") to extend compliance date
- Planning for a long lead time in procuring GAC vessels due to increased demand
- Developing streamline GAC design and performance specifications
- Developing rough order of magnitude capital and operation costs for early budgeting
- Configuring redundancy in lead/lag vessels in parallel to provide uninterrupted supply
- Requiring spent carbon be regenerated and returned (no mixing with other sites)
- Seeking cost recovery when possible

Case Study: Granular Activated Carbon (GAC) Design

Project Background
A large agricultural client in the Central Valley California has been using existing groundwater sources for their production needs. TRC Solutions Inc was retained to design a 2,000-GPM GAC water treatment system, develop performance specifications, solicit bids and develop an Engineer's Cost Estimate. TRC worked with major GAC vendors to obtain bids and pricing.

Raw water for facility operations is currently sourced from groundwater that is contaminated with 1,2,3-trichloropropane (TCP). Raw water is extracted from wells and treated for 1,2,3-TCP and select VOCs using GAC. Treated water is reused for production.

Water Blending Sources and Parameters

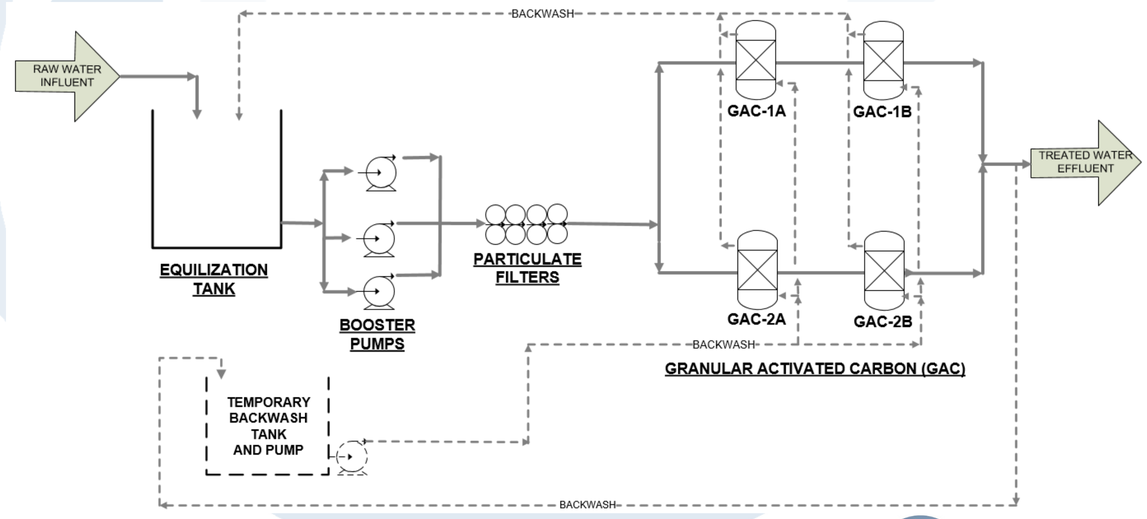
Well No.	1,2,3-TCP (ug/L) (Peak)	Flow Rate (Max)	Notes
Well 4	53.67	225	Harvest season is August through November requiring peak water demand
Well 6	4.91	500	
Well 7	1.34	700	
Well 8	1.12	600	
Well 9	5.4	500	
Well 10	0	800	

Design Parameters

Parameter	Description
Regulatory Compliance	Title 22 Code of Regulations for drinking water standards enforced by State Regional Water Quality Control Board Department of Drinking Water. Effluent: < 5 ppt MCL
Regulations / Quality Control / Certification	NSF 61 - Drinking Water System Components AWWA B604 – Food Chemical Codex Requirements AWWA B604-12 Granular Activated Carbon ASTM – Material and Testing Standards ASME Section VIII, Division 1 –Pressure Vessel Code ASME/ANSI B16.5 Piping and Fittings
Treatment System Flow Rate	Peak flow of 2,000 gallons per minute (gpm). Seasonal low flow of 600 gpm and average of 1,000 gpm
1,2,3-TCP concentrations	Influent: peak of 44 parts per trillion (ppt)
Water Reuse	Reconnect to treated water supply for production
Design Objectives	Compliance with Applicable Drinking Water Standards System Redundancy Downtime and exceedances are not an option

GAC Specifications

Parameter	Description
Equipment Configuration	Two trains of lead and lag vessels at minimum of 30,000-LB per vessel. A total of four vessels.
Isotherm	Estimated at 0.05/lb. per 1000 gallon by carbon supplier.
Empty Bed Contact Time	10-minute per lead vessel.
Material of Construction for Vessel, Piping and Fittings	• Internals manifold for carbon retention • Interior and Exterior Epoxy Coated • Carbon fill and discharge piping with valves • Vent and pressure relief piping • Sampling Ports at various locations (25%, 50%, 75%) • Grounding Lugs • Lead and Lag Piping manifold and valves. • Anti-Siphon loop • Backwash capability with manual valves. • Compressed air connection will be provided. • Sample ports on Influent, Midpoint and Effluent.
Carbon Media	Specifications as follows: • Carbon Type: Pre-washed Coconut Shell, Bituminous Coal or a combination • Screens/Mesh Size U.S. Sieve (ASTM D2862): 12x30 • Iodine Number (ASTM D4607), mg/g 1000 (min) • Moisture by Weight (ASTM D2867): 2% (max) • Effective Size 0.55–0.75 mm • Uniformity Coefficient: 1:9 (max) • Hardness No., Wt. % 95 • Abrasion Number (AWWA B604): 75 (min) • Carbon Tetrachloride Number (CTC): 60 • Apparent Density (ASTM D2854): 0.46 - 0.52 g/cc
Carbon Changeout	Approximately twice a year. Site-specific spent carbon shall be regenerated with virgin carbon added as-needed for reuse. Regenerated carbon must return to site facility (i.e., no regenerated carbon may be delivered that originates from a different site/owner).
Backwash	Approx 1,000 gpm by partially diverting treated water to a temporary backwash tank and pump and recirculating flow to Equalization tank and through the bag filters to capture the fines. Hence, eliminating the need for an auxiliary water source and wastewater discharge.



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