



Wright Water Engineers, Inc.

ANDREW EARLES, Ph.D., P.E., P.H., BC.WRE
EXECUTIVE VICE PRESIDENT

CURRENT Senior Principal/Consultant—Lead engineer and technical expert for wide array of water resources projects related to hydrology, hydraulics, sediment transport, and stormwater management, including criteria, permitting, and water quality. In addition to routine projects, provide water engineering consulting services on domestic and international projects for protection and restoration of historical and cultural heritage sites.

EDUCATION Ph.D., Civil Engineering, University of Virginia (UVA), 1999
M.S., Civil Engineering, UVA, 1996
B.S., Civil Engineering, Stanford University, 1994

REGISTRATIONS Registered Professional Engineer—Colorado #37237, Arkansas #12329, Connecticut #35427, Hawaii #14235, Illinois #062074870, Iowa #21024, Kentucky #35208, Louisiana #31306, Nebraska #E-16541, New Mexico #25426, South Dakota #13431, Texas #137085, Wyoming #16160

OTHER CERTIFICATIONS Professional Hydrologist, Board Certified Water Resource Engineer, American Academy of Water Resources Engineers, Certified Professional in Erosion and Sediment Control (CPESC) #3767

AREAS OF EXPERTISE	Hydrology	NPDES/CDPS Permitting
	Hydraulics	Sampling & Monitoring
	Stormwater Management	Erosion & Sediment Control
	Urban Drainage	Post-wildfire Hydrology & Risk Management
	Flood Risk Management	Mud & Debris Flow
	FEMA CLOMR/LOMR	Expert Witness
	Low Impact Development & Green Infrastructure	

REPRESENTATIVE PROJECTS

Drainage and Water Quality

Mile High Flood District (MHFD) Volume 3, Chapter 4 Update. Project manager for update of Chapter 4 of Volume 3 of Urban Storm Drainage Criteria Manual addressing stormwater best management practices (aka stormwater control measures [SCMs]). Worked with MHFD staff to lead multidisciplinary team including other water and civil engineers, landscape architects, and a geotechnical engineer to update content related to design of SCMs including receiving pervious areas such as buffers and swales, permeable pavements, bioretention, sand filters, extended detention basins, retention ponds, and constructed wetland ponds. Assisted MHFD with stakeholder outreach program.

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City of Aurora Development Reviews. Led team of four reviewers to assist the City of Aurora with review of preliminary and final drainage reports and plans. Part of the motivation for this work was to better understand the City's review process and to reflect this in an update to the City's Storm Drainage Design and Technical Criteria Manual. WWE performed more than a dozen reviews in 2022 and 2023, many of which are still in the review process, requiring updated submittals to address comments. Applied City checklists as a part of reviews and assisted with refining checklists based on updated criteria.

City of Aurora Storm Drainage Design and Technical Criteria Manual Update. Project manager for update of City of Aurora's Storm Drainage Design and Technical Criteria Manual (Aurora Manual). Worked with representatives from multiple City departments and MHFD to identify and implement needed updates. Participated in stakeholder process to obtain input from development community. Project involved extensive input from various City departments and stakeholders.

Colorado Water Conservation Board Rainwater Harvesting Feasibility Assessment. Provided technical input on hydrologic analysis to determine potential quantities of water available for harvesting in different regions of the state. This involved continuous rainfall-runoff analysis using gridded precipitation data and layers for impervious cover. Developed spreadsheet to assess sizing of rain barrels for residential harvesting.

Colorado Department of Public Health and Environment 401 Water Quality Certification Review. Project manager assisting Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) with technical review of analysis and modeling in support of 401 Water Quality Certification for major development projects in Colorado. Current assignments relate to review of hydrology and water quality analysis from mouth of Poudre Canyon to Kersey Gauge on the South Platte River for Northern Integrated Supply Project (NISP) and evaluation of the Halligan and Monument Reservoir expansion projects. The 401 Certification for NISP was completed in early 2020.

Greenwood Village MS4. Assist Planning and Public Works departments during staff transitions to perform staff duties related to MS4 compliance during interim while new employees are being hired and trained. Work involves construction site stormwater inspections, post construction inspections, enforcing maintenance requirements, and similar tasks.

Boulder County MS4. Assist with drainage and water quality aspects of MS4 development reviews including plans for water quality and detention ponds, drainage swales, culverts and other common drainage infrastructure. Consult with other reviewers and prepare written comments for client to provide to applicants.

Westminster On Call Consulting. Assist City of Westminster staff with variety of drainage and water quality issues, including evaluation of potential detention pond retrofit projects, diagnostic work related to nuisance drainage conditions related to ponds and channels and recommendations for potential improvements, periodic review of water quality control measure plans.

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Cherry Creek and E. Iliff Avenue Stormwater Quality. Work with the Mile High Flood District (MHFD) on several aspects of stream restoration project from East Iliff Avenue to Quebec Street in Denver, Colorado. Developed and assisted with designing infiltration benches to provide treatment for roadway improvements. Technical analysis of the infiltration benches helped to form the basis for developing criteria for quantifying runoff reduction that was subsequently integrated into the MHFD's Urban Storm Drainage Criteria Manual. Project also involved application of Water Environment Research Foundation stream crediting guidance to stream restoration project to quantify suspended solids and nutrient reductions that will be realized by stabilizing a highly unstable channel.

Castle Pines MS4. Assist with review of drainage reports and plans in Castle Pines related to features including water quality and detention ponds, channels, outfalls, and other similar features. In addition to assisting with reviews, provide support for developing guidance and criteria and peer review related to MS4 inspections/reporting.

Fountain Creek Hydrology, Geomorphology, and Sediment Transport. Expert on topics related to hydrology, geomorphology, and sediment transport for Pueblo County in negotiations with Colorado Springs related to health of Fountain Creek. Assignment included field and office work to quantify water quality and flood issues for Fountain Creek and to evaluate anticipated changes due to operation of the Southern Delivery System. Provided consultation to Department of Justice and CDPHE on water quality litigation related to compliance issues with Colorado Springs stormwater program.

Southeast Metropolitan Stormwater Authority (SEMSWA) Stormwater Management Manual Update. WWE project manager for update of SEMSWA Stormwater Management Manual. WWE was responsible for chapters related to hydrology (rainfall and runoff), streets, inlets, storm drains, floodplain management, and culverts. WWE provided significant input on the water quality chapter as well.

City of Commerce City Storm Drainage Criteria Manual. Project manager for update of Commerce City Storm Drainage Design Criteria Manual. WWE prepared an update to the 20+ year-old existing criteria manual. Major topics of importance in Commerce City unique to this manual included policies for construction of outfalls and retention practices, industrial site water quality management and low impact development techniques in areas with suitable land use and soils.

Greenwood Village Storm Drainage Criteria Manual. Project manager for update of Greenwood Village Storm Drainage Criteria Manual based on latest guidance from MFHD's Urban Storm Drainage Criteria Manual. Major challenge with project was resolution of multiple overlapping regulations related to Municipal Separate Storm Sewer System (MS4) permit and Cherry Creek Reservoir Control Regulation.

Greenwood Village Small Impervious Area Detention Method. Developed tool for Village staff to use for review of small impervious area additions from approximately 500 to 10,000 square feet to quantify changes in runoff and determine potential applicability of pervious area infiltration for water quality and flood attenuation. Created spreadsheet for use by Village and local engineers, including detailed documentation and instructions.

City and County of Denver Storm Drainage Criteria Manual. Worked with City and County of Denver and MHFD for update of Denver Urban Storm Drainage Design Criteria Manual. Project focused on integrating latest MHFD criteria and developing criteria for small sites (< 1 acre) that require runoff reduction to the extent practicable.

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City of Durango Stormwater Master Plan. Project manager for first phase of Master Plan, which involved creating an updated Storm Drainage Design Criteria Manual for the City. Criteria Manual integrated runoff reduction practices for small sites and updated hydrologic, water quality, and detention criteria. The second phase of the Master Plan is developing watershed hydrology based on the criteria in the Manual. This phase is being led by WWE's Durango office with Dr. Earles as the Principal-in-charge.

MHFD 2011–2015 Update of Volumes 1 and 2 Denver Urban Storm Drainage Criteria Manual (USDCM). Project manager for ongoing update of Volumes 1 and 2 of the MHFD's Urban Storm Drainage Criteria Manual, which addresses fundamentals of drainage, minor and major drainage system design considerations, and criteria and other topics related to the management of the quantity and quality of urban runoff. Volumes 1 and 2 were last updated by WWE in 2001, at which time, served as the primary author of the major drainage chapter.

MHFD 2015 Climate Change White Paper. Project manager and lead author for development of white paper on Planning for Variability & Uncertainty: Climate Change and the Urban Drainage System. Reviewed and synthesized existing climate projections for Front Range and assessed potential vulnerabilities of urban drainage system. Identified policies and criteria that promote resilience and adaptive management practices used by MHFD. Presented findings at MHFD 2015 Annual Conference. Peer review by retired MHFD program managers, State Climatologist, and a University of Colorado climate researcher.

A September to Remember: The 2013 Colorado Flood within the Urban Drainage and Flood Control District. Project manager for creation of “coffee table” book on performance of urban drainage infrastructures during the September 2013 Colorado floods. Primary author of chapter on Boulder flooding, and reviewer/contributor to all chapters.

Boulder Civic Area Ideas Competition and Consulting. Participated as invited juror in Civic Area Ideas Competition, an internet-based planning exercise soliciting broad range of input from planners and engineers. Following competition, performed follow up work for the City of Boulder to evaluate floodplain, water quality, and riparian area constraints and to identify guiding principles.

City of Colorado Springs Stormwater Management Assessment. Worked as consultant to the City of Colorado Springs for its 2009–2012 stormwater management assessment. Provided expertise on volume reduction methods, hydrology, hydraulics, floodplain preservation, and other topics aimed at improving the management of stormwater quantity and quality in Colorado Springs. As a part of this project, performed a detailed review of many criteria manuals, including the Arapahoe County and City of Centennial stormwater management manuals.

Woodland Park Drainage Criteria Manual. Worked with City Engineer and Director of Public Works to adapt stormwater criteria developed as a part of the Colorado Springs Stormwater Management Assessment to smaller town/mountainous setting. Project involved geomorphic assessment of selected streams in Woodland Park working with Colorado State University.

MHFD 2010 Update of Volume 3 Urban Storm Drainage Criteria Manual. Served as project manager for update of Volume 3 of the Urban Storm Drainage Criteria Manual, which addresses water quality. Updates to Volume 3 in 2010 included expanded guidance on volume reduction practices, refinement of stormwater best management practice (BMP) design criteria, guidance on BMP selection for linear projects and transport-oriented developments, and guidance on quantifying benefits of disconnected impervious area.

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MHFD Temporary Diversion Criteria. Worked with MHFD to developing revised temporary diversion criteria for small projects. The previous criterion in the manual is for a two-year diversion period for small projects that may last only days or a couple of weeks. The temporary diversion criteria developed considered seasonality, anticipated base flows, project duration, risk of exceeding capacity, and other factors.

Aspen Urban Runoff Management Plan and Ongoing Services. Project manager for WWE tasks in 2008–2010 development of Aspen Urban Runoff Management Plan (URMP), updating drainage and water quality criteria for the City of Aspen. Lead author of Water Quality and Mudflow chapters and significant contributor as reviewer and editor for chapters related to hydrology. Following completion of the URMP, the City of Aspen established an on-call contract with WWE. Tasks under the on-call contract have included:

- Consultation on drainage and water quality criteria and specifications
- Research on alternative bioretention media mixtures
- Evaluation of National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data versus existing City criteria—due to additional period of record and new data/analysis, the city adopted the new NOAA Atlas 14 data
- Update of urban core master drainage plan to evaluate refined hydrology and improvements implemented by the city

The on-call services include working closely with Aspen's Stormwater manager and staff when questions related to storm drainage criteria arise or when they require general engineering support for urban water resources issues. WWE has been providing these services since 2009.

Iowa Stormwater Management Training. Project manager for development of full-day stormwater training seminar on low impact development (LID) and green infrastructure (GI) for Iowa Economic Development Authority from 2012–2013. Worked with landscape architects and planners to develop, advertise, and deliver training presentations across Iowa.

Colorado State University Stormwater Center GI Training. Assisted with development and presentation of two-day seminar on GI and stormwater management in 2014. Co-taught class with Dr. Chris Olson, Director of Stormwater Center.

Credit Valley Conservation (CVC) LID Monitoring and Analysis. Provided consulting on stormwater monitoring for LID demonstration sites in Credit River Watershed in Ontario, Canada. Assisted with hydrologic data analysis and provided recommendations on monitoring and data analysis. Worked as team with Geosyntec Consultants who were lead consultants for water quality data analysis. Participated in and presented at field tours, workshops, and conferences in 2013 and 2014.

International Stormwater BMP Database. Served as project adviser and technical resource on water quality and quantity analysis for nation's most comprehensive stormwater performance database. Work on BMP Database since 1999 has included development of stormwater monitoring manual, evaluation of data, and development/review of reports/guidance.

Arapahoe County Water and Wastewater Authority (ACWWA) Phase III Drainage Report Reviews. Managed Phase III Drainage Report reviews performed by WWE on behalf of ACWWA. WWE reviews plans for consistency with drainage and water quality master plans for ACWWA service area. Oversaw project engineer and provided peer review.

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Jensen Precast Research and Development. Research and development of vault-type stormwater BMP for sediment removal in 1998. Development involved extensive hydraulic testing at the Colorado State University Hydraulics Lab and detailed data analysis. Patent application filed in January 2000 and granted in March 2002. Field tested the BMP in Virginia and California in accordance with monitoring protocols for certification of proprietary devices.

Hydrology and Hydraulics

Dolores River 2023 River Forecasting. Participated in discussions with Mesa County and Colorado Basin River Forecast Center related to peak flows from 2023 runoff and releases from McPhee Reservoir at Gateway, Colorado. Used upstream and downstream gages and forecasts to estimate forecast peak flows at Gateway, downstream of West Creek. Compared modeled water surface elevations of forecast flows with observations in the field to verify model. Communication with owners of Gateway Canyons Resort with routine forecasts throughout peak runoff.

Meadowbrook Heights Letter of Map Revision (LOMR). Project manager for LOMR to revise floodplain along tributary to Massey Draw due to new development. This was a complex LOMR due to split flow and a supercritical channel. This required non-standard analysis that WWE explained to MHFD and the LORM reviewers. After working through several Additional Data requests, the LOMR was approved in the winter of 2023.

Cottonwood Creek LOMR. Project manager for large-scale LOMR for Cottonwood Creek from the headwaters in Douglas County to the Cherry Creek State Park boundary, affecting several mile of stream in an urbanized area. WWE developed and refined HEC-RAS models, using a recent MHFD Flood Hazard Area Delineation as the starting point for modeling. WWE responded to several Additional Data requests, and the LOMR was finally approved in the winter of 2023.

Orchard Farms LOMR. Project manager for LOMR for development along Big Dry Creek in Thornton and Adams County, Colorado. LOMR was approved in the winter of 2023.

Clear Creek Canyon Hydrology Conditional Letter of Map Revision (CLOMR). Building on CLOMR for Clear Creek from Golden to the South Platte River, this hydrology CLOMR extended analysis up Clear Creek Canyon from Golden to Idaho Springs. WWE used stream gage data and USGS StreamStats to develop hydrologic profiles for events from the 2- to 500-year event for this reach of Clear Creek. This analysis helped to support elevations selected for pedestrian bridges being installed as part of a trails project.

Eaton Draw CLOMR. Worked with Xcel Energy project team for floodplain permitting of transmission line project in Weld County, Colorado. Developed application materials for local floodplain permits for several towers in flood fringe and developed and submitted CLOMR for towers in and near floodway through the Town of Eaton. This project, which has only minor effects on base flood elevations, provides a much needed update to floodplain mapping for Eaton Draw, which dates back to the 1970's and is poorly documented.

Green Valley Ranch East Tributary T Channel Design. Project manager for design of high-functioning, low-maintenance stream restoration project for Tributary T in Aurora, Colorado. WWE performed geomorphic, hydrologic and hydraulic analysis to establish the channel design criteria, and then developed conceptual, preliminary and final designs.

Buena Vista, Arizona Street Scour Analysis. Performed independent evaluation of potential for scour and sizing of countermeasures for pedestrian bridge proposed near Arizona Street and Marquette Avenue in Buena Vista. Independent review was requested by design engineer to resolve dispute with regulatory review agency. The updated analysis prepared by WWE was accepted by all involved parties.

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Sterling Hills Detention and Water Quality Pond Rehabilitation. Project manager for water quality and detention pond rehabilitation project. Existing pond was deficiently designed and had become a nuisance and maintenance burden for residences. WWE developed a design for rehabilitation including a micropool, forebays and an underdrain system. These improvements are expected to improve the ability of the pond to drain between events.

Hanover South Bannock Street In-fill Development. Assisted the Hanover Company with floodplain analysis to determine applicable flood protection elevations and first floor elevations. WWE evaluated current and proposed floodplain mapping and two-dimensional modeling results.

Gavilon 2019 Midwest Flooding Evaluation. Reviewed stream gage data and aerial photographs to determine approximate timing of flooding at Gavilon properties across the Midwest. WWE evaluated ten properties from Wisconsin to Oklahoma and prepared a report and appendices documenting flood hydrographs and aerial photography.

South Platte River Hydrology Conditional Letter of Map Revision (CLOMR). Hydrologic analysis of South Platte River from Chatfield Dam to Fort Lupton on behalf of the MHFD. Evaluated stream gauges on South Platte River and major tributaries based on post-Tri-Lakes data to determine flow frequency relationships based on statistical analysis. Developed peak discharge profiles based on gauge analysis and master plan data to define new proposed regulatory hydrology. Submitted CLOMR with detailed hydrologic analyses, including unsteady hydraulic modeling of floodplain attenuation, to Federal Emergency Management Agency (FEMA) for review and approval. CLOMR covered over a dozen National Flood Insurance Program (NFIP) jurisdictions along the river.

Bulletin 17C Beta Testing. Performed testing of beta version of Bulletin 17C flow frequency analysis methods. WWE performed analyses of several test data sets provided by the contractor developing Bulletin 17C flow frequency methods and performed comparisons of results between Bulletin 17B (previously accepted method) and Bulletin 17C (updated flow frequency methods).

Clear Creek Hydrology CLOMR. Hydrologic analysis of Clear Creek hydrology from Golden to the confluence with the South Platte River. Prepared and submitted CLOMR request that was approved by FEMA based on statistical analysis of stream gauges. The CLOMR hydrology will become the effective hydrology when the MHFD updates the hydraulic analysis and mapping of the floodplain and floodway based on the new hydrology.

Estes Park Hydrology. Developed regulatory hydrology for the Upper Big Thompson River, Fall River, Black Canyon Creek, and Dry Gulch in Estes Park, Colorado. Project included modeling of 2013 flood event, stream gauge analysis, evaluation of rainfall-runoff versus snowmelt-runoff hydrology, and different return periods. Work included statistical analysis of flood frequency. Project included extensive public process that culminated with the Colorado Water Conservation Board accepting the updated hydrology as the basis for a subsequent hydraulic study to define the floodplain and floodways for these waterways.

September 2013 City of Boulder Flood Rainfall-Runoff Analysis. Worked for City of Boulder and MHFD following the September 2013 Flood to analyze rainfall and runoff return intervals from the large flood event. Analyzed rainfall data across watersheds draining through the City of Boulder and assessed rainfall return periods for varying durations within the storm. This work was coupled with estimation of peak runoff rates where data were available and reconciliation of rainfall and runoff return periods. WWE prepared a report that was presented to the City Council and reviewed by the State Climatologist.

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Surfside Club Missouri River Floodplain Permitting. Project manager for retroactive floodplain permitting and No-rise Certification for Surfside Club flood repairs on the Missouri River in Omaha, Nebraska. Supervised analysis of changes that had been made to the Surfside Club property within the floodplain and floodway following flooding in 2011. Analysis included developing a HEC-RAS hydraulic model from a 1975 paper copy of a HEC-2 hydraulic model and assessing the potential effects to the base flood and floodway water surface profiles that may have resulted from the changes made to the property. Ultimately, the analysis indicated the changes made to the property did not cause a rise in the base flood or floodway water surface profiles on the river. Based on this work, the City of Omaha and the Natural Resources District approved a retroactive floodplain development permit addressing the post-flood improvements and The Surfside Club is now able to proceed with business as normal.

Green Gables CLOMR/LOMR and Environmental Permitting. Project manager for water-related permitting for redevelopment of Green Gables Golf Course in the southwestern Metro area (unincorporated Jefferson County). Worked with site civil engineer to provide advice on channel design and led effort for CLOMR. Project also included Section 404 individual permit and mitigation plan. WWE completed LOMR following project construction and is monitoring establishment of wetlands for compliance with the Section 404 permit.

MHFD NOAA Atlas 14 Consulting. Performed statistical analysis to compare NOAA Atlas 14 mapping (released in 2013) with MHFD hourly point precipitation values. Comparisons showed that NOAA Atlas 14 values were lower than current values used by MHFD for some durations. Statistical analysis showed that new published values did not differ from previously used values at a statistically significant level, and therefore, MHFD made a policy decision to continue to use existing values.

Silverthorne Floodplain Permitting and Analysis. Worked with Town of Silverthorne on floodplain delineation and permitting since mid-2000s. Projects have included CLOMRs, LOMRs, and CLOMR/LOMR-F for private developments and modeling for trail construction and mapping updates for Town. Completed existing conditions LOMR for Blue River in 2013 to update mapping based on improved topographic information.

Schwartzwalder Mine Temporary Diversion & Permitting. Project manager for planning, permitting, and construction of temporary diversion for Ralston Creek to reduce uranium concentrations in stream and to allow for clean-up of mine. Developed hydrology and hydraulics for 4,000-foot pipeline and diversion structure. Permitting involved agencies including CDPHE, Division of Reclamation Mining and Safety, U.S. Army Corps of Engineers (USACE) (404), U.S. Fish & Wildlife Service (Preble's Meadow Jumping Mouse), FEMA, and Jefferson County. Project was initiated in 2010 and temporary diversion pipeline was completed in 2012.

Sioux Falls Greenway Floodplain Analysis. Performed hydraulic analysis to evaluate floodplain/floodway effects of proposed greenway improvements for Big Sioux River in Sioux Falls, South Dakota. Project was challenging due to existing flood prone structures, floodway defined from bank-to-bank, and desire to implement improvements to allow better access to the river. Prepared, submitted and obtained CLOMR for project, 2006–2012.

Amazon Flume. Peer reviewer and adviser on design of replacement flume and waste way on Sand Creek in Kansas. Provided review of hydrologic and hydraulic computations and assisted with stormwater management strategy during construction.

Angler Mountain Ranch CLOMR. Performed modeling analysis for proposed bridge across the Blue River in Silverthorne, Colorado for Angler Mountain Ranch development. Involved revision of 100-year floodplain and floodway. CLOMR issued in May 2007.

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Gateway Canyons Floodplain/Floodway. Performed modeling and analysis for floodplain/floodway revisions (CLOMR) for West Creek, John Brown Creek, and the Dolores River. Coordination with Mesa County and participation in public meetings. CLOMR completed in 2008.

Invesco Field LOMR. Performed hydraulic calculations and modeling, assembled LOMR request materials, and responded to review comments for LOMR for Invesco Field on behalf of HNTB Corporation. LOMR granted by FEMA at end of 2005.

Ames Power Plant Federal Energy Regulatory Commission (FERC) Recertification. Project team member for 2005–2006 FERC recertification of the historic Ames hydropower plant near Telluride, Colorado. Evaluated pipeline from Trout Lake to powerhouse from standpoint of hydraulics, pressure, and head.

Kai Makani CLOMR-F/LOMR-F. Prepared forms and elevation certifications for CLOMR-F/LOMR-F for Kai Makani development in Maui, Hawaii. Interacted with FEMA's prime contractor, Michael Baker, Jr., effectively to address requests for additional information.

Water Quality Permitting and Stormwater Management Plans

Villa Lobos Grading Erosion and Sediment Control (GESC) Plan. Worked with contractor to prepare GESC and stormwater management plan (SWMP) for Century Link project in Douglas County, Colorado.

Colorado Stream Quantification Tool (CSQT). Work on project team assembled by MHFD to review and provide comments on the beta version of CSQT developed by the USACE and Environmental Protection Agency (EPA) for wetlands permitting of projects involving work in streams in Colorado. Served as lead expert on issues related to hydrology and provided peer review and technical input for work on hydraulics and geomorphology.

Colorado Department of Transportation (CDOT) Transportation Erosion Control Supervisor (TECS) Classes. Project manager for development and delivery of stormwater training courses for work on transportation projects. Led development of two full-day courses on expectations for TECS, including classroom material on SWMP/permitting, and field training exercises at the CDOT BMP Facility. Team provided training for more than 1,000 stormwater professionals in first year of training.

Colorado Stormwater Council (CSC) Regulation 85 Pollutant Load Analysis. Developed hydrologic approach for estimating nutrient loads in stormwater runoff on annual basis for Colorado MS4 community in response to a requirement of Regulation 85. Project involved inventory of available nutrient data, statistical analysis, and creation of load estimation spreadsheet. Report was approved by Water Quality Control Division (WQCD) and has assisted CSC members in fulfilling permit obligations and better characterizing nutrient loads to MS4s.

MHFD Wetlands and Waters of the US White Paper. Project manager and contributing author and reviewer for technical paper on potential implications of proposed changes in regulatory definitions of "wetlands" and "waters of the US." Project lead to additional site-specific assessments for selected areas in Douglas County, Colorado's MS4 and preparation of a technical memorandum that was used by Douglas County in preparation of comments for EPA Rulemaking.

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Denver International Airport (DEN) Wetlands Permitting. WWE project manager for on call environmental services related to wetland permitting. WWE prepared multiple nationwide permit applications for small projects over the six years that we worked on this project. We also assisted with strategic planning for future projects, and worked with DEN and the Corps of Engineers to develop an approach that will allow for continued use of nationwide permits for projects with independent utility. Assisted DEN with developing environmental management system work instruction for wetland differentiation and permitting.

Aqueous Film Forming Foam (AFFF) Release and Mitigation. Worked with airline at Denver International Airport that inadvertently released AFFF, containing per- and polyfluorinated substances (PFAS). WWE collected samples immediately following the release and assisted with regulatory reporting. WWE provided sampling and advisory services during cleanup, and we continue to work with this airline for sampling to disposed of water containing AFFF that is collected in a lined pond when the fire fighting system deploys AFFF in the hangar.

EPA National Stormwater Calculator (SWC). Reviewer and beta tester of pre-release version of National SWC. Provided comments to EPA via peer review contractor on technical methods and interface. The SWC is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the U.S. (including Puerto Rico). Estimates are based on local soil conditions, land cover, and historic rainfall records.

City and County of Denver *E. coli* Evaluation. Technical lead on issues related to hydrology and modeling for assessment of *E. coli* loading and control measures. Assisted with peer review of spreadsheet-based prioritization methodology for multiple pollutants in major basins in Denver and provided technical support for analysis in the Park Hill basin.

Clear Lake Turbidity Monitoring. Assisted client working on dam replacement project with stormwater and construction dewatering permitting and compliance. As a condition of the Colorado Town of Georgetown Watershed Permit, turbidity monitoring stations were installed along South Clear Creek. Assisted with monitoring plan design, site selection/implementation, troubleshooting, data analysis, and regulatory interactions with Town.

Ski Industry Stormwater Permitting. Assisted clients in Colorado high country with stormwater permitting for ski areas, including on-mountain construction activities and base area development since 1999. Assisted owners and contractors with SWMP preparation, inspections/audits, sampling and monitoring and related tasks. Work has included collection and analysis of biological and water quality data for streams and discharges from construction activities. SWMP, permitting and sampling/monitoring at resorts including Copper Mountain, Winter Park Resort, Aspen-Snowmass, Keystone Resort, Breckenridge Ski Resort, Wolf Creek Ski Area, Durango Mountain Resort, and Steamboat Ski Resort.

Oil and Gas Field-wide Stormwater & Environmental Permitting. Worked with major oil and gas companies on Front Range and Western Slope of Colorado on construction and post-construction stormwater permitting from early 2000s to present. Assisted clients with development of "Umbrella SWMP" approach to simplify permitting and documentation. Assisted with regulatory inspections and responses to Notices of Violation. Work has involved environmental permitting including MS4 permitting, construction dewatering discharge permitting, hydrostatic testing, and others, in addition to stormwater permitting.

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SWMPs/GESCs in MS4 Jurisdictions. Developed multiple SWMPs/GESC manuals in MS4 jurisdictions including City and County of Denver, City of Aurora, City of Arvada, City of Thornton, Town of Parker, Castle Rock/Douglas County, City of Boulder/Boulder County, Jefferson County, and others. In 2010, oversaw preparation of SWMP/GESC plans for more than 100 permitted utility construction projects in the City of Aurora and the City and County of Denver through development of a streamlined permit submittal and review process that has simplified review by MS4s.

City of Arvada SWMP Reviews & MS4 Consulting. Reviewed SWMPs to support City of Arvada, a Colorado MS4 with a large workload of submittals. Completed reviews for proposed development projects and provided comments on SWMPs. Work also included audit of MS4 construction programs and assistance with revisions to stormwater and erosion/sediment control details and specifications.

Denver Linear SWMP. Worked with City and County of Denver, Denver Water, and Xcel Energy to develop a streamlined SWMP for wet and dry linear construction activities. This plan provides an “umbrella” SWMP for wet and dry utility construction activities. The SWMP includes “typicals” and details that illustrate combinations of BMPs that are typically used for specific types of construction activities. The linear SWMP also includes Standard Operating Procedures and BMP installation details. For individual sites that are permanent under the linear SWMP, a streamlined submittal has been developed, which provides site details but refers to the “umbrella” SWMP for many SWMP requirements that apply to a broad range of construction activities.

MHFD Working in Waterways SWMP. Worked with MHFD to develop streamlined stormwater permitting for maintenance activities and small projects in waterways. MHFD conducts numerous maintenance and construction activities along waterways that are much smaller than one acre. Under many MS4 regulations, these activities require a stormwater permit, despite their small size, because they are adjacent to waterways. WWE used a similar approach to the Denver Linear SWMP, above, developing typical details for construction practices frequently used in waterways. WWE and MHFD worked with the City and County of Denver to develop a streamlined permitting project that results in a permitting turnaround time of less than a week for most projects along waterways. This approach has the potential for broad applications throughout MHFD’s jurisdiction.

Western U.S. Construction Site Stormwater Audits. Worked for major national developer to conduct audits of construction sites in more than a dozen western states including California, Texas, and Hawaii. Site audits were unannounced and conducted in accordance with established protocol. Site auditors reported results to corporate national stormwater manager as a part of stormwater compliance program.

Lennar Environmental Management System and Training. Worked with Lennar Chief Counsel and National Stormwater Program Director to assist with development of the Lennar Environmental Management System (LEMS), a company-initiated program to standardize construction site stormwater management documentation. Worked with Lennar environmental managers and consultants to train more than 2,000 employees across the country. On a local level, served as project manager for site inspections at several large Lennar development projects around Denver.

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Village Homes. Assisted Village Homes in complying with the terms of an administrative order from EPA and developing a company-wide stormwater compliance program. Project manager for stormwater management projects at Village Homes' construction sites throughout Colorado. Helped to develop a system to assure that SWMPs were adequate and in place, to conduct and document inspections and to train sub-contractors to comply with stormwater permit conditions. Conducted training sessions for Village Homes' staff ranging from site-superintendents to vice presidents. Assisted Village Homes with establishing the position and training of a "Water Quality Officer" who is responsible for stormwater permit compliance for Village Homes' construction sites throughout Colorado.

Lennar Spill Prevention Control and Countermeasure (SPCC) Guidance. Assisted client with development of SPCC guidance following 2009 updates to SPCC regulations. Reviewed and provided comments on guidance for use by district and regional environmental managers.

Experimental LID/GI Stormwater Monitoring and Data Analysis. Worked under a contract with the National Renewable Energy Laboratory (NREL) to monitor stormwater runoff from an experimental Wal-Mart supercenter in Aurora, Colorado. BMPs monitored included pervious asphalt and concrete, infiltration beds, and bioswales. Four-year monitoring period began in 2006. Report was updated annually with new data.

Cherry Creek Reservoir Phosphorus Credits. Negotiated nonpoint-to-point phosphorus trade credits for two water quality projects in ACWWA's service area. Quantified pollutant removal benefits of proposed ponds, addressed fate and transport of pollutants, and successfully worked with the Cherry Creek Basin Authority and the Technical Advisory Committee to earn trade credits for two nonpoint-source projects. These were the first two projects to receive trade credits in the state of Colorado.

Stormwater Master Planning

Southeast Metropolitan Stormwater Authority (SEMSWA) Southwest Tributaries Master Plan. Project manager for master plan working with SEMSWA and MHFD to update drainage and water quality planning for Cottonwood, Windmill, Lone Tree, and Dove Creeks. This master plan uses updated hydrology that WVE developed for SEMSWA based on NOAA Atlas 14 precipitation and an updated version of the Colorado Urban Hydrograph Procedure (CUHP). A unique aspect of this master plan is evaluation and incorporation of effects of disconnected impervious area at the watershed level due to long term implementation of SEMSWA's 20-10 disconnected area rule.

Silverthorne, Colorado Master Drainage Plan. Principal-in-charge of stormwater quality and drainage master plan for the Town of Silverthorne, Colorado. Work involved hydrologic and hydraulic modeling, identification of recommended improvements and a preliminary evaluation of potential funding mechanisms including a stormwater utility fee.

East Vail Stormwater Master Plan. Principal-in-charge and primary peer reviewer for master plan for East Vail. Work included hydrologic, hydraulic and water quality analyses and preparation of a user-friendly, graphically-driven report. Included evaluation of snowmelt and rainfall-runoff hydrology.

Oak Gulch Hydrologic Analysis. Expert in hydrology and stormwater modeling for innovative evaluation of undeveloped watershed that will soon be urbanized in Parker, Colorado. Worked with team of experts assembled by the MHFD to develop LID plan with distributed stormwater controls. Worked on event-based and continuous modeling of hydrology focused on changes due to hydromodification and stormwater control measures to shift the hydrologic budget back toward the pre-development state. Project has included multiple presentations to professional organizations in Colorado and around the country.

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River Mile Stormwater Management Criteria. Work with MHFD and team of engineers and scientists to develop conceptual criteria for stormwater management using GI for the redevelopment of the Elitch Gardens property in Denver. This redevelopment project involves high-density land uses adjacent to the South Platte River. WWE's work has been related to hydrologic modeling to evaluate water quality and quantity management strategies.

Big Thompson River Corridor Master Plan. Project manager of interdisciplinary team including multiple consultants tasked with developing master plan for nine miles of the Big Thompson River through Loveland and Larimer County, Colorado. Developed multi-objective plan incorporating flood resilience, river health, recreation, and other values and functions identified through extensive public outreach process.

Upper Willow Creek Tributaries Outfall Systems Plan. Subconsultant to ICON Engineering for LID hydrology for MHFD Outfall Systems Plan. Assisted with integrating new methods for evaluating low flow hydrology and infiltration-based stormwater control measures.

Town of Lyons Stormwater Master Plan. Subconsultant to ICON Engineering for developing hydrology for stormwater master plan in Lyons, Colorado. WWE developed CUHP and SWMM models for study watersheds and provided results to ICON for hydraulic modeling and development of master plan improvements.

Cave Springs Recharge Area Water Quality Protection. Worked as a part of a project team in 2014 and 2015 to develop criteria for water quality protection of karst system providing habitat to the Ozark cavefish, an endangered species. Project involves developing criteria for stream buffers/setbacks from losing streams and tiered, risk-based criteria for water quality protection for stormwater, wastewater, and underground storage. Developing criteria for filtration layer of local soils and sand for additional treatment in conventional water quality and detention basins.

City of Aurora Stormwater Program Master Plan (SWPMP). Worked as part of team with Calibre Engineering on update of City of Aurora SWPMP. Primary roles in project related to identifying water quality/MS4 gaps and development of prioritization methodology using Expert Choice decision support model to prioritize capital improvement projects.

City of Glendale and Cherry Creek. Project team member for development of conceptual plan for festival area along Cherry Creek in Glendale. Provided input on water quality criteria and floodplain permitting requirements and strategies. Performed conceptual sizing and developed concepts for management of water quality capture volume as an integrated part of site landscaping.

Park Hill Golf Course. Consultant to Clayton Early Learning, owners of Park Hill Golf Course. Evaluated potential detention storage scenarios for property for existing and potential future conditions and advised client in negotiations with City and County of Denver.

Big Dry Creek Northern Tributaries Outfall Systems Plan (OSP) Update. Project engineer for OSP update sponsored by MHFD, City and County of Broomfield, City of Thornton, City of Westminster, and Adams County. Responsible for oversight and problem solving for modeling using CUHP 2005 and EPA SWMM 5.0, development and evaluation of Alternative, public meetings, and extensive client interaction.

Winter Park Resort Base Area Development Master Planning. Developed Drainage Master Plan and Water Quality Protection Plan for 160 +/- acre development of Winter Park Resort Base area addressing conveyance, water quality, and floodplain issues. Participant in Fraser River restoration master planning by integrating drainage and water quality plans with river restoration plans.

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Durango Mountain Resort Expansion. Provided drainage and water quality master planning. Performed HydroCAD modeling of existing and proposed hydrology and hydraulics for 600-acre development proposal.

Wildfire Hydrology and Debris Flows

CWCB Watershed Health. Project manager and debris flow expert for project to develop Wildfire Ready Watershed guidance for communities in Colorado. Work included developing a method to assess statewide debris flow risk using USGS statistical models and data layers related to topography, soils, and fire intensity (surrogate for soil burn severity). This method was applied to predict potential post-fire debris flow hazards prior to a fire. WWE also assisted with developing fact sheets related to post-fire water quality hazards, debris flow hazards, risks to water supply infrastructure.

Confidential New Mexico Fire Assignment. Currently working on post-fire hazard and risk assessments in New Mexico.

Marshall Fire. Assisted Boulder County following December 2021/January 2022 Marshall Fire, an urban fire that was the most destructive wildfire in Colorado History at the time it occurred. Performed field assessments of burned areas and streams and provided recommendations for control measures to stabilize areas and control pollutants from burned areas. Coordination with affected local governments and the Mile High Flood District. WWE also organized and hosted a short course in Boulder County related to post-fire hazards and control measures through the International Erosion Control Association during the recovery period following the fire.

Oregon 2020 Wildfires. Performed hazard and risk assessments for six wildfires totaling over 500,000 acres in Oregon in fall of 2020 and winter of 2021. Visited burn scar areas and identified hazards and values at risk to assess potential risks of damages.

Southern California Wildfires, 2017 - 2022. Work on hydrology and debris flow risk assessments following a number of major wildfires in Southern California from 2017 through 2022. Work included post-fire watershed assessments and projections of increases in runoff and sediment transport. Identified values at risk and assessed hazards. Analyzed data related to rainfall, soil characteristics, vegetation, and other aspects of post-fire hydrologic risks. Conducted modeling to identify and quantify hazards. Worked with multi-disciplinary team on assessments.

Pitkin and Garfield County Mudflow Assessments. Peer reviewer for staff in Glenwood Springs office for multiple projects related to proposed developments on or near alluvial fans and other flood hazard areas. Discuss approach with project manager and assist with interpretation of results and recommendations.

Vail Golden Peak Mudflow Evaluation. Project manager for mudflow evaluation of proposed Golden Peak mogul course. WWE teamed with CTL Thompson to perform this evaluation, and WWE handled aspects related to hydrology. WWE performed a field assessment and calculations and prepared a report in conjunction with CTL Thompson.

Pitkin County Proactive Fire Hydrology Assessment. Lead engineer for hydrology and mudflow analysis for seven test watersheds in Pitkin County, Colorado to proactively identify post-fire risk before a fire actually occurs. First phase of project included developing hydrology, hydraulics, and bulking factors for selected watershed with development at the urban-wildland interface. Future phases will focus of expanding analysis to other parts of the county and identifying potential mitigation measures.

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Aspen Mud and Debris Flow Study. Project manager for assignment to perform FLO-2D modeling to characterize mudflow and mudflood risk for the City of Aspen. Led team of geologists, environmental scientists, and engineers to perform field work and model analysis. Study area included Aspen Mountain and the commercial core of the City.

Waldo Canyon Post-Fire Hydrology and Mitigation. Peer reviewer for post-fire hydrology work following Waldo Canyon fire near Colorado Springs. Hydrologic assessment helped to support restoration and mitigation efforts.

Fourmile Wildfire Hydrologic and Debris Flow Risk Assessment. Performed wildfire assessment of flooding and debris flow risk following 2010 Fourmile Canyon fire in Boulder County, Colorado. Led consultant's team responsible for developing projections of debris flow potential for a range of storm events anticipated for the summer of 2010. Provided decision makers with risk-based projections and participated in public meetings to emphasize damage potential from runoff events in the burned area. This project involved coordination with multiple agencies including U.S. Geological Survey, U.S. Forest Service, MHFD, and others.

Los Alamos National Laboratory Post-Cerro Grande Wildfire Investigation. Performed field investigations and hydrologic and hydraulic modeling to assess risks of flooding damage to nuclear facilities and other infrastructure and sediment/actinide transport. Large-scale application of HEC-Geo-RAS. Worked as a member of a research team including scientists from the laboratory and researchers from the U.S. Department of Agriculture (USDA) Agricultural Research Service. Research has led to several publications including peer-reviewed paper in *Journal of American Water Resources Association*.

Missionary Ridge Wildfire Assessment of Risk and Protection of Lemon Dam, Durango, Colorado. Worked with Florida Water Conservancy District to assess risk and identify protective measures for the Lemon Dam spillway following the Missionary Ridge Wildfire. Recommended structural and watershed-based measures to minimize potential for damage to the spillway from debris flow events following the wildfire and assisted with preparation of grant applications for implementation funding. Mitigation measures proved extremely effective, preventing damage to the spillway, even during an event with 1-hour rainfall intensities in excess of 100-year event. The project received a nonpoint source excellence award from the State of Colorado.

Santa Susana Wildfire Recovery Assessment, Ventura County, California. Worked as a part of Geosyntec's consulting team for assessment of recovery of burned areas on Santa Susana Field Laboratory site following the Topanga Wildfire. Served in project management and peer review roles for data and reports related to assessment of hydrophobicity, infiltration testing, monitoring of vegetative success, and other metrics of wildfire recovery. Work was conducted as a sub-consultant for Geosyntec, consultant to Boeing.

Jones Gulch Debris Flow Potential Assessment, Keystone, Colorado. Performed debris flow potential assessment and conceptual mitigation design for protection of development proposed along Jones Gulch in Keystone, Colorado. Worked with the Colorado Geological Survey and Summit County to determine applicable debris flow criteria and design parameters. Assessment included evaluation of burned watershed scenario due to susceptibility of forest to wildfire in wake of pine beetle infestation.

Groundwater

Construction Dewatering Projects. Ongoing project work since 1999 for various clients addressing permitting of construction dewatering discharges throughout Colorado in settings ranging from urban to mountain. Work has involved calculation of anticipated pumping rates to draw groundwater down in alluvial aquifer for construction below the water table. Worked with contractors to plan and implement advanced treatment methods, including innovative treatment methods utilizing a combination of chemical treatment and BMPs to remove colloidal clays from groundwater with low alkalinity and low temperatures. Representative clients have included resort developers, general contractors, oil and gas, and linear utilities.

Dewatering permitting experience includes construction dewatering, subterranean discharges (permanent systems, former MINDI), hydrostatic testing, coverage under general stormwater permit for construction, sampling, treatment design, corrective actions, and regulatory communication/correspondence to address exceedances.

Experimental Superstore Monitoring. Evaluated infiltration of stormwater to groundwater table for LID application using bioswales, permeable pavements and other technologies to infiltrate stormwater. Monitored groundwater mounding and groundwater quality in conjunction with surface water hydrology and observed no detectible water quality effects on groundwater over the duration of the study.

West Frisco Gateway Subterranean Dewatering Permitting. Project manager for construction dewatering and subterranean dewatering project in Frisco, Colorado. Work included sampling, reporting, and advice on transition from construction to operational phases over a period of several years.

Pueblo Judicial Building. Assisted with 2014 feasibility analysis of flood proofing and dewatering systems for subterranean portion of planned judicial building adjacent to floodplain.

Expert Witness Assignments

Larson Low Head Dam Drowning. Expert for family of woman who drowned in reverse roller at the Wilmington Dam on the Kankakee river in Wilmington, Illinois. Conducted a field visit, reviewed documents, and performed calculations to assess hazards to boaters approaching dam from upstream direction. Evaluated effectiveness of signage and warnings. Deposed in March 2023.

East Oahu Flooding. Expert on hydrology, hydraulics, and flooding for case related to 2018 flood in East Oahu, Hawaii. Conducted field work, review of documents, and modeling to analyze causes of flooding. Prepared several expert reports to address different areas of flooding. Assisted with settlement negotiations. Provided deposition in July 2022.

Lower Missouri River Flooding Litigation. Expert on hydrology, hydraulics, and flood risk management for the U.S. Department of Justice in case related to allegations of increased flooding of bottom-land farms along the river due to changes in upstream reservoir operation and habitat improvements in river required under the Endangered Species Act. Prepared expert report to rebut plaintiffs' expert, focusing on flow frequency analysis and assessment of historical flooding. Deposition in June 2020 and trial testimony in July 2020.

Louisville, Kentucky Storm Drain Drowning. Expert for plaintiff in drowning of 15-year-old boy who drowned after being swept into a storm drain opening lacking a safety grate. Prepared expert report based on review of information from discovery, site visit, and hydraulic analysis of forces. Deposition in July 2020.

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Missouri Industrial Facilities Clean Water Act Enforcement. Expert for the U.S. Department of Justice in Clean Water Act Enforcement action at two industrial facilities in Missouri. WWE participated in a site visit and provided input on the consent decree and settlement negotiations. Settlement of this case is pending.

Texas Flooding. Expert witness for the U.S. Department of Justice in case related to major flooding in Texas in 2017. Served as rebuttal witness and prepared expert report related to hydrology and flood risk analysis.

Meadowvale Dairy, Rock Valley, Iowa. Prepared an expert report for a litigation matter on behalf of the U.S. Department of Justice evaluating the effects of pollutant releases from a concentrated animal feeding operation. Assignment included evaluation of waters of the U.S. status for the receiving water, an unnamed tributary to the Big Sioux River.

Nashua, New Hampshire Combined Sewer Drowning. Expert witness for plaintiff in case where teenager fell into open hatch to siphon chamber and drowned. The hatch was in poor repair and had become dislodged due to hydrostatic and pneumatic forces. Prepared draft expert report prior to settlement of case.

Bellevue, Nebraska Storm Drain Drowning. Retained as expert to represent plaintiff in storm drain drowning during flood. Entrance to a more than 1,000-foot-long storm drain was unprotected by safety grate, and hazard was hidden by high water, so that entrance was not even visible. Victim fell into channel and was sucked into the storm drain where he drowned. Case settled before preparation of expert report.

Waimanalo Gulch Landfill Flooding. Expert witness on hydrology, hydraulics, and water quality related to case where landfill on Oahu was sued due to flooding that occurred during expansion of the landfill, washing landfill waste into the Pacific Ocean. Analysis included evaluation of plans for interim water management during the expansion project, characterization of storm frequency, and evaluation of how landfill employees responded to the flood event.

Buttermilk Ski Area, Landslide, Aspen, Colorado. Expert witness on hydrology and debris flow that originated on Buttermilk Ski Area. Evaluated hydrology and identified likely causes of debris flow. Prepared expert report and provided deposition in 2014. Expert for Aspen Skiing Company (defendant).

Assessment of Likely Causes of Damages from 2013 Alberta Flood in the Roxboro Neighborhood, Calgary. Performed initial assessment of likely causes of flooding in Roxboro neighborhood of Calgary during 2013 Alberta floods. Performed desktop review of floodplain mapping, peak flow rates, potential obstructions, building codes, and other factors related to residential flood losses.

La Quinta 2014 Flood Assessment. Evaluation of likely causes of flooding from large (>100-year) rainfall event in La Quinta, California in September 2014. Flooding caused extensive damages to golf courses throughout the area, and WWE assessed rainfall and runoff from the event, local retention and infiltration-based criteria, and potential for mud and debris flows.

Cheyenne Creek Flood Assessment, Colorado Springs. Expert witness for plaintiff (upstream property owner) in flooding that resulted from September 2013 Colorado flood. Performed site visit and modeling analysis to evaluate effects of culvert/road crossing capacity and pedestrian bridge on flood elevations.

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Trailhead Development, Boulder. Expert witness representing engineering firm in flood claim related to September 2013 flood in Boulder, Colorado. Reviewed reports and analyzed rainfall, runoff, and temporary and permanent stormwater control measures. Prepared expert report and advised client on responses to opposing experts' reports.

Annie Mitchell Drainage Lawsuit. Expert witness for defendants in drainage lawsuit related to flooding of Aspen Airport Business Center in Colorado. Evaluated hydrology and drainage system constructed for Annie Mitchell affordable housing development. Prepared expert report on causes of flooding and effectiveness of drainage system constructed for Annie Mitchell.

Routt County Erosion Assessment. Expert witness on hydrology, NPDES permitting, erosion, and sediment control in dispute in Routt County, Colorado involving fence line installed without adequate permitting across a mapped landslide area on a steep slope (2011–2013). WWE evaluated effects on the downgradient property owner and recommended mitigation measures. Prepared an expert report and was deposed in this case before it settled.

Pitkin County Mud and Debris Flow. Peer reviewer and advisor for project related to development on alluvial fan in Pitkin County, Colorado. Evaluated debris flow risk and mitigation measures to protect existing development on alluvial fan. Prepared multiple expert letter reports and testified in multiple Board of County Commissioner meetings from 2010–2018.

Columbus Regional Hospital Flooding. Expert witness on hydrology and hydraulics related to 2008 flooding of Columbus Regional Hospital in Columbus, Indiana. Conducted field visit and prepared expert report addressing effects of channel maintenance practices on flooding, including effects of overgrown vegetation, aggradation, fencing, and debris.

Independence, Kansas Flooding. Retained as expert by attorneys for defendant in Sanborn, et al. v. City of Independence, Kansas to investigate flooding and levee operation and maintenance.

Level 3 Communications Hydrologic Budget. Performed analysis to evaluate hydrologic budget for Level 3 Campus at Interlocken business park on behalf of Kiewit Construction Company.

Mandeville Drainage Evaluation. Performed modeling to evaluate the effects of modified drainage for property owner in Mandeville, Louisiana. Analysis included storm sewer modeling with tidally influenced outfall. Gave depositions in May and July 2004.

Judge Field, Salt Lake City, Utah. Expert witness for hydrology in retaining wall failure case. Worked closely with geotechnical expert. Prepared expert report and participated in mediation that led to settlement.

Big Time Burger vs. CMC. Expert for construction defect case related to surface and sub-surface water management. Performed site visit and analyzed hydrology. Prepared expert report and provided deposition. Trial testimony in Denver District Court.

Colorado Oil and Gas Conservation Commission Stormwater Testimony. Provided testimony on behalf of industry in 2006 hearings on development/update of stormwater requirements for oil and gas sites (construction and post-construction). Testimony focused on practical compliance and minimization of overlapping stormwater regulations between different agencies.

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Colorado Water Quality Control (CWQCC) Rulemaking Hearing for Consideration of Revisions to Regulation 5 CCR 1002-72. Prepared written and verbal testimony related to proposed changes to the Cherry Creek Water Quality Control Regulation. Testimony provided overview of ACWWA Lone Tree Creek Pond L-3 Phosphorus Trade Credit project. Verbal testimony before CWQCC on September 15, 2004.

Research and Preparation for Expert Testimony for Low-Head Dam Drowning Incidents in New Jersey, Oregon, West Virginia, Ohio, and Nebraska. Performed sophisticated hydraulic analysis and evaluation of the state-of-the-practice for responsible design of hydraulic structures. New Jersey and Oregon cases settled before trial. Trials are pending in Ohio and Nebraska.

Lucerne, Colorado Flooding Expert Report Development. Prepared expert report for drainage litigation involving overflow of irrigation canal receiving stormwater runoff (plaintiff's expert). Case settled prior to deposition.

Manitou Springs, Colorado Expert Report Development. Prepared expert report related to alleged trespass due to stormwater drainage (defense's expert). Case settled.

Research and Preparation for Expert Report and Testimony for Blackhawk Lodge Casino, Colorado. Performed analysis of foundation drain and dispersion system, including groundwater modeling (defense's expert). Case settled prior to deposition.

Woodland Park, Colorado Expert Report Development. Prepared expert report related to insurance claim for flood damages along Upper Fountain Creek. Investigated channel design, hydrology, and hydraulics (defense's expert).

Stock Residence Flood Evaluation, Jefferson Parish, Louisiana. Developed expert opinions and gave affidavit on flood extent and duration for flooding in New Orleans, Louisiana (plaintiff's expert). Examine effect of channel obstructions, hydrology, and hydraulics.

Drainage-Related Expert Testimony, Scottsbluff, Nebraska. Worked on expert testimony for drainage lawsuit involving personal property damage due to flooding in Scottsbluff, Nebraska (defendant's expert). Assisted attorney in winning summary judgment in client's favor.

Water Engineering for Cultural and Archaeological Sites

Machu Picchu Paleohydrology and Water Engineering. Work with Kenneth Wright, P.E., and colleagues at WWE to study and document water engineering at Machu Picchu. Studies at Machu Picchu have included identification and documentation of the water supply source and infrastructure including stone-lined canals and sculpted fountains, evaluation of terrace engineering and stability, documentation of construction methods and unfinished construction, mapping and assessment of trails, and other related work. Building on the success of the work at Machu Picchu, WWE and the Wright Paleohydrological Institute (WPI) have evaluated additional Inca sites in the Sacred Valley including Tipon, Moray, Saqsaywaman, and, most recently, Ollantaytambo. Participated in three research trips and multiple publications related to this work since joining WWE in 1999.

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Mesa Verde Paleohydrology and Post-Fire Runoff Assessment and Management.

Performed paleohydrological research at Mesa Verde National Park with WWE, WPI, and other collaborators, working with the National Park Service to study and document four ancient water supply reservoirs and a cistern constructed by the Ancestral Puebloans through surveying, sediment stratigraphy, palynology, hydrologic and hydraulic analysis, and other methods. In addition to this paleohydrology work, WWE performed work for the National Park Service following the 2000 Bircher Wildfire, including assessment of elevated runoff potential due to the fire and recommendations for mitigation of adverse effects to archaeological sites in the burn area. Participated in research trips and publications since joining WWE in 1999.

Phnom Bakheng Drainage and Erosion Control, Angkor Archaeological Park, Cambodia.

Consultant to the World Monuments Fund (WMF) evaluating drainage and erosion issues at Phnom Bakheng, one of the earliest sites within the Angkor Archaeological Park. Phnom Bakheng is a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site. WMF is working closely with Authority for Protection and Management of Angkor and the Region of Siem Reap (APSARA) on a project to restore the temple at Phnom Bakheng, which has deteriorated over the centuries. Work has supported WMF/APSARA restoration efforts with analysis of drainage, drainage planning/engineering, and evaluation of erosion.

Wat Chaiwatthanaram, Ayutthaya, Thailand.

Consultant to WMF on flood protection issues for Wat Chaiwatthanaram, a 17th Century Buddhist Temple in Ayutthaya, Thailand, an historic city, which was the second capital of Siam and is a UNESCO World Heritage Site. WMF is working closely with the Thai Fine Arts Department (FAD) and the U.S. Embassy in Thailand on this project, which started in 2012. The site was severely flooded in 2011, when a record monsoon caused extensive flooding on the Chao Phraya River. Work has involved collaboration with the FAD to design a replacement floodwall with an improved safety factor and evaluation of internal drainage and site-wide flood protection and drainage planning. Work with WMF and a team of consultants has involved multiple site visits, meetings with Thai and US Embassy Officials, preparation of reports, and conceptual designs from 2012–present.

Nanyue Palace Water Management, Guangzhou, China.

Assisted WMF with 2011 consultation on water management issues at this 2000-year-old site in the heart of the metropolis of Guangzhou, China. The archaeological site, rediscovered near the city center in the 1970s, includes what is believed to be the earliest discovered Chinese water garden as well as palace ruins. Provided consultation on groundwater and surface water management issues on the site based on field observations, review of documents, and meetings with Chinese engineers and officials.

Shwe-nandaw Kyaung (The Golden Monastery), Mandalay, Myanmar.

Consultant to WMF on site-wide water management issues for Shwe-nandaw Kyaung, a teakwood monastery east of the palace moat in Mandalay. Performed field visit to assess site conditions and identify drainage and flooding issues. Interviewed monks in surrounding compounds and monks that historically lived in monastery. Provided public lecture at U.S. Embassy Jefferson Center in Mandalay. Work with WMF and other consultants to develop plan for restoration and preservation of structure and site. Project began in 2014 and is ongoing.

Ishtar Gate, Babylon, Iraq.

Consultant to WMF on evaluation of groundwater and surface water in the vicinity of the Ishtar Gate, a monumental entryway to the ancient city of Babylon. Performed field visit to identify groundwater and surface water effects on the gate and conceptual mitigation measures to help reduce water flowing into the sump area created by the archaeological excavation of the gate. Reviewed precipitation and surface water data and prepared report with recommendations for improved water management.

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Farnsworth House, Plano, Illinois. Consultant to the National Trust for Historic Preservation on flood risk evaluation of the Farnsworth House, designed by acclaimed architect Mies van der Rohe. Evaluated flood frequency relationships for the Fox River and conceptual alternatives for raising house to mitigate flood risk.

Waikiki Natatorium, Honolulu, Hawaii. Consultant to the National Trust for Historic Preservation on the future of the Waikiki Natatorium, a World War I Memorial on the coastline of Oahu. The Natatorium is a seawater pool with a long history related to the American collegiate and Olympic swimming program. Performed a site visit while in Oahu on a separate assignment and assisted the National Trust with comments on the Environmental Impact Statement (EIS) process. An alternative that preserves the Natatorium ultimately was chosen as the preferred action in the EIS over a beach concept that would have destroyed the Natatorium.

OTHER EXPERIENCE

Instructor in Civil Engineering. University of Colorado, Denver, Colorado, 2001–2011.

- Taught graduate-level classes in Applied Hydrology and Open Channel Hydraulics. Responsible for two weekly lectures, formulation (and solution) of homework and examination problems and assisting students (2001–2003).
- Taught Fluid Mechanics Review Class for Fundamentals of Engineering Examination Refresher Course through University of Colorado, Denver (2003–2012).
- Taught Water Resources Review Classes for Professional Engineering Examination Refresher Course through University of Colorado, Denver (2003–2012).
- Development and presentation of short courses and continuing education (2001–2011)

Urban Watershed Research Institute. Chairman of Technical Steering Committee (2014–2016) and contributing member on topics related to update of EPA Stormwater Management Model (current).

Colorado Stream Management Academy. Instructor of hydrology for interdisciplinary, invitation-only course on the science and engineering of managing streams and watersheds. Course is sponsored by MHFD, the Colorado Association of Stormwater and Floodplain Managers, and the Colorado Riparian Association (2017 to present).

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PROFESSIONAL & HONORARY SOCIETIES

Member of the American Society of Civil Engineers (ASCE)
Member of Environmental and Water Resources Institute (EWRI) of ASCE
Member of ASCE/ERWI Urban Water Resources Research Council (past Chair)
Member of the Colorado Association of Stormwater and Floodplain Managers (CASFM)
Member of the American Water Resources Association (AWRA)
Member International Erosion Control Association (IECA)
Principal Researcher for Wright Paleohydrological Institute
Trustee of Rocky Mountain Hydrologic Research Center

HONORS & INTERESTING FACTS

- Top 20 Under 40, *ENR (Engineering News-Record) Mountain States*, Feb. 28, 2011
- Miembro Honorario, Centro Andino De Estudios, Machu Picchu
- Escape from Alcatraz Triathlon 2013–Swam from Alcatraz to San Francisco as part of triathlon
- Extensive travel and work throughout USA (multiple states), Peru, France, Germany, China, Cambodia, Thailand, Myanmar, Iraq, New Zealand, and others
- Eagle Scout

PUBLICATIONS

- Collar, N.M., and T.A. Earles. 2023. Unique challenges posed by fire disturbance to water supply management and transfer agreements in a headwaters region. *Journal of Environmental Management*. April. <https://doi.org/10.1016/j.jenvman.2023.117956>.
- Earles, A., and A. Pfeiffer. 2021. Using Lane's Sediment-Water Balance to Understand & Mitigate Stream Instability. *Storm Water Solutions*. October 11. <https://www.estormwater.com/sediment-control/using-lanes-sediment-water-balance-understand-mitigate-stream-instability>.
- Wilson, S., A. Bhaskar, A. Earles, B. Chongtoua, B. Zivkovich, M. Grabczyk, and C. Olson. 2021. Monitoring and Characterization of Streamflow Response to Storms in Urbanizing Semi-arid Rangeland and Urban Watershed in the Denver, Colorado, USA Area. Presented at *2021 World Environmental and Water Resources Congress*. Virtual Online. June 7–11.
- Earles, A., B. Chongtoua, J.K. Clary, and B. Zivkovich. 2020. Estimation of Pollutant Load Reduction from Restoration of Cherry Creek in Denver. *Journal of Sustainable Water in the Built Environment, Forum*. 2020. 6(3): 02520002.
- Earles, A., J. Keyes, L. Montesano, and T. Nergaard. 2020. Temporary Diversion Approaches for Projects on Small Streams. *Environmental Connection*. International Erosion Control Association; Volume 14, Issue 4. October/November.
- Earles, A., C. Christoff, N. Collar, and H. Rogers. 2019. *Proactive Planning for Post-Fire Hazards in Pitkin County*. International Erosion Control Association, Mountain States Regional Conference, November 14–15. Denver, Colorado.

Andrew Earles, Ph.D., P.E., P.H., BC.WRE, CPESC

- Olson, C., and A. Earles. 2019. *Workshop on Hydrologic & Hydraulic Modeling Fundamentals for Municipal Reviewers*. 30th Annual 2019 Colorado Association of Stormwater and Floodplain Managers, Crested Butte, Colorado. September.
- Earles, A., and H. Piza. 2019. *Challenges with Creating Effective Local Drainage Criteria Manuals Based on the Urban Storm Drainage Criteria Manual*. 30th Annual 2019 Colorado Association of Stormwater and Floodplain Managers, Crested Butte, Colorado. September.
- Earles, T.A., A. Long, I. Paton, C. Carlson, and S. Schreiber. 2019. *Master Planning for Stream Health in the Rocky Mountain Region – Part 1*. International Erosion Control Association, Annual Conference, Denver, Colorado, February.
- Earles, T.A., B. Chongtoua, J. Ash, and D. Beck. 2019. *Master Planning for Stream Health in the Rocky Mountain Region – Part 2*. International Erosion Control Association, Annual Conference, Denver, Colorado, February.
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