

City of Coachella

Testing and Evaluation of an Alternative
Treatment Process for Removal of Chromium-6
from Groundwater and Water System Planning

Corona Environmental Consulting, LLC

January 8, 2024



Castulo Estrada
Utilities Manager
City of Coachella
53462 Enterprise Way, Coachella, CA

Dear Mr. Estrada,

Corona Environmental Consulting, LLC (Corona) is pleased to submit our proposal to the City of Coachella and the Coachella Water Authority (CWA) in response to the Request for Proposals for the “Testing and Evaluation of an Alternative Treatment Process for Removal of Chromium-6 (Cr-6) from Groundwater and Water System Planning” issued November 8, 2023. Corona is excited to have an opportunity to work with CWA on this issue again as our group has decades of experience understanding, improving, and implementing Cr-6 treatment technologies, including the pilot testing of reduction coagulation filtration with both stannous chloride and ferrous chloride for CWA in 2016. For this effort, we have teamed with our friends and colleagues at Water Works Engineers (WWE) who bring specific expertise in the design and implementation of groundwater treatment systems throughout California and the southwest.

The Corona team is uniquely qualified to support CWA for these efforts having recently completed a pilot study in Dixon, CA that evaluated the long-term implication of stannous chloride application without filtration. In addition, our team has been actively researching and implementing advances in Cr-6 treatment solutions since the previous maximum contaminant level (MCL) was rescinded.

Our proposed approach, as detailed herein, builds upon our previous efforts with CWA and will draw upon our unparalleled experience with the treatment of Cr-6 in groundwater systems, including neighboring systems of Indio Water Authority and Mission Springs Water District. We look forward to working side-by-side with you and CWA staff to effectively solve this challenge and best meets your community’s needs.

Very truly yours,



Craig Gorman
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1 Proposer Statement of Qualifications

1.1 Executive Summary

Corona Environmental Consulting, LLC (Corona) is the most recognized drinking water consulting firm to address hexavalent chromium (Cr-6) compliance concerns for drinking water utilities. We previously supported CWA in 2016-17 and have continued to advance the water community’s understanding for Cr-6 treatment. Following our demonstration of stannous chloride without filtration in the Coachella Valley Water District (CVWD) ID-8 Sky Valley system, Corona just completed bench- and pilot-scale testing of stannous chloride without filtration for Cal Water in Dixon, CA to inform remaining concerns. Those tests confirmed concerns for using stannous chloride without filtration to achieve compliance with the anticipated Cr-6 MCL, namely the release of total chromium, at times several orders of magnitude greater than the current 50 µg/L total MCL. We are glad to partner with **Water Works Engineers (WWE)** with their design and cost estimating expertise. Our proposed approach will (1) evaluate stannous chloride, (2) evaluate Cr-6 treatment technologies in today’s context, and (3) deliver a Preliminary Design Report and Work Plan to meet California Department of Water Resources (DWR) expectations.

1.2 Qualifications and Experience

Corona is a nationally recognized drinking water consulting firm and a leader in addressing complex technical issues confronting the drinking water community. Over our ten years in business since founding in 2013, Corona has built a reputation based on the success of our recommended solutions and fulfilling our clients’ needs. Within the drinking water community, Corona fills a unique role as a specialty consulting firm with the sole purpose of identifying and solving new and previously unsolved problems for the water community through the application of state-of-the-art engineering, science, and technology.

With respect to Cr-6 treatment, Corona brings unapparelled experience and our pioneering research has resulted in significant improvements to the listed Best Available Technologies lowering both capital and operational cost expectations. In 2016, Corona was asked by CWA in 2016 to accompany Hazen as a subconsultant on their contract developing the *2016 Coachella Water Authority Hexavalent Chromium Treatment Facilities Project Basis of Design Report (2016 BDR)* to provide input and oversight of piloting both stannous and ferrous reductants as part of the reduction coagulation filtration process (RCF). The RCF technology had shown increased promise after our team conducted comprehensive pilot testing for the City of Watsonville, CA. Corona and Hazen conducted RCF pilot testing for CWA after the 2016 BDR was issued. The RCF pilot testing concluded in the July 25, 2017, Draft Report by Hazen and Corona, *Coachella Water Authority Stannous Chloride and Ferrous Chloride Testing for Hexavalent Chromium Removal* that the advancements in the RCF process resulted lower lifecycle costs than regenerable strong base anion exchange (SBA) which was previously identified as the preferred Cr-6 treatment technology in the 2016 BDR. Further, the report also commented on the use of Cr-6 reduction using stannous without filtration and recommended filtration be included to be protective of public health.

Table 1. Comparison of CWA Cr-6 Lifecycle Treatment Costs from July 25, 2017, Draft Report “Coachella Water Authority Stannous Chloride and Ferrous Chloride Testing for Hexavalent Chromium Removal by Hazen and Corona (Table 1, page ES-5).

Item	RCF with Ferrous or Stannous	SBA ¹
Capital	\$22.5M	\$13.1M to \$34M
O&M	\$0.9M to \$1.2M	\$1.5M to \$2.7M
Annualized Lifecycle	\$1.9M to \$2.2M	\$2.9M to \$3.3M

In addition to our previous support of CWA to assess Cr-6 treatment, our team has also supported other local area water providers including Indio Water Authority, CVWD, and Mission Springs Water District in addition many others across California.



Figure 1. Tin and chromium residuals accumulated in pipe following pilot testing of stannous chloride without filtration in Dixon, CA (2023).

Recently in 2023, our team concluded a pilot-scale study of stannous chloride without filtration in Dixon, CA, near Sacramento, for California Water Service. This pilot testing confirmed concerns for using stannous chloride without filtration to achieve compliance with the anticipated Cr-6 MCL, namely the release of total chromium, at times several orders of magnitude greater than the current 50 µg/L total MCL, from distribution system and premise plumbing fixtures, and high concentrations of tin from residual stannous. Figure 1 shows tin and chromium residuals that had accumulated in the pipe up until decommissioning of the pilot equipment which operated intermittently for approximately 12 weeks. Based on the results of these efforts, neither the California Water Service, nor the project team believe direct application of stannous for Cr-6 control is a viable treatment approach. The experience and lessons learned from this study will streamline our proposed efforts and provide immediate value to CWA.

Along with our in-house team of water quality and treatment experts, we are pleased to also introduce our preferred partner **Water Works Engineers (WWE)**. WWE was formed in 2005 with a vision to grow a new kind of engineering firm, a firm built on providing exceptional client service from highly experienced engineers in a “hands-on” highly interactive and enjoyable environment. To serve our clients throughout the Western United States, WWE has 100+ employees based in Los Angeles, San Diego, San Mateo, Redding, Roseville, CA, as well as Scottsdale, AZ, Salt Lake City, UT, Albuquerque, NM, and Star, Idaho.

WWE brings extensive experience in the planning and design of water and wastewater pumping, conveyance, and treatment systems. Our expertise includes both process and process-mechanical design of facilities with a broad range of size and complexity to ensure that the facility will provide long-term, reliable, and cost-effective performance. We are committed to providing well thought-out projects that meet our client’s schedule and budget exceed expectations for quality, efficiency, and attention to detail. Our team’s principals and staff have extensive experience with facilities representing a broad range of size and complexity and continually strive to provide practical approaches to projects. WWE’s focus and work approach allow us to provide high-quality planning and design products very efficiently.

Corona and WWE have an extensive history of collaboratively addressing water utility clients’ needs. We are currently working together to support Indio Water Authority efforts to address Cr-6 their concerns and have previously done so for California Water Service. We are confident the Corona/WWE team will exceed CWA’s needs and expectations for this effort. Collectively our team brings leading innovators in water quality analysis, groundwater treatment and optimization, design and implementation, which will be of critical importance when addressing a new MCL that has yet to have a handbook written to determine a utility’s most appropriate path to compliance. Introductions to key staff members are provided below along with resumes included as an appendix to this proposal.

1.2.1 Introduction to Key Staff Members

Dr. Chad Seidel, Principal-in-Charge, is President at Corona Environmental Consulting, LLC where he brings his more than 20 years of consulting experience serving the drinking water community by providing small and large drinking water utilities with process engineering services, from optimization of existing conventional treatment processes to the application of advanced treatment processes for controlling emerging contaminants. Chad has been assisting Cr-6 impacted water utilities in California since 2000. He has led the discovery, testing, and implementation of Cr-6 treatment advances regarding strong base anion exchange, ferrous reduction coagulation filtration, and others to achieve millions of dollars of cost savings for impacted utilities. Chad will direct this project to realize the best, most cost-effective Cr-6 treatment strategy for CWA. Chad will act as principal-in-charge for all project activities.



Craig Gorman, Project Manager, has nearly 20 years of experience dedicated to the treatment of inorganic contaminants in drinking water. Craig has led technology selections, bench- and pilot-scale evaluations, cost estimating and design efforts for inorganic contaminants including Cr-6, arsenic, nitrate, fluoride, boron, uranium, and radium. Specific to Cr-6 treatment, Craig led the development and implementation of pilot testing programs that have revolutionized the treatment marketplace for technologies such as regenerable strong base anion exchange, non-regenerable ion exchange, and reduction coagulation filtration. Recently, Craig was Corona’s technical lead for a pilot study that investigated the use of stannous chloride without filtration. This study exposed significant concerns for the long-term use of this approach for Cr-6 compliance purposes. Craig will act as Corona’s project manager.



Brittany Gregory, Project Lead, is a Water Process Engineer at Corona Environmental Consulting, where she focuses on drinking water treatment selection through alternative treatment assessments, along with treatment process optimization supported by bench- and pilot scale testing. Brittany has led or supported numerous pilot-scale studies in California, most recently a pipe loop study completed to better understand the fate of stannous chloride when used as a reductant for Cr-6 treatment in the absence of filtration. Brittany also has extensive experience in large data management, data visualization tools, and treatment process modelling. Brittany will act as our project lead and will direct any identified bench- or pilot-scale activities.



Dr. Anthony Kennedy, QA/QC, is a water process engineer at Corona and has 10 years of experience as a drinking water and water reuse engineer specializing in advanced water treatment processes such as adsorption, ion exchange, and membrane separation. With the City of Longmont, Denver Water, US Bureau of Reclamation, and Corona, Anthony has performed and led alternative treatment assessments, modeling, water quality assessments, bench- and pilot-scale evaluations, applied research, budgetary cost estimating, and conceptual design efforts for drinking water and water reuse projects that have addressed organic matter, organic micropollutants including per- and polyfluoroalkyl substances, total dissolved solids, taste and odor causing compounds, metals, arsenic, radium, nitrate, selenium, hexavalent chromium, fluoride, and disinfection byproducts. Dr. Kennedy will provide QA/QC oversight and technical support as needed.



Andrew Borgic, P.E. is a water/wastewater process design engineer with experience in large and small civil infrastructure (water and wastewater treatment) projects, including feasibility studies, alternatives analyses, and design for treatment plant upgrades and modifications. His design experience includes preliminary design reports and preparation of final plans and specifications for water and wastewater treatment plant or pump station projects. Typical duties include technical report preparation, preparation of contract drawings and specifications, cost estimate preparation, contractor interaction, field visits, inspections, and engineering services during construction. Andrew will be WWE’s project manager and work alongside closely with Craig Gorman.



Herb Durbin is a Project Engineer with over 23 years of experience in civil and environmental engineering. He specializes in ground and surface water quality and water treatment plant design and optimization. Mr. Durbin has acted in a number of water quality studies and assisted in the designs of numerous large coagulation filtration and adsorption arsenic treatment facilities. Herb will oversee the development of the Preliminary Design Report.



Rachel MacLean, P.E. has gained experience in drinking water design projects, including pipeline and groundwater treatment plant projects. Groundwater treatment project experience includes, PFAS, hexavalent chromium, sulfide, and manganese removal. Typical duties have included development of design specification, cost-estimate preparation, preliminary design development and reporting, chemical feed and storage facility sizing, stormwater and LID design, and construction submittal reviews. Rachel will act as WWE’s project engineer.



1.3 Organizational Chart

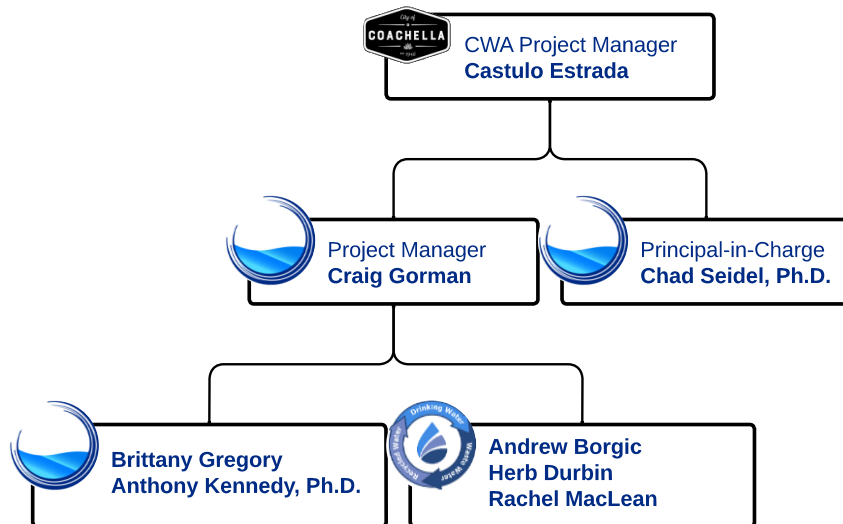


Figure 2. Project Team Organization Chart

1.4 Relevant Project Descriptions

Hexavalent Chromium Treatment Roadmap and Conceptual Design, Indio Water Authority, Indio, CA (May 2022 to present): In preparation for anticipated reissued Cr-6 MCL, Indio Water Authority engaged Corona to evaluate water quality and treatment alternatives for 20 groundwater wells. Strong base anion exchange, both regenerable and non-regenerable, ferrous iron reduction coagulation filtration, and stannous tin reduction were evaluated in terms of water quality, equipment, operation, and well site space constraints. Ultimately, where strong base anion exchange was not already in operation, ferrous iron reduction coagulation filtration was recommended as the treatment alternative for most well sites due to ease of operation and reliability. Indio Water Authority plans to move forward assuming ferrous iron reduction coagulation filtration will be implemented at several well sites, both individually and centralized, upon promulgation of a new hexavalent chromium maximum contaminant level. Strong-base anion exchange stannous chloride options remain in consideration for small footprint well sites and in cases where wells will be used in rare, low production circumstances. As part of that effort, Corona teamed with WWE to develop conceptual designs and pre-purchased equipment specifications for several ferrous iron reduction coagulation filtration treatment systems. Bench-scale testing was also performed to inform conceptual designs.

Stannous Chloride Without Filtration Pilot-scale Evaluation, California Water Service, Dixon, CA: In California Water Service’s Dixon water system, hexavalent chromium was present in three active groundwater wells above the anticipated California State Water Resources Control Board Division of Drinking Water maximum contaminant level of 10 µg/L. These three wells remove hexavalent chromium to below the anticipated MCL using regenerable SBA prior to distribution. However, a newly constructed but inactive well has hexavalent chromium above the anticipated MCL of 10 µg/L and was not equipped with any treatment system. Cal Water engaged Corona to investigate the feasibility of using stannous chloride without filtration to reduce hexavalent chromium to trivalent chromium, which is regulated as total chromium with an MCL of 50 µg/. Bench- and pilot-scale tests were performed that evaluated required doses, reduction times, and impacts



Figure 3. Cal Water Dixon Stannous Without Filtration Pilot Pipe with Chromium and Tin Accumulation.

on pipe materials and typical premise plumbing fixtures. The pilot-scale testing elevated concerns with this potential compliance alternative as some of the measured total chromium samples we’re nearly 80 times greater than the corresponding MCL of 50 µg/L. The blueish hue material in Figure 3 shows accumulation of what is believed to be chromium and tin hydroxides that can be released. The outcomes of this study and concerns regarding chromium and tin accumulation and subsequent release have resulted in Cal Water considering an alternative treatment strategy at this site, namely reduction coagulation filtration.

Stannous Pilot Testing for Hexavalent Chromium Compliance, Coachella Valley Water District (CVWD), Palm Desert, CA: The Coachella Valley Water District (CVWD) has 36 wells requiring treatment to comply with the prior and anticipated Cr-6 MCL of 10 µg/L. After CVWD had designed and was near starting construction of regenerable SBA treatment, Corona was engaged to assess the viability of stannous chloride reduction of Cr-6 to achieve MCL compliance. Stannous chloride



Figure 4. Corona directed full-scale demonstration of stannous chloride without filtration at CVWD ID-8 Sky Valley

facilitated reduction was effectively demonstrated to reduce Cr-6 to concentrations below 10 µg/L through bench-, pilot- and full-scale testing. However, the full-scale demonstration testing program at the CVWD ID-8 system in Sky Valley raised significant concerns regarding the transport and fate of chromium and tin particles in the distribution system and premise plumbing highlighting the need for additional research prior to full-scale implementation.

1.5 References

References for each of the aforementioned projects are provided in the table below.

Project	Client	Contact Name	Contact Phone	Contact Email
Hexavalent Chromium Treatment Roadmap and Conceptual Design	Indio Water Authority	Miguel Peña	760.625.1852	mpeña@indio.org
Stannous Chloride Pilot-scale Evaluation	California Water Service	Tarrah Henrie	408.367.8490	thenrie@calwater.com
Stannous Pilot Testing for Hexavalent Chromium Compliance	Coachella Valley Water District	Robert Cheng	760.485.9003	rcheng@cvwd.org

1.6 Subcontractors

As described above, we have included Water Works Engineers to conduct cost estimating, develop preliminary site layouts, and develop preliminary cost estimates for the selected treatment alternatives. As necessary, WWE will also conduct preliminary sewer capacity and distribution system hydraulic analyses. Water Works Engineers brings decades of experience in the design and construction of groundwater treatment facilities which will be leaned upon on these efforts to allow CWA to provide make informed decisions about the Cr-6 compliance options.

2 Proposed Method to Accomplish the Work

Our team recognizes CWA has previously invested considerable resources to address their Cr-6 compliance challenges for the previous MCL. At the time the previous MCL was rescinded, Hazen and Corona recommended CWA pivot from regenerable SBA to an RCF process for Cr-6 treatment at their impacted wells. However, on the heels of that recommendation, neighboring communities were exploring a potential low-cost alternative using direct application of stannous chloride without filtration. While compelling from a cost and operational perspective, this approach raised concerns about its long-term applicability given the potential for chromium accumulation and release in the distribution system.

In the years since, our team has continued to investigate advances in the listed BATs for Cr-6 treatment as well as the viability of the use of stannous without filtration. These areas include understanding the performance and regeneration efficiency of newly available SBA resins, exploring vendor provided ‘mobile’ regen approaches, and further optimizing the RCF process, each of which has improved the economics and feasibility of these treatment approaches.

With all these things in mind, our proposed approach for CWA is not to start over, but rather make use of CWA’s previous investments in this space while simultaneously updating these analyses with the current

understanding of Cr-6 treatment approaches, risks, and mitigation strategies. Our proposed work plan is outlined below:

Step 1 Stannous Chloride Evaluation: Despite the concerns around stannous chloride, CWA would be remiss not to confirm whether this technology is appropriate for further consideration. As such, our team will develop a comprehensive benefit / risk analysis to be presented to CWA staff within one month of notice to proceed. Given what is known today, we foresee two possible outcomes of this initial step:

- 1) stannous without filtration is eliminated from further consideration or
- 2) a pipe rack or similar study will be required to understand if there are specific water quality characteristics in the CWA supply that prevent the accumulation and subsequent release of chromium in the distribution system or premise plumbing.

If stannous without filtration is not eliminated and warrants testing or study, there may be cost-sharing opportunities to collaboratively achieve this with other regional utilities (e.g. CVWD, MSWD, IWA) who also desire clearly answering these questions. We believe our team is best suited to implement this type of study to quickly and efficiently illuminate the residual concerns and permitting hurdles given our recent experiences and on-going discussions with the Division of Drinking Water regarding stannous without filtration. If this is the selected route, our team will work closely with CWA staff to determine the appropriate level of effort to address any concerns, as well as cost-sharing opportunities.

Deliverables: *In-person workshop to present stannous chloride benefit / risk analysis*

Step 2 Cr-6 Treatment Technology Evaluation: Given the time that has elapsed since CWA last considered Cr-6 treatment, it is warranted to reevaluate the water supply and production details in light of the improvements to the relevant Cr-6 treatment technologies. Following Step 1, our team will conduct a preliminary assessment of Cr-6 treatment technologies including:

- *Regenerable strong base anion exchange*
 - *On-site regeneration*
 - *Mobile regeneration*
- *Non-regenerable strong base anion exchange*
- *Reduction, coagulation, filtration*
- *Stannous without filtration (if considered viable following Step 1)*

Technologies such as reverse osmosis and weak base anion exchange will also be considered; however, the limitations of these technologies that existed in 2016 have not advanced and it is unlikely they will progress in in the analysis. This analysis will provide performance estimates of each of the technologies that consider CWA's unique water quality and production needs. Ultimately our team will develop and work through a qualitative and quantitative decision matrix with CWA staff to identify the most appropriate, safe, and sustainable Cr-6 removal technology for the impacted wells. The decision matrix will include representative Class 5 cost estimates for a 2,000 gpm well site can be extrapolated to each of CWA's wells, operational requirements, risks, benefits, site needs and limitations, etc.

Deliverables: *Decision matrix workshop, Draft and final Cr-6 Treatment Technology Evaluation*

Step 3: Preliminary Design Report and Work Plan: Following the treatment technology selection, a preliminary design report (PDR) will be developed with context from the 2016 BDR in mind, or the 2016 BDR will be updated if SBA with centralized regeneration is the recommended path forward. The PDR will

include at a minimum the following information for each of the six impacted wells: site and yard piping layouts, well pump and electrical upgrades, design parameters, and 20-yr net present worth cost analyses. If the RCF technology is selected, preliminary sewer capacity analyses will also be provided. The PDR will serve as the backbone for DWR’s required work plan from which all subsequent tasks and schedule details can be developed. The PDR will also be a required element to pursue additional funding opportunities from DWR or other agencies.

Deliverables: Draft and Final PDR including Executive Summary and Work Plan

3 Certification of Proposal

The undersigned hereby submits its proposal and, by doing so, agrees to furnish services to the City in accordance with the Request for Proposals (RFP), and to be bound by the terms and conditions of the RFP.

4 Cost Proposal

The following table presents a detailed schedule of 2024 hourly rates for all staff positions that would be assigned to the proposed services for both Corona and Water Works Engineers. All travel related expenses (e.g. airfare, hotel, ground transportation, etc.), project related supplies, laboratory services and other related project direct costs will be reimbursable with a 10% mark-up. All subcontractor or sub-consultant costs will have a 5% mark-up.

Category	2024 Hourly Rates	Key Staff
Corona Environmental Consulting		
Partner	\$355	Seidel
Principal Professional	\$320	Gorman
Supervising Professional	\$280	
Senior Professional	\$245	Kennedy
Associate Professional	\$210	Gregory
Professional	\$180	
Administrator	\$120	
Intern	\$105	
Water Works Engineers		
Principal Engineer II	\$293	
Principal Engineer I	\$272	
Senior Project Engineer II	\$253	Borgic
Senior Project Engineer I	\$235	Durbin
Project Engineer II	\$217	
Project Engineer	\$203	
Associate Engineer II	\$191	
Associate Engineer	\$180	MacLean
Staff Engineer II	\$165	
Staff Engineer	\$147	
Jr. Engineer	\$117	
Senior Administrative Assistant	\$117	
Administrative Assistant	\$83	

5 Addenda

We acknowledge receipt of ADDENDUM NUMBER 1, issued 1/4/2024.

Dr. Chad Seidel is President at Corona Environmental Consulting, LLC where he brings his more than 20 years of consulting experience serving the drinking water community by providing small and large drinking water utilities with process engineering services, from optimization of existing conventional treatment processes to the application of advanced treatment processes for controlling emerging contaminants. Chad has been assisting Cr-6 impacted water utilities in California since 2000. He has led the discovery, testing, and implementation of Cr-6 treatment advances regarding strong base anion exchange, ferrous reduction coagulation filtration, and others to achieve millions of dollars of cost savings for impacted utilities. Chad will direct this project to realize the best, most cost-effective Cr-6 treatment strategy for CWA.



Licenses

Registered Professional Engineer in AZ, CO, GA, IL, MA, NJ, NY, PA, TX, WA

Education

Ph.D., Civil and Environmental Engineering, University of Colorado Boulder, 2006. Dissertation Title: *"Investigation of Hexavalent Chromium as a Future Regulated Drinking Water Contaminant"*

M.S. Civil and Environmental Engineering, University of Colorado Boulder, 2000. Thesis Title: *"Understanding Disinfection Byproduct Behavior in Water Distribution Systems"*

B.S. Environmental Engineering, Montana Tech of the University of Montana: Valedictorian, 1998

Representative Projects

Hexavalent Chromium Treatment Valuation, Indio Water Authority, CA: Corona was engaged by IWA to conduct a 'valuation' of their Cr-6 treatment systems. The valuation compared contracted performance metrics and costs with full-scale performance data and determined that the systems are not operating as designed and thereby increasing IWA ongoing operational costs. Corona staff visited the treatment sites and develop a strong understanding of each system's performance. One of the recommendations from this effort was that IWA investigate whether new resins could be beneficial at these locations.

Hexavalent Chromium Treatment Implementation, California Water Service, CA: Corona completed a Cr-6 treatment study for California Water Service (Cal Water). This study addressed the treatment needs for three of Cal Water's districts that are heavily impacted by the Cr-6 MCL, including wells in Willows, Dixon, and the Salinas service areas. In total, the water quality, and site-specific constraints of 27 wells were evaluated and Cr-6 treatment recommendations were made. Based upon historical water quality and operational preferences, strong base anion exchange was found to be the low-cost alternative for all but one of wells requiring treatment. Cal Water, with Corona as a technical lead, applied for and was awarded a \$5 million grant from the Proposition 50, Chapter 6b program to support the construction of full-scale SBA-IX treatment units. As a part of this grant, testing was conducted to optimize the SBA-IX process. This testing included investigating new-to-market resins and brine treatment and minimization efforts much in-line with the needs of this project. Chad directed and oversaw the test plans and testing for all phases of this project. As a result of these efforts, Cal Water has 8 full-scale SBA-IX systems that have been operational since 2016.

California American Water, Cr-6 Compliance and Implementation, Sacramento, CA: California American Water (CAW) has seven groundwater wells above the 10 µg/ Cr-6 MCL. Corona investigated compliance strategies including blending, well modification, and treatment alternatives. This desktop evaluation identified SBA-IX as CAW's most effective compliance solution, which was then confirmed via site specific pilot testing. The water quality of CAW's Cr-6 impacted wells are ideally suited for SBA-IX treatment since the background water quality matrix, specifically nitrate and sulfate, are relatively low. However, CAW's wells are generally located on small parcels which would make the implementation of this treatment difficult if not impossible without the acquisition of additional property. In response to this constraint, Corona recommended SBA-IX be implemented in a nonregenerable mode, which to our knowledge has yet to be permitted in California for this purpose. Corona has since assisted with the

procurement, design, and permitting of the full-scale installations which began operating in 2017. Since the full-scale systems have been online, Corona has continued their support of CAW by pilot testing the Purolite Lewatit TP107 and Purolite PWG600E2 SBA-IX resins as potential alternatives to the Purolite A600E 9149 which is currently in use. As a result of these efforts, CAW has elected to replace the resin at one of their sites with the Lewatit product as this product should result in significant cost savings.

Stannous Pilot Testing for Hexavalent Chromium Compliance, Coachella Valley Water District, CA: The Coachella Valley Water District (CVWD) engaged Corona to evaluate treatment alternatives for 30 wells that required treatment to comply with the former Cr-6 MCL of 10 µg/L. This included an analysis of traditional treatment techniques, such as strong base anion exchange (SBA-IX) and ferrous facilitated reduction/ coagulation/ filtration that are proven technologies for Cr-6 removal. Over the course of this project, Corona's advances in stannous chloride research led to CVWD placing their planned strong base anion exchange (SBA-IX) treatment designs on hold to evaluate the use of stannous chloride for Cr-6 compliance. This investigation included bench-, pilot- and full-scale demonstrations of the application of stannous chloride for Cr-6 reduction to Cr-3.

Additional Cr-6 project experience and list of relevant project experience available upon request.

Relevant Publications and Presentations

- Tarrah Henrie, Sarah Plummer, John Orta, Steve Bigley, Craig Gorman, Chad Seidel, Kyle Shimabuku, Haizhou Liu, Full-scale demonstration testing of hexavalent chromium reduction via stannous chloride application, AWWA Water Science, 10.1002/aws2.1136, 1, 2, (2019).
- Plummer, Sarah; Gorman, Craig; Henrie, Tarrah; Shimabuku, Kyle; Thompson, Robert; Seidel, Chad. (2018). Optimization of strong-base anion exchange O&M costs for hexavalent chromium treatment. Water Research. 139. 10.1016/j.watres.2018.04.011.
- Moffat, Ivy; Martinova, Nadia, Seidel, C., Thompson, C. (2018), Hexavalent Chromium in Drinking Water. Journal - American Water Works Association, 110: E22-E35. doi: 10.1002/awwa.1044
- Li, X. , Green, P. G., Seidel, C. , Gorman, C. and Darby, J. L. (2016), Chromium Removal From Strong Base Anion Exchange Waste Brines. Journal - American Water Works Association, 108: E247-E255. doi:10.5942/jawwa.2016.108.0049
- Li, X. , Green, P. G., Seidel, C. , Gorman, C. and Darby, J. L. (2016), Meeting California's Hexavalent Chromium MCL Using Strong Base Anion Exchange Resin. Journal - American Water Works Association, 108: E474-E481. doi:10.5942/jawwa.2016.108.0112
- Gorman, C. , Seidel, C. , Henrie, T. , Huang, L. and Thompson, R. (2016), Pilot Testing Strong Base Anion Exchange for CrVI Removal. Journal - American Water Works Association, 108: E240-E246. doi:10.5942/jawwa.2016.108.0028
- Seidel, C., Gorman, C., Ghosh, A., Dufour, T., Mead, C., Henderson, J., Li, X., Darby, J., Green, P., McNeill, L., Clifford, D., 2014. Hexavalent Chromium Treatment with Strong Base Anion Exchange, Water Research Foundation, Project No. 4488. Denver, CO.
- Seidel, C., Najm, I., Blute, N., Corwin, C., Wu, X., "National and California Treatment Costs to Comply with Potential Hexavalent Chromium MCLs" *Journal of the American Water Works Association*, June 2013.
- Seidel, C., Corwin, C., "Total Chromium and Hexavalent Chromium Occurrence Analysis" *Journal of the American Water Works Association*, June 2013.
- McGuire, M.J., Blute, N.K., Seidel, C., Qin, G., Fong, L., "Pilot-Scale Studies of Hexavalent Chromium Removal from Drinking Water," *Journal of the American Water Works Association*, Vol. 98, No. 2, February 2006.

Mr. Gorman has nearly 20 years of experience dedicated to the treatment of inorganic contaminants in drinking water. Craig has led technology selections, bench- and pilot-scale evaluations, cost estimating and design efforts for inorganic contaminants including hexavalent chromium [Cr-6], arsenic, nitrate, fluoride, boron, uranium, and radium. Specific to Cr-6 treatment, Craig led the development and implementation of pilot testing programs that have revolutionized the treatment market place for technologies such as regenerable strong base anion exchange, non-regenerable ion exchange, and reduction coagulation filtration. Recently, Craig was Corona's technical lead for a pilot study that investigated the use of stannous chloride without filtration. This study exposed significant concerns for the long-term use of this approach for Cr-6 compliance purposes.



Licenses

Registered Professional Engineer – Colorado PE 43422

Education

M.S. Civil Engineering, University of Colorado at Boulder, Boulder, CO, August 2005

Thesis Title: "Initial Measurements and Test System Development for Evaluation of a Novel, Hybrid Reverse Osmosis-Electrodialysis Process"

B.S. Environmental Science, State University of New York at Plattsburgh, Plattsburgh, NY, December 1999

Representative Projects

Stannous Chloride Evaluation for Reduction of Cr-6, California Water Service, Dixon CA: The application of stannous chloride (SnCl_2) an NSF certified corrosion inhibitor has been considered a potential compliance alternative for hexavalent chromium (Cr-6) treatment. In this case, SnCl_2 would be added at the wellhead where it reduces Cr-6 to trivalent chromium (Cr-3) without filtration. This approach has been demonstrated at other utilities, and while successful at maintaining Cr-6 concentrations below the MCL, raises significant concerns with regards to the fate, accumulation, and potential release of chromium in the distribution system or premise plumbing.

To this end, Corona designed a simulated system using representative pipe materials to better understand the degree of chromium accumulation that can be expected. The system also includes in-home appurtenances such as sediment filters and water filters to better understand how these items may be impacted by SnCl_2 treated water. The results showed significant accumulation of both tin and chromium on pipe surfaces, fouling of in-home filtration devices, and several samples with total chromium results more than 50 times greater than the regulated limit. This study has prompted the client to proceed with reduction coagulation filtration for Cr-6 compliance.

Hexavalent Chromium Reduction Coagulation Filtration Optimization, City of Watsonville, CA: The City of Watsonville, CA has five wells with Cr-6 in excess of the 10 $\mu\text{g/L}$ MCL. A desktop evaluation identified reduction coagulation filtration (RCF) as the most cost-effective solution given the City's ability to discharge the iron laden backwash water directly to sewer. That said, significant cost savings could be realized if the instantaneous backwash volume could be minimized, eliminating the need for increasing the sewer capacity. This opportunity was explored through on-site pilot testing that investigated alternative media configurations. The testing identified a media design that operates at twice the hydraulic loading rate and half the backwash rate of traditional sand and anthracite media, resulting in 75% decrease in the instantaneous backwash volume. The anticipated cost savings resulting from the pilot testing are estimated to be in excess of \$5M (2017 dollars).

Hexavalent Chromium Treatment Implementation, California Water Service, CA: Corona completed a Cr-6 treatment study for California Water Service (Cal Water). This study addressed the treatment needs for three of

Cal Water's districts that are heavily impacted by the Cr-6 MCL, including wells in Willows, Dixon and the Salinas service areas. In total, the water quality and site-specific constraints of 27 wells were evaluated and Cr-6 treatment recommendations were made. Based upon historical water quality and operational preferences, strong base anion exchange was found to be the low-cost alternative for all but one of wells requiring treatment.

Cal Water, with Corona as a technical lead, applied for and was awarded a \$5 million grant from the Proposition 50, Chapter 6b program to support the construction of full-scale SBA-IX treatment units. As a part of this grant, testing was conducted to optimize the SBA-IX process. This testing included investigating new-to-market resins and brine treatment and minimization efforts much in-line with the needs of this project. Craig led the development and execution of the test plans for all phases of this project. As a result of these efforts, Cal Water has 8 full-scale SBA-IX systems that have been operational since 2016.

California American Water, Cr-6 Compliance and Implementation, Sacramento, CA: California American Water (CAW) has seven groundwater wells above the 10 µg/ Cr-6 MCL. Corona investigated compliance strategies including blending, well modification, and treatment alternatives. This desktop evaluation identified SBA-IX as CAW's most effective compliance solution, which was then confirmed via site specific pilot testing. The water quality of CAW's Cr-6 impacted wells are ideally suited for SBA-IX treatment since the background water quality matrix, specifically nitrate and sulfate, are relatively low. However, CAW's wells are generally located on small parcels which would make the implementation of this treatment difficult if not impossible without the acquisition of additional property. In response to this constraint, Corona recommended SBA-IX be implemented in a non-regenerable mode, which to our knowledge has yet to be permitted in California for this purpose. Corona has since assisted with the procurement, design, and permitting of the full-scale installations which began operating in 2017. Since the full-scale systems have been online, Corona has continued their support of CAW by pilot testing the Purolite Lewatit TP107 and Purolite PWG600E2 SBA-IX resins as potential alternatives to the Purolite A600E 9149 which is currently in use. As a result of these efforts, CAW has elected to replace the resin at one of their sites with the Lewatit product as this product should result in significant cost savings.

Additional Cr-6 project experience and other relevant project experience available upon request.

Relevant Publications

- Gorman, C., Kennedy, A., Samson, C., Plummer, S., Townsend, E., Seidel, C. (2023), Improvements in the Reduction Coagulation Filtration Process for Hexavalent Chromium Treatment. AWWA Water Science, doi.org/10.1002/aws2.1315
- Li, X. , Green, P. G., Seidel, C. , Gorman, C. and Darby, J. L. (2016), Chromium Removal From Strong Base Anion Exchange Waste Brines. Journal - American Water Works Association, 108: E247-E255. doi:10.5942/jawwa.2016.108.0049
- Li, X. , Green, P. G., Seidel, C. , Gorman, C. and Darby, J. L. (2016), Meeting California's Hexavalent Chromium MCL Using Strong Base Anion Exchange Resin. Journal - American Water Works Association, 108: E474-E481. doi:10.5942/jawwa.2016.108.0112
- Plummer, Sarah & Gorman, Craig & Henrie, Tarrah & Shimabuku, Kyle & Thompson, Robert & Seidel, Chad. (2018). Optimization of strong-base anion exchange O&M costs for hexavalent chromium treatment. Water Research. 139. 10.1016/j.watres.2018.04.011.
- Gorman, C. , Seidel, C. , Henrie, T. , Huang, L. and Thompson, R. (2016), Pilot Testing Strong Base Anion Exchange for CrVI Removal. Journal - American Water Works Association, 108: E240-E246. doi:10.5942/jawwa.2016.108.0028
- Seidel, C., Gorman, C., Ghosh, A., Dufour, T., Mead, C., Henderson, J., Li, X., Darby, J., Green, P., McNeill, L., Clifford, D., 2014. Hexavalent Chromium Treatment with Strong Base Anion Exchange, Water Research Foundation, Project No. 4488. Denver, CO.

Anthony is a water process engineer at Corona and has 10 years of experience as a drinking water and water reuse engineer specializing in advanced water treatment processes such as adsorption, ion exchange, and membrane separation. With the City of Longmont, Denver Water, US Bureau of Reclamation, and Corona, Anthony has performed and led alternative treatment assessments, modeling, water quality assessments, bench- and pilot-scale evaluations, applied research, budgetary cost estimating, and conceptual design efforts for drinking water and water reuse projects that have addressed organic matter, organic micropollutants including per- and polyfluoroalkyl substances, total dissolved solids, taste and odor causing compounds, metals, arsenic, radium, nitrate, selenium, hexavalent chromium, fluoride, and disinfection byproducts.



Licenses

Registered Professional Engineer – Colorado (52405)

Education

B.S./M.S./Ph.D. – Civil Engineering, University of Colorado Boulder, 2013

Representative Projects

Arsenic and Hexavalent Chromium Removal Alternatives Assessment, Oak Hills/Salinas Hills/Stockton, CA: A total of three separate water systems owned and operated by California Water Service were concerned with the presence of arsenic and hexavalent chromium concentrations above existing and anticipated maximum contaminant levels, respectively, in their groundwater sources. In addition to evaluating raw groundwater quality, treatment assessments were performed for coagulation filtration, adsorption, strong base anion exchange, and ferrous iron reduction coagulation filtration. In collaboration with Water Works Engineers, LLC, preliminary lifecycle cost estimates and layouts for several treatment alternatives at each water system were developed. California Water Service is expected to move forward with full-scale design of recommended treatment systems at all three water systems. Anthony served as Corona’s technical lead.

Hexavalent Chromium Treatment Roadmap and Conceptual Design, Indio, CA: In preparation for a new hexavalent chromium maximum contaminant level, Indio Water Authority engaged Corona to evaluate water quality and treatment alternatives for 20 groundwater wells. Strong base anion exchange, both regenerable and non-regenerable, ferrous iron reduction coagulation filtration, and stannous chloride reduction were evaluated in terms of water quality, equipment, operation, and well site space constraints. Ultimately, where strong base anion exchange was not already in operation, ferrous iron reduction coagulation filtration was recommended as the treatment alternative for most well sites due to ease of operation and reliability. Indio Water Authority plans to move forward assuming ferrous iron reduction coagulation filtration will be implemented at several well sites, both individually and centralized, upon promulgation of a new hexavalent chromium maximum contaminant level. As part of that effort, Corona teamed with Water Works Engineers, LLC to develop conceptual designs and pre-purchased equipment specifications for four ferrous iron reduction coagulation filtration treatment systems. Bench-scale testing was also performed to inform conceptual designs. Anthony served as Corona’s co-project manager and technical lead.

Stannous Chloride Evaluation, Dixon, CA: In California Water Service’s Dixon water system, hexavalent chromium was present in three active groundwater wells above the anticipated California State Water Resources Control Board Division of Drinking Water maximum contaminant level of 10 µg/L. These three wells remove hexavalent chromium to below the anticipated MCL using regenerable strong base anion exchange prior to distribution. However, a newly constructed but inactive well had hexavalent chromium above the anticipated maximum contaminant level of 10 µg/L and was not equipped with any treatment system. California Water Service engaged Corona to investigate the feasibility of using stannous chloride without subsequent filtration to reduce hexavalent chromium to trivalent chromium prior to distribution. Bench- and pilot-scale tests were performed that evaluated required doses, reduction times, pipe materials, and typical premise plumbing fixtures. This testing is expected to support California Water Service’s decision on whether to use stannous chloride in the Dixon water system.

Brittany Gregory is a Water Process Engineer at Corona Environmental Consulting, where she focuses on drinking water treatment selection through alternative treatment assessments, along with treatment process optimization supported by bench- and pilot scale testing. Brittany has led or supported numerous pilot-scale studies in California, most recently a pipe loop study completed to better understand the fate of stannous chloride when used as a reductant for hexavalent chromium treatment in the absence of filtration. Brittany also has extensive experience in large data management, data visualization tools, and treatment process modelling.



Education

MASc., Civil and Resource Engineering, Dalhousie University, Halifax, NS, 2017
BScE., Geological Engineering, University of New Brunswick, Fredericton, NB, 2015

Licenses

Professional Engineer – New Brunswick M8556

Representative Projects

Stannous Chloride Evaluation, California Water District, CA: California Water Service's (CalWater) Dixon Water system has multiple groundwater sources with hexavalent chromium at concentrations exceeding the anticipated California State Water Resources Control Board Division of Drinking Water (DDW) maximum contaminant level (MCL) of 10 µg/L. Three of these wells utilize regenerable strong base anion exchange to remove hexavalent chromium to below the anticipated MCL; however, a newly constructed groundwater well with elevated hexavalent chromium is not yet equipped with treatment. CalWater contracted Corona to determine the feasibility of applying stannous chloride without filtration to reduce hexavalent chromium to trivalent chromium to achieve the anticipated MCL prior to distribution. Both bench-scale and pilot-scale testing was completed to evaluate the required stannous chloride doses and reduction times to achieve sufficient hexavalent chromium reduction, along with its impact on various pipe materials and typical premise plumbing fixtures. The results obtained from this study are expected to support CalWater's decision on whether to use stannous chloride at the Dixon system.

Larkfield Water Treatment Plant Filter Pilot Study, California American Water, CA: California American Water (CAW)'s Larkfield Water Treatment Plant consolidates the treatment of four groundwater wells with elevated iron, manganese, and arsenic. Current treatment consists of the addition of ferric chloride, sodium hypochlorite, and potassium permanganate to remove arsenic, iron, and manganese to below their respective regulatory limits through a coagulation greensand-filtration process. CAW approached Corona to develop and execute a filter pilot study to evaluate whether permanganate could be replaced by sodium hypochlorite to continuously regenerate their greensand media while still achieving their finished water quality goals. The pilot study was also used to evaluate alternative media configurations, as well as validate increased ferric chloride doses for additional arsenic removal. Brittany created the pilot test plan, erected the pilot system, and trained operations staff to complete the daily sampling requirements. Based on the pilot study results, Brittany developed a full-scale demonstration protocol to confirm the long-term capability of sodium hypochlorite to continuously regenerate greensand media. Corona continues to support the full-scale demonstration efforts and will update the site's operation and maintenance plan upon receiving a permit amendment from DDW.

NWTP Long Term Water Quality Strategies, Town of Gilbert, AZ: The Town of Gilbert engaged Corona as the technical advisor for the design of a new water treatment facility to replace their existing North Water Treatment Plant. The primary drivers for the new plant include existing infrastructure deficiencies, high disinfection byproduct (DBP) formation from their surface water sources, along with the need for flexible processes to treat highly variable source waters. Brittany is acting as the assistant project manager for Corona, is overseeing the data management and analysis for the project, along with the subsequent performance model that will help predict key performance parameters at the new facility. She has also planned and executed a 15-month pilot study that is being used to optimize the selected treatment processes, calibrate the performance model, and confirm the treatment changes will not result in the need for additional corrosion studies with the local regulators. Brittany has also developed an interactive dashboard to visualize historical treatment and water quality data, along with modelled treatment projections based on the pilot study data.

ANDREW BORGIC, P.E.

Project Manager



Education

M.S. – Civil/Environmental Eng.
University of CA, Davis (2007)
B.S. - Civil Engineering,
CA State University, Chico (2004)
B.S. – Mechanical Engineering,
CA State University, Chico (2004)

Years of

Experience
17 years with
the firm / 20
years total

Registration

Registered Civil
Engineer
California - C73792
Certified QSP

Memberships

CWEA
AWWA

Mr. Borgic is a water/wastewater process design engineer with over 20 years of experience in large and small civil infrastructure (water and wastewater treatment) projects, including feasibility studies, alternatives analyses, and design for treatment plant upgrades and modifications. His design experience includes preliminary design reports and preparation of final plans and specifications for water and wastewater treatment plant or pump station projects. Typical duties include technical report preparation, preparation of contract drawings and specifications, cost estimate preparation, contractor interaction, field visits, inspections, and engineering services during construction.

REPRESENTATIVE PROJECT EXPERIENCE

Indio Water Authority - Hexavalent Chromium Treatment Concept Development and Conceptual Design – Indio, CA (Conceptual Design) Mr. Borgic provided preliminary design services in collaboration with Corona Environmental Consulting for the treatment of hexavalent chromium utilizing ferrous iron reduction coagulation filtration (RCF) and/or strong-base anion exchange at two well treatment plants and two individual well sites. WWE developed filtration and chemical feed system sizing, assisted with site layouts, conceptual level cost estimates, and evaluated backwash waste alternatives based on hard and soft cost analysis. WWE drafted a procurement specification for the pre-purchase of the treatment system so the design and construction could be performed.

Eastern Municipal Water District – Plant 134 GAC Improvements Project – Highland, CA (Design/Build) Mr. Borgic performed project management duties in the design and engineering construction management duties for the project. The purpose of the project was to reduce disinfection byproduct (DBP) precursors in the form of total organic carbon (TOC) from the treated water post-membrane treatment prior to disinfection. To accomplish this, a new 4-mgd side-stream granular activated carbon (GAC) system was designed and constructed at the existing WTP, in addition to access improvements to facilitate the large carbon delivery vehicles.

Golden State Water Company – Southwest Well Improvements Project – Torrance, CA (Design-Build) Mr. Borgic was the Project Manager on this design-build project which included the design and construction of treatment facilities to address water quality concerns at four different wellsites (7 wells total): 129th St, Belhaven, Southern, and Doty. The new treatment facilities include: chlorine contact tanks, pyrolusite media filtration systems, filter backwash tanks, dissolved oxygen augmentation, and chemical feed improvements.

Cal Water – Dominguez 215/216 Improvements Project – Carson, CA (Design) Mr. Borgic performed project management duties in the design for the Dominguez 215/216 Project. The purpose of the project is to centralize treatment of two existing drinking water wells and improve water quality in the system. The project includes the following improvements: piping and control valves to centralize treatment, baffled chlorine contact pressure vessels, liquid oxygen storage and feed system, and chemical feed system improvements. The new treatment facilities will be rated for 2,700-gpm. The project will also include flow control and pressure sustaining valves, to allow for the finished water to be split between two distributions systems.

Cal Water – Dominguez 272 Well Improvements Project – Compton, CA (Design) Mr. Borgic performed project management duties in the design for the Dominguez 272 Project. The purpose of the Project is to address water quality concerns in the system including: color and odor; methane; hydrogen sulfide; and low dissolved oxygen in the system water. The Project included the design of the following improvements at the existing wellsite: well pump, air stripper system for methane and hydrogen sulfide removal, booster pumps, chlorine contact tank, and chemical feed system.

California Water Service - Dominguez Well 275 Treatment Facilities Project – Carson, CA (Study/Design/CM) Mr. Borgic provided preliminary engineering analysis, design, and services during construction to bring Well 275-01 back into operation while meeting CWS's water quality goals including color, odor, sulfide and methane removal from the groundwater and the reduction of total trihalomethanes in the finished water. Mr. Borgic performed a cost/performance analysis for a range of treatment options that would meet or exceed their project goals. The facility improvements at Well 275-01 (800-gpm) utilizes the following process train: basket strainers, air stripping, gas scrubbers, booster pumps, ion exchange and disinfection through chloramination.

California Water Service - Dominguez Well 294 Treatment Facilities Project – Long Beach, CA (Study/Design/CM) Mr. Borgic provided preliminary engineering analysis, design, and services during construction to bring Well 294-01 back into operation while meeting CWS's water quality goals including color, odor, sulfide and methane removal from the groundwater and the reduction of total trihalomethanes in the finished water. Mr. Borgic performed a cost/performance analysis for a range of treatment options that would meet or exceed their project goals. The facility improvements at Well 294-01 (1,200-gpm) utilizes the following process train: basket strainers, air stripping, gas scrubbers, booster pumps, ion exchange and disinfection through chloramination.

Golden State Water Company Southern Well No. 6 Manganese Treatment Gardena, CA (Design/Build) Mr. Borgic was the Project Manager for the planning, design of a new Mn Treatment Facility that includes, 1,000 gpm ATEC Pressure Filter System, 40,000-gallon Backwash Tank, New aqueous ammonia and fluoride injection point and 110-gpm Decant Pump Station (Backwash recycle).

City of Pomona – Chino Basin VOC Plant Project – Pomona, CA (Design-Build) Mr. Borgic oversaw the mechanical piping, structural improvements, and site civil design for the installation of three (3) dual 12-ft diameter GAC, skid mounted adsorption systems at three separate well sites for the removal of TCE, PCE and 1,1-DCE. Each adsorption system is run in lead-lag operation with a design flowrate of 1,100-gpm.

City of Torrance North Well Field Project Phase III Design Build Project – Torrance, CA (Design-Build) Mr. Borgic was the Project Manager on this design-build project in which the City is expanding its groundwater pumping, storage and treatment capacity to obtain the City's full groundwater allotment and provide sufficient reserve capacity to participate in conjunctive use and enable additional groundwater extractions during a drought or emergency. The project includes demolition of an existing well, storage tank and chemical system, and construction of two new wells, a 2.5-MG prestressed concrete tank (mostly buried), Utility Building with booster pumps, chemical storage and feed systems, office and lab space, electrical room, restroom, and associated site improvements.

City of Oceanside – Robert A. Weese Water Filtration Plant, Chemical Facilities Upgrades Design-Build Project – Vista, CA (Design-Build) Mr. Borgic served as the Engineering Project Manager and Project Quality Manager for the replacement and upgrade of 7 chemical feed systems at the 25-mgd surface water treatment facility. The design-build project includes the design, permitting, construction, and start-up of the following chemical feed systems, aluminum sulfate, aqueous ammonia, sodium hydroxide, sodium hypochlorite, sulfuric acid, anionic polymer, and cationic polymer. Each chemical facility includes the design and construction of the chemical truck delivery system, chemical tanks, secondary containment, feed pumps, and the associated piping, valves, and control



Herb Durbin, PE Project Engineer

<u>Education</u>	<u>Years of Experience</u>	<u>Registration</u>	<u>Memberships</u>
B.S. - Civil Engineering, Arizona State University (2000)	9 years with the firm/ 23 years total	Registered Civil Engineer: Arizona - 43538	AWWA AZ Water

Mr. Durbin is a Project Engineer with over 23 years of experience in civil and environmental engineering. He specializes in ground and surface water quality and water treatment plant design and optimization. Mr. Durbin has acted in a number of water quality studies and assisted in the designs of numerous large Coagulation Filtration and Adsorption Arsenic treatment facilities.

Representative Project Experience

- **Indio Water Authority - Hexavalent Chromium Treatment Concept Development and Conceptual Design – Indio, CA (Project Engineer)** Mr. Durbin provided preliminary design services in collaboration with Corona Environmental Consulting for the treatment of hexavalent chromium utilizing ferrous iron reduction coagulation filtration (RCF) and/or strong-base anion exchange at two well treatment plants and two individual well sites. Mr. Durbin developed filtration and chemical feed system sizing, assisted with site layouts, conceptual level cost estimates, and evaluated backwash waste alternatives based on hard and soft cost analysis. Mr. Durbin drafted a procurement specification for the pre-purchase of the treatment system so the design and construction could be performed.
- **Engineering Services for Design and Construction of Municipal Water Supply Wells Arsenic Reduction Facilities, Lathrop, CA (Project Engineer)** Mr. Durbin, as project engineer, designed arsenic treatment processes for six of the City's drinking water wells. As part of this project, we prepared an Engineering Report as a requirement of the Safe Drinking Water State Revolving Fund (SDWSRF) application. Our team recommended coagulation filtration at a centralized facility to treat five of the impacted wells for a total flow of 6,250 gpm (9 MGD). Conducted detailed analyses of design alternatives to determine the most optimal facility configuration including pH adjustment with CO₂ carbonic acid feed and aeration for CO₂ stripping, finished water equalization and booster pumping, and residuals handling equipment including a filter press to facilitate virtually 100% recycle of water through the treatment system. The arsenic treatment equipment was procured through a supplier pre-selection contract that was ultimately pre-purchased and provided to the general contractor for installation.
- **Engineering Services for Design of the Arsenic Mitigation Project Water Treatment Facility, Keyes Community Services Water District, CA (Project Engineer)** Mr. Durbin, as project engineer, designed arsenic treatment processes for Districts drinking water wells. As part of this project, we prepared an Engineering Report as a requirement of the Safe Drinking Water State Revolving Fund (SDWSRF) application. Our team recommended coagulation filtration at a centralized facility to treat the four impacted wells. Conducted detailed analyses of design alternatives to determine the most optimal facility configuration including piping, finished water equalization and booster pumping, and residuals handling equipment including a filter press to facilitate virtually 100% recycle of water through the treatment system. The arsenic treatment equipment was procured through a supplier pre-selection contract that was ultimately pre-purchased and provided to the general contractor for installation.
- **Arizona American Water, Paradise Valley Arsenic Removal Facility (Project Engineer)** Arizona American Water (Currently EPCOR) owns and operates the water system serving portions of the Town of Paradise Valley and the City of Scottsdale. Water is supplied from a total of seven wells located throughout the service area. Due to the wells' naturally occurring arsenic levels, treatment is required to ensure that arsenic concentrations in the finished water will be consistently below the pending MCL.
- The Paradise Valley Arsenic Removal Facility (PVARF) has been designed and constructed under the design-build process by the design-build team with DL Norton. This facility consolidates water from multiple well sources and treats the water using a coagulation-filtration process in a split stream mode of operation to produce a blended water quality containing not more than 8 µg/L of arsenic with full solids handling.

Rachel MacLean, PE

Staff Engineer



Education

M.S. – Chemical Engineer,
University of Idaho (2017)
B.S. - Chemical Engineering,
University of Idaho (2015)
B.S. – Chemistry,
University of Idaho (2015)

Years of

Experience
2 years with
the firm/ 5
years total

Registration

Registered Civil
California - 95839

Memberships

AWWA

Ms. MacLean has gained experience in drinking water design projects, including pipeline and groundwater treatment plant projects. Typical duties have included development of design specifications, cost-estimate preparation, preliminary design development and reporting, chemical feed and storage facility sizing, stormwater and LID design, and construction submittal reviews.

Representative Project Experience

Indio Water Authority - Hexavalent Chromium Treatment Concept Development and Conceptual Design – Indio, CA (Design)

Ms. MacLean is providing preliminary design services in collaboration with Corona Environmental Consulting for the treatment of hexavalent chromium utilizing ferrous iron reduction coagulation filtration (RCF) and/or strong-base anion exchange at two well treatment plants and two individual well sites. Ms. MacLean has developed site layouts, conceptual level cost estimates, and has evaluated backwash waste alternatives based on hard and soft cost analysis.

Cal Water - Per-and Polyfluoroalkyl Substances (PFAS) Treatment Evaluation – Visalia & Bakersfield, CA (Design)

Ms. MacLean provided preliminary design services in collaboration with Corona Environmental Consulting for the PFAS treatment of three groundwater wells. The project included the evaluation of treatment alternatives for the removal of PFAS in three wells ranging in flow from 600-1,350-gpm. Ms. MacLean evaluated treatment alternatives based on hard and soft cost analysis for non-regenerable strong base anion exchange and granular activated carbon. She developed site layouts for each treatment alternative at each site and developed conceptual level capital and operations & maintenance cost estimates.

Cal Water - Dominguez Well 215-216 Well Improvements– Carson, CA (Design)

Ms. MacLean provided engineering design support for the Dominguez Well 215-216 Well Improvement project. The purpose of the project is to centralize treatment of two existing drinking water wells and improve water quality in the system. The project includes the following improvements: piping and control valve to centralize treatment, baffled chlorine contact pressure vessels, liquid oxygen storage and feed system, chemical feed improvements. The new treatment facility will be rated for 2,700-gpm.

City of Torrance – Design-Build North Torrance Well Field Project (NTWFP) – Torrance, CA (Design-Build)

Ms. MacLean is providing engineering support services to the design-build contractor, Pacific Hydrotech, for the NTWFP, which includes three 3,000-gpm wells (one existing), 2.5-MG prestressed concrete tank, chemical feed systems, 10,000-gallon hydropneumatics tank and a 9,000-gpm booster pump station. Ms. MacLean has developed a test plan and is overseeing testing for hydrogen sulfide removal from the tank. She is also developing conceptual design for manganese removal using greensand filtration.

