Alan King

Director of Public Works & Utilities

Alan King currently serves as Director of Public Works & Utilities (PW&U) for the City of Wichita, Kansas. He reports to the City Manager and elected Board of Council Members and is responsible for all aspects of managing the PW&U Department which includes water rights, water treatment and distribution, wastewater treatment and collection, storm water, streets, facilities, fleet, and environmental services. The Department consists of over 850 full time employees. Mr. King participates in City's senior management team. Mr. King has over 40 years of experience working the Public Works sector dealing with management and infrastructure challenges. His past assignments include City and County of Broomfield, Colorado and City of Bellevue, Washington. Mr. King also worked in the private side as a consultant with clients across the United States. Mr. King has a Bachelor Degree in Business Administration and is currently enrolled in a Masters of Public Administration program.

Joseph T. Pajor

Deputy Director of Public Works & Utilities

Joe has served as the Deputy Department Director since October of 2009. He has over 38 years of service with the City. His assignments have included: energy, water, wastewater, solid waste, housing development, and industrial development. He has served as an adjunct instructor at Friends University and Wichita State University. Joe has a Master's Degree in physics from Wichita State University and a Bachelor's Degree, also in Physics, from Benedictine College in Atchison, Kansas. He has done additional graduate work at Kansas State University. He holds the Certificate in Public Management issued jointly by the International City/County Management Association and WSU.

Don Henry

Assistant Director of Public Works & Utilities

Don manages four divisions responsible for water treatment, wastewater treatment, environmental health activities, and stormwater management. He joined the City in 1998 and worked as a food and water quality inspector in his first six years. Don ran the water quality program from 2004-2007 prior to becoming Division Manager. He became the Assistant Director in Nov. 2011. Don holds a Bachelor of Science in Biology from Midwestern State University in Wichita Falls, Texas and completed the miniMPA in 2012 through Wichita State University's Executive Development in Public Administration Program. He is a Registered Environmental Health Sanitarian through the Kansas Joint Credentialing Committee of Sanitarians, Kansas Environmental Health Association.

Scott Macey, PE

Water Resources Engineer

Scott joined the City of Wichita in 2014 as Water Resources Engineer. Recent work has included modeling the City's water resources for future drought conditions. In 2016 and 2017, Scott worked at Wichita's Aquifer Storage and Recovery facilities. He holds a Bachelor of Science in Civil Engineering from University of Missouri-Rolla.

Brian, Meier
Principal-in-Charge

30 years of experience

Brian has served municipal and industrial clients for the past 30 years and will serve as your main point of contact as the project manager. He is responsible for working with clients to find the best and most economical solutions to meet his clients' needs. 20 years ago, Brian started our Wichita office and has been instrumental in growing our experience and team to best serve the needs of communities across the state of Kansas. He has experience in regulatory compliance, primarily relating to public water supply and includes Water Right administration and management. Brian's responsibilities also include quality control and assurance. He has been tasked with ensuring that projects are completed on schedule, within budget and in adherence with the highest quality standards possible. He has served as a project manager for numerous design, construction and resource planning projects including water resource planning, facility evaluations, well field expansion, aquifer evaluation and groundwater remediation.

Education

- BS, Industrial Engineering

Specialties

- Regulatory Compliance; Water Right Administration and Management; Water Resource Planning; Well Field Expansion; Aquifer Evaluation

Key Projects

New Water Source Development | McPherson BPU, Kansas

Project manager responsible for planning and evaluation for the development of an alternate water supply source for the McPherson BPU. Due to declining water levels within the existing well field BPU required a supplemental source of supply in order to reduce the use of existing groundwater resources to sustainable levels. Sources evaluated included both surface water and groundwater. The development of a new well field was selected for additional evaluation. The project includes preliminary design of the well field, approximately 20 miles of raw water pipeline and a new water treatment facility. Groundwater modeling and new water right applications are included in the project.

Water and Waste Water Master Plan | City of Wichita

Principal-in-Charge for master plan updates to the Water and Waste Water Utilities in Wichita. He was responsible for the coordination of all activities including adherence to schedule and budget and reviewing and evaluating recommended improvements to aid in the risk management process. This ongoing evaluation includes the general conditions, capacities, and operational considerations for all water and wastewater facilities. The evaluation and modeling will result in the development of new CIP's for the combined Utility.

Project Planner and Coordinator | City of Wichita

Project coordination and management services for numerous City of Wichita Integrated Local Water Supply Plan (ILWSP) projects including distribution system analysis, well field evaluations and the Aquifer Storage and Recharge (ASR) project. Project elements have included assistance with project permitting, regulatory compliance, construction oversight, assistance with land acquisition and public relations.

DONALD R. KOCI

506 Dawn Lane
Colwich, Kansas 67030
Phone: 620.664.0273 (cell), 316.721.4655 (home)
Email: DRKoci11@gmail.com

OBJECTIVE — Attain career goals utilizing education and experience in fields of water and wastewater treatment system development, environmental science and geology.

EDUCATION

1982-1987	Bachelor of Science in Geology, Kansas State University, Manhattan, KS
2009-2010	MiniMPA, Wichita State University, Hugo Wall School (Public Administration)

PROFESSIONAL

1999-Present	Licensed Geologist, State of Kansas (Lic. #78)
2006-Present	Kansas Class IV Water Supply System Operator Certification (#15805)
2016-Present	Kansas Class II Wastewater Treatment Facility Operator Certification (#19243)

EMPLOYMENT

2018-Present	Staff Hydrogeologist, Burns & McDonnell, 800 E. 1st, Wichita, KS 67202
2017-2018	Environmental Services Manager, City of Hutchinson PO Box 1567, 1500 South Plum St., Hutchinson, Kansas 67504
2015-2017	Supt. of Water and Wastewater Treatment Systems, City of Hutchinson
2009-2015	Superintendent of Water Production and Treatment, City of Hutchinson
2004-2009	Environmental Geologist, City of Hutchinson
1991-2004	Hydrogeologist/Asst. Manager, Equus Beds Groundwater Management District No. 2, 313 Spruce Street, Halstead, Kansas 67056
1987-1991	Hydrologic Technician, Equus Beds Groundwater Management District No. 2,

WORK EXPERIENCE and RESPONSIBILITIES

Water and Wastewater Treatment Systems -

- Commissioning and performance testing oversight of Clinton, OK Water Treatment Plant, including assistance with operational start-up tasks and plant operator training.
- Involvement with various water supply/treatment and environmental consulting projects for clients including Clay Center KS, Hays KS, Russell KS, McPherson KS, Wichita KS, Hutchinson KS and Clinton OK.
- Responsible for ensuring safe, high quality drinking water to the citizens of Hutchinson KS, and adequate water supply for fire safety protection.
- Implementation of the Hutchinson Reverse Osmosis Water Treatment Center including: design input, construction oversight, daily collaboration with project superintendent and inspection services, fiscal oversight, plant start-up oversight, staff training, data collection and reporting.

- Water Plant Superintendent responsibilities: supervision of five water operators, two lab techs, and one plant supervisor, fiscal/budget/operational/maintenance/purchasing oversight responsibilities for all water plant and field facilities (19 water wells, 2 booster stations and 4 storage facilities), responsible for regulatory compliance and reporting, planning and budgetary preparation of Capital Improvement Projects (CIPs) and Municipal Equipment Replacement Fund (MERF).
- Worked under the direct oversight of the Public Works Director and was acting Public Works Director in his absence.
- Wastewater Treatment Plant Superintendent responsibilities: supervision of ten operators, two lab techs, one plant supervisor and one lab supervisor, fiscal/budget/operational/maintenance/purchasing oversight responsibilities for all wastewater treatment plant and field facilities (33 lift stations), responsible for regulatory compliance and reporting, planning and budgetary preparation of CIPs and MERFs.
- Responsible for efficient treatment of wastewater and solids removal to ensure environmental safe discharge of effluent water meeting NPDES requirements, and proper disposal and application of biosolids per regulation.
- Responsible for proposal development, planning and implementing multiple operational and efficiency improvement projects for both water and wastewater.
- Responsible for organizing staff meetings, regulatory inspection and meeting preparation, City Council and other presentations, facility tours, interdepartmental coordination, responses to public and media inquiries, working under the direct supervision of the Public Works Director.
- Oversight of Industrial Pretreatment program.
- Oversight and inspection of pipeline installation project for Water Plant/4th & Carey Project.
- Utilization of technical equipment including Foxboro transmitters and transducers, GPS units, ultrasonic and mechanical flowmeters, Siemens controls, variable frequency drives, large capacity pumps, motors, water/wastewater quality monitors, aerators, samplers, chemical feeders, etc.

Environmental -

- As Environmental Services Manager for COH, provided division head oversight of both Water and Wastewater Treatment Divisions along with groundwater remediation, Class I UIC and environmental project oversight. Provided direct supervision of the Water/Wastewater Treatment Superintendent and the Water Quality Coordinator.
- Oversight, planning, design and implementation of the 4th & Carey Contamination Remediation Project.
- Permit compliance responsibility (i.e. water appropriation, NPDES)
- Responsible for indirect and direct oversight of groundwater remediation operations, monitoring and reporting activities (5 remediation wells, 150 monitoring wells, 10+ miles of pipelines, 4 AS/SVE source area systems).
- Remediation report collaboration with consultants and final review approval.
- Oversight of Obee Superfund Landfill Subsite data collection, monitoring and reporting.
- Maintaining good rapport and regular contact with KDHE staff in multiple bureaus and sections about regulatory compliance issues.
- Oversight of Class I UIC well operations, monitoring and reporting.
- Technical advisor for Hutchinson on salt solution mining subsidence and catastrophic sinkhole events.

- Well design and implementation for RW-4 remediation well.
- Planner, designer and coordinator for implementation of RW-4 Alternative Remediation Project (remediation through irrigation).
- Utilization of ArcGIS, Microsoft Office products, Wonderware SCADA software, Lucity asset management software, Munis financial accounting software, Ultipro personnel/time report software, and other specialty software applications.
- Environmental and hydrologic studies coordinator.
- Director and quality assurance officer of State accredited water quality laboratory.
- GMD2 researcher and data analyst for Wichita aquifer storage and recovery project
- Site geologist for many monitoring well installations.
- Developed computer groundwater MODFLOW models for groundwater remediation, wellhead protection, groundwater appropriation applications and hydrologic studies.
- Coordinated hydrologic investigations and co-authored published hydrologic reports.
- Assisted Bureau of Reclamation with program development for ArcView software.
- System manager and programmer of Campbell Scientific automated atmospheric and hydrologic data collection platforms.
- Data research for Kansas Geological Survey reports and publications.
- Coordinator of aquifer pump tests including installation of automated dataloggers and pressure transducers for data collection and analysis.
- Compliance officer overseeing installation of cathodic protection grounded installations.
- Administrator of groundwater protection projects and programs.
- GMD2 analyst of groundwater appropriation applications for compliance with State (DWR) and local (GMD2) regulations.

ORGANIZATIONS and MEMBERSHIPS

AWWA/KsAWWA -- WEF/KWEA -- KRWA -- KMU
KSU Alumni Assn -- Sacred Heart Catholic Church -- St. Francis of Assisi Coaching Staff

BOARDS, COMMITTEES and COUNCILS

Equus Beds Groundwater Management District No. 2, Director/Treasurer
South-Central KS Water Coalition / REAP Water Resources Committee
Lower Ark Basin Advisory Committee (LABAC)
Equus-Walnut Regional Area Water Committee (RAC)
Kansas State University Geology Advisory Council
Kansas Municipal Utilities (KMU) Water/Wastewater Advisory Committee
Kansas Class I UIC Well Operator Coalition
Kansas Department of Health and Environment monitoring well design regulation committee

PUBLICATIONS AUTHORED

American Society of Civil Engineers' *Civil Engineering* Magazine, 4th & Carey/RO Treatment Plant Project (July 2009)
AWWA *Opflow* Magazine, Biofilm Control, Vol. 39-No. 9 (September 2013)
USGS Report, Biochemical Processes, Water-Resources Investigations Rept. 03-4213 (2003)
Wellhead Protection Area Design Reports for multiple South-Central Kansas cities
KGS Technical Report Contributor (salinity and nitrate investigations in GMD2)

PRESENTATIONS and PUBLIC SERVICE PROGRAMS

American Water Works Association (AWWA), Webinar on Biofilm Treatment (2013)

American Membrane Technology Association (AMTA), 4th & Carey Groundwater Remediation & Reverse Osmosis Water Plant Project (2011)
KDHE Abandoned Well Plugging Workshops
KDHE Environmental Conference, 4th & Carey/RO Plant Project
KMU Workshop, Reverse Osmosis Treatment Process
Kansas Governor's Conference (2017), RW-4 Alternative Groundwater Remediation
AWWA 2016 ACE Conference, Asset Management
Various City Council meetings and GMD2 Board of Director meetings
Annual Kansas Cosmosphere Space Camp, RO Water Treatment
Various Civic and Church organizations, Remediation and Water Treatment Projects
Various Middle and High Schools, Remediation and Water Treatment Projects
Advisor for graduate students during environmental research for thesis preparation
Mentor for Hutchinson annual Disability Mentoring Day
Planned and coordinated 2017 "Imagine a Day Without Water" AWWA event to promote importance of infrastructure rehabilitation and replacement.

TRAINING and CERTIFICATIONS

OSHA 40 Hour Hazwoper Certified (2007-present)
FEMA National Incident Management System IS-00700 (2007)
FEMA National Incident Management System IS-00100.PW (2007)
18-week Wastewater Treatment Plant Operation and Maintenance Course (2016)
18-week Potable Water System Operation and Maintenance Course (2006)
Great Plains Institute Ethics Course (2012)
AWWA Water Well Rehabilitation & Asset Management (2013)
University of Kansas Environmental Engineering Conference Training (2015)
AWWA/ACE Conference Workshops (2016)
KMU Groundwater System Operations Certificate (2014)
Kansas Water and Energy Partnership - Energy Management at Public Water & Wastewater Utilities (2014)
KRWA Chlorine Safety (2007)
Various others identified on KDHE Public Water Supply Technical Section website

EMPLOYMENT AND PROFESSIONAL REFERENCES

Brian Meier, Burns & McDonnell, Managing Associate - Ph: 316.554.6996
Reg Jones, City of Hutchinson Public Works Director (retired) -- Ph: 620.664.0802
Tim Boese, GMD2 Manager -- Ph: 316.835.2224
Mike Dealy, KS Geological Survey & former GMD2 Manager -- Ph: 316.943.2343
John Deardoff, City of Hutchinson City Manager -- Ph: 620.694.2611

John N. Winchester, P.E.

High Country Hydrology, Inc.

Education:

M.S., Civil Engineering,
Colorado State University, 1990

B.S., Watershed Sciences
Colorado State University, 1987

Years Experience:

With this Firm: 10
With Other Firms: 18

Modeling Experience:

ExcelCRAM
MODSIM
StateMod
RiverWare
EPANet
Custom (Excel, VBA, Fortran)

Registrations and Memberships:

Registered / Licensed Professional Engineer:

State of Colorado
State of Kansas
State of New Mexico
State of Oklahoma (inactive)

Member, American Water Resources Association
- Chair, Wildland Hydrology Technical Committee (2001-2014)
- Board member, Colorado Section (2003-2004)

Member, American Society of Civil Engineers

EXPERIENCE NARRATIVE

Mr. Winchester is a water resources engineer with 25+ years' experience in water resources planning, analysis and design. This has included modeling of raw water collection and delivery systems, analyzing water rights, and studying physical hydrology. Mr. Winchester also has experience with watershed-scale projects, dealing with the problems of erosion, sedimentation and wildfire science.

Water Rights

Mr. Winchester has experience in water rights of the western United States, and has worked for both applicants and objectors in Colorado water court. This has included the quantification of historical diversions and consumptive yield, the impacts caused by a change of use or point of diversion, and the quantification of exchange potential. He has experience designing augmentation plans, and has designed accounting systems to demonstrate compliance with water rights decrees. Mr. Winchester has developed and used distribution system, raw water collection system and streamflow analysis models, which include direct flow, storage and exchange water rights. These models have been used for water operations analysis, water rights applications, and both intrastate and interstate litigation. He has reviewed and critiqued surface water accounting models and the data used in them. He has completed the engineering analyses necessary for the filing of a new water right, and to satisfy due diligence requirements for conditional rights.

Water Resources Modeling

Mr. Winchester has developed and used distribution system, raw water collection system and streamflow analysis models, which include direct flow, storage and exchange water rights. These models have been used for water operations analysis, water rights applications, and both intrastate and interstate litigation. He has built, reviewed and critiqued surface water accounting systems and the use of data in them.

Some of the more frequently used models he has direct experience with include:

- ExcelCRAM, a proprietary network model that allocates flow based on user-defined priorities. Mr. Winchester built a raw water collection and delivery system model for the City of Aurora, CO. This includes water supplies from three river basins, senior water rights owned by others, and both river and contract exchanges. He has also modified, reviewed and/or used ExcelCRAM models for the Oklahoma Water Resources Board, the City of Boulder, the Centennial W&SD, and the Upper Eagle Regional Water Authority.

- MODSIM, a publicly available optimization model developed by Colorado State University. Mr. Winchester built MODSIM models of the raw water systems for Colorado Springs CO and Wichita KS, and used them to evaluate potential water supply alternatives.

- RESNET, a proprietary network model owned by Burns & McDonnell. This model is a daughter of an older version of MODSIM, and used to evaluate local supply options for the city of Wichita, KS.

- RiverWare, developed by CADSWES at the University of Colorado. Mr. Winchester modified and ran a RiverWare model of the Pecos River in New Mexico for the New Mexico Office of the State Engineer. This work included adding additional water users and channel routing between Fort Sumner and Brantley reservoirs.

- StateMod, developed by Boyle Engineering, is used by the State of Colorado to model its large river basins. Statemod is an accounting-type model that allocates water based on priority date. Mr. Winchester used Statemod to analyze potential changes in flow on the White and Yampa rivers that could result from energy development.

- Custom models. These have included FORTRAN, BASIC and spreadsheet models written for specific locations or projects. These include models of the Fryingpan-Arkansas system and the Platte River system in Wyoming, Colorado and Nebraska.

Mr. Winchester has authored numerous reports on water supply and watershed yield for large municipalities and irrigation companies, including yields for the dry, average annual, and wet years, as well as firm yields for collection systems with storage.

Physical Hydrology and Hydraulics

Mr. Winchester has theoretical and practical experience in physical hydrology. He has calculated watershed yield under a variety of hydrology conditions and climates. He has used tree rings to extend river hydrographs back in time to look at the frequency and duration of droughts. Mr. Winchester has conducted specialized snowmelt research at ski areas to determine the snowmelt timing of man-made snow, and how that affects water quality. He has installed and maintained stream gage and water quality sampling devices in high altitude watersheds and has used the date collected by those systems to perform analyses. He has specialized experience analyzing stream stability in steep, high altitude streams, and quantifying the amount of change the stream should be capable of absorbing before the threshold of stability is crossed. He was the primary hydrologist on a team that prepared an Environmental Impact Statement that quantified the hydrologic response to catastrophic wildfire in the Santa Fe watershed, and has helped The Navigators with their response to the Waldo Canyon Fire west of Colorado Springs CO.

Mr. Winchester has been involved in more than a dozen projects to replace private bridges lost during the 2013 flood on the Front Range of Colorado. This included creating HEC-RAS models of the affected properties, calculating the flood elevations for various flow rates, creating maps comparing inundation pre- and post-flood, as well as adjusting bridge and channel geometry to satisfy floodplain development criteria.

Environmental Assessments / Environmental Impact Statements

Mr. Winchester has prepared or contributed to EA and EIS documents for a variety of projects, including the hydrologic response of a watershed in New Mexico to fuels reduction and wildfire, reclamation of prominent abandoned gravel pits in Teller and El Paso counties, and the modification of a channel for construction of a water diversion facility on the Eagle River. He completed the hydrologic modeling and associated documentation required for a municipality to obtain a permit to store non-project water in a Reclamation reservoir. He has prepared preliminary environmental scoping for proposed pipeline construction projects in El Paso County, and has reviewed environmental reports completed by others. Most recently he oversaw the preparation of the hydrology section of an EIS on the Rio Grande in southern New Mexico for the U.S. Bureau of Reclamation.

Water Resources Planning

Mr. Winchester specializes in providing raw water resources engineering and planning to municipalities and other water users. This has included modeling of streams, diversions, storage, and delivery systems. He has built and used models spanning all levels of complexity, from those based in spreadsheets, to specialized models in Modsim and Riverware, to custom-built legacy models in Fortran. These models are used to identify restrictions in raw water systems, and to determine how system yields would change if changes were made to water supplies, storage, or delivery. Mr. Winchester also specializes in water rights engineering, including all engineering aspects related to water rights quantification for water court applications. To support permitting efforts, he has quantified how river and system operations would change for proposed projects.

Climate Change / Drought

Since 2004, Mr. Winchester has assisted with or conducted a wide variety of paleo hydrologic and climate change analyses for municipal and commercial clients. This has included developing naturalized flows for key gauges that were correlated with tree-ring data to develop paleo hydrologic flow records, and analyzing paleo hydrologic flow records to establish the depth and duration of prehistorical droughts. This data was then used to construct longer model data sets, which were used in raw water models for several clients to provide more robust modeling of potential droughts. Both Aurora Water and the City of Wichita have used these and other climate techniques to determine the sensitivity of their systems to potential changes in hydrology due to climate change.

Mr. Winchester has used CMIP3 and CMIP5 data to determine the projected changes in evapo-transpiration of irrigated areas due to the projected increase in temperatures. This involved using existing weather station data to determine the current ET, and then simulating future ET due to higher temperatures. The difference in the irrigation water requirement will either have to be made up with increased irrigation or deficit irrigation. John provided this analysis to the City of Greeley, which used incorporated this additional demand in their projection of future demands as part of project permitting.

Mr. Winchester has also analyzed streamflow records in Colorado to determine how the snowmelt runoff hydrographs have changed to date. Because many water rights that have been changed from one use to another are limited by date to specific diversion seasons, a large enough change in the timing of the runoff hydrograph could reduce the potential yield of these rights. John has analyzed runoff hydrographs and date-limited water rights for a municipality in Colorado.

Registrations

Mr. Winchester is a registered Professional Engineer in Colorado, New Mexico, Kansas, and Oklahoma (inactive).

Employment History

Water Resources Engineer /President, High Country Hydrology, Boulder CO 2008-Present.

Water Resources Engineer /Project Manager, Hydrosphere Resource Consultants, Boulder CO. 1996-2008.

Project Engineer, Hurst & Associates, Boulder CO. 1996.

Water Resources Engineer, Gronning Engineering Company, Denver CO. 1990-1995.

RECENT PROJECT EXPERIENCE

Raw Water Collection and Delivery

Raw Water Collection System Modeling (2018) Created a raw water model for the combined City of Steamboat Springs and Mt. Werner Water District in Routt County, Colorado. The model allows the user to simulate operations under different hydrologic conditions, including potential flows from both the historical record and the paleo-drought of record, as derived from tree-ring records. The user can vary a number of variables that affect the raw water system, including turning on and off various proposed projects, simulating infrastructure outages, varying instream flow requirements, and the impacts of major events such as a fire in the watershed and a Colorado River Compact call by lower-basin states.

Reservoir Sizing and Operations Analysis, Aurora Water (2018) Using Aurora's raw water model, worked with Lynker Technologies and RJH Engineers to determine the optimal size for a new off-channel reservoir in Aurora's system. This included determining the size that provided the greatest increase in yield for both the existing system, as well as with anticipated future projects. This information was used as the foundation for design and permitting.

Analysis of Water System, Wolf Creek Ski Area (2018) Project manager for to review the water rights and physical facilities at the Wolf Creek Ski Area, and providing an assessment of the ski area's water system ability to meet demand, as part of the reissuing of a Special Use Permit for ski area operations by the US Forest Service. This included reviewing the Ski Area's water rights (direct diversion, storage, exchange, and augmentation), verifying the locations of the diversion points, and comparing physical and legal supply to historical and projected future demands.

USBR Fryingpan-Arkansas Operations Model of the Arkansas Basin (2015-2016) As a subcontractor to Precision Water Resources Engineering, provided technical information regarding major water users, reservoir operations, and exchanges to PRWE while they built a Riverware model of the Fryingpan-Arkansas project. Reclamation will use the model to analyze requested storage contracts in Federal facilities, and annual operations, specifically the release of water from upper-basin reservoirs down to Pueblo Reservoir.

Box Creek Reservoir Sizing and Operations, Aurora Water (2014-2016) Worked with Roger Wolvington of Lynker Technologies to use Aurora's raw water model to analyze the optimal size of Box Creek Reservoir, a proposed reservoir in the upper Arkansas river basin between Twin Lakes and Turquoise reservoirs. The reservoir will be used to stage water on its way from the Arkansas and Colorado basins on its way to Aurora in the South Platte basin. The analysis include evaluating the yield that would result from different size reservoirs, which was particularly important because a smaller reservoir could be filled by gravity while a larger reservoir would have to be pumped.

Project Operations Analysis, Rio Grande Project (2015-2016) The Rio Grande Project delivers water for irrigated agricultural on the Rio Grande basin in southern New Mexico and west Texas. As a subcontractor to Precision Water Resources Engineering, analyzed modeling output provided by Reclamation of the Rio Grande Project in the in the Rincon and Mesilla Basins to determine impacts to streamflow, reservoir elevations, and ground water levels. Reclamation proposed to keep interim operations, and our work was used to quantify the changes that would occur in the basin.

Cooperative Water Operations, Castle Pines North Metropolitan District (2015-2016)
Modeled a trade between Castle Pines North Metro District and the Central Colorado Water Conservancy District to determine how much water could be moved using a contract exchange on the South Platte River. A trade between CPNMD and CCWCD could increase the reliable of CPNMD's lower South Platte deliveries to its diversion point in Chatfield Reservoir, and would increase the amount of water available to CCWCD through reduced transit loss as well as provide a senior supply of water it can use for augmentation.

Integrated Water Master Plan, Aurora Water (2015) Worked with prime contractor MWH and Lynker Technologies on an integrated water master plan. As a modeling resource, our work included adding potential projects to the model, providing QAQC for model runs, troubleshooting when scenarios of projects provided unanticipated results, attending presentations, and reviewing reports written by MWH.

Montgomery Reservoir Alternatives Analysis, Colorado Springs Utilities (2014) As a subcontractor to Applegate Group, participated in an analysis of alternatives to raising Montgomery Dam in Park County Colorado. Mr. Winchester was part of a team that generated and analyzed alternatives, including making preliminary estimates of project yields, projecting permitting requirements, proposing potential levels of public acceptability, and ranking the likelihood of project success. These findings were put into a matrices so the projects could be ranked using quantitative measures, and the top alternatives presented to Utilities.

Raw Water System Model, The Navigators (2013) As part of a water rights application, Mr. Winchester prepared a Modsim model of The Navigators raw water diversion and delivery system. This model included both existing and proposed water rights, and simulated the operation of existing and proposed on- and off-channel reservoirs to meet irrigation demand for both The Navigators and a private golf course they provide water for. Model operations looked at different operating priorities for diverting, storing and delivering water under a variety of hydrologic conditions. This work provided The Navigators with information about the frequency of diversions and volume of water the proposed reservoirs will likely experience. In turn, this provides information that can be used to determine if these projects are financially feasible, which is one part of the decision about whether they should be built or not.

Raw Water System Model, Wichita KS (2012-2013) Mr. Winchester built a Modsim model of the City of Wichita's raw water collection and delivery system. This included model elements for surface water diversion and storage in Cheney Reservoir, aquifer storage and recovery in the Equus Beds Aquifer, and two additional well fields. In addition to the historical gage record, High Country is developing paleohydrologic streamflows to extend the period of record the model operates on. The model will be used to evaluate new supply alternatives as part of the City's on-going water planning efforts, and provided yield information regarding reservoir yield for on-going negotiations with a neighboring project. The project included model documentation and training for city staff so they can take over model operation. The staff also anticipates using the model to determine how various levels of conservation will affect the City's ability to withstand multi-year droughts.

River Exchange Modeling, South Platte River, CO (2009-2013) The Castle Pines North Metropolitan District was developed using non-renewable Denver Basin ground water as its water supply. The District purchased agricultural rights in the lower South Platte basin, and retained High Country to calculate the exchange potential between the historical diversion points and proposed diversion locations, up to and including Chatfield Reservoir. In addition to calculating streamflows at all measured inflow, diversion and exchange points, recent exchanges by senior water rights holders were researched and tabulated to determine how much the raw exchange potential should be reduced by historical exchanges. The engineering report from this work was used by the District's legal counsel during preparation of the proposed decree, negotiations with objectors, and trial preparation. Mr. Winchester was deposed and testified at trial for this case, which ultimately settled.

Raw Water Model Review, Wichita KS (2010) The City of Wichita owned a raw water model developed by a Kansas consulting firm. High Country was retained to evaluate the model engine and data, and to make recommendations to the City regarding the suitability of the model for continued use. Our work found that allocation routines in the model engine were fairly state of the art, the user interface was non-existent, making the model very difficult for the uninitiated to operate. This analysis was used by the City in designing its on-going raw water planning efforts.

Raw Water Forecasting Model Update, Aurora, Colorado (2009) Updated Aurora's raw water forecasting model to incorporate additional period of record and features available since the completion of the original model. In addition to adding time series data, this included additional user interface controls and working on the graphical user interface.

Raw Water System Model Update, Aurora, Colorado (2009) Added 4 years of of daily data to the model's period of record. This included historical daily data for streamflow, diversions, and gains and losses, as well as potential demands and exchange requirements for both Aurora Water and other water users.

Phantom Canyon Operations (2008) Phantom Canyon was the preferred alternative to Colorado Springs Utilities' Southern Delivery System is a diversion and delivery system from the Arkansas River in Fremont County near Florence. As part of Springs Utilities' analysis of this alternative, John analyzed how the Phantom Canyon Project, a proposed reservoir and pump-storage project located near Penrose, could be utilized in the system. This analysis found that the project could increase supply during droughts by providing storage that could be drawn down during dry years.

Economic Analysis of the Arkansas Basin, Aurora, Colorado (2006) Project manager responsible for developing a raw water system economic analysis tool. This software tool calculates the cost per acre-foot of water delivered to a pump station that delivers water to the South Platte basin. The tool calculates the cost for each water supply, and includes the cost of purchase, storage, exchange and pumping between the physical source and delivery to the South Platte basin. This tool allows the City to determine the cost and benefits of new projects in relation to its existing water rights and facilities.

Raw Water Collection and Delivery System Model, Aurora, Colorado (2003-present) Project manager responsible for expanding the City of Aurora's existing raw water collection system model to include all the City's facilities in Colorado, Arkansas and South Platte basins, down to the City's diversion at Strontia Springs. The model includes the operation of diversions, pipelines and tunnels, reservoirs, and river and contract exchanges. The model allows the City to analyze the benefit of various projects and determine the optimal order of implementation from a water operations perspective. Ongoing.

Modeling in Support of an Environmental Assessment, Aurora, Colorado (2003-2006) Project engineer on a team of consultants which prepared an Environmental Assessment for the U.S. Bureau of Reclamation, on behalf of the City of Aurora, to obtain long-term contracts for storage space and contract exchanges in the Fryingpan-Arkansas Project. This work included performing modeling work, writing technical memos on both the model and model results, working with other technical specialists to translate model output into information meaningful to other disciplines, and presenting model results at public meetings.

Raw Water Forecasting Model Upgrade, Aurora, Colorado (2006) Project manager tasked with updating Aurora's raw water forecasting model to incorporate additional features identified since the completion of the original model. These include additional user interface controls, a shorter but more detailed analysis period, and the ability to specify more reservoir contents and water right specific operations.

Raw Water Forecasting Model, Aurora, Colorado (2002) Project engineer responsible for developing and implementing a forecasting model to predict reservoir reserves under various user-specified yield and demand assumptions. This included determining return periods for the users' water rights for historical hydrology given current facilities, and implementing the model so the user can select various inflows and municipal demands.

Arkansas Basin Strategic Plan, Aurora, Colorado (2000-2003) Project manager responsible for developing a strategic plan for the City of Aurora's Arkansas River Basin raw water operations. The majority of this project was focused on building a raw water allocation model of Aurora's rights in the Arkansas basin, including contract and river exchanges to move water from the lower Arkansas basin to upper basin reservoirs. Water rights modeled included native and transmountain diversions, direct diversion, storage and exchange rights. Modeling the interaction of senior water users with Aurora's operations was very complex, particularly the interaction of competing exchanges on the Arkansas River.

NWCCOG Upper Colorado River Basin Study, Summit / Grand counties, CO (2000-2001) Designed a survey that was mailed to major water users in Summit and Grand counties, Colorado. Information from the surveys and interviews with users was used to calculate historical and potential future water demands for a 50 year period, which were input into the Denver Water Department's PACSM model. Memos documenting system operation and model nodes in the system was provided to Denver Water.

Arkansas Basin Raw Water Storage Analysis (1994) Project engineer for the construction and operation of MODSIM network models to estimate the storage requirements in the Upper Arkansas Basin Reservoirs for the City of Colorado Springs. Included analyzing the system to be modeled; the collection, storage, organization and use of hydrologic data; documentation of the model and report preparation.

Pikes Peak and Blue River Collection - Yield Update and System Improvements Study (1993) Project engineer responsible for calculating the constrained, unconstrained and demand limited yields for the City of Colorado Springs' collection systems. Average annual and dry-year yields were calculated on a daily basis for the 42-year period from 1950 through 1991. Improvements to the existing system were evaluated and recommended in order of increased yield per dollar spent.

Arkansas River Exchange Modeling (1992) Maintained and operated a model that calculates the daily exchange potential between any two points on the Arkansas River from Las Animas to Leadville. Expanded the model to include more intermediate points, extend farther downstream, and extend the period of record 5 years (for a total of 44 years). This included acquiring data from various sources, verifying data integrity, coding model changes, obtaining and analyzing model results. Ran the model to determine the potential exchange yield to the City of Colorado Springs for various development scenarios, and to determine operational guidelines for the Water Resources Department on the operation of the City's exchanges.

Fryingpan-Arkansas River Basin Operations Study, CO (1992) Modeled project operations and alternatives for raw water storage for Colorado Springs. Assisted in the conversion of a USBR river accounting model and database from Fortran 4 (CYBER platform) to Fortran 77 (PC-based). Updated the model and database to extend the period of record from 37 to 45 years.

Twin Lakes Reservoir and Canal Company System Yield Evaluation, CO (1991) Evaluated the historical and potential yields for the Twin Lakes Transmountain Collection System. Yields were estimated on a monthly basis for the 41-year period from 1950-1990. Though several studies have estimated the Twin Lakes yield, this was the first study to calculate yields which agreed with historical diversions.

Water Supply Permitting Study, Colorado Springs, CO (1993-1994) Assisted in the study and review of four major raw water delivery alternatives for the City of Colorado Springs, including the Southern Delivery System, which was subsequently built. The study included the review of the social, economic, environmental and project permitting issues involved with each alternatives. The report identified the key issues to be addressed for completion of each of the projects. Attended public meetings and focus groups, as well as numerous private meetings to determine public opinion about alternative pipeline routes.

Elephant Rock Reservoir Yield Study, CO (1992) Calculated yield for Elephant Rock Reservoir, a proposed impoundment on the Arkansas River north of Buena Vista, Colorado. Streamflow at the reservoir site was calculated from adjacent gages on the Arkansas River. Legally divertable flows were derived from the calculated streamflow and the Arkansas River call record for the water years from 1966 through 1990.

Durango Water Supply Study, Durango, CO (1992) Assisted with calculating the basin yield for the Pine River, north of Bayfield, Colorado, as part of a water supply study for the City of Durango, Colorado. This work included an analysis of basin characteristics and a correlation with gages in similar basins.

South Slope Collection System Yield Analysis (1994) Calculated the basin yield for the upper Beaver Creek basin on the south slope of Pikes Peak. Storage requirements were calculated for different reservoir inflow / outflow scenarios so reservoir operators would be informed how not to violate a hold order issued by the State Engineer's Office. As part of the work, reservoir operations were modeled to determine how to maximize the firm and average annual yields from the project.

Water Rights

Climate Change analysis of Junior Water Rights, (2018) Analyzed historical streamflow records across Colorado to determine if snowmelt runoff hydrographs have changed in timing or amount. By themselves, large changes in runoff timing have the potential to reduce yields of water rights that are date limited.

Augmentation Plan using new rights, Colorado Springs Utilities (2016-2018) Provided engineering analyses to support an application to use transferred agricultural rights for augmenting well pumping and aquifer recharge on Fountain Creek, replacing return flows owed to the Arkansas River, and adding the new sources of water to Springs' existing local exchanges. This work analyzed the available supply vs demand for augmentation water, exchange potential between the augmentation stations and upstream depletions, and the change in exchange potential since Spring's original exchange rights were decreed.

Change of Water Rights, Colorado Springs Utilities (2015-2016) Provided the water rights engineering necessary to change shares in agricultural ditches on Fountain Creek to municipal and other consumptive uses. This included reviewing previous changes, determining if conditions that existed at the time of the previous changes still exist, quantifying the consumptive use and return flows, and writing engineering reports to document the work.

Straight Line Diagram for Coal Creek, Gunnison County CO, Western Resource Advocates (2014)
Created a straight line diagram of the water rights Coal Creek, including direct flow, storage and ground water rights. The map included the appropriation and adjudication dates, rates and volumes. The map was generated with information from decrees and cross-checked with the water commissioner.

New Water Right for Quail Lake, Colorado Springs (2014)
Provided an engineering report to support the application in Case No. 2007CW120, which requested a conditional water right to store incidental inflows in a city reservoir due to precipitation events.

Review of Water Rights, Presbyterian Highlands Camp, Allenspark CO (2013) After a change in staff, Mr. Winchester reviewed the physical and legal supplies for the camp, including an augmentation plan that allows the camp to store senior consumptive use water and augment the North St. Vrain River during times the camps rights are out of priority. Prepared a summary of water rights and operations, and reviewed it with staff so they could remain in compliance with their water rights decrees. He prepared the annual filing of water rights activities for the State Engineer's Office, and met with camp staff and the Water Commissioner to plan operations that would maximize the recorded use of the camp's water rights.

New Water Rights for Upper Williams Creek Reservoir, El Paso County CO (2012-2015) Provided engineering support for Colorado Springs Utilities for a new water rights filing for Upper Williams Creek Reservoir (2012CW31). This included determining the physical inflow to the reservoir, as well as the exchange potential into the reservoir from sources upstream on Fountain Creek. Mr. Winchester has met with City, attorneys and objectors as part of settlement negotiations.

2010 Abandonment List, Colorado Springs CO (2011) Worked on behalf of Colorado Springs Utilities to assess and address water rights that had been put on the Division 2 abandonment list. This included assessing historical use, potential legal yield and potential uses of water rights not currently being used. This work was provided to City staff and outside counsel for use in the formal protest.

River Exchange, Colorado Springs, CO (2011-2012) Analyzed river exchange for exchanging sewered return flows of Denver Basin ground water to existing points of diversion on Pikes Peak (2-04CW132). Determined supply of replacement water, river exchange potential, and available flows at the proposed points of diversion. Prepared an engineering report in support of a water rights filing, responded to comments by objectors.

River Exchange, Colorado Springs, CO (2011-2012) Analyzed river exchange from Pueblo Reservoir to existing points of diversion on Fountain Creek (2007CW122). Determined supply of replacement water, river exchange potential, and available flows at the proposed points of diversion. Prepared engineering report, responded to comments by objectors.

Jordan Reservoir Accounting System (2010) Developed an Excel-based accounting system for Jordan Reservoir, located near Cripple Creek, CO, for reporting reservoir operations to the Colorado State Engineer. This involved correcting the reservoir's area-capacity curve to reflect changes made to the service spillway, calculating the net evaporation for the reservoir, and building a spreadsheet that the homeowners association could use to record reservoir elevation and river call. The spreadsheet calculates the amount of evaporation that the HOA has to purchase from other water rights owners to prevent injury to other water rights owners in the basin.

Water Rights Valuation, Upper Fountain Creek CO (2009) On behalf of Colorado Springs Utilities, analyzed the yield and reliability of a water right on upper Fountain Creek offered for sale to the Utility. This included analyzing historical diversions, call records, physical hydrology, and potential fit with the existing Colorado Springs system. A valuation was then developed for this right using comparable sales and other information from the basin. This information provided market information as part of the Utility's decision whether to purchase the right.

Water Rights Valuation, Lower Fountain Creek CO (2009) On behalf of Colorado Springs Utilities, analyzed the yield and reliability of a water right on lower Fountain Creek offered for sale to the Utility. This included analyzing historical diversions, call records, physical hydrology, and potential fit with the existing Colorado Springs system. A valuation was then developed for this right using comparable sales and other information from the basin. This information provided market information as part of the Utility's decision whether to purchase the right.

River Exchange into Pueblo Reservoir, Pueblo CO (2009) Analyzed the effect of the Pueblo County RICD on the undecreed exchange potential into Pueblo Reservoir for Colorado Springs Utilities. This included calculating senior and shared exchanges already decreed and stipulated to in previous water rights actions. This work provided Utilities with a foundation for negotiations with other water users about leased and other waters being exchanged into Pueblo Reservoir.

Engineering Report for River Exchange Decree, Colorado Springs, CO (2007-2008) Prepared an engineering report for the Colorado Springs Utilities in support of water rights filing 2005CW95, a river exchange on the Arkansas River from Pueblo Reservoir to a new point of diversion in Fremont County, CO. Reviewed and updated Utilities' exchange model. Calculated daily exchange potential for period of record. Oversaw the determination of water quality impacts as a result of the exchange. Prepared engineering report.

River Basin Water Rights Modeling, Southeast Oklahoma (2007-2008) Project engineer for a project to construct ExcelCRAM models of four watersheds in southeastern Oklahoma for the Oklahoma Water Resources Board. The original model was constructed to analyze how pumping from the Arbuckle-Simpson aquifer would affect permitted surface water rights. Additional models were built to help the OWRB determine if there is sufficient surface water in these basins to issue additional water permits. Model development included calculating the native physical hydrology, including both baseflow and storm runoff. The models included all the permitted water rights in each basin, and the model was built so the results could be exported to ArcMap.

Marshall Ditch Water Rights Analysis, Boulder, CO (2006) As project engineer, researched historical use of shares purchased by the City of Boulder Open Space Department. This involved determining the ownership history of each share, determining the historical location of use, the per-share allocation, the historical consumptive use associated with each share, and the waterway receiving water for the return flows.

Water Rights Analysis, Rio Blanco County, CO (2005-2006) Project manager to review the water rights portfolio of a private landowner and make recommendations about how to maximize the value of their holdings. This included reviewing decrees, retrieving historical use records, talking to the local water commissioner, and writing a letter report detailing the findings.

Water Rights Analysis, Wolf Creek Ski Area, CO (2006) Project engineer responsible for determining physical water yields at the Wolf Creek Ski Area, and comparing that to the water rights owned by the Ski Area. The water rights analysis included looking at the exchange potential on the South Fork of the Rio Grande, and the ability of the Ski Area to move augmentation water from the main stem of the Rio Grande

to the ski area across some State instream flow rights. The project also calculated the demand associated with the permitted level of ski area development, and compared the demand with the water rights owned by the Ski Area.

Jordan Reservoir, B Lazy M Homeowners Association, Cripple Creek CO (2005-2006) Project manager responsible for developing an augmentation plan for a reservoir built without water rights. This included doing the field survey to develop the area-capacity-elevation curve, determining the augmentation requirement for the reservoir, meeting with the water commissioner, and researching water rights for purchase and transfer.

New Water Rights Filing, The Navigators, Colorado Springs, (2006) Project manager for a team of engineers tasked with determining the amount of additional yield that could be obtained from a new water right filing on Camp Creek, an indirect tributary to the Arkansas River. This included field visits to survey potential reservoir sites, developing native hydrology for an ungaged stream, and working with attorneys and other consultants to determine the optimal size of the right based on the physical and political realities of the area.

Water Rights Accounting, New Mexico ISC, (2004-2005) Project manager responsible for developing an accounting system for the New Mexico Interstate Streams Commission on the Pecos River, for water bypassed, lost and replaced in conjunction with habitat maintenance and recovery for the Pecos Bluntnose Shiner. This consisted of developing loss coefficients for bypass and block releases, and the creation of an accounting system that included river and losses, as well as the delivery of replacement water. The accounting system was designed so it could be completed either electronically or by hand so that it was understandable to all levels of water users, and so it would summarize water operations on a monthly and annual basis. In addition, Hydrosphere developed both a users manual and a technical reference for the accounting tool.

Water Rights Valuation, The Navigators, Colorado Springs (2005) Project manager responsible for determining the present value of water rights owned by The Navigators in the Fountain Creek basin. This included calculating the physical yield of the basins and the subsequent yield of the water rights, identifying potential buyers, estimating potential value from water leases and sales, and developing recommendations to enhance the value of the rights.

Viele Lake Water Rights Analysis, Boulder, CO (2002) As project engineer, helped analyze and respond to a right owned by Boulder on the abandonment list. The right concerned a lake in the middle of a public park adjacent to the South Boulder Recreation Center. This included field visits to determine the source and fate of water entering and leaving the lake, the calculation of a water budget to determine a precipitation-runoff coefficient for the basin, the interaction of ground water and surface water in the reservoir, the generation of an engineering report to support the filing of a new water right for the reservoir. Developed an accounting system for Boulder to track reservoir contents, releases, augmentation, and for filing water rights information with the Colorado Department of Water Resources.

Navigators Well Augmentation, Colorado Springs, CO (2000-2005) Project manager responsible for augmenting a well originally drilled as an alternate point of diversion. This entailed identifying augmentation water in the client's water rights portfolio, preparing a temporary substitute supply plan for the State Engineer's Office, and adjudicating of a permanent augmentation plan in water court.

Colorado City Water Rights Accounting System, Colorado City, CO (2000) Updated the original Colorado City Metropolitan District's water rights accounting system to include annual diversion limits specified in the District's decrees. This included meeting with the client and the Division water commissioner, obtaining and reviewing the decrees, and creating an accounting system acceptable to both the client and

the water commissioner. To allow the District to divert without exceeding its annual limits, the accounting system also includes a prioritized list specifying what rights are to be utilized in which order.

River System Water Operations, N. Platte River, WY / NE (1999-2000) Project engineer responsible for modeling lower-basin river operations in Nebraska v. Wyoming interstate compact litigation. This included evaluating, modifying and running an existing FORTRAN model of the river system. Evaluated the model's mass balance, continuity and cause / effect relationships between streamflows, diversions and reservoir operations. The NE v. WY case settled shortly before the case was to go to trial in 2000.

Analysis of Water Banking in the Lower Arkansas River Basin, Fort Lyon, CO (1995) Project engineer for a study by the Colorado Division of Wildlife which examined the feasibility of water banking in the Lower Arkansas River basin in eastern Colorado to enhance fish and wildlife programs. The analysis was based on water assumed to come from the Fort Lyon Canal, as well as the Nee So Pah, Nee No She and Nee Skah reservoirs.

Riss Reservoirs Diversion and Augmentation Study, Cripple Creek, CO (1996) Performed streamflow measurements, land surveys, and other field work to allow for the accurate monitoring of water levels in three private reservoirs. Determined a course of action to mitigate out-of-priority diversions. Developed water budget for reservoir system. Analyzed basin runoff and river call to quantify augmentation.

Hydraulics Analysis and Technical Design

Rio Grande Project Operations, New Mexico and Texas (2015) Provided the technical analysis of a modeling analysis for the reoperation of the Rio Grande Project as part of an EIS conducted by Reclamation. This included analyzing model output and summarizing impacts to different stakeholders and environmental factors for different operational scenarios.

HEC-RAS Modeling for Replacement of Private Bridges, Boulder County CO (2013-2016)
Created HEC-RAS models for more than two dozen property owners who lost their private bridges during the 2013 flood on the Front Range of Colorado. This included meetings with Boulder County to determine the County's expectations for modeling, obtaining pre- and post-flood LIDAR data and using it to generate cross-sections of the stream channel, obtaining historical flow and roughness data used in previous studies, setting up and running the models, creating maps and tables of model output, meeting with property owners and county staff to review results, and writing reports to document our methodology and findings.

Site Plan Development, Lao Buddhist Temple, Westminster CO (2014) Pro-bono development of a drainage plan for a new temple after the original was lost in a fire. This included calculating the pre- and post-development runoff, sizing the detention pond and outlet, preparing an engineering report to obtain the construction permit, and preparation of construction drawings.

Streamflow Modeling for Environmental Protection, White River Basin CO) (2012-2013) In 2012, The Nature Conservancy worked with the US Fish & Wildlife Service to determine appropriate flow targets for the White River near the Colorado-Utah state line. High Country assisted The Nature Conservancy by reviewing the Statemod model of the White River Basin, and by calculating flow statistics for various hydrologic year classifications. These included peak day, peak and low-flow durations, as well as ramping flows and average flow durations. Discussions with the Fish & Wildlife Service and other interested parties are on-going.

Streamflow Modeling for Environmental Protection, Yampa River Basin CO (2010) The Yampa River is one of the few river basins in Colorado with significant amounts of unappropriated water. The Yampa basin is also the site of proposed oil shale development, which will require large amounts of water for mine processes. The Nature Conservancy retained High Country to evaluate how oil shale development would affect streamflows in the Yampa and Little Snake rivers. John used the State of Colorado's surface water model StateMod to

replicate model results for a Programmatic Biological Opinion, and then evaluate depletions due to estimated future withdrawals. This work provided The Nature Conservancy with changes in streamflow that could then be used by biologists and engineers to determine changes in habitat, sediment discharge and other environmental factors.

Colorado River Model Review, Grand County, CO (2008) Provided modeling review services for Trout Unlimited, a non-profit environmental organization, for a proposed water supply development project in the upper Colorado River basin. Proponents want to divert more water through the Colorado-Big Thompson collection system by reoperating part of the Windy Gap project. Trout unlimited retained High Country to review the proponent's modeling to both verify that modeling was done correctly, and to evaluate and explain model output in an non-technical manner. Information provided by High country allowed Trout Unlimited attorneys to make specific requests regarding operations and trigger points for environmental flows.

Quandary Village Drainage Analysis, Summit County CO (2009) Quandary Village, a subdivision on the north side of Hoosier Pass, was developed in the middle of a raw water collection system for Colorado Springs Utilities. John analyzed drainage through the subdivision to determine which landowners should be approached regarding drainage issues. Problems included slope stability and loss of collection system yield due to regarding during the development process.

Pueblo of Isleta Sedimentation Project, Isleta, NM (2006) Project engineer on a team assembled to correct a sedimentation problem in the Rio Grande at the Pueblo of Isleta. The pueblo is 10 miles south of Albuquerque and straddles the Rio Grande. Various factors have conspired to cause sedimentation at a cultural site on the Pueblo, and Hydrosphere was retained to help design a program to restore the channel to a more original condition. This work included field visits to the site to observe excavation of the sediment, hydraulic analysis to determine velocities critical for sediment movement, meeting with the pueblo hydrologist and tribal elders to discuss potential options, and developing operating plans for a diversion dam on the pueblo.

Water Demand Study, Greeley, CO (2003-2004) Project manager for a team that built a database tool to analyze residential water demand, and to determine if residents were using more water than necessary to maintain their lawns. Landscaping and impermeable areas were digitized for six representative neighborhoods in and around Greeley. Water demand was calculated from weekly meter readings. A database tool was built which compared the water use to the theoretical irrigation requirement, and compared total use to variables such as assessed value, lot size, and neighborhood.

Jasper Lake Inundation map, Nederland, CO (2001) Project manager for the preparation of a dam break inundation map for Jasper Lake, located west of Nederland, Colorado. This map was included in an Emergency Preparedness Plan required by the State Engineer for high hazard dams in Colorado. The project included the collection of field data, determining the likely mode of dam failure, modeling the flood wave from a dam break until it fit within the 100-year flood plain, and the preparation of the inundation map.

Edwards Water Treatment Plant Intake Hydraulics, Edwards, CO (2001) Project engineer responsible for calculating the effects of constructing a river intake structure for the Edwards Water Treatment Plant on the Eagle River at Edwards, Colorado. This involved obtaining stream cross-sections and river hydrology for the 100-year flood, and then running a REC-RAS model to determine the differences on the water surface elevation. Surface water elevations were particularly important to local officials because the backwater caused by the structure reached a newly constructed pedestrian bridge.

Floodplain Changes on Vail Golf Course, Vail CO (2004) Project engineer for Vail bridge rehabilitation project. Ran existing HEC-RAS model of Gore Creek through the Vail Municipal Golf Course for existing and proposed future channel geometry to determine the impact of a bridge modification on the water surface level. Worked with other engineers to modify bridge redesign and grading to keep floodplain within current boundaries.

Phoenix Channel Assessment, Phoenix, AZ, (2000) Reviewed HEC-RAS modeling of a floodway though Phoenix AZ. This included the review of roughness coefficients, the location and spacing of channel cross-sections, and the model representation of several multiple-opening bridges in the reach.

Bike / Hike Bridge, Church Ditch Company, Northglenn, CO (1993) Performed survey and HEC-2 modeling to determine the backwater curve above several culverts for the Church Ditch Company. These water elevations were used in siting a new pedestrian bridge.

Municipal Water Distribution System Modeling, Phoenix AZ (1996) As a project engineer, used MapInfo geographic information system and EPANET hydraulic modeling software to calculate the transport of contaminants in the Phoenix AZ metropolitan distribution system in support of litigation. This included the determination of supply, demand and conveyance in both space and time.

Municipal Water Distribution System Modeling, Burbank CA (1997) As a project engineer, used EPANET hydraulic modeling software to calculate the transport of contaminants in the Burbank/Redlands CA metropolitan distribution system in support of litigation. This included the determination of supply, demand and conveyance in both space and time.

Municipal Water Distribution System Modeling, Honolulu HI (1998) As a project engineer, used EPANET hydraulic modeling software to calculate the transport of contaminants in the Honolulu HI metropolitan distribution system in support of litigation. This included the determination of supply, demand and conveyance in both space and time.

Colorado Public Service Company –Gas Pipeline Permitting, Leyden, CO (1999) Project engineer that prepared environmental and construction permits where the installation of a 20 inch gas pipeline near Leyden, Colorado, crossed several small streams.

Beaver Creek SnowTel site Installation, Beaver Creek Ski Area CO (2002) On behalf of Beaver Creek Ski Area, as part of their snowmaking water rights return flow obligations, worked with the Colorado NRCS to design and install the Beaver Creek Village (06k45s) and McCoy Park (06k44s) SnowTel sites. This included making a field tour with NRCS personnel to determine siting requirements, reviewing the methods of measurement, and maintenance requirements and schedules. These sites are fully instrumented and provide current data to the NRCS via satellite telemetry.

Eagle Park Reservoir Data Collection and Telemetry, Climax CO (1999) Project manager for the Design, purchase and installation of remote monitoring and data collection equipment for a high altitude reservoir to help facilitate daily operations and administer water rights decrees. Sensors installed in the reservoir and at the outlet are used to calculate storage and release information, which is collected and stored in a data logger. The data logger is connected via a SCADA system to a central computer.

Black Lakes Data Collection and Telemetry, Vail Pass, CO (1999) Project manager for the Design, purchase and installation of remote monitoring and data collection equipment for two remote high altitude reservoirs to help facilitate daily operations and administer water rights decrees. Reservoir storage and release information is collected and stored in solar powered data loggers, then downloaded daily to a local computer via cellular phone.

South Boulder Creek Gage Installation, Boulder, CO (2001) Project engineer responsible for site selection, equipment procurement and installation of area-velocity flow sensors and data logger for long-term monitoring of stream flows in South Boulder Creek for the City of Boulder Open Space Department.

Review of Clear Creek School Drainage Master Plan, Evergreen, CO, (2002) As project manager, reviewed a Drainage Master Plan for the new Clear Creek High School on behalf of a land owner with property adjacent to the new school. Verified that the design met county code, reviewed assumptions and calculations. Provided a letter report to client with recommendations.

Towaoc Canal Reach 3 and Laterals Designs, Dolores Project, CO (1991) For the USBR, assisted in the design of more than 50 irrigation canal cross-drainage structures. This included culvert sizing, inlet and outlet erosion protection, determination of hydraulic conditions above, below and in the cross-drainage, interceptor ditches, and final grade of the earthwork. Involved in sizing and placement of baffled outlets, riprap and inlet and outlet structures. Provided geomorphology study of buried siphon and pipeline drainage crossings, and hydraulic review of turnout structures.

Watershed Sciences

Perflourinated Compound Contamination, Sugarloaf CO (2018) Project manager for a project looking for the origin and spread of PFCs in unincorporated Boulder County. Guided and oversaw multiple rounds of testing to determine the extent of PFC contamination originating at two fire stations. Sampling and analysis of well water. Oversaw public information campaign and public meetings. Invited speaker at EPA Region 8 listening session held in Colorado. Interaction with Fire Protection District Board of Directors, and made recommendations regarding mitigation for treating well water at fire stations and private residential wells.

Post-fire Watershed and Channel Assessment, Colorado Springs (2012-2013) On behalf of The Navigators, provided consulting services about channel stability and potential post-wildfire flood flows for Camp Creek on the west side of Colorado Springs. This included evaluating slope size, stability and geology, potential rain and debris volumes, and the size of debris nets to capture debris flows before they reached the Glen Eyrie property. In 2013 we calculated the capacity of the existing channel and provided a stage-discharge table to The Navigators to help them track storm flows.

Water Supply for Fire Fighting, Sugar Loaf CO (2008) Analyzed the physical supply and reliability of water sources for the Sugar Loaf Fire Protection District, located west of Boulder CO. This evaluation was used by the Insurance Services Organization (ISO) to help determine the suppression and prevention rating for the fire department, which directly affects homeowner insurance rates. Using topographical maps and stream gages from adjacent basins, John developed the water supply for 12 water sources in the district during a 100-year drought. This included consideration of the physical condition of the individual supply points, and de-rating the calculated supply to account for inefficient operation, bypass seepage, etc.

Stream Stability and Connected Disturbed Area Surveys, Summit County, CO (2002) As project engineer, lead a two-person team in collecting stream stability data for third order streams at Copper Mountain and Keystone ski areas. This included habitat classification within the channel, channel and bank stability analyses, pebble counts, vegetation and land use classification. Performed connected disturbed area surveys of roads, determining how roads and other disturbed areas are connected to the streams, thereby contributing water and sediment to peak flow runoff.

Three Lakes Clean Lakes Assessment (2002-2007) As project engineer, calculated physical hydrology for Lakes Grand, Shadow Mountain and Granby, located on the western edge of Rocky Mountain National Park. The inflows and outflows were used in a model which was used to determine water quality for different operational scenarios.

Gunnison River Temperature Model (2002) As project engineer, calculated the physical hydrology for Blue Mesa Reservoir, located on the Gunnison River in western Colorado. Inflows, outflows and other losses became input to a temperature model of the reservoir, which was used to determine how downstream temperatures would vary in response to different operational scenarios.

Trout Unlimited In-stream Improvement Project (2001) Project manager for a multidisciplinary project to improve trout habitat in the South Platte River. This project analyzed the existing trout habitat in the river, physical improvements that could be made, and water rights that could be acquired to maintain the improvements.

Animas River Studies (2000) As project engineer, carried out field and technical analysis to help determine the cause of impoverished fish populations and macroinvertebrate communities in the headwaters of the Animas

River near Silverton, Colorado. Collected water quality samples; took measurements of physical habitat, channel characteristics and streamflow. Calculated basin and sub-basin yields and hydrographs. Calculated concentrations of metals along the study reach to determine which sections were above and below both state and EPA standards.

Orphan Sites Project, Idaho Springs, Colorado Project engineer responsible for modeling sediment yield from an abandoned mine tailings pile near Idaho Springs, Colorado. Using RUSLE (Revised Universal Soil Loss Equation), the sediment load to Clear Creek was calculated for existing and post-cleanup conditions.

Pikeview Quarry, Colorado Springs, CO Project engineer for Environmental Assessment for the reclamation of the Pikeview Quarry near Colorado Springs, Colorado. Determined the changes in annual runoff, peak flow, and sediment yield from the quarry for the existing quarry size and two different development alternatives, for both during mining and after reclamation. Wrote a summary report included as an appendix of the EA.

Mule Creek Gravel Pit, Divide, CO Project manager for developing an Environmental Assessment for re-opening an abandoned gravel pit near Divide, Colorado. In exchange for being allowed to remove gravel from U.S.F.S. property, the proponent of the project was willing to reclaim the site, which has been devoid of vegetation for approximately 30 years. The project included photo a photo simulation of what the mine might look like under continued present conditions and for two proposed alternatives.

Vail Water Quality, Vail, CO As project engineer, helped develop and carry out a water quality data sampling program for the Vail ski area's snowmaking system. This included testing source water, water in the snowmaking system, in manmade and natural snow, and in snowmelt runoff.. Analyzed results to determine the fate of metals as water moved through the snowmaking system.

Stream Stability Analysis - Vail, CO. As project engineer, conducted stream stability analysis on high altitude streams in the Rock Mountains of Colorado. Performed bed material, cross-sectional, thalweg and discharge surveys to determine the discharge at which bed material movement would begin. This was coupled with snowmelt-runoff calculations and included as part of a application by Vail Associates to the U.S. Forest Service to expand snow making operations at Vail.

Stream Stability Analysis - Beaver Creek, CO. As project engineer, conducted stream stability analysis on high altitude streams at Beaver Creek, Colorado. Performed bed material, cross-sectional, thalweg and discharge surveys to determine the discharge at which bed material would begin to move. This was coupled with calculations of how snowmelt-runoff would change as a result of tree cutting for trail expansion and included as part of a report to the U.S. Forest Service by Vail Associates.

Keystone Water Quality, Keystone, CO (2000) Designed and installed streamflow measuring systems, snow lysimeters and sample collection systems, and automatic water quality sampling systems for six locations on Keystone Mountain to help quantify the movement of metals through Keystone Resort's snowmaking system. Helped develop a water quality data sampling program. Used data from this sampling program to develop basin and sub-basin hydrographs. Created a snowmelt model which used streamflows and measured metals concentrations to calculate stream loadings for metals under different hydrologic and ski area development scenarios.

Instream Flow Program Monitoring, Boulder, CO (1996-1997) Measured streamflows in Boulder Creek to assist compliance with the Colorado Water Conservation Board's Instream Flow program for the creek. Measured stream flows and developed rating curves for critical locations in the creek.

EMPLOYMENT HISTORY

June 2008 – Present Principal, High Country Hydrology. Water resources engineering, planning and management, specializing in the analysis of surface water systems. Water planning and management consulting for municipal and other governmental agencies regarding raw water systems. Hydraulic and hydrologic modeling. Water rights engineering. Calculation of watershed yield and watershed management. Snow hydrology.

Aug. 1996 – May 2008 Water Resources Engineering, Hydrosphere Resource Consultants / AMEC Earth & Environmental. Water distribution system analyses, including water flow and contaminate transport. Modeling of multiple sources, flow paths and demands in the finished water distribution system. Watershed yield, including the quantity and timing of snowmelt runoff from high altitude watersheds in the Rocky Mountains. Streamflow measurement, channel stability analyses, slope failure investigations and changes in watershed yield in response to tree cutting.

Feb. 1996 - Jun. 1996 Design Engineering, Hurst & Associates. Design engineering for commercial and residential land development. Storm water runoff, routing, storage and release. Earth works cut and fill calculations. Roadway alignment, horizontal and vertical curves. EPA noise assessments.

Aug. 1990 - Jan. 1996 Water Resources Engineering, Gronning Engineering Co. Technical water rights appraisals, water supply studies on design and operations analysis of complex, integrated water resource systems. Performed hydrologic studies including watershed yield analyses, reservoir siting and sizing, storm water drainage, drought severity-frequency and water resources statistical analysis. Developed and programmed computerized models to simulate river basin operations, irrigation systems, municipal raw water collection and delivery systems, reservoir operations, water exchanges and water rights accounting.

CONSULTANT REPORTS

Winchester, J. Engineering Report for Case No. 2016CW3056, Augmentation Plan and Conditional Right of Exchange for Colorado Springs Utilities. February 16, 2018.

Winchester, J. Engineering Report for Case No. 2015CW3002 Change of Type and Place of Use of Fountain Mutual Irrigation Company Water Rights for Colorado Springs Utilities. September 1, 2017.

Winchester, J. Engineering Report for Case No. 2015CW3001 Change of Type and Place of Use of Chilcott Ditch Water Rights for Colorado Springs Utilities Colorado Springs. CO September 11, 2017.

Winchester, J. Engineering Report Case No. 2007CW120 Water Storage Right for Quail Lake, for Colorado Springs Utilities. July 31, 2014.

Winchester, J. Engineering Report 2012CW31 Water Storage Right for Upper Williams Creek Reservoir and Appropriative Rights of Exchange, for Colorado Springs Utilities. August 30, 2012.

Winchester, J. Engineering Report for Case No. 2004CW0132 Exchange of Denver Basin Ground Water. April 2012, for Colorado Springs Utilities.

Winchester, J. Engineering Report 2009CW279 South Platte River Exchange Right Application for Castle Pines North Metro District. February 2012.

Del Toro, M., J. Winchester. Engineering Report for 2007CW122 Appropriative Rights of Substitution and Exchange in the Arkansas River and Fountain Creek and its Tributaries, for Colorado Springs Utilities. March 2011.

Winchester, J. Expert Report of John Winchester, P.E., District Court, Water Division 2, Pueblo County, Colorado Water Court Case No. 2010CW26, for Verhoeff Farms. January 2011.

Winchester, J. Engineering Report In support of Water Rights Application 2006CW110, for Colorado Springs Utilities. August 8, 2010.

Winchester, J., B. Hanna. Engineering Report 2005CW95 Arkansas River Exchange Right Application. AMEC Earth & Environmental, for Colorado Springs Utilities. June 2008.

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McCord, J., K. Richards, L. Hall, J. Winchester. Hydrologic and Geomorphic Data and Information to Support Rio Grande Riparian Restoration Pueblo of Isleta, New Mexico. Hydrosphere Resource Consultants. February 2006.

Rozaklis, L., J. Winchester. Water Supply and Water Rights Evaluation of Burke Park and Maxwell Lakes. For the City of Boulder Parks and Recreation Department. Hydrosphere Resource Consultants. March 2, 2004.

Rozaklis, L., J. Winchester. Engineering Report Viele Lake Storage Right Application. For the City of Boulder Parks and Recreation Department. November 2003.

Hydrosphere Resource Consultants, Anchor Point Group. Upper San Pedro Watershed Wildfire Hazard Assessment And Mitigation Plan (a series of seven reports). August 2003.

Maest, A., W. Walsh, J. Winchester. Upper Animas River Biological Evaluation, Hydrosphere Resource Consultants. March 2001.

McCord, J., J. Winchester. Effects of Vegetation Management Programs on Soils and Waters of the Santa Fe Watershed, New Mexico. Hydrosphere Resource Consultants. July 2000.

PUBLICATIONS

Winchester, John. "Knowledge Management for the 21st Century." Proceedings of the USCID Conference on Meeting Irrigation Demands in a Water-Challenged Environment, Fort Collins, Colorado, Sep 28 - Oct 1, 2010. *Refereed*

Winchester, John. "Predicting When The Well Will Go Dry: A Review Of Commonly Used Models For Water Supply Planning And Management." AWRA Watershed Update, Sep-Dec 2008, Vol 6, No. 3. http://www.awra.org/committees/techcom/watershed/watershed.html

Winchester, John. "Is your water supply model right for the job?" Southwest Hydrology, Vol. 6 / No. 3, May / June 2007, p 10-11

Winchester, John, and Knapp, Gerry. "Multi-Basin Modeling for Water Supply, or Playing 4-Dimensional Chess at Your Desk." Proceedings of the USCID Conference on Water Rights and Related Water Supply Issues, Salt Lake City, Utah, October 13-16, 2004. *Refereed.*

McCord, James, J. Winchester. "Pre-Fire Analysis of Management Alternatives: the Santa Fe Municipal Watershed." Southwest Hydrology, Vol. 3 / No. 5, September / October 2004, p 28-29.

Winchester, John. 2002. "Erosional Response to a Stand Replacement Fire." Geological Society of America Annual Meeting. October 27-30, 2002. Denver, CO.

Winchester, John. 2001. "Water, Water Everywhere." Christian Camp & Conference Journal, September / October, 2001, p11-14.

Winchester, John. 2001. "A Historical View – Transmountain Diversion Development in Colorado." Proceedings of USCID Conference on Transbasin Water Transfers, Denver, Colorado, June 26-30, 2001. *Refereed.*

McCord, James, J. Winchester. 2001. "Analysis of management alternatives for the Santa Fe Municipal Watershed." New Mexico Decision-Makers Earth Science Field Conference. May 8-11, 2001. Santa Fe, NM.

Winchester, John, J. McCord. 2001. "Soil & Water Effects Analysis of Management Alternatives for the Santa Fe Municipal Watershed." Rocky Mountain and South-Central Sections, GSA, Joint Annual Meeting, Albuquerque, NM, April 29–May 2, 2001.

Winchester, John. 1999. "Using Felled Timber as Water Bars to Control Post-Fire Erosion." Fire Management Notes, October, 1999.

Del Toro, M., J. McGrady, and J. Winchester. 1996. "Management and Operation of the Colorado Springs Exchange Program - an Environmental Option." Proceedings of Conserv96, Responsible Water Stewardship. A national conference jointly sponsored by AWRA, ASCE, and AWWA. Orlando, Florida, January 4-8, 1996.

Del Toro, M., J. McGrady, and J. Winchester. 1995. "Strategies for Providing Reliable Supplies of Raw Water." AWWA / WPCA Annual Conference, Sheridan, Wyoming, September.

Clark, J., and J. Winchester. 1994. "Reusable Water Exchange Modeling." Water Policy & Management: Solving the Problems. Proceedings of the 21st Annual Conference of the ASCE Water Resources Planning & Management Division, Denver, Colorado, May 23-26, 1994.

DANIEL W. CLEMENT

Staff Hydrogeologist

Mr. Clement works as a Hydrogeologist in the Water Group in Wichita Kansas. His work is focused on development and optimization of groundwater resources, water rights consulting, and large capacity well design. His career continues to integrate technology with hydrogeology which provides clients with a unique vision of subsurface information. His work includes experience with Water Rights Consulting, Well Condition Assessments, Aquifer Storage and Recovery Wells, Municipal Wellfield Development, Aquifer Sustainability Analysis, Groundwater Modeling, Groundwater Surface Water Interaction Studies, and extensive use of Geographic Information Systems.

EDUCATION

- BS, Geology

5 YEARS WITH BURNS & MCDONNELL

8 YEARS OF EXPERIENCE

HYDROGEOLOGIC EXPERIENCE

Aquifer Storage and Recovery Accounting, City of Wichita

Wichita, Kansas, 2014-Ongoing

Mr. Clement has assisted with the assembly of the annual accounting and reporting of water recharged to the Equus Beds aquifer by the City of Wichita ASR project. The Cities ASR project is focused on restoring water levels and preventing the migration of chloride contamination into the City's Equus Beds Well Field, which is has been one of the primary sources of water for the City since the 1940s. Mr. Clement has assisted with the annual updates and maintenance of an existing United States Geological Survey (USGS) MODFLOW three-dimensional numerical groundwater flow model. The model was developed in conjunction with the USGS and is used annually to calculate the volume of recharge water in the well field, track the migration of the recharged water through the well field, estimate the impact of the well field on groundwater contaminant plumes from multiple nearby chloride contamination sources, and to manage operating scenarios of the Equus Beds Well Field.

Aquifer Storage & Recovery Phase II Startup and Operations Monitoring | City of Wichita

Bentley, Kansas | 2013-15

Project Hydrogeologist Mr. Clement served as the hydrogeologist for the startup and commissioning of the City of Wichita's Phase II ASR systems. Phase II of the City's ASR project captures excess flows from the Little Arkansas River utilizing a surface water intake and advanced water treatment plant followed. The water from the ASR Phase II water treatment plant can be recharged to the Equus Beds Aquifer through a network of recharge wells and recharge basins where it is stored within the aquifer for later use. During the commissioning of the ASR Phase II water treatment plant and recharge well network his services on the project included well yield characterization, defining well redevelopment protocols, recharge basin capacity analysis, geochemistry reviews, and operations management.

R9 Water Ranch Development | City of Hays

Hays, Kansas | Ongoing

Project Hydrogeologist Mr. Clement serves as a hydrogeologist for a project evaluating the suitability of a former large-scale agricultural irrigation property as a potential sustainable municipal water supply. His services have included water rights consulting, aquifer testing, aquifer characterization, groundwater modeling, regulatory permitting, and stakeholder coordination. The project may include approximately 75 miles of pipeline, booster pump stations, and 10-20 new wells, collection pipeline, and storage tanks.

DANIEL W. CLEMENT
(continued)

Groundwater & River Interaction Study | Arkansas City
City of Arkansas City, Kansas | 2015-2018

Project Hydrogeologist Mr. Clement serves as the hydrogeologist for an ongoing project that is examining the relationship between the Arkansas River and the adjacent Arkansas City wellfield. The existing Arkansas City wellfield is completed in the Arkansas River alluvium which recharged largely in part by the flows in the Arkansas River. Mr. Clement performed an advanced hydrogeologic study which led to the characterization of the relationship between the City's wellfield and the Arkansas River. His services on the project have included field services, drilling supervision, pump testing, hydrogeologic data analysis, aquifer characterization, stream-aquifer interaction classification, and water rights consulting.

Coal Combustion Residual (CCR) Monofill and Pond Closure - Groundwater Model Development | Confidential Client

Project Hydrogeologist Mr. Clement and the Burns and McDonnell hydrogeology team assembled a groundwater model to assist with permitting the closure of a CCR ponds and site Monofill. The developed groundwater model expedited the safe closure of the CCR ponds and expedited the permitting timeline by illustrating groundwater flow under various hydrologic and adjacent surface water conditions. The model illustrated that existing supply wells and monitoring wells would adequately long-term capture and detection of any potential groundwater contamination.

High Capacity Well Permitting – Groundwater Model Development | Confidential Client

Project Hydrogeologist Mr. Clement and the Burns and McDonnell hydrogeology team assembled a groundwater model to support a high capacity groundwater well permit application to supply water to a new Combined Cycle Gas Turbine (CCGT) facility. A groundwater model was assembled based on regional hydrogeologic data and calibrated to mirror the results of extensive pump testing at the site. The developed model was able to successfully reproduce observed groundwater levels and was utilized to project how future pumping scenarios would affect groundwater levels. In addition to the groundwater model, Mr. Clement has worked with the State's DNR to develop and submit high capacity well permit applications.

Groundwater Model Development – PCE and TCE Contamination Transport | Confidential Client

Project Hydrogeologist Mr. Clement and the Burns and McDonnell hydrogeology team assembled a groundwater model to simulate the fate and transport of tetrachloroethylene (PCE) and trichloroethylene (TCE). The project site utilizes multiple high capacity wells to capture and remove contamination and provide hydraulic control of the remaining plume. A groundwater model was developed to specifically include calibrated solute transport (MODFLOW MT3DMS). The groundwater model is currently being utilized to optimize remediation activities by limiting pumping to wells that are most efficient at contaminant removal. Modeling results have been utilized to indicate a potential for long-term energy and water savings by shutting down upgradient wells and focusing on specific down gradient remediation efforts.

Chloride Migration/Water Supply Investigation | McPherson BPU
McPherson, Kansas | 2016

Assistant Project Hydrogeologist Mr. Clement served as an assistant hydrogeologist for a multiphase project for McPherson Board of Public Utilities characterizing new municipal groundwater supplies and potential long-term risks associated with nearby oilfield brine contamination encroachment. His responsibilities have included municipal water demand planning, water rights consulting, well log analysis, groundwater contamination delineation, aquifer parameterization, historic and seasonal groundwater flow determination, coordination with state and local regulatory agencies, and GIS based data analysis.

DANIEL W. CLEMENT
(continued)

Emergency Groundwater Well Design & Construction | National Beef
Liberal, Kansas | 2016

Project Hydrogeologist Mr. Clement served as the field hydrogeologist during the emergency re-drill and design of a groundwater supply well for a beef packing facility in Liberal, Kansas. A catastrophic well casing failure at one of the facilities groundwater wells lead to potential water shortages at the packing facility. Mr. Clement provided field oversight of the emergency re-drilling services and facilitated expedited permitting processes by the State of Kansas Division of Water Resources and the Department of Health and Environment.

Hays Well Field Low Head Dam Study | US Army Corps of Engineers
Hays, Kansas | 2014

Assistant Project Hydrogeologist Mr. Clement serves as an assistant project hydrogeologist for an ongoing study targeted at adding municipal well operation flexibility and sustainability to the Smoky Hill River Alluvial Aquifer by increasing the amount of aquifer recharge from river flow via the construction of low head dams. Responsibilities include sediment sampling, remote sensing data processing, GIS analysis, monitoring well data collection, and stream-aquifer interaction analysis.

Cedar Bluff Reservoir Artificial Aquifer Recharge Release | City of Hays
Hays, Kansas | 2013

Project Hydrogeologist Mr. Clement served as the project hydrogeologist tracking the effective recharge to the Smoky Hill River Alluvial Aquifer from surface water released from Cedar Bluff Reservoir. Responsibilities included tracking progress of release flows, monitoring well observations, GIS analysis, recharge estimation, sediment sampling, stream flow measurements and preparation of the hydrogeologic report.

PAUL MCCORMICK, PE

Associate Geological Engineer

Mr. McCormick has more than 24 years of experience involving all aspects of hydrogeologic investigations and well design for water supply purposes. Numerous clients have found his leadership, management and technical capabilities to be significant factor in the success of their projects.

EDUCATION

- BS, Geological Engineering

REGISTRATIONS

- Professional Engineer: (MO, KS, IA, SD, NE)

11 YEARS WITH BURNS & MCDONNELL

24 YEARS OF EXPERIENCE

Mr. McCormick has extensive experience in water supply studies which included hydrogeologic field investigations, analysis of aquifer properties, and groundwater computer modeling. He has designed and overseen construction of test wells, water supply wells, and well fields for numerous municipal, industrial, and private concerns. He has managed numerous projects with supplies ranging in size from 30 gpm to 125 MGD utilizing conventional vertical well, radial collector well, and aquifer storage and recovery technologies. His expertise also includes two- and three-dimensional groundwater flow modeling and distribution system analysis and modeling.

WATER – GROUNDWATER WELLS

Aquifer Storage and Recovery, City of Wichita

Wichita, Kansas, 2007 - Present

Mr. McCormick is a senior hydrogeologist, engineer and project manager for an innovative water supply project for the City of Wichita, Kansas. His responsibilities include project management activities; coordination with regulatory agencies; 3-D groundwater modeling; well system design; and construction supervision. The project, known as the Equus Beds Recharge Project, was undertaken to determine the feasibility of using above base flow water in the Little Arkansas River and for aquifer recharge in an area of the Equus Beds Aquifer. The alluvial aquifer had experienced a decline in water levels over the past 50 years due to excessive pumping, leading to a water table depression and migration of saline water toward the aquifer. One of the project's goals is to restore the water table and protect water quality in this portion of the aquifer. The project is part of the City's Integrated Local Water Supply Plan which will optimize several local water sources to meet demands through the year 2050.

Aquifer Storage and Recovery Accounting, City of Wichita

Wichita, Kansas, 2008 through 2015

Mr. McCormick is the lead hydrogeologist/engineer and groundwater flow modeler for annual accounting and reporting of water recharged to the Equus Beds aquifer by the City of Wichita ASR project. The Cities ASR project is focused on restoring water levels and preventing the migration of chloride contamination into the City's 100 MGD Equus Beds Well Field, which is has been one of the primary sources of water for the City since the 1940s. Mr. McCormick first began working on this project in 2007, and he has continued to assist the City annually with modeling efforts to calculate and track the volume and migration of the recharged water. Mr. McCormick updated and maintained an existing United States Geological Survey (USGS) MODFLOW three-dimensional numerical groundwater flow model for this purpose, and then took the lead for the City during development of a revised groundwater flow model that was constructed using the USGS MODFLOW2000 code. The model was developed in conjunction with the United States Geological Survey and is used

annually to calculate the volume of recharge water in the well field, track the migration of the recharged water through the well field, estimate the impact of the well field on groundwater contaminant plumes from multiple nearby chloride contamination sources, and to manage the day to day operating scenarios of the Equus Beds Well Field. Mr. McCormick continues to maintain the groundwater model and updates the model annually to reflect the real pumping conditions of that year. The groundwater model update is documented annually in a report submittal for the Kansas Department of Water Resources.

McPherson BPU, Kansas, New Well Field and Groundwater Model
McPherson, Kansas | 2016

Due to declining water levels within their existing well field, BPU required the development of a supplemental source of supply in order to meet projected future water use. Burns and McDonnell provided planning and evaluation for the development of an alternate water supply source for the McPherson BPU. Sources evaluated included both surface water and groundwater. The project includes preliminary design of the well field, approximately 20 miles of raw water pipeline and a new water treatment facility. Groundwater modeling and new water right applications are included in the project. Mr. McCormick assisted in the development of a groundwater and solute transport model that simulated the impact of a new well on water levels in the aquifer and also evaluated the fate and transport of a chloride plume that is located several miles from the new well field property. The model was also used to support the water right applications needed for the new well field. The model was reviewed by the Kansas Division of Water Resources and the Groundwater Management District No.2.

Water Supply Development, City of Clinton
Clinton, Oklahoma, 2015

Mr. McCormick is the senior hydrogeologist and engineer for the development of a groundwater supply for the City of Clinton. The City's surface water sources are drying up due to prolonged drought, and a groundwater supply is being developed to replace them. The project includes a minimum of five alluvial wells, raw water distribution, and a 4.0 MGD reverse osmosis treatment plant. Mr. McCormick is the lead hydrogeologist for the design and construction of the water supply wells and the deep injection well for RO reject disposal. This deep injection well will be the first well in the state of Oklahoma specifically permitted for injection of non-hazardous municipal waste.

Collector Well Preliminary Design, Florida Power & Light
Miami, Florida, 2013

To satisfy the increasing power demand in the area, FPL is undertaking the addition of two additional nuclear reactor units to a generating station. A backup cooling water supply is required, and in this location will be provided through the construction of collector wells. Mr. McCormick was the lead hydrogeologist and groundwater flow modeler developing the design for the collector wells and well field. This required conducting extensive groundwater modeling to evaluate the aquifer response and yield in a challenging geologic environment. Regulatory requirements for permitting the wells were stringent, with oversight from numerous federal and state agencies including the Nuclear Regulating Commission, Fish and Wildlife Administration, Environmental Protection Agency, and numerous interested public entities. Through his modeling efforts Mr. McCormick was able to optimize the collector well design and reduce the required number of wells from four down to two. This design minimized the costs to FPL, while meeting the very strict regulatory requirements. At 62.5 million gallons per day each, these will be the largest collector wells in the world, as well as the first collector wells constructed in a hard rock environment.

PAUL MCCORMICK, PE
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Collector Well Siting Study, Ameren UE
Near Mokane, Missouri, 2008
Mr. McCormick was a project engineer for a hydrogeologic investigation that was completed to determine the suitability of the Missouri River alluvial aquifer as a groundwater source for a nuclear power plant's required capacity of 50,000 gallons per minute. The hydrogeologic investigation was designed to evaluate the aquifer and determine suitability and locations for appropriate sites for construction of horizontal collector wells.

City of Hays, Kansas, Water Supply Management
Hays, Kansas | 2012 - Present
City of Hays maintains three well fields for raw water supply, the Big Creek alluvial well field, the Smoky Hill River alluvial well field, and the Dakota bedrock well field. The vulnerability of these well fields to drought has fostered a culture of water scarcity that has limited Hays opportunities for economic development and growth. Mr. McCormick is project manager and lead hydrogeologist/engineer for the development of a groundwater supply at the R9 Ranch, located 66 miles south of the City. The R9 Ranch well field will provide an additional groundwater supply to supplement the City's existing water portfolio and reduce their drought vulnerability. This project will be the first inter-basin transfer of water in the State of Kansas, and as such is undergoing extensive regulatory and public scrutiny. Mr. McCormick is the lead groundwater flow modeler for the City. MODFLOW2000, a three-dimensional groundwater analysis package developed by the United States Geological Survey is being utilized to evaluate the changes to the water rights of the new well field, determine the sustainable yield of the aquifer, and evaluate the effects on surrounding well owners. Preliminary design of the well field of the well field includes 12 to 14 groundwater wells, 66 miles of pipeline, and associated pump stations and storage tanks.

Well Field Optimization & Improvement Study, Industrial Client
Borger, Texas, 2015
Mr. McCormick was the project manager, hydrogeologist and engineer for a water supply improvement study for an industrial client requiring approximately 10 million gallons per day of raw water supply. The water is supplied from 26 wells in 3 well fields. The study evaluated well conditions, operation & maintenance practices, aquifer yield, and permitting issues. Recommendations included changes to operations and maintenance practices, well replacement scheduling, and optimization of future well design to maximize yield and sustainability. Work is ongoing and includes design of multiple replacement wells and associated infrastructure.

Water Supply Well, Ameren UE
Rush Island, Missouri, 2009
Mr. McCormick was a project engineer for design and construction of two water supply wells for the Rush Island power plant. These vertical wells were deep bedrock wells constructed in a geologic setting with significant water quality and capacity challenges.

Well Field Evaluation, US Army Corps of Engineers
Hays, Kansas, 2013
Mr. McCormick served as project manager and senior hydrogeologist for a study to evaluate the use of low head dams to artificially recharge the Smoky Hill River Alluvial Well Field for the City of Hays, Kansas. The project included an evaluation of well field yield, storage, water rights, and dam type and construction. The investigation consisted of data

PAUL MCCORMICK, PE
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review, existing water rights analysis, aquifer storage capacity and use of low head dams to reduce the drought vulnerability of the resource.

Water Supply Well Design, Greenwood Utilities
Greenwood, Mississippi, 2013
Mr. McCormick served as project hydrogeologist for the design of a vertical well for public water supply. He designed a 1200 gpm water well in a challenging geologic environment. The design was engineered to address issues of high turbidity cause by the aquifer materials.

Evaluation of Supply, Treatment, & Distribution System, Missouri-American Water Company
Parkville, Missouri, 2013
Mr. McCormick was project engineer for a study concentrated on determining the most financially feasible methods to incrementally increase water supply to meet the demands of a system that has experienced significant residential growth over the past five years. As part of the study the existing well field was evaluated, and additional wells sites were explored to determine the most cost effective raw water supply for a new water treatment plant.

Water Supply Well Evaluation, Greenwood Utilities
Greenwood, Mississippi, 2011
Mr. McCormick served as project hydrogeologist for the evaluation of the design and construction of a water supply well. Highly turbid water was being produced due to problems with the design and construction of the existing well. Mr. McCormick developed a plan to test and evaluate the well design, construction, and development to determine the source of the problem and develop a plan to mitigate.

Crystal River Well Field, Progress Energy
Crystal River, Florida, 2011
Mr. McCormick was the senior hydrogeologist for the addition of six new vertical wells at the Crystal River well field. He was responsible for evaluating the previously completed hydrogeologic study and using the information to design and construct the well field expansion. Six existing wells were also rehabilitated to recover lost capacity. The expanded water supply was used to supply cooling water for electrical power generation.

East Chiller Water Supply Well, TECO
Houston, Texas, 2010
Mr. McCormick was the design engineer for what was to be a 1500 gpm water well to supply chiller water for a hospital complex in Texas. During his evaluation of the hydrogeology Mr. McCormick was able to design and implement changes that resulted in the well producing 2000 gpm.

Combined License Application, Ameren UE
Near Mokane, Missouri, 2010
Mr. McCormick was a senior hydrogeologist on a study to support the COLA application for a nuclear power plant. His role was peer review of the evaluation of the regional and site-specific hydrogeology for construction of two new reactor units.

PAUL MCCORMICK, PE
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Chloride Migration Evaluation, Kansas Corporation Commission
Burrton, Kansas 2009
Historic oil field brine contamination has resulted in significant levels of chloride in the Equus Beds aquifer near Burrton. This contamination is migrating to the east and impacting surrounding groundwater users. The KCC was investigating the extent and spread of the contaminant plumes. Mr. McCormick was the hydrogeologist/engineer and lead groundwater modeler tasked with evaluating the existing data, utilizing a MODFLOW groundwater model to determine the aquifer flow conditions, and conduction transport modeling to evaluate the migration of chloride through the subsurface.

Bentley Wellfield Rehabilitation, City of Wichita
Wichita, Kansas, 2009
Mr. McCormick served as the senior hydrogeologist and engineer for wellfield design, construction and testing of water supply wells of a supplemental wellfield in Wichita, Kansas. The Bentley Well Field Project was undertaken as part of the City of Wichita's Integrated Water Supply Plan to develop a wellfield utilizing induced infiltration through the river bank alluvium of the Arkansas River. Mr. McCormick's responsibilities included well and wellfield design, field inspection, supervision of testing, regulatory contact and coordination, and final design reporting.

Water Supply Well No. 17, City of Junction City
Junction City, Kansas, 2008
Mr. McCormick served as project hydrogeologist for a for design and construction of a new vertical well for the City of Junction City, Kansas. Well design, construction, performance testing and completion were assessed as part of the project.

Aquifer Recharge Evaluation, Kansas Corporation Commission
Garden City, Kansas 2007
Declining water levels in western Kansas have caused extensive challenges for groundwater users near Garden City. The KCC undertook a study to evaluate the feasibility of using excess flow in the Arkansas River through existing irrigation ditches to divert the water to areas away from the stream that are suitable for recharging the alluvial and High Plains aquifer. Mr. McCormick was the hydrogeologist/engineer and lead groundwater modeler for this study. As part of the project a hydrologic assessment of the ditches was conducted to evaluate their capacity and connection to the underlying aquifer. Then extensive three-dimensional modeling of stream interaction and groundwater flow was conducted to determine the capacity of the ditches to recharge the aquifer.

Aquifer Evaluation, City of Sioux Falls
Sioux Falls, South Dakota, 2005
Mr. McCormick was the project manager of a water supply study to investigate the available yield from the Wall Lake aquifer. The study was designed to determine the quantity and quality of groundwater immediately available from the aquifer as well as to evaluate the long-term effects of pumping on the aquifer water levels.

LUCA DeANGELIS, PE, PG

Associate Geological Engineer/Hydrogeologist

Luca DeAngelis has over 19 years of experience in the environmental and water supply industries, focusing on water rights consulting, development of groundwater resources, aquifer evaluations, and water resource planning. Luca has experience managing, evaluating, planning and designing water supply projects for municipal, state and federal government agencies and private utilities. His experience includes the design and construction oversite of over 100 water supply wells constructed in both alluvial and bedrock aquifers.

Luca holds a B.S. degree in Geological Engineering from the University of Missouri-Rolla and an M.S. degree in Civil Engineering from the University of Kansas and is a registered professional engineer and professional geologist in several states. His areas of expertise include: water rights permitting, water supply well design, water supply well field design, numerical groundwater and solute transport modeling, groundwater/surface water interaction studies, aquifer test analysis, river system analysis, supply well pump selection, distribution system analysis, borehole geophysics, and wellhead protection area delineation.

EDUCATION

- Master of Science, Civil Engineering, University of Kansas, 2008
- Bachelor of Science, Geological Engineering, University of Missouri-Rolla, 1996

REGISTRATION

- Professional Engineer (KS, NE)
- Professional Geologist (MO, NE, WY)

ORGANIZATIONS

- American Water Works Associations
- National Ground Water Association

EXPERTISE

- Hydrogeology – water supply and contaminant transport
- Water resources engineering
- Numerical modeling

5 YEAR WITH BURNS & MCDONNELL

21 YEARS OF EXPERIENCE

GROUNDWATER MODELING

Nebraska Department of Natural Resources, Development of a Groundwater Model*

Big Blue and Little Blue River Basins, NE 2012-2013

Project Manager and Lead Hydrogeologist. Mr. DeAngelis led development of a groundwater flow model for the Big Blue and Little Blue River basins that was used by the NDNR to calculate the groundwater depletion component of the Virgin Water Supply (VWS). The total area of the combined Blue River basin in Nebraska is approximately 7,100 square miles. This information was used by NDNR in the calculation of the VWS and the determination of the appropriation status of the basin. Calculation of a groundwater depletion component of streamflow effectively requires the modeler to quantify how much additional streamflow would have been observed if groundwater pumping activities had not occurred within the basin.

USGS Ozark Aquifer Model Review*

Kansas, Missouri, Oklahoma Tri-State Region - 2010

The Missouri Department of Natural Resources (MDNR) requested an expert technical review of a regional groundwater modeling study of the Ozark Plateaus Aquifer System. Mr. DeAngelis provided the primary technical review and project management for this project. The Ozark aquifer is the primary drinking water and industrial water supply aquifer for Southern Missouri, Southeast Kansas, and Northeast Oklahoma and the aquifer has experienced localized groundwater elevation declines on the order 400 to 500 feet since the 1960s. The USGS model was developed for use as a resource management tool that could be used to predict the impact of future groundwater withdrawals on the aquifer. The model was constructed to evaluate potential declines in the Ozark Aquifer over a period of 50 years (2007 to 2057) and concluded that even modest increases in pumping in some of the major

population centers of Southern Missouri are not sustainable. The project team reviewed the groundwater flow model and has provided written comments to the MDNR Water Resources Center. MDNR reviewed the model and submitted comments to the USGS and several partnering state agencies to address several of the deficiencies noted by technical staff.

McPherson BPU, Kansas, New Well Field and Groundwater Model

McPherson, Kansas | 2016

Due to declining water levels within their existing well field, BPU required the development of a supplemental source of supply in order to meet projected future water use. Burns and McDonnell provided planning and evaluation for the development of an alternate water supply source for the McPherson BPU. Sources evaluated included both surface water and groundwater. The project includes preliminary design of the well field, approximately 20 miles of raw water pipeline and a new water treatment facility. Groundwater modeling and new water right applications are included in the project. Mr. DeAngelis developed a groundwater and solute transport model that simulated the impact of a new well on water levels in the aquifer and also evaluated the fate and transport of a chloride plume that is located several miles from the new well field property. The model was also used to support the water right applications needed for the new well field. The model was reviewed by the Kansas Division of Water Resources and the Groundwater Management District No.2.

City of Hays, Kansas, Water Supply Management

Hays, Kansas | 2016

City of Hays maintains a diverse portfolio of raw water supply sources that includes three well fields: the Big Creek alluvial well field, the Smoky Hill River alluvial well field, and the Dakota bedrock well field. Declines in groundwater levels observed during the drought prompted the development of a tool, the Aquifer Health Index (AHI), to help City staff operate the alluvial well fields in a sustainable manner. Mr. DeAngelis developed the AHI, which is a spreadsheet tool that evaluates the relationship between groundwater elevations in the alluvium, streamflow in Big Creek and the Smoky Hill River, and well field pumping to produce a score that is indicative of the current health of the aquifer system. The spreadsheet tool was developed using over a decade's worth of water level and streamflow data and is based on standard statistical techniques, including cumulative frequency curves, which relate current groundwater elevations, streamflow conditions, and well field pumping to past observed values. The tool is used to assist well field managers in evaluating conditions within the aquifers and is currently used by the City as a means for initiating water conservation measures.

Nebraska Department of Natural Resources, Development of a Conceptual Groundwater Model*

Lower Platte and Missouri River Tributary Basins, NE

Project Manager and Lead Hydrogeologist. Mr. DeAngelis was the project manager and technical lead for a study that determined the feasibility of developing a groundwater model for the Lower Platte/Missouri Tributary Basins, which include the land areas that drain directly to the Missouri River downstream of the Niobrara River, as well as the easternmost portions of the Lower Platte River Basin. The study was developed to help water administrators understand the impacts of land use development on streamflow. The project team reviewed available geologic and hydrogeologic data to develop a conceptual model of the hydrogeologic framework of the Basins. This included the development of a regional potentiometric surface map that included both Basins. The study determined that there is sufficient hydrologic and hydrogeologic data in this region to support a groundwater model. Development of the Lower Platte/Missouri Tributaries groundwater flow model is now in progress. Mr. DeAngelis was the project manager for the development of the groundwater model.

Metropolitan Utilities District, New Well Field and Groundwater Model

Omaha, Nebraska | Ongoing

Mr. DeAngelis is the lead hydrogeologist and lead groundwater flow modeler for the Metropolitan Utility District's Platte West Well Field. This is a new 52 MGD

well field that provides water to the Greater Omaha, NE area that began pumping in 2009. Mr. DeAngelis first began working on this project in 2004 during the permitting and well field design phase of the project. His responsibilities on this project have included: design of 32 water supply well, contractor management during well installation, and review of the well performance tests for the new wells. Mr. DeAngelis also led development of a numerical groundwater flow model that was constructed using the USGS MODFLOW code. The model was used to: ensure compliance with a Clean Water Act Section 404 permit, estimate the impact of the well field on nearby lakes, estimate the impact of the well field on the Platte River, estimate the impact of the well field on groundwater contaminant plumes from a nearby Superfund Site, and to manage the day to day operating scenarios of the Platte West Well Field. Mr. DeAngelis continues to maintain an active copy of the groundwater model and updates the model annually to reflect the real pumping conditions of that year. The groundwater model update is documented annually in a report submittal for the USACE, which is a requirement of the 404 Permit. Permit related documents are reviewed by the USACE Omaha and Kansas City Districts and by the USEPA.

Groundwater and Solute Transport Modeling for Nitrate and Uranium Management* - Hastings Utilities

Hastings, NE; 2010-2014

Mr. DeAngelis was the lead groundwater modeler responsible for developing a groundwater flow (MODFLOW) and solute transport (MT3DMS) model to assist Hastings Utilities in managing their well field, which has been impacted by nitrates and uranium. The modeling effort involved refining an existing regional scale model (COHYST), adapting the regional scale model for use at the well field management scale, interpreting over 700 nitrate and 40 uranium samples collected from wells located within the well head protection zone, inputting the nitrate data into the groundwater model, and using MT3D to simulate the changes in concentrations in pumping wells over time. The results of the model were used by Hastings Utilities as one method to manage influent concentrations into their water treatment plant.

Groundwater Surface Water Interaction Study, Platte West Well Field*

Omaha, NE; 2008-2009

Mr. DeAngelis developed and implemented a field testing procedure to quantify the degree of interconnection between the Platte River and the adjacent alluvial aquifer. The results of this study were used to quantify the percentage of water obtained by a new well field from induced infiltration of the Platte River. The methodology used for developing this estimate included: conducting a extended aquifer test (91 hours), monitoring aquifer drawdown at eight (8) wells and three (3) river points, analysis of the aquifer test data using the Theis method of images, estimation of the distance to the line source of recharge using the method presented in Rorabaugh, and the solution of the Glover and Balmer equation. The Glover and Balmer solution calculates the ratio of water obtained from the recharge source at the time of equilibrium pumping. The result of this process is an analytically derived flux target that was used to calibrate the conductance term used in the MODFLOW River Package by varying the hydraulic resistance.

New Well Field Siting and Groundwater Modeling Study*, Council Bluffs Water Works

Council Bluffs, IA; 2007-2008

Mr. DeAngelis developed and implemented a field testing program to locate a 20 MGD well field for the City of Council Bluffs, Iowa. The field testing program included supervision of test hole drilling, interpretation of boring logs and downhole geophysics and design and implementation of aquifer pumping tests. Aquifer test analysis included the use of image well theory to estimate the distance to the line source of recharge (Missouri River) and to estimate the percentage of water obtained from induced infiltration. Mr. DeAngelis served as the lead groundwater modeler and developed a numerical model to estimate the impact of a fully operational well field on a nearby oxbow lake (Lake Manawa). Part of the study included the evaluation of historical flow conditions within the Missouri River, which included development of flow duration curves and streamflow rating curves by decade.

Former Nebraska Ordnance Plant*, United States Army Corps of Engineers
Mead, NE; 2000-2004

Mr. DeAngelis was the lead groundwater modeler responsible for expanding and improving an existing numerical groundwater flow (MODFLOW) and transport (MT3DMS) model to evaluate the effectiveness of an installed remedial system at the Mead Superfund Site. The project consisted of expanding the existing model domain to include the physical boundaries of the aquifer (previously not included) as well as revising model inputs with newly acquired site data and evaluating the impact on extraction well capture zones. Project deliverables included a report, which was accepted by USEPA and NDEQ. Also developed a numerical groundwater flow (MODFLOW) and transport (MT3DMS) model to evaluate the effect of groundwater circulation wells (GCWs) on contaminant mass removal at the site. Project deliverables included a report which was accepted by USEPA and NDEQ.

Groundwater Modeling Study, Mojave Solar*, LLC.
Barstow, CA; 2008-2009

Mojave Solar, LLC proposed to construct a 150 MW solar thermal generating facility near Barstow, CA. Mr. DeAngelis was part of a team that implemented a large scale basin characterization program to support the project permitting process, which included review fro the California Energy Commission (CEC) and the Mojave Water Authority (MWA). Mr. DeAngelis developed a groundwater flow model that accurately simulated the observed magnitude and direction of the hydraulic gradient. The groundwater basin is extremely complex, including numerous faults, areas of basalt flows, areas of exposed plutonic rocks, and 400 feet relief in the piezometric surface elevation. After a rigorous calibration process, the groundwater model was able to reproduce the observed groundwater flow directions and was approved by the CEC and MWA.

CITY OF WICHITA PROJECTS

City of Wichita, Kansas, Water Resources Modeling
Wichita, Kansas | 2015

Mr. DeAngelis was part of a Burns and McDonnell team that reviewed the City of Wichita's MODSIM-DSS model. The City maintains this model and uses it to simulate various drought scenarios to assist in evaluating the effects of various conservation efforts and infrastructure enhancements. Our team's objective was to review of the effects of 1% drought on the City's two distinct resources, the Equus Beds Regional Aquifer, and Cheney Lake. The model was run utilizing future demands in order to review how various levels of City wide conservation and withdrawal of Aquifer Storage and Recovery Credits affects the sustainability of both the groundwater and surface water resources. The City is basing its drought and water supply conservation plan on the results of the model to facilitate future operational triggers and subsequent responses to drought. Burns & McDonnell's review resulted in some minor modifications to the model and improvements in the documentation of the model.

Aquifer Storage and Recovery Well Design (Equus Beds Aquifer) * | City of Wichita
Wichita, Kansas | 2008-2009

Project Hydrogeologist Mr. DeAngelis developed final designs for 30 dual purpose recharge/ pumping wells for the City of Wichita Aquifer Storage and Recovery Project. Mr. DeAngelis reviewed downhole geophysical logs (spontaneous-potential, single point resistance, and gamma), geologist logs, and sand gradation samples to develop the well designs, which were reviewed by Burns & McDonnell and accepted by the City as final. The wells will be used to recharge the Equus Beds aquifer during high river stage conditions in the Little Arkansas River, and will also be used as a reserve raw water supply during low river stage conditions. Typical wells were constructed approximately 250 feet below ground surface and had yields in excess of 1,000 gpm.

Municipal Water Supply Well Design (Arkansas River Alluvium), Bentley Well Field* | City of Wichita
Wichita, Kansas | 2008 - 2009

Project Hydrogeologist Mr. DeAngelis reviewed downhole geophysical logs, geologist logs, and sand gradation samples to develop well designs for six (6) replacement water supply wells at the City of Wichita's Bentley well field. The wells were completed in the alluvium of the Arkansas River. Mr. DeAngelis also reviewed the results of an extended aquifer test and of each well performance test to determine site specific aquifer parameters and ensure that the wells were operating at or above the specified well efficiency. Typical well yields were in excess of 1,000 gpm

PUBLICATIONS

Elmore, Curt, PhD, & DeAngelis, Luca (2004). Modeling a Ground Water Circulation Well Alternative – Ground Water Monitoring and Remediation. *Ground Water Monitoring and Remediation*, Winter 2004, Volume 24, No.1

**denotes experience prior to joining Burns & McDonnell*

NATHANIEL K. DUNAHEE, PE

Associate Environmental Engineer

Nathan Dunahee has a wide range of technical capabilities with expertise in water treatment process optimization, disinfection, filtration, coagulation, softening, and emerging water quality concerns. Nathan's strong background in academic research with the University of Illinois, University of Michigan and Water Research Foundation, coupled with his expertise in physical and chemical processes, helps bridge the gap between fundamental research and developing engineering solutions.

EDUCATION

- B.S. Civil Engineering, University of Illinois, 1999
- M.S. Environmental Engineering, University of Illinois, 2001
- USEPA Graduate Research, University of Michigan, 2001 - 2004

REGISTRATIONS

- Professional Engineer (KS, MO, LA)

6 YEARS WITH BURNS & MCDONNELL

14 YEARS OF EXPERIENCE

Nathan specializes in finding practical, cost-effective methods to enhance performance by improving the physical and chemical processes of water treatment. Bench and pilot scale testing has included coagulation, membranes, disinfection, advanced oxidation, conventional treatment, lime softening, filtration, biologically active carbon, and other plant processes. He provides expertise at the national level and serves on two AWWA technical committees overlooking Emerging Water Quality Concerns and Taste & Odor.

DRINKING WATER - TREATMENT

Shreveport Water Master Plan | City of Shreveport

Shreveport, Louisiana | 2016 (ongoing)

Lead Project Engineer for the development of the Amiss WTP master plan and ozone improvement study. This project will identify required improvements and phasing for supply, treatment, and distribution system improvements to address several water quality issues as well as to address recent shortfalls in plant capacity. Conducted bench scale testing, process, and regulatory evaluations of the three plants with total capacity of 78 MGD. The evaluation included raw water ozone, coagulation improvements, evaluation of the 24 filters and backwash system, regulatory compliance review, hydraulic review, ozone evaluation, and chemical feed assessment. Concepts will be developed to select recommended improvements with City staff to address all supply, treatment and distribution needs to increase plant capacity from 78 MGD to meet a future build-out demand of 110 MGD. Low cost concepts have been developed to improve process performance by modifying coagulant type, location and injection style and by expanding sedimentation capacity in the existing plant to avoid costly new infrastructure.

Water Supply & Treatment Plant Master Plan | City of North Kansas City

North Kansas City, Missouri | 2016

Lead Process Engineer for the Phase 1 evaluation of the North Kansas City water supply system and water treatment plant improvements. The study was initiated due to a recommendation by others that the City develop a new water source and construct a 7.5 MGD new water plant and well field estimated at about $40 million. Project included a process, regulatory, filter, disinfection, solids handling, and electrical evaluations. This study developed conceptual designs and opinions of probable costs for the well and plant improvements, an update to the operations cost, and present value analysis for several of the chemical change options. Improvements totaled $13.6 million and met all the project goals for 1/3 of the cost of a new facility. The final report was issued and serves as a MDNR Engineering Report. Work includes extensive participation with City staff and the City Council.

NATHANIEL K. DUNAHEE, PE

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Water Treatment Plant Improvements | City of Harrisonville
Harrisonville, Missouri | 2016

Lead Process Engineer. Based on a Facility Evaluation conducted by Burns & McDonnell, process improvements were selected and designed for the Harrisonville Water Treatment Plant to address taste and odor concerns, update faulty or outdated equipment and ease future expansion to 3 MGD. Project included new chemical feed systems, solids contact clarifier equipment, a new high service pump station and wet well, and yard piping modifications. Other plant improvements included the implementation of a modular ozone system for raw water injection with considerations for disinfection use in the future. Coordinated with state regulatory agencies to receive construction variances where needed and to comply with requirements to receive federal funding on the project.

Fulbright Filter Evaluation | City Utilities
Springfield, Missouri | 2014

Project Manager and Lead Process Engineer. Burns & McDonnell conducted a filter evaluation of the six dual-media filters at the 20 MGD Fulbright Water Treatment plant. The project included onsite evaluations of the filter structures, surface wash, underdrains, media, and backwashing systems. A number of improvement alternatives were presented to City Utilities according to relative capital expenditure requirements and provided benefit. After successful completion of this project, the project team was asked to conduct a similar evaluation at their Blackman WTP. Burns & McDonnell also developed an annual inspection protocol and provided training to enable Fulbright and Blackman WTP staff to conduct similar evaluations in the future.

Taste and Odor Study | City of Kansas City
Kansas City, Missouri | 2015

Project Manager and Lead Process Engineer. Burns & McDonnell conducted a taste and odor evaluation for Kansas City's 240 MGD water treatment plant. The study focused on bench-scale testing of PAC, coordination of PAC addition with chlorine and permanganate addition, and evaluation of operational procedures. The study resulted in use of a different PAC type and implementation of new monitoring procedures to improve the WTP's ability to quickly respond to and mitigate taste and odor events.

Water Treatment Plant Improvements | City of Lawrence
Lawrence, Kansas | 2016

Process Engineer. Based on the results of a taste & odor study conducted by Burns & McDonnell in 2013, the City of Lawrence decided to move forward with various process and chemical feed improvements at both the Kaw and Clinton Water Treatment Plants to enhance treatment and streamline operations. Project included upgrade of several chemical feed systems including liquid lime, ferric chloride, carbon dioxide, and a batch lime slaking system. Other plant improvements included new rapid mix systems and basin equipment repairs.

Taste and Odor Reduction and Process Evaluation | City of Lawrence
Lawrence, Kansas | 2013

Project Manager/Process Engineer to optimize existing treatment processes and improve the reduction of taste and odor compounds MIB and geosmin. The study identified several improvements to presedimentation, coagulation, chemical

utilization, disinfection, and filtration. Bench-scale testing was performed to evaluate different coagulants, polymers, and various PAC types. Additional testing was conducted to determine the potential benefit of adding new processes, included ozone, ozone/peroxide, and UV/peroxide for taste and odor reduction. Results from testing were used to rank each technology in regards to effectiveness and cost-efficiency.

Filter Evaluation | City of Lawrence

Lawrence, Kansas | 2012

Project Manager/Process Engineer for the filter evaluation at the Clinton Water Treatment Plant. The 25 MGD facility has eight dual media filters that were struggling to meet capacity and treatment goals. The average filter run times ranged between 20 and 30 hours with elevated turbidity. Tasks included a filter evaluation, three operator training workshops, annual filter inspection protocol, and operation and maintenance manual. Twelve filter investigation techniques were performed, including filter coring, turbidity retention profile, media analysis, media stratification, backwash inspection, backwash flowmeter calibration, and underdrain inspection. Process and operational improvements were made that extended filter run time from 30 to 140 hours, improved filtration, and increased overall WTP capacity.

Water Master Plan | City of Lawrence

Lawrence, Kansas | 2011

Lead Process Engineer for improvements and expansion to the water treatment capacity at the Kaw Water Treatment Plant. Tasks included a process evaluation and regulatory evaluation to improve treatment, add capacity, and lower operating cost per MGD. Improvements where recommended for primary treatment, chemical utilization, lime softening, recarbonation, and filtration to expand capacity without adding new basins or filters.

NATHANIEL K. DUNAHEE, PE

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Harrisonville Filter Rehabilitation | City of Harrisonville
Harrisonville, Missouri | 2015

Lead Process Engineer. Based on recommendations from a filter evaluation conducted by Burns & McDonnell, four filters at the Harrisonville were rehabilitated to meet regulatory requirements and improve filter performance at current plant flow rates and at future increased plant capacity. New Leopold underdrains with slotted media retention caps were installed to replace outdated underdrains and preclude the need for support gravel. This allowed additional media to be added to the filters which, combined with other improvements, increased filter runtimes and increased public safety. The filters were also retrofitted with air scour, which provides for more efficient filter cleaning, improving filter performance between cleanings and increasing the longevity of the filter media.

Water Treatment Plant Improvements | City of Harrisonville
Harrisonville, Missouri | 2015

Lead Process Engineer Burns & McDonnell was retained to design the improvements at the Harrisonville Water Treatment Plant. Final recommendations included installation of ozone for pre-oxidation, improved rapid mix, new solids contact clarifier equipment and tube settlers, new chemical feed systems, and filter improvements. Upon completion of the evaluation, Ms. Thompson led the development of the Capital Facility Plan and design of the WTP improvements.

Water Treatment Plant Expansion | City of Harrisonville
Harrisonville, Missouri | 2013

Lead Process Engineer for the study to expand capacity from 1.8 to 3.0 MGD and improve treatment performance. The raw water quality is highly variable and is difficult to treat. Tasks included a process, regulatory, and hydraulic evaluation. Bench-scale testing was conducted to determine and prioritize improvements to 1) reduce taste and odor compounds, natural organic matter, and manganese, 2) improve coagulation, disinfection, and filtration, and 3) expand treatment capacity. Four process alternatives were developed based on bench scale testing for coagulation (alum, ferric and polymer) and taste and odor reduction (PAC, permanganate, UV/peroxide, and ozone). The alternatives were developed through preliminary concept design phase with life cycle costs and non-economic selection criteria to compare and rank alternatives.

Water Treatment Plant Improvements Design | City of Atchison
Atchison, Kansas | 2014

Process Engineer/Technical Advisor for the preliminary design, final design, and construction phase. The 10 MGD plant continual struggled with meeting finished water goals and regulatory requirements for total organic carbon reduction, disinfection compliance, excessive disinfection byproduct formation, and cryptosporidium reduction credit. The project included improvements to presedimentation, primary treatment, filtration, and chemical optimization. The design also included ozone on the raw and settled water for oxidation, disinfection, and process improvements.

Atchison Water Treatment Plant Improvements (Filter Evaluation) | City of Atchison
Atchison, Kansas | 2013

Lead Process Engineer. As part of a complete process evaluation for the Atchison Water Treatment Plant, Burns & McDonnell conducted an evaluation to prepare for conversion of the filters to biological active filters. Project included onsite evaluations of the filter structures, media, and backwashing systems. The resulting report identified potential areas for improvement in media cleaning through installation of an air scour system, new media retention caps, and calibration of backwash flow metering.

NATHANIEL K. DUNAHEE, PE

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Water Treatment Plant Improvements Study | City of Atchison

Atchison, Kansas | 2012

Project Manager/Process Engineer to improve treatment performance and finished water goals. The 10 MGD plant continual struggled with meeting finished water goals and regulatory requirements for total organic carbon reduction, disinfection compliance, excessive disinfection byproduct formation, and cryptosporidium reduction credit. Twelve different treatment alternatives were evaluated. The top six alternatives were bench tested, including powdered activated carbon, enhanced coagulation, MIEX, and ozone, to develop site-specific design recommendations.

Main Treatment Plant Evaluation Disinfection Feed System Improvements | City of Wichita

Wichita, Kansas | 2015

Process Engineer. Burns & McDonnell was retained to design improvements to the gaseous chlorine and ammonia feed systems at the Main Water Treatment Plant (150 MGD). Improvements included new feed equipment, installation of redundant piping systems and electrical modifications.

East Plant Evaluation | City of Wichita

Wichita, Kansas | 2014

Project Manager/Process Engineer. The City of Wichita operates a 160 MGD WTP with blended surface water and groundwater sources. Due to water source availability, the city desires to have a flexible treatment approach that will allow for treatment of individual sources. Burns & McDonnell was retained to perform a process evaluation to assess the WTP's ability to treat only groundwater and identify improvements that would be required. Project included a process evaluation, bench and full-scale testing, operational evaluation, and regulatory evaluation. Alternatives included rehabilitation of the east plant with five options ranging between conventional and high-rate lime softening.

ASR Advanced Oxidation Optimization | City of Wichita

Wichita, Kansas | 2013

Project Manager/Process Engineer to optimize the new Aquifer Storage and Recovery Phase II Surface Water Treatment Plant (ASR SWTP). The ASR SWTP treats the Little Arkansas River during high-flow events for direct injection into the Equus Beds Aquifer. The 30 MGD facility includes ultrafiltration membranes and advanced oxidation with ozone and hydrogen peroxide to reduce atrazine, provide 4-log virus inactivation, and reduce bromate. Bench and full-scale testing was conducted to optimize the treatment process. Ozone and hydrogen peroxide dose was reduced from 15 to 8 mg/L and 22 to 5 mg/L, respectively, for most operating scenarios. Bromate formation was reduced from over 100 to under 10 µg/L for several operating scenarios.

Cheney Reservoir Ozone Evaluation | City of Wichita

Wichita, Kansas | 2012

Project Manager/Process Engineer for reducing bromate in the ozonated raw water from Cheney Reservoir. The raw water ozonation at Cheney Reservoir was designed to operate between 4 to 5 mg/L continuous dosing without taking into account raw water quality or bromate formation. This mode of operation translates to increased chemical use, energy consumption, and bromate formation up to three times the regulatory requirement. Ozone testing included a continuous-flow bench-scale ozone testing unit that combines the reliability of pilot-scale testing with the cost-effectiveness of bench-scale methods. Ozone dose, demand, decay, CT credit, and bromate formation curves were developed to determine the ozone dose required to achieve disinfection, color reduction, taste and odor abatement, oxidation goals, and bromate formation.

NATHANIEL K. DUNAHEE, PE

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ASR Hydrogen Peroxide Residual Evaluation | City of Wichita

Wichita, Kansas | 2011

Project Manager/Process Engineer for the study focused on the fate and impact of the 17 to 20 mg/L hydrogen peroxide residual leaving the new Aquifer Storage and Recovery Phase II Surface Water Treatment Plant (ASR SWTP). The 30 MGD facility includes ultrafiltration membranes and advanced oxidation with ozone and hydrogen peroxide. Processed water would be sent to wells and the Main Water Treatment Plant (MWTP). Bench-scale testing was conducted to determine 1) hydrogen peroxide decay and reaction rate of residual leaving the SWTP, 2) impact to corrosion of piping, valves, and metal surfaces, 3) impact on the wells and MWTP.

Main Water Treatment Plant Evaluation | City of Wichita

Wichita, Kansas | 2011

Project Manager/Process Engineer to determine practical ways to effectively treat eight new raw water blending scenarios. The study included bench-scale testing and performance-based assessment for each treatment process, modifications required for each blending scenario (physical, chemical, and operational), and improvements that could be made to improve plant performance, filtration, disinfection, finished water quality, and reduce operating costs.

Water Treatment Plant Process Improvements | City of Bossier City

Bossier City, Louisiana | 2015

Project Manager/Process Engineer to determine practical ways to effectively treat eight new raw water blending scenarios. The study included bench-scale testing and performance-based assessment for each treatment process, modifications required for each blending scenario (physical, chemical, and operational), and improvements that could be made to improve plant performance, filtration, disinfection, finished water quality, and reduce operating costs.

Construction and Operational Phase Services | City of Bossier City

Bossier City, Louisiana | 2011-2013

Project Manager/Process Engineer for the construction and operational phase services for the Water Treatment Plant Expansion and Rehabilitation capital improvements. The $85 million project included improvements to the existing facilities and expands plant capacity. The addition of Plant No. 3 provides an additional 25 MGD capacity consisting of pretreatment, MF/UF membranes, ozone, and GAC contactors.

Water Treatment Process Evaluation | City of Bossier City

Bossier City, Louisiana | 2010

Project Manager/Process Engineer to expand treatment capacity from 20 to 25 MGD and improve treatment performance. Tasks included a process, regulatory compliance, and hydraulic evaluation to enhance the performance of existing processes. Testing included coagulation and jar testing, filter evaluation, bench scale ozone testing, disinfection byproduct formation and mitigation strategies, and treatment optimization. Filter performance was improved by examining a series of performance indicators and quantitative evaluations. Ozone testing included a continuous-flow bench-scale ozone testing unit that combines the reliability of pilot-scale testing with the cost-effectiveness of bench-scale methods. Ozone dose, demand, decay, CT credit, and bromate formation curves were developed to determine the ozone dose required to achieve disinfection, color reduction, taste and odor abatement, and oxidation goals. Bromate mitigation strategies were evaluated to reduce bromate from 20 to less than 10 µg/L.

NATHANIEL K. DUNAHEE, PE

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Water Treatment Plant Expansion | City of Monroe
Monroe, Louisiana | 2014

Process Engineer. Due to increased demands, the City of Monroe hired Burns & McDonnell to develop the preliminary design for the expansion from 12 to 20 MGD. Tight site constraints, variable water quality, high manganese, and high disinfection byproduct formation potential were some of the main design challenges. Through strategic equipment selection and basin configuration, the team developed a compact solution that will provide high quality water and operational flexibility.

Water Treatment Plant Expansion Evaluation | City of Monroe
Monroe, Louisiana | 2012

Project Manager/Process Engineer for the evaluation to expand capacity through a two phased approach 1) increase existing capacity from 12 to 18 MGD without any new basins or filters, and 2) add 8 MGD of new capacity. The expansion would also include improve treatment performance and reduce operating cost per MGD. Bench scale testing and filter evaluation identified process improvements to rapid mix, coagulation, primary treatment, filtration, and disinfection.

Copper Corrosion Control Study | McPherson Board of Public Utilities
McPherson, Kansas | 2012

Process Engineer McPherson BPU retained the services of Burns & McDonnell to conduct a study on the causation of copper leaching within their distribution system. Project included an analysis of water quality characteristics to determine the factors responsible for copper release. The final report provided a summary of the analysis results and recommendations for the selection of an appropriate corrosion control strategy.

Water Research Foundation Project 4216 | Castaic Lake Water Agency (CLWA)
Santa Clarita, California | 2010

Process Engineer and Ozone Bench Scale Testing. Electrochemical reactor and ozone testing for the Castaic Lake Water Agency (CLWA), Santa Clarita, California. The results from this study are part of the Phase II testing for the Water Research Foundation (WRF) Project 4216: An Electrochemical Reactor to Minimize Brominated DBPs in a Conventional Water Treatment Plant. The goal of this project is to further advance the design and understanding of the electrochemical reactor for drinking water treatment. The testing includes seventeen flow-through bench-scale reactor configurations in combination with five different ozone doses. Water quality monitoring included chlorine, chlorine dioxide, chlorate, TTHMs, HAAs, total and speciated organic halides (TOBr and TOCl), bromide, bromine, and bromate.

Electronic Operations and Maintenance Manual | City of Bentonville
Bentonville, Arkansas | 2012

Project Engineer of the project that developed a web-based electronic operation and maintenance manual that utilized an interactive platform to easily navigate through and access a wide range of valuable resources, including contract drawings, operation and preventive maintenance protocols, troubleshooting guides, training videos, equipment manuals, process descriptions, lab procedures, warranty and repair information, photos, etc. The project included workshops with plant staff to encourage their involvement and feedback through the project to ensure the project would assist operations and maintenance staff.

NATHANIEL K. DUNAHEE, PE

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Process Optimization | Multiple Clients

Multiple Locations | 2004-2016

Project Lead: Nathan has performed process optimization testing and evaluations for over 30 clients in 12 states, including: Main Water Treatment Plant Evaluation (Wichita, KS), Disinfection Byproduct and Ozone Oxidation Study (Atchison, KS), WTP Expansion (Columbia, MO), Coagulation, Polymer, and PAC Evaluation (Ft. Smith, AR), Ozone and Filter Optimization (Bossier City, LA), Advanced Oxidation Study (Norman, OK), Ozone and Biofiltration Testing, (Lewisville, TX), WTP Expansion and Improvements (Miami-Dade, FL), Ozone Evaluation (St. George, UT), Castaic Lake Water Agency WRF Study (Santa Clarita, CA), Manganese Investigation and Disinfection (Greenville, NC), WTP Expansion Evaluation (Tulsa, OK), and Ozone Feasibility Study (Costa Mesa, CA).

PROJECT COMPLETED PRIOR TO BURNS & MCDONNELL

Water Treatment Expansion Project* | City of Manhattan

Manhattan, Kansas | 2006

Project Engineer for the Water Treatment Expansion Project, Manhattan, Kansas, to expand plant capacity from 20 to 30 MGD. Modifications were made to the treatment process to improve water quality goals and treatment efficiency. Project responsibilities included process improvements and a new lime feed system. The design replaced the existing slakers with a batch slaking system, aging tank, grit removal, and lime slurry loop delivery system.

Lake Draper Water Treatment Plant Improvements and Expansion* | City of Oklahoma

Oklahoma City, Oklahoma | 2005

Design Engineer for the City of Oklahoma, Oklahoma, Lake Draper Water Treatment Plant improvements and expansion. This project expanded plant capacity from 90 to 150 MGD and will provide enhanced treatment for increased TOC reduction and finished water quality. Key aspects of the $35-million project included a comprehensive process, regulatory compliance, hydraulic, and structural evaluations. Project included developing a web-based electronic operation and maintenance manual that utilizes fully integrated 3-D renderings to easily navigate through and access a wide range of valuable resources, including contract drawings, operation and preventive maintenance protocols, troubleshooting guides, training videos, equipment manuals, process descriptions, lab procedures, warranty and repair information, photos, etc.

Water Treatment Plant Expansion Evaluation* | City of Norman

Norman, Oklahoma | 2006

Project Engineer for the City of Norman, Oklahoma, Water Treatment Plant Expansion Evaluation. The project goals were to expand plant capacity, enhance the efficiency of exiting treatment processes, and provide a long-term solution for taste and odor control and disinfection. Conducted a bench-scale and desktop evaluation of the following taste and odor removal technologies: ozone, ozone peroxide, GAC contactors, PAC, UV with PAC, and UV with hydrogen peroxide. Evaluated alternatives for solids contact clarifiers, filtration, taste and odor control, and disinfection strategies. Developed several hydraulic profiles, identified hydraulic limitations for each plant process, and provided candidate solutions to remedy key hydraulic bottlenecks.

NATHANIEL K. DUNAHEE, PE

(continued)

Water Treatment Plant Advanced Oxidation Evaluation* | City of Norman

Norman, Oklahoma | 2007

Project Engineer for the City of Norman, Oklahoma, Water Treatment Plant Advanced Oxidation Evaluation. The purpose of this study was to evaluate and compare ozone, chlorine with powder activated carbon (PAC), UV with PAC, and UV with hydrogen peroxide. The project goals were to satisfy primary disinfection requirements, reduce taste and odor compounds, and provide enhanced public health protection. The bench-scale analysis included MIB, geosmin, bromate, chlorinated disinfection byproducts, quenching, and changes in raw water quality. Testing included ninety-five pharmaceutically active compounds and the six algal toxins listed on the US EPA priority list, including the five hepatotoxins, microcystin-LR, -RR, -LA, -YR, and cylindrospermopsin, and the neurotoxin anatoxin-a. The results from this analysis showed how susceptible each compound was to oxidation and how the percent reduction improved as a function of dose. The results were then used to optimize taste and odor abatement and enhanced public health protection without excessive disinfection byproduct formation.

Water Treatment Plant Expansion Design* | City of Norman

Norman, Oklahoma | 2008

Project Engineer for the City of Norman, Oklahoma, Water Treatment Plant Expansion Design. The $24 million project addressed changes in lake water quality, integration of ozone, and a client challenged by residential growth, seasonal taste and odor complaints, and control of DBPs. Project included a process, regulatory compliance, structural, and hydraulic analysis of the existing and expanded facility. Design included new 12 MGD solids contact clarifier, chemical feed and filtration improvements, and integration of ozone for disinfection, taste and odor abatement, and oxidation of micro-pollutants.

Disinfection System Improvements, Blackman/Fullbright Water Treatment Facilities* | City Utilities

Springfield, Missouri | 2008

Process Engineer for the City Utilities (Springfield, MO) disinfection system improvements at the Blackman and Fullbright water treatment facilities. The project included criteria ranking and selection process comparing the continued use of gaseous chlorine, bulk, and on-site generation sodium hypochlorite generation (OSHG). A code analysis was conducted to determine the adequacy for building reuse and new facilities required for each alternative. The results of this study showed that OSHG disinfection (the highest ranked alternative) was most favorable in terms of employee and offsite safety, the two highest weighted criteria. The present worth of OSHG was ranked favorably due to the low operations cost for salt and electricity that offset the initial capital investment.

McBaine Water Treatment Plant Expansion Study* | City of Columbia

Columbia, Missouri | 2009

Project Engineer for the City of Columbia, Missouri McBaine Water Treatment Plant Expansion Study to identify and recommend process modifications and improvements to the conventional softening plant. Project goals include expanding plant capacity from 32 to 60 MGD, reduce disinfection by-product formation, address GWUDI classification issues, improve finished water quality, and reduce emerging contaminants.

Ozone Evaluation Study* | Mesa Consolidated Water District

Costa Mesa, California | 2006

Project Engineering for the Mesa Consolidated Water District Ozone Evaluation Study, Costa Mesa, California. Color levels have been high historically (up to 90 c.u.) and prone to bromate formation in the presence of ozone. The purpose of the

bench-scale testing was to determine the efficacy of ozone in reducing color in the well water while minimizing bromated formation. Bromate mitigation strategies were evaluated, including pH suppression, ammonia, and hydrogen peroxide.

Ozone and Biofiltration Bench and Pilot-Scale Testing* | Upper Trinity Regional Water District

Lewisville, Texas | 2005

Project Engineering for the Upper Trinity Regional Water District, Lewisville, Texas. The purpose of the study was to validate ozone and biofiltration as potential treatment options for the Tom Harpool Regional WTP. Initial ozone bench-scale testing was conducted followed by ozone/biofiltration pilot-scale testing. Biofiltration performance was compared with and without preozonation, and for several nutrient supplementation strategies, including carbon, nitrogen, and phosphorus addition. Bench and pilot testing included MIB, iron, manganese, bromate, DOC, and color. The results from this study build upon recent AWWA RF biofilter project conducted at the Arlington Kubala WTP. Results from this study indicate that nutrient supplementation may conventional biofiltration, including improved color, taste and odor, and DOC reduction.

Hialeah and Preston WTP Expansion and Improvements Project* | City of Miami

Miami-Dade, Florida | 2006

Process Engineer. Bench-scale ozone and jar testing for the Hialeah and Preston WTP Expansion and Improvements Project, Miami-Dade, Florida. Phase 1 of this on-going project is to identify and recommend process modifications and improvements to the conventional lime softening WTPs to address a reclassification of the ground water source.

Quail Creek WTP Ozone Project* | Washington County Water Conservancy District's (WCWCD)

St. George, Utah | 2007

Process Engineer. Bench-scale ozone testing for the Washington County Water Conservancy District's (WCWCD) Quail Creek WTP Ozone Project, St. George, Utah. Bench and pilot-scale ozone testing were conducted to evaluate ozone for taste and odor control of MIB and geosmin. Peroxone was recommended with a multi-layer bromate mitigation strategy for varying conditions. Full-scale design of a 60 MGD intermediate-ozone facility is currently underway.

Water Research Foundation (WRF) Project* | Castaic Lake Water Agency (CLWA)

Santa Clarita, California | 2008

Process Engineer. Electrochemical reactor and ozone testing for the Castaic Lake Water Agency (CLWA), Santa Clarita, California. The results from this study are part of the Phase II testing for the Water Research Foundation (WRF) Project 4216: An Electrochemical Reactor to Minimize Brominated DBPs in a Conventional Water Treatment Plant. The goal of this project is to further advance the design and understanding of the electrochemical reactor for drinking water treatment. The testing includes seventeen flow-through bench-scale reactor configurations in combination with five different ozone doses. Water quality monitoring included chlorine, chlorine dioxide, chlorate, TTHMs, HAAs, total and speciated organic halides (TOBr and TOCl), bromide, bromine, and bromate.

Utilities Commission Manganese Investigation Study* | City of Greenville

Greenville, North Carolina | 2007

Project Engineer for the Greenville, North Carolina, Utilities Commission Manganese Investigation Study. Events during the late summer and fall months make manganese control very challenging for plant staff. The goals of the study were to determine if soluble manganese could be oxidized and removed prior to filtration. Tests revealed that a specific range of

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ozone doses applied to the raw water resulted in the production of colloidal manganese that was not removed through the coagulation, sedimentation, or filtration.

Western Corridor Pipeline and Pump Station Study and Preliminary Design* | Beaver Water District

Lowell, Arkansas | 2008

Project Engineer for the Western Corridor Pipeline and Pump Station Study and Preliminary Design, Beaver Water District, Lowell, Arkansas. The project included a detailed study and preliminary design of a 60-inch water transmission line, remote storage reservoir, and pump station to each of the four customer cities. The study identified the environmental, geotechnical, hydraulic, regulatory, local, and other issues associated to the pump station and pipeline alternatives. Design included developing system head curves for the pipeline and four pump stations, a topographic and photographic survey, plan and profiles of pipeline alternatives, pump station size and layout options, hydraulic analysis, and preliminary cost estimates.

Regional Growth Study, Beaver Water District* | Beaver Water District

Lowell, Arkansas | 2007

Project Engineer for the Regional Growth Study, Beaver Water District, Lowell, Arkansas. Project goals included defining limits of existing source water supply, treatment, and transmission needs through 2055. The study established population predictions that were used to develop future water demands and to forecast when the existing water supply and treatment systems will need to be expanded. The project prioritized capital improvement program and implementation plan and developed guidelines for future water reuse programs.

A.B. Jewell Water Treatment Plant Evaluation and Master Plan* | City of Tulsa

Tulsa, Oklahoma | 2005

Project Engineer for the City of Tulsa, Oklahoma, A.B. Jewell Water Treatment Plant evaluation and master plan to expand plant capacity from 107 MGD to 120 MGD, and ultimately 150 MGD. This project included a process, regulatory compliance, and hydraulic evaluation to optimize treatment and expand plant capacity. Developed low cost operational and capital improvements to maximize the efficiency of existing treatment processes and reduced DBP formation. Several alternatives were evaluated and bench-scale tested to examine the impacts of potential process improvements on water stability, primary treatment, filtration, and disinfection.

Wastewater Treatment Plant Upgrade and Expansion* | City of Manhattan

Manhattan, Kansas | 2008

Design Engineer for the City of Manhattan, Kansas Wastewater Treatment Plant Upgrade and Expansion. The $35 million project expanded plant capacity from 8.6 to 11 MGD and included process improvements, new UV disinfection system, and biological nutrient removal to meet stringent effluent nitrogen and phosphorus limits. Design responsibilities included four new aeration basins, three final basins, peak flow holding basin, blower building, effluent flowmeter vault, and modifications to the existing aeration basins, non-potable water system, splitter structures, and drain systems.

**denotes experience prior to joining Burns & McDonnell*

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Master Resume Additional Information (For Internal Use Only)

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Full Education:
BS, Civil Engineering, University of Illinois, 1999
MS, Environmental Engineering, University of Illinois, 2001
USEPA Graduate Research, University of Michigan, 2001-2004

Registrations/Certifications:
Professional Engineer (KS), 2008, License # 20335
Professional Engineer (LA), 2010, License # 35819
Professional Engineer (MO), 2015, License # 2015008905

Expertise:
Water treatment optimization
Coagulation
Softening
Filtration
Disinfection
Advanced treatment
DBP mitigation strategies
Taste and odor
Emerging contaminants
Bench/pilot scale testing

Professional Associations:
American Water Works Association
Water Research Foundation
American Society of Civil Engineers

National AWWA Committees:
Taste and Odor
Emerging Water Quality Concerns

Training:
List specific training and dates

Awards:
List awards

Global Practice:
WTR

Office Location:
KCM

NATHANIEL K. DUNAHEE, PE

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Years with Other Firms: 10
USEPA 06/2001-06/2004
Carollo Engineers 06/2004-06/2010
Burns & McDonnell 06/2010-Present

Burns & McDonnell Anniversary: 06/01/2010

Tracy Streeter

Director
Kansas Water Office

Tracy Streeter has served as the Director of the Kansas Water Office, the state's water planning, policy and coordination agency since 2004. Tracy was re-appointed by Governor Sam Brownback on December 31, 2010 and served previously for Governors' Kathleen Sebelius and Mark Parkinson. Before joining KWO, he served as Executive Director of the State Conservation Commission. Tracy has 32 years of experience in Kansas water resources management.

Tracy serves as Chair of the Governor's Drought Response Team and is an appointed member to the Western States Water Council. In 2013, he was appointed by the Governor to co-lead the development of a 50 Year Water Vision for Kansas along with the Kansas Secretary of Agriculture.

A native Kansan, Tracy grew up on a diversified family farm in Brown County and graduated from Horton High School. He earned undergraduate degrees from Highland Community College and Missouri Western State University and a graduate degree from the University of Kansas. Tracy served eight years on the Valley Falls Board of Education and is a private pilot.