

DEPARTMENT OF WATER RESOURCES

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May 11, 2017

Mr. David E. Capka, P.E.
Director, Division of Dam Safety and Inspections
Federal Energy Regulatory Commission
888 First Street, N.E., Routing Code: PJ-123
Washington, D.C. 20426

FERC Project No. 2100 – Oroville Emergency Recovery – Spillways,
Proposed Members of Independent Board of Consultants

Dear Mr. Capka:

By letter dated February 17, 2017, the California Department of Water Resources (DWR) proposed five qualified experts to serve as members of the Independent Board of Consultants (BOC) for the Oroville Emergency Recovery – Spillways project. The BOC members were approved by the Federal Energy Regulatory Commission (FERC) by letter dated February 21, 2017. Subsequent to FERC's approval, two of the BOC members developed conflicts and resigned from the BOC.

Therefore, DWR has selected two additional experts to serve as members of the BOC:

- Paul G. Schweiger, P.E.; M.S. Civil Engineering – Hydrology/Hydraulics; B.S. Civil Engineering
- John K. Egbert, P.E.; M.S. Civil Engineering; B.S. Civil Engineering

Mr. Schweiger's and Mr. Egbert's resumes are enclosed for your review. Upon your approval, DWR will immediately engage the new BOC members to carry out the BOC responsibilities outlined in FERC's February 21, 2017 letter.

If you have any questions or would like to discuss this further, please contact me at (916) 502-2067.

Sincerely,

A handwritten signature in blue ink that reads "Ted Craddock".

Ted Craddock, Project Manager
Oroville Emergency Recovery – Spillways
Executive Division

Enclosures

cc:

**Ms. Sharon Tapia, Chief
Division of Safety of Dams
2200 X Street, Room 200
Sacramento, California 95818**

**Mr. Frank L. Blackett
Regional Engineer
Federal Energy Regulatory Commission
100 First Street, Suite 2300
San Francisco, California 94105-3084**



*Excellence Delivered **As Promised***

Paul G. Schweiger, PE, PEng, CFM

Vice President and Manager Dams and Hydraulics Section

CURRENT RESPONSIBILITIES:

Vice President and Manager Dams and Hydraulics Section

overseeing many areas of water resources engineering, including dam design and inspection, dam assessments, and design reviews, as well as providing construction contract administration services for dam and flood control projects. Special areas of expertise include hydrologic and hydraulic (H&H) studies for dams and bridges, dam rehabilitation, and facilitating potential failure modes analyses (PFMA). Has provided engineering services on more than 500 dams of various types and sizes. Other technical specialties include designing fish passage facilities, conducting hydraulic analyses of natural and man-made waterways using steady and unsteady flow modeling techniques, performing water supply and safe-yield investigations for complex water supply systems, preparing bridge scour and spillway erodibility investigations, and developing computer software for water resources engineering applications. Possesses proficiency with DAMS2/SITES, WSP2, HEC-1, HEC-HMS, HEC-2, HEC-RAS, HEC-4, NWS DAMBRK, MAPS, HY 8, KYPIPE, FlowMaster and HMR52 software. Leads 2-D hydraulic modeling investigations using XP 2D, Flo-2D, SMS 2D, and TUFLOW. Has provided expert testimony and litigation support as a Hydraulic Engineer in the area of riverine flooding, water supply system operation, and public safety at low-head dams. Expert Hydrology and Hydraulics Engineer on U.S. Army Corps of Engineers (USACE) Independent Peer Review Panels for Dam Safety Action Classification (DSAC) I Dams and new dam designs. Approved Federal Energy Regulatory Commission (FERC) facilitator for performing failure modes analysis (FMA) exercises for dams.

YEARS EXPERIENCE WITH FIRM: 30

YEARS EXPERIENCE WITH OTHER FIRMS: 3

EDUCATION:

BS, Civil Engineering - Water Resources Engineering, University of New Brunswick, 1983
MS, Civil Engineering - Hydrology/Hydraulics, University of New Brunswick, 1986

Paul frequently teaches dam safety seminars and webinars for FEMA, ASDSO, USFWS, USSD, and the NRCS. He is the lead instructor for the following popular ASDSO seminars:

- Lessons Learned from Dam Failures
- Inspection and Assessment of Dams



PROFESSIONAL REGISTRATION(S):

PE: Pennsylvania - No. PE040000E (1990)
 New Jersey - No. 24GE03637400 (1991)
 New York - No. 087043 (2009)
 West Virginia - No. 018419 (2009)
 North Dakota - No. PE-6634 (2010)
 Illinois - No. 062062959 (2010)
 Virginia - No. 0402049595 (2011)
 Arizona - No. 53970 (2012)
 New Hampshire- No. 14329 (2014)
 Montana - No. PEL-PE-LIC-40011 (2015)
 Georgia - No. PE040845 (2016)
 South Carolina - No. 33285 (2016)
 Connecticut - No. PEN.0031607 (2016)
 Massachusetts - No. 52929 (2016)
 PEng: Manitoba - No. 40413 (2016)
 ASFPM Certified Floodplain Manager - No. US-12-06194 (2012)

SUMMARY OF EXPERIENCE:

Type II Independent External H&H Peer Review (IEPR)/Safety Assurance Review (SAR), Construction Phase, Portugués Dam, Ponce, PR, U.S. Army Corps of Engineers (USACE), Louisville District. Hydraulic Engineer for the Type II IEPR/SAR of the design and construction of a 220-foot-high roller-compacted concrete (RCC) dam located in southern Puerto Rico. In accordance with the Federal Water Resources Development Act and USACE criteria, the dam required review to make certain that, at the 50 percent construction stage, all key requirements of the design intent were being fulfilled. Responsibilities included performing a construction site visit and a hydraulic review of key design and construction documents. Participated in review teleconferences and assembled a final review report for the Type II IEPR/SAR process at the 50 percent construction phase of the project.

Type II Independent External H&H Peer Review IEPR/SAR, Rio Grande Floodway, San Acacia Phase I-II Levee Construction, Socorro County, New Mexico, U.S. Army Corps of Engineers (USACE), Albuquerque District. Hydrology and Hydraulics Peer Review Member for expert review of technical engineering components of the project involving the design and construction of more than 3.4 miles of engineered levee from the Socorro Diversion Channel to approximately a quarter mile south of Otero Avenue in Socorro County, New Mexico. Provided technical reviews in the specialty area of Hydrology and Hydraulics. The engineered levee was constructed using material from the removal of the existing levee and spoil bank. Ancillary work to the construction of the engineered levee included an inspection trench, excavation and backfill, a soil-bentonite low permeability cutoff wall, levee subdrainage system, removal, and replacement of 12-inch diameter HDPE pipe for cross drainage, installation of gabion

mattresses, jetty jack demolition, riprap placement, articulated concrete block revetment, and seeding completed levee slopes.

Indefinite Design and Related Services, Independent External H&H Peer Review (IEPR) for Dams, U.S. Army Corps of Engineers (USACE), Pittsburgh District. Senior Hydrology and Hydraulics Reviewer for several USACE Dam Safety Action Class I dams, including Barker Dam and Austin Dam in Texas and Westville Dam in Massachusetts. Performed site visits; participated in project debriefings; reviewed reports, drawings, inspections, analyses, and other project files; and prepared independent assessment reports and debriefings for each project.

C.W. Bill Young Regional Reservoir Renovation, Tampa, FL, Tampa Bay Water. Project Principal for the \$150 million renovation of an aboveground, off-stream reservoir located in Tampa, Florida. The reservoir has a storage capacity of 15.5 Bgal and is used to supplement demand when available surface water withdrawals are limited. The project involved designing a renovation of the reservoir, which required excavation of the soil wedge, removal of the existing geomembrane, placement of additional embankment on the existing embankment, a new geomembrane, a gravel drain, and construction of stair-step soil-cement over the entire length of the upstream slope. Work included preparing designs, performing 2D dam breach analyses, conducting PFMA using FERC procedures, providing construction support and post-construction inspection services, and conducting emergency action plan (EAP) exercises.

PFMA for Rehabilitation of Buckeye Lake, Columbus, OH, Ohio Department of Natural Resources (ODNR). PFMA Facilitator conducting a PFMA exercise for the 4-mile-long Buckeye Lake according to FERC procedures. In addition to ODNR staff, the PFMA team included expert independent consultants Dr. Donald Bruce, Dr. George Filz, and Trent Dreese. Recommendations from the PFMA were subsequently adopted by ODNR and incorporated into the rehabilitation designs for the dam.

Round Valley Dams PFMA, Clinton Township, Hunterdon County, NJ, New Jersey Water Supply Authority (NJWSA). Project Principal and PFMA Facilitator conducting a week-long PFMA exercise for the three embankment dams making up the Round Valley Reservoir complex according to FERC procedures. The three embankments are among the five largest embankment dams in New Jersey. In addition to NJWSA and New Jersey Department of Environmental Protection staff, the PFMA team included expert independent consultants Dr. Donald Bruce, David Paul, and Trent Dreese. Recommendations from the PFMA were subsequently adopted by the NJWSA and led to a significant rehabilitation program for each of the dams.

Spruce Run Dam Inspection and PFMA, Clinton Township, Hunterdon County, NJ, New Jersey Water Supply Authority (NJWSA). Project Manager on a team conducting a formal inspection of the Spruce Run Dam and Reservoir, involving review of existing files and reports; field inspection, including dams and concrete spillway, outlet tower, bridges and vaults, outlet

pipes, and plunge pool; instrumentation evaluation; and inspection reports. The 72-inch outlet conduits were inspected using confined-space entry procedures.

Risk Mapping, Assessment, and Planning Program Support, Lessons Learned from Dam Incidents and Failures, RiskMAP, Federal Emergency Management Agency (FEMA) Headquarters and FEMA Regions IV, VIII, and IX, U.S. Department of Homeland Security, FEMA. Completed a significant research and educational outreach effort for FEMA and the National Dam Safety Program. The project included in-depth research and prioritization of past dam failures and incidents. The primary objective involved creating a website that conveyed lessons learned from dam incidents and failures in an innovative, user-friendly manner that appealed to contemporary users from a broad spectrum of dam safety professions. The website allowed access to pertinent graphics, narratives, photographs, videos, best practice resources, technical papers, and other available information. The project scope addressed a range of failure modes, dam types, and dam safety practices, including lessons learned relating to a spectrum of dam safety topics such as engineering and design, emergency planning and response, operation and maintenance, and regulatory issues.

ASDSO Seminar on Lessons Learned From Dam Failures – Denver, CO, New Orleans, LA, Chicago, IL, Association of State Dam Safety Officials (ASDSO). [2011-2017][54569] As Lead Instructor, conducts 3-day engineering seminar. The course, "Lessons Learned from Dam Failures provides instruction on common failure modes for most types of dams and levees with primary emphasis on dams. The principles, concepts and design standards taught are applicable to anyone conducting inspections, performing assessments, conducting risk analyses, or involved in the design of a dam or levee project. Participants learn about potential failure modes, conditions that can lead to these failure modes, approaches to responding to dam and levee failure modes to avert failures, and defensive design details or modifications for dams and levees to increase their resistance to various failure modes. These lessons learned are illustrated using numerous case histories from dam and levee failures and incidents.

Development of Guidelines for the Evaluation of Risk-Based Hydrologic Safety of Dams, RiskMAP, Washington, DC, U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA). Project Principal and co-author for a guidance document to evaluate the hydrologic safety of dams, including guidelines for determining the spillway design flood for new and existing dams. The compilation and publication of FEMA's *Selecting and Accommodating Inflow Design Floods for Dams* document will provide a tool to assist state dam safety programs in evaluating the adequacy of their current hydrologic guidelines and provide dam designers with a consistent methodology across state lines. The guidelines are intended to assist states and dam owners with difficult decisions and limited resources related to protecting the public safety and public resources. Tasks included performing a comprehensive literature review, administering a questionnaire regarding current hydrologic guidelines to each state and federal agency that regulates dams, preparing a report summarizing the state of the practice, and preparing a guidance document for the hydrologic safety of dams.

Natural Resources Conservation Service (NRCS) Seminar – Inspection and Assessment of Dams, McKinney, TX, Duluth, GA, Seattle, WA, and Little Rock, AR, Tampa, FL, White Plains, NY, Columbia, SC, Pittsburg, PA, Austin, TX, Omaha, NE, Salt Lake, UT, Casper, WY, Jackson, MS, Association of State Dam Safety Officials (ASDSO). [2011-2017][54569] As Lead Instructor, conducts 3-day engineering seminar. The course, "Inspection & Assessment of Dams," was developed as the request of NRCS Headquarters. The seminar provides comprehensive instruction in inspection and evaluation techniques for dams. Although the content was tailored to focus on NRCS dams emphasizing NRCS policies and requirements, the principles, concepts and procedures taught were readily adaptable to any organization conducting dam inspections and evaluating their compliance with current design standards. The target audience is NRCS personnel and state dam safety officials; however, dam owners, engineers and personnel operating and maintaining dams also found the course relevant. Participants are familiarized with a variety of dam types and their appurtenances, instructed in the function of typical dam features, and were made aware of common dam failure modes and the conditions that can lead to these failure modes. Actual dam-failure cases are presented so that participants could grasp the seriousness and responsibilities associated with performing dam inspections, knowing what to look for, and being able to identify potential deficiencies at dams before they become a problem. Public safety, security, and liability were also discussed along with approaches to responding to dam incidents.

Indefinite Delivery/Indefinite Quantity Architectural/Engineering Services for the Dam Program, Little Grassy Dam 3-D CFD Spillway Hydraulic Analysis, Williamson County, IL, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Project Principal for a detailed 3-D CFD hydraulic analysis of Little Grassy Spillway. The project included performing a detailed hydrologic assessment of various precipitation events, including the probable maximum precipitation (PMP) event, and a detailed assessment of the service spillway for capacity using a 3-D model. The 3-D hydraulic model was used to simulate multiple hydrologic loading scenarios, including the probable maximum flood (PMF) event.

3-D Computational Fluid Dynamics (CFD) Hydraulic Analysis of Spillway, Lake Scranton Dam Rehabilitation Engineering Services, Lackawanna County, PA, Pennsylvania American Water. Project Principal helming a detailed 3-D hydraulic analysis of the auxiliary spillway of Lake Scranton Dam. The project involved performing a detailed hydraulic assessment of the capacity of the existing and the proposed spillways using a 3-D CFD model.

Tempe Town Lake Dam Replacement, Tempe, AZ, City of Tempe. Chief Engineer for the evaluation and design for the replacement of the Tempe Town Lake downstream dam. Tempe Town Lake is formed by two Bridgestone inflatable rubber dams constructed across the Salt River channel at the upstream and downstream ends of the lake. The downstream dam consists of four 16-foot-high air-inflated rubber bladders, each approximately 240 feet long anchored to a concrete foundation slab. Our firm assisted the City in providing the best possible downstream dam replacement option. The initial phase involved developing alternatives for replacement of

the downstream dam; conducting an alternatives workshop with project stakeholders; performing H&H analyses associated with the design inflow conditions; and preparing preliminary design plans, a basis-of-design report, and documentation for presentation of the alternatives process and recommended alternative to the City Council and Mayor. The design phase of the project included site surveying; geotechnical investigation and analyses; hydrologic, hydraulic, and structural analyses; final construction plans and project specifications; and permitting. Provided technical oversight and direction and conducted quality control reviews.

3-D Computational Fluid Dynamics (CFD) Hydraulic Analysis of Upper Handelong Mixing Tanks, Stony Garden Water Treatment Plant Improvements, Northampton County, PA, Pennsylvania American Water. Project Principal directing the detailed 3-D CFD hydraulic analysis of the existing Upper Handelong mixing tanks. The project included performing a detailed hydraulic assessment of the in-tank mixing dynamics and the efficiency of baffle arrangement in the tank, using a 3-D CFD model.

Gilboa Dam Improvements, Schoharie County, NY, New York City Department of Environmental Protection. As Senior Engineer, provided technical support on structural stability analyses to assess the overflow portion of Gilboa Dam, the downstream discharge channel, and associated project features. The project involved the reconstruction of the 180-foot-high, 2,000-foot-long composite cyclopean-concrete gravity and earthfill embankment structure originally built in 1927. The project also involved the reconstruction of the 1,324-foot-long stair-stepped cyclopean-concrete gravity overflow section and associated training walls, as well as new low-level outlets works, for an estimated total construction cost of more than \$300 million.

Upper Brushy Creek 32 - Independent Design Review, Williamson County, TX, U. S. Department of Agriculture, Natural Resources Conservation Service, Texas State Office. Project Manager and Technical Reviewer for assembling and managing the independent design review team. Work included making sure that the dam rehabilitation design conformed to all applicable NRCS policy and technical guidelines.

18 Dam Inundations and Assessments, Statewide NH, New Hampshire Department of Environmental Services (NH DES). Project Principal overseeing completion of dam assessment reports for 18 Natural Resources Conservation Service dams in New Hampshire. Work includes performing dam inspections; conducting reconnaissance of downstream impact areas; performing dam failure modeling using HEC-RAS; preparing inundation mapping; completing hydraulic, hydrologic, and auxiliary spillway analyses using SITES; identifying deficiencies; and developing rehabilitation alternatives and planning-level cost estimations.

Dam Emergency Intervention Toolbox, Statewide MT, State of Montana. Project Principal in charge of the planning phase of a dam emergency intervention toolbox. Work included collecting and reviewing existing information on the topic and compiling, reviewing, and

organizing the most useful information into a simple electronic database. Documents and other resources were collected from a broad range of sources including literature review and outreach efforts to the dam safety community. Future phases of this work may include developing a “Dam Emergency Plan” for use by dam owners and others in preparing for future incidents at dams and adding this information to a website as an educational and outreach tool.

West Virginia Dam Assessments, Harmon Creek Riser Structure Modifications, Brook County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service, West Virginia State Office. Project Principal overseeing the modification of six 2-stage riser structures within the Harmon Creek watershed to address chronic clogging of the lower opening that sets normal pool. Evaluated existing trash racks and lower-level orifices; developed alternate trash-rack options including modifications to the existing system and complete reconstruction; modified the lower-level orifices; and prepared design reports, cost estimates, and construction documents.

Expert Witness Litigation Support, Downingtown, PA, Travelers Insurance. Hydrologic and Hydraulic Engineer collecting hydraulic conditions data to support litigation services.

Indefinite Delivery/Indefinite Quantity Architectural and Engineering Services – Assessment of Three Dams, Aroostook County, ME, U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS), Maine State Office. Handled the completion of dam assessment reports for three NRCS dams in Maine. Work included performing dam inspections; conducting reconnaissance of downstream impact areas; performing dam failure modeling using HEC-RAS; preparing inundation mapping; completing hydraulic, hydrologic, and auxiliary spillway analyses using SITES; identifying deficiencies; and developing rehabilitation alternatives and planning-level cost estimations.

Dam Inundation and Emergency Action Plans – Eastern Region, United States, U.S. Department of Agriculture, United States Forest Service. Project Principal overseeing inundation mapping for six high-hazard dams within the United States Forest Service Eastern Region as part of a nationwide indefinite delivery/indefinite quantity architectural and engineering services contract. The project included Council Bluff Dam, Celina Lake Dam, Indian Lake Dam, Day Lake Dam, Timbre Ridge Dam, and Vesuvius Dam.

Dam Inundation and Emergency Action Plans – Southern Region, United States, U.S. Department of Agriculture, United States Forest Service. Project Principal overseeing inundation mapping for six high-hazard dams within the United States Forest Service Southern Region as part of a nationwide indefinite delivery/indefinite quantity architectural and engineering services contract. The project included Winona Reservoir Dam, Upper Sherando Dam, Sherando Dam, Spring Lake Dam, Skitty Creek Cliffside Dam, and Boykin Springs Dam.

Indefinite Delivery/Indefinite Quantity Architectural/Engineering Services for the Dam Program, 2-D Dam Breach Analysis of 4 Dams in Lacreek National Wildlife Refuge - Dam

Failure Consequence and Hazard Classification Analysis, Bennett County, SD, U.S.

Department of the Interior, U.S. Fish and Wildlife Service. Project Principal supervising detailed 2-D dam break hydraulic analysis of Lacreek Site 7, Site 8, Site 9, and Site 10 dams and the downstream areas in Bennett County, South Dakota. The project included performing a failure consequence assessment using state-of-the-art 2-D hydraulic models and reassessing the hazard classification of the Lacreek Site 10 dam.

Reconstruction of Dam, Dikes, and Associated Facilities, Ashokan, NY, New York City

Department of Environmental Protection. Project Principal for dam inspections; condition assessments; conceptual, preliminary, and final design; and construction plans and specifications for repairs and upgrades to a cyclopean masonry gravity dam, eight earthen dikes, and appurtenant structures. Participates in PFMA workshops and provides quality assurance reviews of completed work products. Work has also included a PFMA conducted using FERC procedures and a site-specific probable maximum precipitation (PMP) study.

Beaverdam Creek and Goose Creek Dams – Master Plan Study and Dams Operation,

Ashburn, Loudoun County, VA, Loudoun Water. Project Principal on this effort to estimate the safe yield of a complex water supply and storage system as part of a master planning study. The purpose of the planning study is to optimize the integration of the Potomac Water Supply Plan, which includes a pump intake on the Potomac River to supply raw water for treatment or storage in existing quarries, with existing infrastructure recently purchased from the City of Fairfax. These assets include a water treatment plant, river intakes on Goose Creek, and more than 1.5 Bgal of raw water storage within Beaverdam Creek Reservoir. Work includes developing a complex computer model and hydrologic database to simulate the daily operation of the pump intakes and various combinations of available storage facilities and pipeline connections. Safe yield for a range of possible operating assumptions and future conditions was investigated based on a custom computer model simulation. Optimized operation and phasing of the system were refined using model results.

Professional Engineering and Related Services, Bel Air Reservoir Feasibility Study, Bel Air,

MD, Maryland American Water. Project Principal heading the team estimating the safe yield of the Bel Air water system, including potential enhancements. Due to anticipated future shortfalls in the Harford County system, several options to mitigate the risk of a water deficit were investigated. The purpose of the study was to analyze the operation of a proposed off-stream reservoir and estimate the average raw water supply that could be provided by the system through the drought of record. Work included developing a custom computer model and hydrologic database to simulate the daily operation of the existing system and proposed reservoir from 1926 to the present. Investigated safe yield and the amount of required storage for a range of possible operating assumptions and potential permit restrictions based on the computer model simulation. Citing this analysis, identified and recommended water appropriation and stream-flow-by requirements as part of the Water Appropriation Permit process with Maryland Department of the Environment.

High-Hazard Dam Audits and Operations and Maintenance Program Development, Various Locations, PA, Aqua Pennsylvania, Inc. Project Principal administering the preparation of dam audits and detailed operation and maintenance manuals for the client's portfolio of nine high-hazard water supply dams in Pennsylvania. The audits included reviewing files of the project history at each site, assessing the condition of all components of each dam including the dam structure and all appurtenances, assessing the client's dam management program for each facility, and preparing a 10-year capital expenditure plan for each facility.

Indefinite Delivery/Indefinite Quantity Architectural/Engineering Services for the Dam Program, Bear Canyon Dam, Grant County, NM, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Project Principal for the evaluation of options to increase conveyance capacity at Bear Canyon Dam. Work included evaluating multiple options for increasing spillway capacity, developing construction cost estimates for each alternative, ranking the alternatives, preparing an alternatives analysis report, and organizing workshops to review the study results with the stakeholders.

Six Dam Assessments, Statewide MA, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), Massachusetts Office. Oversaw completion of dam assessment reports for six NRCS dams in Massachusetts. Work included performing dam inspections; conducting reconnaissance of downstream impact areas; performing dam failure modeling using HEC-RAS; preparing inundation mapping; completing hydraulic, hydrologic, and auxiliary spillway analyses using SITES; identifying deficiencies; and developing rehabilitation alternatives and planning-level cost estimations.

Dam Condition Assessments, Statewide ND, North Dakota State Water Commission. Directed a study that involved conducting detailed 2-D hydraulic analyses of 122 dams and their downstream areas in North Dakota. The project included performing a failure consequence assessment using state-of-the-art 2-D hydraulic models. The breach impacts were expressed in terms of the number of lives in jeopardy and the potential for loss of life at each structure and at each road crossing. Tasks included reviewing existing H&H data, collecting topographic data, and developing detailed 2-D hydraulic models for each dam. The 2-D dam breach models were used to simulate two failure scenarios – a sunny day breach and a probable maximum flood breach. The final deliverable included a comprehensive relational database of all of the assessed consequences resulting from a breach of each dam.

Dams Hazard Classification Review, Statewide, ND, North Dakota State Water Commission. Project Principal on this effort to review the current hazard classification of 90 dams located in North Dakota. Following a review of available data, used the 2-D model to assess the dam embankment breaches and released the reservoir storage dynamically through the breach opening and routed the water downstream. The impacts were expressed in terms of the number of lives in jeopardy and potential for loss of life at each structure. Using the estimated level of impacts, recommendations for the hazard classification of the dams were made based on ACER 11 criteria and Federal Emergency Management Agency 333 guidelines.

Pikes Creek Dam Rehabilitation (PADEP D40-018), Luzerne County, PA, Pennsylvania American Water. Project Principal overseeing the completion of planning and design-phase services for rehabilitating the 65-foot-high, 2,155-foot-long homogenous earthfill dam. Pikes Creek Dam is a high-hazard structure with an ogee crest principal spillway and flashboard/ogee crest auxiliary spillway. Engineering studies and construction plans were reviewed and augmented with subsurface explorations, site reconnaissance, and field surveys to assess the dam's condition and compliance with current dam safety design criteria. Alternative design solutions were developed and critiqued relative to costs and construction practicality. Two-dimensional hydraulic analyses were also performed to identify downstream infrastructure at risk to inundation during activation of the auxiliary spillway. Alternative solutions evaluated included embankment armoring and the application of crest gates, fuse gates, and labyrinth spillways to increase spillway capacity. Compiled a preliminary design memorandum presenting preliminary design construction plans, design analyses documentation, and estimated cost of construction for the recommended design solution. The selected dam rehabilitation included the use of Hydroplus Fuse gates, underwater installation of upstream closure gates of the outlet conduits, and modification of the embankment to include an internal chimney drain and filter with flatter slopes.

Miner Flat Dam, White Mountain Indian Reservation, Whiteriver, AZ, White Mountain Apache Tribe. Senior Project Engineer for design of the Miner Flat Dam. The proposed structure is a roller-compacted concrete (RCC) dam, approximately 160 feet high with a crest length of approximately 450 feet. Due to the complex geology of the proposed dam foundation, an early site review was critical. Our firm reviewed existing data, including previous studies; developed preliminary site model; and identified, collected, and analyzed additional data to better characterize the geologic conditions at the proposed dam site. Also completed conceptual design of the RCC dam.

Renwick Dam Rehabilitation, Phase II, Construction-Phase Services, Cavalier, Pembina County, ND, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), North Dakota State Office. Managed construction-phase support services to the NRCS for the rehabilitation of an existing 50-foot-high, 2,100-foot-long zoned earthfill dam. Tasks included project management and providing resident engineering services during the trial placement and production placement of the roller-compacted concrete (RCC). The construction-phase support services included full-time resident inspection, shop drawing reviews, and inspection of the all aspects of the construction project. Rehabilitation measures included a new embankment section at the location of the original grass-lined auxiliary spillway, placement of approximately 19,000 cubic yards of air-entrained RCC for a new stepped spillway, construction of reinforced-concrete spillway training walls, installation of a drainage system under the new spillway, and outlet works modifications.

Sheppard-Myers Dam Rehabilitation Conceptual Design, West Manheim Township, York County, PA, Borough of Hanover. Project Principal in charge of H&H analyses and design for

improvements to Sheppard-Myers Dam. The goal of the project was to perform an alternatives analysis to determine the most appropriate rehabilitation alternative to remedy the known dam deficiencies. An initial condition assessment of the dam and its appurtenances was performed to identify known and potential deficiencies. This information was used to develop four potential rehabilitation alternatives. Tasks included conducting a site inspection of the dam and its appurtenances, reviewing historic dam documentation, previous watershed and reservoir routing models, and annual inspection reports, compiling a comprehensive list of known and potential dam deficiencies, performing H&H analyses for the conceptual design of dam rehabilitation alternatives, estimating the probable maximum flood and other events using both HEC-1 and HEC-HMS hydrologic models of the watershed and reservoir, evaluating conveyance capacity and preparing spillway discharge rating curves for the existing principal and auxiliary spillways. Designed both a single-stage and a two-stage labyrinth weir spillway, new spillway chutes, and stilling basins for the proposed alternatives; prepared detailed cost estimates for each proposed rehabilitation alternative; and created a conceptual design report.

2-D Hydraulic Modeling and Analysis, Roaring Brook, Lackawanna County, PA, Pennsylvania Department of Transportation, Bridge Quality Assurance Division. Project Principal in charge of a detailed 2-D hydraulic analysis of Roaring Brook in Lackawanna County, Pennsylvania. The project included performing hydraulic simulations of 100- and 500-year rainfall events using 2-D hydraulic models and assessing the flow depths and velocities around critical structures along the stream reach. Tasks included reviewing existing H&H data; collecting best-available topographic data; and developing detailed 2-D hydraulic models.

2-D Dam Failure Analysis, Breach Consequence Assessment, and Hazard Classification Reassessment of Four Dams in Necedah National Wildlife Refuge, Juneau County, WI, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Project Principal heading a detailed 2-D dam break hydraulic analysis of four dams and their downstream areas in Juneau County, Wisconsin. The project included performing a failure consequence assessment using state-of-the-art 2-D hydraulic models and reassessing the hazard classification of each of the four dams. Tasks involved reviewing existing H&H data; collecting best-available topographic data; developing detailed 2-D hydraulic models; and completing hazard class assessments using modeling results and the U.S. Bureau of Reclamation's ACER 11 and the U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) 333 criteria. The 2-D dam breach model analyses were performed to simulate multiple failure scenarios, including failure of the dams during a sunny day and during various levels of hydrologic loading conditions that embrace the probable maximum flood event.

Flood and Dam Basic Ordering Agreement, Fairfax County, VA, County of Fairfax Department of Public Works and Environmental Services. Project Principal heading the team providing consulting engineering services on an as-needed, task-order basis for flood mitigation and monitoring, dam safety, and dredging services. Provided services for 30 task orders, including on-call emergency services, dredging projects, topographic surveys, geographic information system

(GIS) utilization, pond retrofits, riser structure modifications, and H&H analysis including Federal Emergency Management Agency floodplain mapping and SITES analysis.

Dam Breach Hydraulic Study for the Tempe Town Lake Dam Replacement, Tempe, AZ, *City of Tempe*. Project Principal in charge of a detailed 2-D dam breach hydraulic study of the Tempe Town Lake downstream dam. Tempe Town Lake is formed by two Bridgestone inflatable rubber dams constructed across the Salt River channel at the upstream and downstream ends of the lake. The downstream dam consists of four 16-foot-high air-inflated rubber bladders, each approximately 240 feet long anchored to a concrete foundation slab. The initial phase involved developing alternatives for replacement of the downstream dam; conducting an alternatives workshop with project stakeholders; performing H&H analyses associated with the design inflow conditions; and preparing preliminary design plans, a basis-of-design report, and documentation for presentation of the alternatives process and recommended alternative to the City Council and Mayor. The design phase of the project included site surveying; geotechnical investigation and analyses; hydrologic, hydraulic, and structural analyses; final construction plans and project specifications; and permitting. Work included developing a detailed 2-D hydraulic model of the reservoir and downstream areas and modeling multiple breach scenarios.

Lee Hall Reservoir Dam Improvement Project, Newport News, VA, *City of Newport News*. Project Principal providing quality control reviews for preliminary and final design of spillway capacity and embankment stability improvements for the Lower Lee Hall Dam, which was originally constructed in the 1890s. The Lee Hall Reservoir was formerly divided into two pools impounded by two structures: a 30-foot-high railroad embankment (Upper Reservoir) and an 18-foot-high by 2,200-foot-long earthfill dam embankment (Lower Reservoir). Final design consisted of raising the Lower Reservoir normal pool elevation, increasing the crest height of the dam embankment, installing a new 150-foot-wide labyrinth principal spillway, armoring a portion of the Lower Lee Hall Dam embankment using articulating concrete block (ACB) mats to allow overtopping, and removing the hydraulic control structure at the railroad embankment.

Rehabilitation of Robin Hood Dam, Keene, NH, *City of Keene*. Peer Reviewer for the articulating concrete block (ACB) overtopping design and related H&H analysis for the Robin Hood Dam. Also attended meetings with the New Hampshire Department of Environmental Services and provided on-site construction support during ACB placement. Robin Hood Dam was the first ACB embankment overtopping protection project completed in New Hampshire.

Dam Break Analysis for Clifton Forge Dam, Clifton Forge, Alleghany County, VA, *Town of Clifton Forge*. Project Principal in charge of conducting a detailed dam break analysis of Clifton Forge Dam and its downstream floodplains in Alleghany County, Virginia. Tasks included reviewing existing H&H data; analyzing soil, land use, and topographic data; developing H&H models of the study site using HEC-GeoHMS, HEC-HMS, HEC-GeoRAS, HEC-RAS, and geographic information system (GIS) software; applying HMR 51 and 52 methodology to obtain

probable maximum precipitation/storm estimates; modeling the dam breach and running the unsteady flow hydraulic computations in HEC-RAS; and determining the flood inundation areas using GIS. Evaluated sunny-day and hydrologic loading conditions to predict the flood extents and water surface elevations of outflow from the reservoir for each scenario.

Dam Break Analysis and Inundation Mapping for Beaverdam Creek Dam and Goose Creek Dam, Loudoun County, VA, City of Fairfax, Department of Utilities. Project Principal for developing H&H models to conduct dam breach analyses of Beaverdam Creek Dam and Goose Creek Dam. The analyses included data collection, geographic information system (GIS) map processing for the preparation of the H&H models, simulation of dam breach under sunny-day and severe weather conditions, and estimation of incremental damage resulting from dam failure.

Dam Break Analysis for Greenwood Lake Dam, North Attleboro, MA, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Project Principal heading a team conducting a detailed dam break analysis of Greenwood Lake and its downstream floodplains in Bristol County, Massachusetts. Tasks included reviewing existing H&H data; analyzing soil, land use, and topographic data; developing H&H models of the study site using HEC-GeoHMS, HEC-HMS, HEC-GeoRAS, HEC-RAS, and geographic information system (GIS) software; applying HMR 51 and 52 methodology to obtain probable maximum precipitation/storm estimates; modeling the dam breach and running the unsteady flow hydraulic computations in HEC-RAS; and determining the flood inundation areas using GIS. Evaluated sunny-day and hydrologic loading conditions to predict the flood extents and water surface elevations of outflow from the reservoir for each scenario.

Operations and Maintenance Template and Training, Honolulu, HI, Hawaii Department of Land and Natural Resources. Senior Engineer for the development of operation and maintenance guidelines and a template to be used by dam owners in the state of Hawaii. The guidelines and template were developed to comprise best practices industrywide and provide an easy-to-use template for developing a functional and practical operations and maintenance plan. In addition to the development of the guideline and template, also provided 1-day operation and maintenance training on each of the four major islands of Hawaii. Workshops were attended by owners, engineers, regulators, inspectors, and contactors involved in the operation of dams in the state.

Spillway Capacity Upgrade Alternatives Assessment for Sandy River Reservoir, Prince Edward County, VA, Virginia Department of Conservation and Recreation. Project Principal for technical review of watershed modeling and reservoir routing of Sandy River Reservoir. The dam impounding Sandy River Reservoir had inadequate spillway capacity, and this study was completed to confirm the conveyance capacity of the dam and evaluate alternatives to bring the dam into compliance with current Virginia dam safety regulations. Developed a SITES watershed model and HEC-HMS watershed model to compute the spillway design flood and evaluate alternatives to upgrade the reservoir. Alternatives to address overtopping of the

embankment dam included lowering the auxiliary spillway crest, widening the auxiliary spillway, armoring the embankment to allow overtopping, and raising the embankment. Probable construction cost estimates were prepared.

Raw Water Supply System, Loudoun County, VA, Loudoun Water. Project Manager in charge of the team determining the safe yield of a complex water supply and storage system that is proposed by Loudoun Water as part of a preliminary engineering report. The proposed system included a pump intake on the Potomac River, which would supply up to 40 mgd for treatment or storage in existing quarries. Demands and available storage in the quarries varied over the projected planning horizon. Work included developing a complex computer model and hydrologic database to simulate the daily operation of the pump intake and various combinations of quarries. Data and analyses also included daily fluctuations in water demand, net evaporation from the quarries, sedimentation within the quarries, operation of the intake during times of poor water quality (turbidity), and projected wastewater return flows for the period of record from 1929 to 2008. Safe yield for a range of possible operating assumptions and future conditions was investigated based on computer model simulation. Refined the operating rules for the system using model results.

Upper Pahrnagat Dam Breach Consequence and Hazard Classification Reassessment, Breach Analysis, and Inundation Mapping, Lincoln County, NV, U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS). As Project Principal, managed a detailed 2-D dam break hydraulic analysis of Upper Pahrnagat Dam and its downstream areas in Lincoln County, Nevada. The project included performing a failure-consequence assessment using state-of-the-art 2-D hydraulic models and reassessing the hazard classification of the dam. Tasks included reviewing existing H&H data; collecting best-available topographic data; developing a detailed 2-D hydraulic model; and completing a hazard-class assessment using modeling results and the U.S. Bureau of Reclamation's ACER 11 criteria. The 2-D dam breach model was developed to simulate multiple failure scenarios, including failure of the dam during a sunny day and during various levels of hydrologic loading conditions that embrace the probable maximum flood event.

Hawi No. 3 Reservoir Maintenance and Remediation Improvements, Hawi, HI, Hawaii Department of Land and Natural Resources. Senior Engineer/Reviewer for the rehabilitation of an earth-embankment dam located on the island of Hawaii and classified as a small dam. The project included the development of alternatives for the removal, rehabilitation, and operational reduction of the reservoir system. The operational reduction alternative was selected for the final design and included a number of modifications to the facility to improve performance and reduce risk. The modifications included spillway reconstruction, embankment regrading, replacement of the intake structure for the outlet works, replacement of the inflow diversion gate valve, and access road improvements.

Valuation Study for Springton Dam, Delaware County, PA, Aqua Pennsylvania, Inc. Senior Project Manager for cost estimate preparation to replace Springton Dam, an earthen

embankment structure approximately 75 feet high and 1,600 feet long. The project involved developing cost estimates for the replacement of Springton Dam in kind and the replacement of Springton Dam as a new roller-compacted concrete (RCC) gravity dam. Both dam replacement concepts included upgrading the conveyance capacity of the dam to meet current regulatory requirements. Our firm also prepared conceptual design drawings.

Natural Resources Conservation Service (NRCS) Seminar – Inspection and Assessment of Dams, McKinney, TX, Duluth, GA, Seattle, WA, and Little Rock, AR, Association of State Dam Safety Officials (ASDSO). As Lead Instructor, conducted a 3-day engineering seminar. The course, "Inspection & Assessment of Dams," was developed as the request of NRCS Headquarters. The seminar provided comprehensive instruction in inspection and evaluation techniques for dams. Although the content was tailored to focus on NRCS dams emphasizing NRCS policies and requirements, the principles, concepts and procedures taught were readily adaptable to any organization conducting dam inspections and evaluating their compliance with current design standards. The target audience was NRCS personnel and state dam safety officials; however, dam owners, engineers and personnel operating and maintaining dams also found the course relevant. Participants were familiarized with a variety of dam types and their appurtenances, instructed in the function of typical dam features, and were made aware of common dam failure modes and the conditions that can lead to these failure modes. Actual dam-failure cases were presented so that participants could grasp the seriousness and responsibilities associated with performing dam inspections, knowing what to look for, and being able to identify potential deficiencies at dams before they become a problem. Public safety, security, and liability were also discussed along with approaches to responding to dam incidents.

2-D Flow Dam Break Analysis, Inundation Mapping, and Emergency Action Plan (EAP) for C.W. Bill Young Regional Reservoir, Tampa, Hillsborough County, FL, Tampa Bay Water. Project Principal for development of a 2-D hydraulic model and performance of a detailed dam break analysis of the Tampa Bay Reservoir. Participated in the design and permitting of improvements to the reservoir. Due to the flat terrain, the dam break analyses were completed using a comprehensive 2-D hydraulic model with more than 8 million grid cells, modeling an area of about 2,000 square miles to simulate multidirectional flows downstream of the dam. Analyses were performed to evaluate the sensitivity of the inundation area limits to the breach location and breach parameters. Four breach locations were selected and inundation maps were prepared. Dam breach videos and other graphics were prepared to support the EAP exercise.

Dam Breach Inundation, Hazard Classification, and Spillway Design Flood Determination for Five Dams in Prince Edward, Buckingham, and Hanover Counties, VA, Virginia Department of Conservation and Recreation. Project Principal for watershed modeling, reservoir routing, and dam breach inundation modeling of South Anna Site #52B, Slate River Site #7, and Bush River Sites #4B, #5, and #6. Work included the review of pertinent design information, dam and watershed site visits, development of a watershed model using HEC-HMS, and development of a hydraulic model for reservoir and downstream flood routing using HEC-RAS. According to

current Virginia dam safety regulations, the hazard classification of each dam was identified and an incremental damage analysis was performed to determine the regulatory spillway design flood. Deficiencies in spillway capacity were identified and dam failure inundation maps were prepared.

Cimarroncito Dam, Breach Modeling and Inundation Mapping, Cimarroncito, NM, Town of Cimarroncito. Project Principal overseeing work for H&H modeling and inundation mapping for Cimarroncito Dam. The project included hydrologic modeling of the watershed using HEC-HMS, unsteady hydraulic analyses using HEC-RAS to route the breach hydrograph downstream, and mapping of the inundation limits using ArcGIS.

Engineering Services for Dam Engineering Program, Beaverdam Creek Dam and Goose Creek Dam, Loudoun County, VA, City of Fairfax, Department of Utilities. As Senior Project Engineer, conducted a preliminary condition assessment, reviewed the H&H models for dam breach analyses of Beaverdam Creek Dam and Goose Creek Dam, and provided preliminary design services to rehabilitate Beaverdam Creek Dam. The analyses included data collection, geographic information system (GIS) map processing for the preparation of the H&H models, simulation of dam breach under sunny day and severe weather conditions, and estimation of incremental damage resulting from dam failure. Also responsible for conducting emergency action plan tabletop exercises for both dams.

Octoraro Reservoir Hydraulic Investigations, Chester County, PA, Chester Water Authority (CWA). Project Principal for investigation of flooding along the Octoraro Creek. Octoraro Reservoir is the source of raw water for the CWA's Pine Grove water treatment plant, located immediately downstream from Pine Grove Dam. Flooding of Octoraro Creek is a concern for the CWA. Responsible for technical review of hydraulic analyses along Octoraro Creek and hydraulic investigations to develop stage-discharge relationships for two staff gages upstream of the reservoir. Field measurements of total stream flow were taken. A computer model application was prepared to compute the discharge over the ogee spillway and through the tainter gates based on hydraulic conditions in the reservoir and in Octoraro Creek. This task included field of survey streams, the spillway, a bridge, and the staff gages.

Lake Ingram Dam, Breach Modeling and Inundation Mapping, Clovis, NM, Town of Clovis. Project Principal for H&H modeling and inundation mapping for Lake Ingram Dam. The project included hydrologic modeling of the watershed using HEC-HMS, unsteady hydraulic analyses using HEC-RAS to route the breach hydrograph downstream, and mapping of the inundation limits using ArcGIS.

Dam Assessments, Breach Modeling, and Inundation Mapping for 112 Dams Located in WV, WI, NH, ND, and NM, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Project Principal overseeing the team developing dam failure models; preparing inundation mapping using HEC-GeoRAS, HEC-RAS, ArcGIS, and Google Earth software; and performing dam assessments for 112 NRCS dams located in West Virginia, Wisconsin, New

Hampshire, North Dakota, and New Mexico. The dam breach unsteady-state hydraulic models range in reach lengths from 2 miles to 66 miles and include junctions and downstream tributaries. The H&H modeling tasks involved reviewing existing H&H data, including as-built drawings and emergency action plan (EAP) maps; collecting and processing topographic data using state-of-the-art geographic information system (GIS) tools; building and preparing dam breach models using HEC-GeoRAS and HEC-RAS software; preparing inundation mapping using ArcGIS and Google Earth tools; comparing dam breach inundation maps with existing EAP maps, relevant Federal Emergency Management Agency (FEMA) studies, and FEMA 100- and 500-year floodplain maps; and preparing user-friendly deliverables including four-dimensional inundation mapping videos using advanced ArcGIS and Google Earth tools. The dam assessment tasks also included performing dam inspections; conducting reconnaissance of downstream impact areas; preparing hydrologic and auxiliary spillway models using the NRCS SITES program to evaluate the sufficiency of the existing dams to conform to current design and analysis criteria; identifying deficiencies; preparing failure indexes; and developing and evaluating rehabilitation alternatives.

Stang Lake Dam Breach Consequence and Hazard Classification Reassessment, Breach Analysis, and Inundation Mapping, Otter Tail County, MN, U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS). Project Manager overseeing a detailed 2-D dam break hydraulic analysis of Stang Lake Dam and its downstream areas in Otter Tail County, Minnesota. The project involved performing a failure-consequence assessment using state-of-the-art 2-D hydraulic models and reassessing the hazard classification of the dam. Tasks included reviewing existing hydrologic and hydraulic data; collecting best-available topographic data; developing a detailed 2-D hydraulic model; and completing a hazard-class assessment using modeling results and U.S. Bureau of Reclamation's ACER 11 criteria. The 2-D dam breach model was run to simulate multiple failure-mode scenarios, including failure of the dam during a sunny day and under hydrologic loading conditions. Conclusions from the analysis included a recommendation to reclassify the dam as a significant-hazard structure from its current high-hazard classification.

Dam Design Services, Technical Evaluation and Construction Cost Estimating for Valenciano Dam, PR, Aqua Pennsylvania, Inc. Senior Project Manager overseeing the preparation of cost estimates and review of design drawings and reports for the construction of Valenciano Dam, which is a water supply impoundment being proposed by the Puerto Rico Aqueduct and Sewer Authority in the east-central territory of Juncos, Puerto Rico. The project would create a 10,500 acre-foot storage impoundment for water supply to the nearby developing communities, potentially serving 50,000 clients in five municipalities. It includes a 116-foot-high roller-compacted concrete (RCC) gravity dam that is 1,040 feet long with a gated concrete spillway. Associated with the dam are a raw water pump station, ancillary buildings, and raw water pipelines internal to the site. Engineering services include preparing summary reports and presentations regarding the risks and costs associated with constructing, operating, and maintaining this project.

Salem Fork Site 11 and Site 11A Hydrologic Analysis, Auxiliary Spillway Integrity Analysis, Dam Break Analysis, and Inundation Mapping, Harrison County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Project Principal for a detailed hydrologic study, auxiliary spillway integrity analyses, and dam break hydraulic analyses of Salem Fork Site 11 and Site 11A dams and their floodplain in Harrison County, West Virginia. Tasks included reviewing existing H&H data; collecting topographic data; developing several NRCS SITES H&H models; performing a site visit; completing an approximate survey of channel obstructions; and developing a detailed hydraulic model using HEC-GeoRAS, HEC-RAS, and ArcGIS software. The dam breach model was run to simulate failure of the dam during both sunny-day and hydrologic loading conditions in order to predict the flood extents and water surface elevations of outflow from the reservoir for those scenarios. A complete dam assessment, including developing dam rehabilitation alternatives was also prepared for this project.

Rehabilitation Design for Upper Deckers Site 1, Preston County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Project Principal in charge of conceptual, preliminary, and final design and construction-phase services for the rehabilitation of Upper Deckers Site 1 Dam. The rehabilitation design included armoring the embankment with roller-compacted concrete (RCC), constructing a new reinforced-concrete riser structure, and raising the normal pool approximately 10 feet.

Upper Deckers Site 1 Hydrologic Analysis, Auxiliary Spillway Integrity Analysis, Dam Break Analysis, and Inundation Mapping, Preston County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Project Principal overseeing a detailed hydrologic study, auxiliary spillway integrity analyses, and dam break hydraulic analyses of Upper Deckers Site 1 Dam and its floodplain in Preston County, West Virginia. Tasks included reviewing existing H&H data; collecting topographic data; developing several NRCS SITES H&H models; performing a site visit; completing an approximate survey of channel obstructions; and developing a detailed hydraulic model using HEC-GeoRAS, HEC-RAS, and ArcGIS software. The dam breach model was run to simulate failure of the dam during both sunny-day and hydrologic loading conditions in order to predict the flood extents and water surface elevations of outflow from the reservoir for those scenarios. A complete dam assessment, including developing dam rehabilitation alternatives, was also prepared for this project.

Devil's Kitchen Dam Breach Consequence and Hazard Classification Reassessment, Breach Analysis and Inundation Mapping, Williamson County, IL, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Project Principal in charge of a detailed 2-D dam break hydraulic analysis of Devil's Kitchen Dam and its downstream areas in Williamson County, Illinois. Devils Kitchen Dam is a 100-foot-high concrete gravity dam constructed between 1943 and 1959. Also performed a failure consequence assessment using state-of-the-art 2-D hydraulic models and reassessed the hazard classification of the dam. Tasks included reviewing existing H&H data; developing a detailed 2-D hydraulic model; and completing a hazard class assessment

using modeling results and U.S. Bureau of Reclamation's Assistant Commissioner, Engineering and Research (ACER 11) criteria. The 2-D dam breach model was run to simulate failure of the dam during a sunny day and under hydrologic loading conditions.

New Creek Site 14 Dam Rehabilitation, Grant County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. Senior Project Manager in charge of investigations, preliminary and final design, and construction-phase services for the rehabilitation of an existing 114-foot-high, 940-foot-long zoned earthfill dam. Rehabilitation measures included slope stabilization, roller-compacted concrete (RCC) auxiliary spillway armoring, a new toe drain system, and outlet works modifications.

Dam Engineering Services, Rehabilitation of Lake Natalie Dam, Gouldsboro, PA, Big Bass Lake Community Association. Senior Project Manager of an engineering study, final design, and construction-phase services for the rehabilitation of Lake Natalie Dam, which included stabilizing the existing timber-crib structure; addressing seepage and sinkholes in the dam; improving site access; and increasing discharge capacity to safely pass the probable maximum flood. The selected alternative included installing an impervious liner within the embankment and armoring the embankment with articulated concrete blocks. Prepared design drawings and specifications for the selected alternative.

Renwick Dam, Pembina County, ND, U.S. Department of Agriculture, Natural Resources Conservation Service. As Senior Civil Engineer, reviewed the roller-compacted concrete (RCC) and hydraulic design elements of a rehabilitation project for the existing 40-foot-high dam. The dam has a 145-square-mile drainage area and was constructed in 1961 for flood control and recreation purposes. The rehabilitation project will increase the height of the dam by approximately 5 feet and included the construction of a 500-foot-wide RCC spillway within the central portion of the embankment.

Meander Reservoir Emergency Action Plan Mapping, Mineral Ridge Dam, Mahoning County, OH, Mahoning Valley Sanitary District. Project Director of hydraulic analyses and inundation mapping for Mineral Ridge Dam in Ohio. Work included performing site visits and downstream bridge reconnaissance; performing dam-failure modeling using HEC-RAS for five scenarios, including Sunny Day Breach, Probable Maximum Flood (PMF) Breach, 25 percent PMF Breach, PMF No Breach, and 25 percent PMF No Breach; and preparing inundation mapping and a summary report.

Water Resources Study and Implementation Plan, Doddridge County Water Supply Study, Doddridge, WV, West Fork Conservation District. Senior Project Manager of an engineering study for priority areas in Doddridge County to determine the most cost-effective means of meeting future water demands over a 25-year planning period. Work included identifying surface water sources, including river intakes, pumped storage reservoirs, and conventional reservoirs, that could satisfy projected demands. Tasks also involved determining the safe yield of the town of West Union's current source of supply.

Upper and Lower Hereford Manor Lake Dams Breach Design, Beaver County, PA, *Pennsylvania Department of General Services.* Project Principal overseeing the preparation of a comprehensive plan for controlling sediment-laden runoff from the breach of two earth embankment dams located on Doe Run. The dams are homogeneous earthfill dams, 40 feet high by 450 feet long and 37 feet high by 1,000 feet long, respectively. The erosion control plan covered both the breach and the disposal areas and included diversion-of-water measures to convey off-site flow around the work areas. Responsibilities also included preparation of final construction documents and cost estimates.

Various Dam Safety and Water Resources Engineering Assignments, Specific Outlet Works Inspections at Dams, Chester County, PA, *Chester County Water Resources Authority.* Project Principal heading a team tasked with preparing technical specifications and bidding quotations; coordinating with contractors; and observing the inspection of Beaver Creek Dam's 30-inch-diameter principal spillway conduit and impact basin. To date, a manned-entry inspection of Barneston Dam's 4-foot by 4-foot principal spillway conduit during low-flow conditions has been completed. The inspection was performed from downstream proceeding upstream, with each joint inspected along its perimeter. Joint gaps were recorded at each conduit joint.

Various Dam Safety and Water Resources Engineering Assignments, Emergency Action Plan (EAP) Revisions, Chester County, PA, *Chester County Water Resources Authority.* Project Principal overseeing preparation of revised EAPs for four high-hazard dams, including Beaver Creek Dam, Barneston Dam, Hibernia Dam, and Struble Dam.

Indefinite Delivery/Indefinite Quantity Dam Architectural/Engineering Services, Dam Assessments, WV, NH, NM, WI, and ND, *U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS).* Project Principal overseeing preparation of dam assessment reports for 103 NRCS dams located in West Virginia, New Hampshire, New Mexico, Wisconsin, and North Dakota. Work included performing dam inspections; conducting reconnaissance of downstream impact areas; performing dam-failure modeling using HEC-RAS; preparing inundation mapping using ArcGIS; conducting H&H analyses; performing auxiliary spillway analyses using SITES; identifying deficiencies; and developing rehabilitation alternatives and planning-level cost estimations. Work also included estimating persons at risk and completing NRCS risk evaluations.

Indefinite Delivery/Indefinite Quantity Dam Architectural/Engineering Services, Nationwide, *U.S. Department of Agriculture, Natural Resources Conservation Service.* Project Manager and Senior Engineer on work to provide technical oversight and quality reviews for dam assessments, dam designs, and design reviews for dam projects located in West Virginia, New Hampshire, New Mexico, Wisconsin, North Dakota, and Texas. A significant component of this work involved providing hydraulic modeling and developing inundation maps that

depict areas of flood risk in the event of a dam failure. Inundation mapping for more than 80 dams was completed.

Indefinite Delivery/Indefinite Quantity Dam Architectural/Engineering Services, Dam Assessments, WV, WI, ND, NM, and NH, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Senior Project Manager for the preparation of dam assessment reports for 79 dams. Work included performing dam inspections; conducting reconnaissance of downstream impact areas; performing dam-failure modeling using HEC-RAS; preparing inundation mapping using ArcGIS; conducting H&H analyses; performing auxiliary spillway analyses using SITES; preparing failure-risk indexes; identifying deficiencies; and developing rehabilitation alternatives.

On-Call Dam Consulting Services, Reading, PA, City of Reading. Senior Project Manager in charge of various dam safety and water resources assignments, including the rehabilitation of Bernhart Dam, a more than 100-year-old earth embankment structure. Our firm designed a safe means to dewater the reservoir and inspect the dam and also developed long-term solutions to the dam's problems, which included inoperable outlet works, embankment seepage, and sinkholes in the embankment.

Design of Nature-Like Fishway (Bypass Channel) for West Abutment of Sunbury Inflatable Dam, Sunbury, PA, Pennsylvania Department of General Services/Department of Conservation and Natural Resources. Project Principal heading a team to design a nature-like fishway/bypass channel at the west abutment of the inflatable dam on the Susquehanna River in Sunbury, Pennsylvania. This project involved evaluating fishway alternatives and performing a conceptual design study and final design of the selected nature-like fishway alternative. A 15-pool serpentine natural bypass was designed for this 8-foot-high inflatable dam using state-of-the-art fishway design technology developed by Dr. Luther Aadland, who participated as a technical advisor to the design team. The project included detailed bathymetric surveys, site surveys, geophysical surveys, an environmental assessment, hydraulic modeling, public meetings, and regulatory meetings and coordination. Total project costs are estimated to be approximately \$3 million.

Design of Breaches for Upper and Lower Hereford Manor Lake Dams, Beaver County, PA, Pennsylvania Department of General Services. Senior Project Engineer for technical support and reviews of breaches for the Upper and Lower Hereford Manor Lake Dams located on Doe Run in Beaver County. The Upper and Lower Hereford Manor Lake Dams are homogeneous earthfill dams 40 feet high by 450 feet long, and 37 feet high by 1,000 feet long, respectively. The project included subsurface investigations; bathymetric and land topographic surveys; H&H analyses; gas, electric, and communications utility relocations; preparation of design reports, contract drawings, and specifications; and permitting coordination with the Pennsylvania Department of Environmental Protection, the U.S. Army Corps of Engineers, the Federal Aviation Administration, and the Pennsylvania Department of Transportation. The project also

included reestablishing Doe Run downstream of the Lower Dam and designing a new 8-foot-high by 12-foot-wide box culvert to convey the reestablished stream under a state highway.

Tenaska Water Supply Feasibility Study, DeHart Dam, Dauphin County, PA, Harrisburg Water Authority. Project Principal in charge of the safe-yield analyses for the Authority's water supply system and the potential for transfer of water to Tenaska, Inc., for a proposed power-generation facility. Work included developing a computer model and hydrologic database to simulate the daily operation of the reservoir for the period of transposed streamflow record from 1929 to 2011. Safe yield for a range of possible operating conditions was investigated based on computer model simulation. Results were summarized in a letter memorandum.

Indefinite Delivery/Indefinite Quantity Dam Architectural/Engineering Services, Upper Deckers Creek Site 1 Safe-Yield Study, Preston County, WV, U.S. Department of Agriculture, Natural Resources Conservation Services (NRCS). Project Manager for an assessment of safe yield at Upper Deckers Creek Site 1. Work included developing a computer model and hydrologic database to simulate the daily operation of the reservoir for the period of transposed streamflow record from approximately 1910 to 2011 and investigating safe yield for a range of possible storage conditions based on computer model simulation and on requirements in compliance with the West Virginia Division of Health Guidelines. Tasks involve preparing drawdown statistics, a safe-yield-probability relationship, and a summary report.

Litigation Support Services, Wilkes-Barre, PA, Powell Trachtman Logan Carrle and Lombardo. Project Principal of a team providing litigation support services for Rokom (doing business as Woodlands Inn & Resort) versus CECO Associates and Commonwealth of Pennsylvania Department of Transportation in support of CECO Associates. Performed field reconnaissance; gathered data; and performed H&H analyses related to the November 2006 flooding, claimed to be caused by the design of the culvert.

Conceptual Study Rehabilitation and Design of Rock-Ramp Fishway at Shenango Intake Dam, Conceptual Study of Alternatives, Sharon, PA, Aqua Pennsylvania, Inc. Project Manager for a Conceptual Study of Alternatives Report featuring modification alternatives for public safety improvements at Shenango Intake Dam, a 110-foot-long low-head dam in the Shenango River in Sharon, Pennsylvania. Alternatives considered included grouted boulder fill on the downstream face, a rock-ramp fishway, and structural modifications to the dam. Hydropower alternatives were also analyzed from a regulatory, construction, and cost-feasibility perspective. The rock-ramp fishway was designed using technology developed by Dr. Luther Aadland, who participated as technical advisor to the design team.

Final Design for the Rehabilitation of Martin Lake Dam, Balcones Canyonlands National Wildlife Refuge, TX, U.S. Department of the Interior, U.S. Fish and Wildlife Service. Senior Project Manager for conceptual and final design of modifications to rehabilitate the 24-foot-high Martin Lake Dam, a high-hazard embankment dam with inadequate spillway capacity and seepage issues. The final design included converting the embankment to a roller-compacted concrete

(RCC) drop structure with overtopping protection and new outlet works. The project also included geotechnical subsurface exploration, geophysical investigations, hydraulic analyses, an environmental assessment, and site surveys.

Jenkintown-Wyncote Station Parking Garage Facility, Philadelphia, PA, *Southeastern Pennsylvania Transportation Authority.* Project Principal in charge of conducting a detailed H&H study for the downstream and upstream reaches of Tookany Creek near the intersection of Glenside Avenue and Greenwood Avenue for the Jenkintown-Wyncote Station platforms and parking garage project. Tasks included collecting and analyzing topographic data of the channel and floodplains, as well as streamflow data; performing flow-duration analysis; building and calibrating a HEC-RAS hydraulic simulation model; and performing hydraulic model runs for various parking garage layout scenarios, including modeling a proposed access bridge. The project also included coordination with floodplain management officials from local municipalities.

Bathymetric Survey, Chester County, PA, *Chester Water Authority.* Project Principal overseeing the assessment of changes in storage capacity within Octoraro Reservoir. A bathymetric survey of the reservoir was performed and compared to a 1998 survey. Deliverables included contours of the reservoir bottom, computation of reservoir volume, and a technical report discussing methodology and documenting changes with time.

King William Reservoir Concept Confirmation, Design, Bidding, and Construction Services, King William County, VA, *City of Newport News Waterworks.* As Project Engineer, performed tasks involving an 88-foot-high, 700-foot-long earthfill dam with more than 2 miles of Virginia Department of Transportation primary Route 626 relocation. The project was halted about halfway through the concept confirmation due to the suspension of critical environmental permits. Work completed included more than 1,600 LF of subsurface drilling in 19 holes; tabletop evaluation of core and shell borrow material; local and nationwide permits to allow the subsurface investigations to be performed; H&H analyses; preliminary outlet works design; preliminary design of Route 626 relocation; a reservoir clearing plan; and an aerial survey for final design.

Potential Failure Mode (PFM) Exercise for a Dam, WI, *Confidential Client.* Participated as Lead Hydrologic and Hydraulic Engineer in the week-long PFM exercise for a dam. The PFM exercise was facilitated by an expert in the field.

ASDSO Dam-Owner Workshops, Bismarck, ND, *Association of State Dam Safety Officials (ASDSO).* As Instructor, conducted 1-day dam-owner seminars for state dam safety agencies throughout the United States. The project included coordinating workshops with ASDSO and state officials; preparing course materials; and conducting workshops.

Waterways Engineering Throughout Pennsylvania, Earth Spillway Integrity Evaluation/SITES Seminar, Harrisburg PA, *Pennsylvania Department of Environmental Protection*

(PADEP). Senior Project Manager for work that involved developing and delivering a 2-day seminar on evaluating the integrity of earth spillways using the Natural Resources Conservation Service's SITES computer program. Co-lectured the seminar with Mr. Darrell Temple and Mr. Danny McCook. The seminar was presented to approximately 40 engineers from the PADEP and Department of Conservation and Natural Resources along with engineers from our firm.

Lost River Site No. 16, Dam Break Analysis and Inundation Mapping, Hardy County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. Project Manager on this effort to conduct a detailed DAMBREAK hydraulic analysis for Lost River Dam No. 16 in Hardy County, West Virginia. The analysis included reviewing existing hydrologic and hydraulic data; collecting topographic data from the U.S. Geological Survey digital topographic database and survey; and developing a detailed hydraulic model using HEC-GeoRAS, HEC-RAS, and ArcView software. The model was performed to simulate dam-failure scenarios, including sunny day failure and probable maximum flood failure, and to predict the flood extents and water surface elevations from the flood waves for each scenario. Tasks also included modeling temporary structures, including bridge structures within the HEC-RAS model, and plotting the inundation limits for each scenario.

Upper Occoquan Dam, Fairfax, VA, Fairfax Water. Project Principal for technical oversight for field investigations and conceptual, preliminary, final, and design support services during construction for outlet works upgrades to the existing 70-foot-high by 740-foot-long Upper Occoquan Dam built in the late 1950s to impound the 10 Bgal Occoquan Reservoir. Upgrades consisted of modifying three outlet works structures at the dam. The primary modified structure involved a large concrete intake and powerhouse building containing a 1,000 kW hydroelectric station. The hydro-station was decommissioned to allow for construction of a new 70-foot-high concrete control tower and related appurtenances to increase outlet works capacity to current industry guidelines for reservoir draining. Other upgrades included adding custom-designed slide gates and a new trash rack and debris removal system to an adjacent structural steel raw water intake to better control unfavorably high manganese levels, adding piping interconnections between the new control tower and existing raw water lines, and lining a 70-foot-high concrete screen chamber silo with a polyvinyl chloride (PVC) membrane to abate seepage and alkali-aggregate reactivity. With hydro-station decommissioning at both the upper and lower dams, the project also involves assisting the owner with surrendering its current FERC license and transferring regulatory jurisdiction to the Commonwealth of Virginia. Services also included conducting emergency action plan (EAP) exercises with more than 50 participants and performing inspections and reporting in accordance with FERC requirements.

Conowingo Dam Fishing Wharf and Trail Enhancements, Darlington, MD, Exelon Generation Company, LLC/Exelon Power. Project Principal overseeing the design and permitting of various recreational improvements located along the Susquehanna River downstream of the Conowingo Dam hydroelectric power plant. Improvements in Cecil County included a new

2,400-foot walking trail, a trailhead parking area, and an associated driveway entrance along S.R. 0222. Improvements in Harford County included a new Americans with Disabilities Act (ADA)-accessible fishing wharf located approximately 500 feet downstream of the dam. The fishing wharf design included an overlook area, a 250-foot-long ADA-accessible walkway, sculptural oversized steps for able-bodied fishermen, and a 160-foot-long fishing pier containing 14 ADA-accessible fishing stalls. The operation of the hydroelectric power plant created water elevations at the fishing wharf that varied by as much as 9 feet every day. A post-and-lagging wall design was used for the fishing wharf, which allowed construction to be performed in the wet. Construction activities were scheduled to comply with instream work restrictions associated with migratory fish. The design was completed in 2008 and construction was completed in 2009.

Phase I Dam Investigations and Dam-Owner Training for 16 High- and Significant-Hazard Dams, Island of Oahu, HI, State of Hawaii, Department of Land and Natural Resources (DLNR).

Assistant Project Manager overseeing the inspection and preparation of Phase I inspection reports for 16 high- and significant-hazard dams on the island of Oahu, Hawaii. Responsibilities included performing detailed inspections of each dam; reviewing available plans, reports, and studies; and preparing detailed inspection reports with recommendations for addressing deficiencies. Project tasks also involved meetings with DLNR and conducting a 3-day training seminar for more than 100 attendees, including dam owners, regulators, design engineers, first responders, and other interested parties at the conclusion of the study.

Dam Safety for Nationwide U.S. Fish and Wildlife Service Dams, Dam Safety Modifications to the High-Hazard Dams on the Crab Orchard National Wildlife Refuge, Marion, IL, U.S.

Department of the Interior, U.S. Fish and Wildlife Service (USFWS). Senior Project Manager heading the team analyzing and preparing designs for improvements to Crab Orchard Dam, Devils Kitchen Dam, and Little Grassy Dam. Devils Kitchen Dam consists of a 100-foot-high concrete gravity dam constructed between 1943 and 1959. Services provided for this dam included performing field seismic study review, field surveys, hydraulic analyses, stability analyses, and subsurface investigations, in addition to drilling new drains, installing new instrumentation, replacing and automating outlet works actuators, and designing articulated concrete block armoring for the auxiliary spillway. Crab Orchard Dam is a 35-foot-high, 2,500-foot-long earth embankment with a concrete ogee service spillway and a four-bay fuse-plug spillway. Services provided for this dam included performing monument surveys; removing fish screens from the 300-foot-long service spillway; and designing modifications to the outlet works actuators, concrete repairs, and eroded areas of the embankment. Little Grassy Dam is a 50-foot-high, 2,400-foot-long embankment dam with a concrete service spillway and a two-bay fuse-plug auxiliary spillway. Services provided for this dam included emergency repairs to the outlet works gate operators, redesign of the outlet works control house, design of concrete repairs, and evaluation of the stability of the service spillway. USFWS Safety Evaluation of Existing Dams inspections, emergency action plan functional exercises, and updates to the standard operating procedures were also performed for each dam.

Ryerson Station State Park Dam, Greene County, PA, Pennsylvania Department of Conservation and Natural Resources. Senior Project Manager reviewing hydraulic analyses for the conceptual design of dam rehabilitation alternatives for the existing concrete gravity dam. Prepared spillway discharge rating curves for the existing spillway based on the U.S. Department of the Interior, Bureau of Reclamation's methodology presented in *Design of Small Dams*. Performed hydraulic analyses using the U.S. Army Corps of Engineers HEC-RAS computer model to assess tailwater conditions during extreme flood events.

Evaluation of Flood-Related Human Mortality and Morbidity Risks in New Orleans, LA, U.S. Army Corps of Engineers (USACE). Assistant Project Manager on this study using the LifeSim model to simulate a levee break event following the flooding from Hurricane Katrina. The model was calibrated using fatality records in five parishes of greater New Orleans. LifeSim estimated potential life loss for future events using updated population-at-risk estimates. The results were used by the USACE in a risk assessment study to inform decision makers of the residual risk that exists after hurricane events and investigate possible risk reduction measures.

Water Resources Study, Morgan County, WV, Eastern Panhandle Conservation District. Senior Project Manager in charge of preparing an engineering study for a priority area of Morgan County to determine the most cost-effective means of meeting future water demands over a 25-year planning period. Work involved identifying surface water sources, including a pumped storage reservoir or a conventional reservoir, to satisfy projected demands.

Hillside Filter Dam and Huntsville Intake Dam Removal Projects, Luzerne and Lackawanna Counties, PA, Pennsylvania American Water. As Project Engineer, secured an emergency permit from the Pennsylvania Department of Environmental Protection to remove two run-of-the-river concrete dams; reestablish the stream channel; reconstruct 200 LF of right streambank; and remove gravel deposits. The permit application included preparing a plan for the stream restoration work.

C-1 Canal Rediversion Project - 60 Percent Design, Brevard County, FL, St. Johns River Water Management District. Senior Project Manager in charge of providing the 60 percent design of the C-1 Canal rediversion. The C-1 Canal is located in coastal Brevard County and discharges to the Indian River Lagoon via Turkey Creek. The C-1 Canal is the central component of a 100-square-mile drainage and control system constructed in the 1920s to provide flood protection to 80,000 people and also carries large volumes of freshwater, nutrients, and sediments from the historic St. Johns River floodplain eastward to Turkey Creek and the Indian River Lagoon. The purpose of this project was to divert a portion of the surface water in the C-1 Canal and its drainage basin by pumping it back into the St. Johns River following treatment in the Sawgrass Lake Water Management Area, which was expected to improve the water quality in the Indian River Lagoon by reducing the fresh water contribution from the canal drainage basin. The design involved the MS-2 structure, the realignment of the C-37 Canal, and an access bridge across the C-37 Canal. The MS-2 structure is a 140-foot-wide by 8-foot-high weir structure

across the C-1 Canal and includes three overshot weir gates and an access bridge across the canal.

Safety Evaluations of Existing Dams (SEED) Inspections and Dam Safety Engineering Services, Various Locations Throughout the U.S., U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS). Senior Project Manager heading a team coordinating and performing dam safety services for the USFWS through two consecutive 5-year indefinite delivery contracts. Work included SEED inspections for dam, as well as their design for repair, modification, and new construction. Tasks also included performing H&H modeling; performing dam-failure modeling using HEC-RAS and GIS mapping; providing emergency action plan updates; and conducting preparedness exercises. USFWS dams were inspected in Virginia, North Carolina, South Carolina, New Hampshire, Massachusetts, Michigan, North Dakota, South Dakota, Illinois, Texas, Wisconsin, Missouri, Tennessee, and Arkansas.

Value Engineering Studies for Martin Lake Dam, Balcones Canyonlands National Wildlife Refuge, TX, and Visitors Center Dam, IL, U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS). Senior Project Manager for value engineering studies of dam rehabilitation designs at the Martin Lake Dam and Visitor Center Dam requested by the USFWS. Work included performing site inspections; developing cost-saving ideas and concepts; and preparing reports documenting costs, findings, and recommendations.

Susquehanna River Bridge Replacement, Evaluation of Causeway Design for New I-76 Bridge, Fairview Township, York County, and Swatara Township, Dauphin County, PA, Pennsylvania Turnpike Commission. Senior Project Manager for providing litigation support and for evaluating the performance of an existing temporary causeway used to construct a new bridge across the Susquehanna River near Harrisburg. Work included performing extensive statistical analyses of more than 100 years of daily river flows; performing hydraulic modeling using the HEC-RAS model; and evaluating a range of causeway configurations and modifications to minimize construction delays resulting from overtopping.

Dam Design Services, Designing Roller-Compacted Concrete (RCC) Overtopping Protection for Springton Dam, Delaware County, PA, Aqua Pennsylvania, Inc. Senior Project Manager on this effort to prepare hydraulic analyses and conceptual designs of roller-compacted concrete (RCC) overtopping protection and spillway enlargement for Springton Dam, an earthen embankment approximately 70 feet high and 1,600 feet long. The project involved performing a detailed topographic and feature survey, a jurisdictional wetland determination, a bog turtle habitat assessment, and an environmental assessment. Work also included highway bridge replacement and traffic detour studies. Conceptual design drawings and detailed planning-level cost estimates were also prepared.

Indefinite Delivery Contract for Dams, Lost River Site 16, Hardy County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Senior Project Manager in charge of work to complete planning-level studies through final design of a new 90-foot-high zoned

earthfill flood control and water supply dam. Detailed H&H analyses were completed using the NRCS SITES computer model. The model was used to evaluate the proposed spillway susceptibility to erosion damage and breaching. The project also included establishing Global Positioning System (GPS) control, extensive aerial mapping of the Lost River Valley, stakeout of exploratory drill holes and test pits, on-site exploration of subsurface conditions, laboratory testing of soil and rock samples, materials studies, preliminary zoning/design of the earthfill embankment, proportioning of various hydraulic structures, and preparing final design documents for the construction of the dam.

Redbank Valley Intake Dam Rehabilitation, Armstrong and Clarion Counties, PA, Redbank Valley Municipal Authority. Senior Project Manager providing final design of a new concrete gravity dam, water supply intake, and Denil-type fish passage facility to replace the existing dam and eliminate hazardous hydraulic backwash. H&H analyses were performed to assess the impact of the proposed dam rehabilitation, as well as a proposed pump station and proposed water treatment plant upgrades on the water surface profiles of the Redbank Creek. Responsibilities included preparing final design documents and permit applications; conducting public meetings; and providing technical support during construction.

Salt Fork Lake Dam Emergency Action Plan (EAP), Guernsey County, OH, Ohio Department of Natural Resources, Division of Parks & Recreation. Senior Project Manager for the development of the EAP for the 61-foot-high Salt Fork Lake Dam, a high-hazard dam located on Salt Fork Creek in Guernsey County, Ohio. In February 2005, following heavy precipitation, seepage and boils were observed at the toe of the dam. Our firm designed remedial measures. Construction of the new toe drain system was completed in 2006.

Auxiliary Spillway Integrity Evaluations and SITES Analyses for Waynesboro Nursery Dam, Lake Laura Dam, and Todd Lake Dam, Augusta and Shenandoah Counties, VA, Headwaters and Lord Fairfax Conservation Districts. Senior Project Manager in charge of performing auxiliary spillway integrity analyses using the SITES computer model. Performed supplemental watershed analyses using HEC-HMS and performed hydraulic analyses using HEC-RAS. The geologic profiles for each auxiliary spillway were developed by performing subsurface explorations and laboratory testing to characterize the soil and rock materials beneath the spillway.

12th Street Dam - Field Reconnaissance Studies, Increasing Storage Capacity at the Elkins Water Supply Dam, Elkins, WV, Elkins Water Treatment Plant. Project Manager for work inspecting the City of Elkins water supply dam and intake and evaluating the potential for increasing the storage capacity of the system by installing a crest gate on the dam. This project also involved preparing a periodic inspection report and an application for a certificate of approval to register the city's intake dam with the West Virginia Department of Environmental Protection, Division of Dam Safety.

Roanoke Rapids Dam, Roanoke Rapids, NC, Dominion Generation. Senior Project Manager for a quality review of various elements in preliminary investigations of the south non-overflow section of this 3,050-foot-long, 80-foot-high concrete gravity dam. Ongoing monitoring indicated that possible changes were occurring in the structure that could potentially impact the performance of the dam. Tasks performed under this initial study included an inspection of the structure, exploratory borings, petrographic examination of concrete core samples, installation of additional surface monuments and piezometers, point load tests, partial section stability analyses, and review and analysis of instrumentation and drain flow data. The study concluded that alkali-silica reaction in the concrete was leading to structural distress within this section of the dam. Our firm provided recommendations for further investigations, monitoring, and analyses.

Design of Inflatable Dam/Gate Flashboard Replacement System for a Hydroelectric Project, WI, Confidential Client. Senior Project Engineer for the technical review and development of specifications and contract documents for a state-of-the-art, 4-foot-high flashboard replacement system. The project involved collecting and evaluating technical data and installation options for both rubber dams and hydro gates. The project also included collecting performance data from several dam owners where these systems were installed. The final contract documents were prepared to allow the contractors to prepare bids using either flashboard replacement system.

Flood Studies, Philadelphia, PA, U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA), Region III. As Project Engineer, assisted with coordinating work and providing technical guidance and review of H&H analyses. Our firm, in a joint venture, was issued task orders to develop Digital Flood Insurance Rate Maps (DFIRMs) and flood insurance studies (FIS) for Clinton and Centre Counties, Pennsylvania, in accordance with FEMA DFIRM geographic information system (GIS) database specifications. Responsibilities involved combining the effective FIS and flood hazard mapping information for 65 communities within Clinton and Centre Counties into a single countywide FIS and DFIRM using automated procedures within a GIS environment.

Community Water Supply Capital Program, Charlottesville, VA, Rivanna Water and Sewer Authority. Senior Project Manager for providing safe-yield analyses of an existing 10 mgd municipal water system. The long-term impact of future reservoir sedimentation and a variety of newly imposed minimum instream flow (MIF) release requirements were included in the analysis using a customized computer model to simulate the combined operation of seven reservoirs and two river intakes located throughout Albemarle County. Also investigated water supply expansion options, including raising the existing reservoirs and constructing new reservoirs, to satisfy a 50-year planning horizon. The preferred alternative involved the expansion of the existing Ragged Mountain Reservoir by constructing a new and taller dam immediately downstream of the existing dam. The reservoir would be filled by a combination of natural runoff and pumping from an inter-basin transfer. Services included preparing and submitting a U.S. Army Corps of Engineers joint permit application and additional analyses to

support MIF negotiations with the Virginia Department of Environmental Quality and The Nature Conservancy.

White Tanks Flood-Retarding Structure (FRS) No. 4, Maricopa County, AZ, Flood Control District of Maricopa County. Senior Project Manager of a Natural Resources Conservation Service (NRCS) planning-phase study for the rehabilitation of White Tanks FRS No. 4. The project included the preparation of an NRCS work plan/environmental assessment, which involved developing alternatives for no action; decommissioning/removing the dam; rehabilitating the dam to meet current criteria; and developing a national economic development alternative. Completed unsteady flow analyses using the U.S. Army Corps of Engineers HEC-RAS computer model for the reach downstream of the dam to estimate flood depths and velocities during extreme events for the alternatives under consideration.

Design of Fish Passage Facilities for Sunbury Inflatable Dam, Sunbury, PA, Pennsylvania Department of General Services/Department of Conservation and Natural Resources. Project Manager for designing a fishway at the east and west abutments of the inflatable dam on the Susquehanna River in Sunbury. This project involved evaluating fishway alternatives and performing a physical hydraulic model study of the selected alternative. An 11-pool serpentine vertical-slot fishway with a fish-counting facility was designed at the east abutment of this 8-foot-high inflatable dam using state-of-the-art operating features, including automated inflatable-type gates and real-time Web camera viewing of the fish passage. The design capacity of the fishway is approximately 500,000 American shad annually. The project also involved designing a nature-like fishway at the west abutment of the dam.

Final Design of Fish Passage Facilities at Black Rock and Norristown Dams, Philadelphia, PA, Exelon Power. Project Manager for evaluating fishway types and managing final design for two new Denil-type fishways. Services included ground surveys and bathymetric surveys; subsurface exploration and testing of soil and rock materials; H&H analyses; preliminary design and layout; final design; preparation of plans and specifications; environmental assessments; historical research of cultural resources; permitting; and bid-phase, construction-phase, and start-up services. The Norristown Fishway project was the recipient of the 2008 Association of Conservation Engineers Carl V. Anderson Award of Merit. Both projects were selected to receive a 2009 American Council of Engineering Companies of Pennsylvania Diamond Award for Engineering Excellence.

Elkwater Fork Water Supply Dam, Randolph County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. Assistant Project Manager managing investigations and design of this 130-foot-high, 700-foot-long roller-compacted concrete (RCC) gravity dam with a construction cost of \$33 million. Services included ground surveys and aerial mapping of the dam and reservoir area; subsurface exploration and testing of soil and rock materials; H&H analyses; preliminary design and layout; final design; preparation of plans, specifications, and construction cost estimate (PS&E); and preparation of a construction schedule. Tasks also

included providing bid-phase and construction support services. Construction was completed in 2009.

Zelienople Borough Safe-Yield Study, Zelienople, PA, Borough of Zelienople. Senior Project Manager in charge of completing safe-yield analyses for the Borough's water supply system. The system consists of three "off-stream" reservoirs located on the north side of Connoquenessing Creek. The structures were identified in past inspections to be deficient; the analyses were completed as part of a program for developing remedial solutions for the system. The project also included the preparation of final design plans, development of permits for the selected alternative, and discussions with neighboring water systems to develop an emergency water source for the system's continued operation.

Fellsmere Water Management Area, Soil Cement Embankment Slope Protection, Fellsmere, FL, St. Johns River Water Management District. Project Manager for evaluating upstream-facing systems and slope protection for a 16-foot-high, 10-mile-long embankment. Evaluated slope protection alternatives including riprap, articulated concrete blocks, Fabriform, gabions, and soil-cement. Soil-cement slope protection was determined to have significant cost-saving benefits, which subsequently led to the execution of a comprehensive field exploration and testing program to identify potential suitable on- and off-site soil materials for making soil-cement. More than 40 test pits were excavated within the 6-square-mile reservoir area. Laboratory testing of the soil material was performed in the firm's certified soils laboratory in Harrisburg, Pennsylvania. Material testing included soil classification tests, moisture-density tests, and wet-dry tests of molded cylinders. A comprehensive mix-design program was performed to determine the optimum cement content for different soil materials and the overall most economical soil-cement mix.

Elkwater Fork Dam Safe-Yield and Reservoir-Sizing Study, Randolph County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. Senior Project Manager in charge of assessing the safe yield and sizing of the proposed Elkwater Fork Reservoir. Work included developing H&H data and a custom computer model to simulate the daily operation of the system.

S.R. 0015 Corridor, Section C41, Watershed Analyses, Lycoming County, PA, Pennsylvania Department of Transportation, District 3-0. Senior Project Manager on this effort to complete hydrologic watershed modeling to assess potential magnitudes of increases in peak discharge frequency relationships and runoff volumes associated with proposed S.R. 0015 improvements in Lycoming County, Pennsylvania. Modeling was completed using the U.S. Army Corps of Engineers HEC-1/HEC-HMS computer model using Soil Conservation Service (now Natural Resources Conservation Service) methodology. Watershed parameters were developed using geographic information system (GIS) applications. The hydrologic model included the interaction of existing and proposed roadway culverts and proposed detention basins. Results of these analyses were compared with discharge frequency relationships from the ongoing Lycoming County, Act 167 Stormwater Management Study.

Community Water Supply Capital Program Management, Minimum Instream Flow (MIF)**Release Equipment Conceptual Study, Charlottesville, VA, Rivanna Water and Sewer Authority.**

Senior Project Manager for performing field investigations and developing alternatives for piping equipment to discharge MIF releases at three dams: Lower Ragged Mountain Dam, South Fork Rivanna Dam, and Sugar Hollow Dam. The work consisted of site visits, a review of record drawings and engineering reports, identification of alternative methods of installing valves and flow control measurement devices, and preparation of a letter report documenting the findings.

Community Water Supply Capital Program Management, Source Water Study,**Charlottesville, VA, Rivanna Water and Sewer Authority (RWSA).**

Project Manager on this effort to evaluate the safe yield of the existing RWSA source water system and various expansion options. The long-term impact of reservoir sedimentation and a variety of reservoir conservation release requirements were also evaluated using a custom computer model programmed to simulate the combined operation of seven reservoirs and two river intakes. A detailed hydrologic database for each source of supply was developed for the period of record from 1926 to approximately 2007. Investigated water supply expansion options, including raising the reservoirs and constructing new reservoirs.

Kaufman, Indian Run, Pine Run, and Mount Laurel Dams and Reservoir Improvements,**Schuylkill County, PA, Schuylkill County Municipal Authority.**

Senior Project Manager for preliminary investigations and concept development as part of an overall program to address dam safety deficiencies identified at four earthfill dams by the Pennsylvania Department of Environmental Protection. Services included detailed inspections, topographic surveys and mapping, and H&H analyses to assess spillway capacity, dam embankment, and foundation strength. Screened alternatives for increasing spillway capacity and developed conceptual designs and cost estimates for addressing deficiencies.

Investigations to Lower Birch Run Reservoir, Water Allocation Permit Application,**Chambersburg, PA, Borough of Chambersburg.**

Senior Project Manager overseeing the quality control of investigations, application preparation, and negotiations with regulatory agencies in obtaining a renewed water allocation permit. Services included computer modeling of the watershed and system operations to assess safe yield under various scenarios of demand, conservation release, pass-by, and reservoir operation. The project resulted in the issuance of a 25-year water allocation permit that provided for withdrawal levels meeting projected demand and containing variable multi-stage pass-by requirements based on actual stream flow and reservoir-level parameters.

Water Supply Needs Evaluation, Amelia Court House Source Water Study, Amelia County,**VA, Appomattox River Water Authority.**

Project Manager in charge of evaluating the potential safe yield and construction cost of a reservoir on Jacobs Run. A computer model was programmed

to simulate the daily operation of the reservoir. A hydrologic database was developed for the period of record from 1926 to approximately 2003.

Design of Modifications and Removal of Four Dams on the West Fork River, Clarksburg, WV, Clarksburg Water Board. Senior Project Manager in charge of providing the design of modifications and the removal of four low-head run-of-river dams on the West Fork River in Harrison County, West Virginia, to improve public safety and eliminate the hazardous hydraulic backwash.

Hydrological Safe-Yield Investigations, VA, Confidential Client. Senior Project Manager for developing an application designed to simulate the operation a city's water supply system and assess safe yields for various hydrological conditions. The system consists of five reservoirs, two river intakes, and several deep wells. The application was developed using Visual Basic 6.0 and Access 2000.

Safe-Yield Study of Raw Water Supply System, Chester, PA, Chester Water Authority. Senior Project Manager on this effort to determine the safe yield of the raw water supply system, including the Octoraro Reservoir, in light of the severe 2002 drought. A custom computer model was programmed to simulate the operation of the system on a daily basis for a 91-year period of record, including complex operating rules. The safe yield was expressed as a function of usable storage of the system. A statistical analysis was performed to evaluate the severity of the drought in relation to past drought events. Sensitivity analyses were also performed to evaluate various water supply expansion alternatives and the loss of yield due to reservoir sedimentation.

Quemahoning Whitewater Release Feasibility Study, Johnstown, PA, Cambria Somerset Authority. Senior Project Manager for work providing technical guidance and review for the safe-yield study to evaluate the availability of water for recreational release from the Quemahoning Reservoir to supplement natural streamflows and provide enhanced whitewater boating opportunities downstream. The analysis involved using a customized computer model to confirm availability of water for proposed whitewater releases and providing recommendations regarding operational rules governing the timing of the releases.

Water Resources Studies, Hardy County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. As Senior Project Manager, oversaw water resources studies and associated reports for three sites in eastern West Virginia. The project included evaluating safe yield of two existing reservoirs and one river intake and developing concepts and estimated costs for constructing and operating two water treatment plants.

Design of Inflatable Gate for Kimball Creek Dam Spillway, Calistoga, CA, City of Calistoga. As Senior Project Engineer, provided technical guidance for preliminary and final design services to the prime design consultant for modifications to an existing ogee-shaped concrete spillway. Performed an alternatives analysis for a new 4-foot-high by 58-foot-long inflatable

gate system to be installed on the existing spillway crest and prepared drawings and specifications for the selected alternative, a Bridgestone Inflatable Rubber Dam. The alternatives analysis included evaluating spillway hydraulics, cost, and suitability with existing site geometry for each alternate. The project also included preliminary design of a new control building and remote power supply.

Water Supply Alternatives Study, Petersburg, VA, Appomattox River Water Authority (ARWA). Project Manager on work to identify and evaluate raw water supply expansion alternatives to increase the safe yield of the existing system to meet long-term water supply needs for Petersburg, Colonial Heights, and the counties of Prince George, Chesterfield, and Dinwiddie. Identified, screened, and evaluated 17 water supply alternatives in accordance with the U.S. Army Corps of Engineers' 404 permit guidelines and the U.S. Environmental Protection Agency's National Environmental Policy Act regulations. This project required significant regulatory and resource agency interaction. The final study report included an evaluation of the safe yield, practicality, and environmental impacts of each alternative.

Brown Bridge Dam Spillway Addition, East Bay Township, Grand Traverse City, MI, Traverse City Light and Power. Senior Project Manager in charge of this effort to prepare design and contract documents for the construction of an auxiliary spillway addition at the Brown Bridge Dam hydroelectric facility. The project included site surveys and mapping; preliminary layout and preparation of final design, plans, and specifications for two new roller-compacted concrete (RCC) stepped spillways, earth dike, and stilling basins; hydraulic modeling using the HEC-RAS computer program; riprap design; construction cost estimating; preparation of an engineering hydrologic, hydraulic, and geotechnical design report; a project-specific Construction Quality Control Inspection Program in accordance with Federal Energy Regulatory Commission criteria; and assistance with local and state permit applications.

Marysville Upland Reservoir Safe-Yield Study, Marysville, OH, City of Marysville. Project Manager for work to perform safe-yield analyses for a new 1,400 Mgal upland reservoir for the City of Marysville. The analyses included reconstituting missing streamflow data and developing a computer model to determine the safe yield of the proposed system for different configurations and operating assumptions.

Dam Break Analyses for Emergency Action Plans, Hydraulic Analyses for Washington Dam No. 3, Washington County, PA, Pennsylvania American Water. Project Manager conducting H&H analyses to determine the adequacy of the existing spillway to pass the probable maximum flood.

Open-End Agreement for Geotechnical Engineering, Lake Hauto Dam, Nesquehoning, PA, Pennsylvania Department of Environmental Protection. Senior Project Engineer providing technical review and evaluation of safety rehabilitation permit applications including roller-compacted concrete (RCC) and articulated concrete blocks overtopping/armoring designs for this 35-foot-high earth embankment dam.

Lyman Run Dam – Final Design and Construction, Potter County, PA, Pennsylvania Department of General Services. Project Manager for designing the removal and replacement of the 52-foot-high earthfill dam with a new earthfill dam containing a new 8-cycle, 224-foot-wide labyrinth spillway with a roller-compacted concrete (RCC) foundation. The design included preparing plans, specifications, and an emergency action plan and performing environmental analyses, surveying, geotechnical foundation exploration, permitting, and construction inspection services. Also responsible for overseeing construction-phase professional services, quality assurance services during construction, and start-up services.

FERC, Part 12D, Dam Failure Mode Analysis (FMA) Pilot Study and the Inspection, WI, Confidential Client. Project Engineer/Consultant Safety Inspector participating in the FMA report and the Part 12D consultant safety inspection report (CSIR) for this dam pilot study. The FERC began the development and implementation of a Performance Monitoring Program as part of its Part 12D Dam Inspection Program in the fall of 2001. Participated on the development committee made up of dam owners, consultants, and FERC staff. The development proceeded with a near complete overhaul of the Part 12D inspection report format based upon an FMA approach procedure and the development of a supporting technical information document. In 2002, eight pilot projects were undertaken by the members of the committee to test the procedural process developed through committee brainstorming meetings. After the completion of the pilot exercises, the committee reassembled and revised the preliminary documents based upon field experiences. This was one such pilot study.

Restoration of Bear Creek Timber Crib Dam, Macungie, PA, Bear Creek Historical Society. Project Manager for the design, permitting, and construction-phase services to replace a historic timber crib dam. The 360-foot-long, 18-foot-high dam was replaced with a new 4,600-cubic-yard roller-compacted concrete (RCC) dam with a timber facing to preserve the historic appearance. As part of this project, a Memorandum of Agreement was prepared with the Pennsylvania Historical and Museum Commission and the U.S. Army Corps of Engineers. This project was completed under a design-build contract for \$810,000.

Jackson County Lake Project, Jackson County, KY, Jackson County Water Association and Jackson County Empowerment Zone Community, Inc. As Senior Project Engineer, conducted safe-yield, conservation release, and H&H investigations for a new 132-foot-high, 760-foot-long roller-compacted concrete (RCC) gravity dam to be located on War Fork in Jackson County, Kentucky. The proposed reservoir would have a storage capacity of 4,400 acre-feet to provide 3.5 mgd for municipal water supply as well as to provide a recreation facility.

Environmental Evaluation - Raising Lake Chesdin, Petersburg, VA, Appomattox River Water Authority. Project Manager on this work to perform an environmental evaluation of increasing the normal pool of Lake Chesdin between 1 and 3 feet to heighten safe yield. The study involved performing a rim survey that identified potential negative environmental impacts.

Interaction with resource and regulatory agencies was also initiated to identify issues and assess permitting requirements associated with raising lake levels.

Rehabilitation of Upper Shawme Lake Dam, Sandwich, MA, *Town of Sandwich.* Project Manager for preliminary engineering analyses to rehabilitate Upper Shawme Dam, a 10-foot-high, 190-foot-long earth embankment structure constructed in 1650. Engineering analyses included performing geotechnical exploration; developing conceptual rehabilitation alternatives for the embankment and spillway; and identifying rehabilitation requirements for the fish ladder.

Pohick Creek Dams Nos. 2, 3, and 8, Fairfax, VA, *Fairfax County Department of Public Works and Environmental Services.* Project Principal overseeing an investigation of the structural integrity of the existing emergency spillway for each of these three dams during passage of extreme flood events. The three dams were originally designed by the former Soil Conservation Service (now the Natural Resources Conservation Service) in the late 1960s and early 1970s and are earthfill embankment structures approximately 40 feet high with grass-lined emergency spillways ranging from 70 to 75 feet in width. The investigations included performing subsurface explorations and laboratory testing to characterize the soil and rock materials beneath the spillway and conducting H&H analyses to characterize a range of extreme flood events. Following these analyses, the SITES computer model, which was recently released by the U.S. Department of Agriculture, Natural Resources Conservation Service, was used to evaluate each spillway's susceptibility to soil erosion damage and breaching. The recommended remedial alternative for the three dams consisted of extending the existing emergency spillway beyond the toe of the dam embankment and lining the spillway with articulated concrete blocks to prevent severe soil erosion damage and breaching during extreme floods to bring the dams into compliance with county, state, and federal dam safety regulations.

Identifying and Screening Pumped-Storage Dam Sites Upstream of Brasfield Dam, Petersburg, VA, *Appomattox River Water Authority.* Project Manager for work that involved screening pumped storage dam sites on tributaries in the 1,333-square-mile watershed of the Appomattox River upstream of Lake Chesdin. Considerations for the dam site screenings included maximizing additional safe yield; minimizing construction, operation, and maintenance costs; and minimizing adverse environmental impacts. Conceptual plans and costs estimates were developed for the six sites with the greatest development potential.

Preliminary Design Report for Rehabilitation of Upper and Lower Owl Creek Dams, Tamaqua, PA, *Tamaqua Borough Authority.* Project Manager in charge of evaluating alternatives to rehabilitate and increase the discharge capacity of two water supply embankment dams. The study included performing H&H analyses to define the probable maximum flood hydrographs; screening rehabilitation alternatives; and preparing conceptual designs and cost estimates. The recommended alternative for both dams included abandoning the deteriorated concrete spillways and incorporating a new principal spillway within a new roller-compacted concrete (RCC) overlay at each dam.

Investigations to Lower Birch Run Reservoir, Safe-Yield Study, Chambersburg, PA, Borough of Chambersburg. Project Manager for work to determine the safe yield of the borough's two reservoirs for existing and further-developed conditions. U.S. Geological Survey streamflow records collected in the study watershed between 1961 and 1981 were obtained and statistically correlated with the long-term streamflow records of a downstream gage. Investigations were performed to evaluate the benefits of raising the normal pools of Long Pine Run Reservoir and Birch Run Reservoir and constructing a new dam at the existing intake. A computer model was programmed to simulate the daily operation of the raw water system.

Shavers Creek Spillway/Dam Repair, State College, PA, The Pennsylvania State University. Project Manager for this work to provide screening alternatives for increasing discharge capacity at this 50-foot-high earthfill dam to safely pass the probable maximum flood. The selected alternative included replacing the deteriorated concrete spillway with a new reinforced-concrete spillway; armoring the embankment with articulated concrete blocks; and constructing a new bridge across the spillway. Prepared design drawings and specifications for the selected alternative and provided bid-phase and construction inspection services. This is the highest dam in the United States armored with articulate concrete blocks and the first of its kind in Pennsylvania.

Facing Systems for Roller-Compacted Concrete (RCC) Dams and Spillways, Skokie, IL, The Portland Cement Association. Principal Author of a document presenting and describing the performance of upstream- and downstream- facing systems used worldwide on RCC dams. The purpose of the document is to provide dam designers with state-of-the-art information for designing RCC dams. The document included more than 75 photographs and sketches illustrating the details of 17 upstream-facing systems and 12 downstream-facing systems.

Moshannon Valley District Safe-Yield Study, Philipsburg, PA, Pennsylvania American Water. Project Manager for determining the safe yield of a small water supply system consisting of a reservoir, a spring, and two wells. The study included collecting and analyzing operating data and streamflow data and evaluating the performance of the system using a custom daily flow computer model. Also performed a statistical analysis of the system to establish a safe-yield-probability relationship for the system.

Statistical Analysis of Streamflows for Trout Run, Philipsburg, PA, Pennsylvania American Water. As Project Manager, performed a comprehensive statistical analysis of measured streamflows and spring flows at several locations within a watershed to determine low-flow statistics for the watershed. The study involved correlating concurrent short-term flow records within the watershed with long-term streamflow records at nearby gauging stations.

Roller-Compacted Concrete (RCC) Guide Specifications for Embankment Overtopping and Emergency Spillway Projects, Portland Cement Association. Co-author of guide specifications and commentary for RCC embankment overtopping and emergency spillway projects.

Route 35, Victory Bridge Over the Raritan River, Bridge Scour Report, Middlesex County, NJ, New Jersey Department of Transportation. Project Manager conducting the hydraulic and scour evaluation for a new 4,000-foot-long bridge over a tidal-influenced reach of the Raritan River.

Safe Yield of Tamaqua Dams, Schuylkill County, PA, Tamaqua Area Water Authority. Project Manager determining the safe yield of the reservoirs of three dams. A custom computer model was programmed to simulate the daily operation of the raw water system and determine the safe yield of the system. A hydrologic database was developed for the period of record from 1920 to approximately 2000. The study also determined the reduction in safe yield if one of the dams was decommissioned and breached.

Rehabilitation of Shavers Creek Dam, State College, PA, The Pennsylvania State University. Project Manager on this effort to evaluate alternatives for increasing the spillway capacity of Shavers Creek Dam, a 48-foot-high earth embankment dam with a crest length of approximately 600 feet and a drainage area of 8.3 square miles. Final design, plans, and specifications followed the selection of the rehabilitation alternative.

Supplemental Water Supply Study, Petersburg, VA, Appomattox River Water Authority (ARWA). Project Manager in charge of evaluating sedimentation in the 36-year-old Lake Chesdin and assessing alternatives to increase the safe yield of the system. The sedimentation investigation included digitizing the 1965 reservoir mapping and preparing a difference or sediment map by subtracting the three-dimensional surface of the reservoir measured in a 2000 bathymetric survey from the 1965 reservoir mapping. Alternatives evaluated to increase the safe yield included increasing the storage in Lake Chesdin by installing an inflatable dam on the spillway crest of Brasfield Dam; dredging the reservoir; constructing a new dam on the Appomattox River at Genito; and constructing a pumped storage facility adjacent to the Appomattox River.

Lebanon Source Water Availability Study, Lebanon, PA, City of Lebanon Authority. Project Manager on this effort to analyze sources of supply to determine the safe yield and availability of surplus water. The study involved developing a hydrologic database and a computer program to simulate the daily operation of the city's river intake on the Swatara Creek in combination with a 1.2 Bgal reservoir. The daily simulation of the city's raw water system for several scenarios was performed from 1919 to 1996.

Lake Chesdin Safe-Yield Study, Petersburg, VA, Appomattox River Water Authority. As Project Manager, determined the safe yield of Lake Chesdin, an 11.6 Bgal man-made lake with a 1,333-square-mile drainage area. A computer model was programmed to simulate the daily operation of the raw water system and compute the safe yield of the system. A hydrologic database was developed for the period of record from 1926 to approximately 1999. The study analyzed the impacts that reservoir sedimentation, system operation, and the flow-by requirements have on the safe yield of the system.

Olivenhain Dam, San Diego, CA, San Diego County Water Authority. As Task Engineer, evaluated upstream facing systems for a 318-foot-high, 2,400-foot-long roller-compacted concrete (RCC) gravity dam. A polyvinyl chloride (PVC) membrane facing system manufactured by CARPI was selected and drawings and specifications were prepared. Olivenhain Dam, which involves 1.4 million cubic yards of concrete is the largest and highest RCC gravity dam in the United States.

Wyoming Valley Levee Raising Project, Inflatable Dam Feasibility Study, Wilkes-Barre, PA, Luzerne County Flood Protection Authority. As Project Manager, provided a comprehensive study to evaluate the feasibility of an inflatable dam across the Susquehanna River at Wilkes-Barre. The inflatable dam and associated recreational facilities were part of the mitigation plan for the Wyoming Valley Levee Raising Project. The U.S. Army Corps of Engineers (USACE) had studied concepts for an inflatable dam on the Susquehanna River in the Wyoming Valley. The USACE reconnaissance study concluded that an inflatable dam project was economically justified. Since the reconnaissance study resulted in favorable technical findings for the project, a second-phase feasibility study was commissioned by the Luzerne County Flood Protection Authority to further investigate engineering, environmental, and economic issues and public acceptance of the project. This second-phase study included a detailed evaluation of the total project costs and benefits. Performed a rigorous evaluation of engineering, environmental, economic, and financial issues to identify the optimum project configuration. Evaluated many complex interrelated issues, including water quality, fish passage, recreation, economic development potential, existing infrastructure modifications, construction costs, and operation and maintenance costs. The study also involved extensive regulatory agency coordination and public participation. Total project costs were estimated to be approximately \$14 million. This project received the Consulting Engineers Council of Pennsylvania 2001 Honor Award for Studies, Research, and Consulting Services for Engineering Excellence, as well as the American Consulting Engineers Council's 2001 Honor Award.

Quantitative Risk Analysis of Damage Resulting From Spillway Erosion for Pohick Creek Dam No. 4, Fairfax, VA, Fairfax County Department of Public Works. Project Manager heading a risk analysis of damage resulting from the erosion and breaching of the grass-lined spillway of a 42-foot-high earthfill dam. The analysis included performing H&H analyses; assigning probabilities to extreme precipitation events; and performing emergency spillway erodibility analyses for a range of flood events. Tasks included estimating downstream damages for each event and computing expected annual damages.

Hunting Run Dam, Spotsylvania, VA, Spotsylvania County. As Project Manager, provided conceptual design studies, preliminary design, and final design of a 90-foot-high, 2,200-foot-long composite roller-compacted concrete (RCC)/earthfill dam. The dam creates a 3 Bgal reservoir for pumped storage from the Rappahannock River. The construction cost for the dam and appurtenant structures was approximately \$20 million.

Penn Forest Dam - Final Design and Construction, Bethlehem, PA, *City of Bethlehem.* Project Manager for the preparation of designs, contract drawings, specifications, and cost estimates for elements of eight contracts for the construction of a new 1,940-foot-long, 180-foot-high roller-compacted concrete (RCC) replacement dam. Performed dam stability analyses, dam design and layout, and repair/modifications to existing appurtenances. The new 380,000-cubic-yard RCC dam was buttressed on the downstream face by earth material from the existing embankment dam. The total cost for the project was \$65 million.

Emergency Spillway Erodibility Evaluation, Pohick Creek Dam No. 4, Fairfax, VA, *Fairfax County Department of Public Works.* Project Manager in charge of investigating the integrity of the emergency spillway at Pohick Creek Dam No. 4 and preparing a remedial design to correct deficiencies. Investigations included conducting on-site geotechnical exploration of the spillway; performing hydraulic modeling of the spillway flows using the HEC-RAS computer program; and determining the theoretical eroded profile for the probable maximum flood using the SITES computer program. Assessed the potential damage to the spillway and dam. Prepared three spillway erosion protection alternatives.

Scour Evaluation, Donald Ross Road, West Palm Beach, FL, *Palm Beach County Board of Commissioners.* As Hydraulic Engineer, provided scour evaluation of a bascule bridge over a tidal passage. Determined total scour estimates using Federal Highway Administration HEC-18 guidelines, recent technical papers, and laboratory scour modeling studies.

Motts Run Reservoir, Fredericksburg, VA, *Spotsylvania County.* As Project Manager, provided safe-yield investigations, watershed modeling, and flood investigations related to the development and design of a pump-storage reservoir. The safe-yield investigations involved developing an in-house computer model to simulate pumping from the Rappahannock River to the reservoir using complex operating criteria.

NJ Route 29 Scour Investigations, Trenton, NJ, *New Jersey Department of Transportation.* Project Manager providing hydraulic and scour evaluations for a 2,300-foot-long scour wall located along the east bank of the Delaware River in the city of Trenton.

Raw Water Supply Study, Bethlehem, PA, *City of Bethlehem.* As Hydraulic Engineer, developed reservoir refill and drawdown statistics; revised storage condition curves; and performed detailed safe-yield investigations for a large water supply system. Developed a computer model to simulate the operation of the system for several conditions, including pumped storage and an inter-basin transfer. Prepared more than 70 years of runoff data and other hydraulic information to support the computer modeling. Also prepared quarterly monitoring reports and "worst case" forecasts for use in guiding the operation of the water system during the three-year construction/replacement of the City's primary reservoir.

Dam Design Value Engineering Study, Norfolk, VA, *City of Norfolk.* Hydrologic and Hydraulic Engineer serving on a value engineering team created to review proposed designs for the

rehabilitation of three earth dams. Total proposed construction value was \$20 million. Reviewed proposed designs; evaluated cost-effective alternatives; and prepared a report containing recommendations.

Lost River Dam, Site No. 4, Hardy County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Project Engineer tasked with providing hydraulic design and construction cost estimates of repair alternatives for a 500-foot-wide emergency spillway for an 89-foot-high earthfill dam designed by the NRCS. The rock in the spillway bottom was overexcavated during construction and required corrective measures to restore the channel to design grades.

Penn Forest Dam, Conceptual Design Phase, Bethlehem, PA, City of Bethlehem. As Project Engineer, provided conceptual design studies for the rehabilitation/replacement of a 1,930-foot-long, 145-foot-high earthen dam. Investigations included evaluating nine alternatives to restore the safe yield of the system. Evaluated the most feasible alternatives, which included breaching the dam and identifying new sources of supply; installing an upstream liner and cutoff; constructing a concrete diaphragm core wall; and replacing the dam with a new roller-compacted concrete (RCC) dam. The engineering investigations were reviewed by an internationally recognized board of dam engineering experts, independently engaged by the City of Bethlehem.

Water Resources Study, McDowell County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. As Project Engineer, performed a countywide water resources study. Conducted safe-yield analyses and developed flood control benefit costs for proposed surface water impoundments. The study's recommended plan included constructing two new roller-compacted concrete (RCC) dams. The proposed structures measured 62.5 and 94.5 feet high and 400 and 525 feet long, respectively.

Lost River Dam, Site No. 27, Hardy County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. Civil/ Hydrologic and Hydraulic Engineer for preparation of the final design of a riser structure; conducted hydraulic analyses for a 75-foot-high earthfill flood control dam and appurtenances. Hydraulic analyses included sizing the principal spillway, emergency spillway, outlet works, and diversion facilities. Performed a dam breach analysis using NWS DAMBRK.

Year Open-End Geotechnical Engineering Contract, Bridge Scour Evaluation for the Dualization of the I-695 Bridge Over Bear Creek, MD, Maryland Transportation Authority. As Project Engineer, performed hydraulic analyses for a 3,900-foot-long bridge over a tidal waterway.

North Fork, Hughes River Dam, Ritchie County, WV, U.S. Department of Agriculture, Natural Resources Conservation Service. As Civil/Hydraulic Engineer, provided conceptual design studies, preliminary design, and final design of an 80-foot-high, 600-foot-long roller-compacted concrete

(RCC) dam with a 320-foot-long emergency ogee spillway crest section. This \$17 million dam has a 90-square-mile drainage area.

Ware Creek Reservoir, Williamsburg, VA, James City County. Project Engineer performing safe-yield analyses for a proposed 50-foot-high, 1,450-foot-long water supply dam.

Safe-Yield Study, Norfolk, VA, City of Norfolk. As Hydraulic Engineer, analyzed a complex water supply system consisting of six reservoirs, two river intakes, and several deep wells. This project included reconstituting missing streamflow data and developing a computer model to determine the safe yield of the system for various historical droughts.

Antietam Dam, Dam Breach Analysis, Waynesboro, PA, Borough of Waynesboro. As Hydraulic Engineer, conducted a dam breach analysis; performed site investigations; provided a hydraulic analysis of dam failure using NWS DAMBRK; and prepared inundation mapping.

New Jersey Bridge Scour Evaluation Program, Southern Counties in NJ, New Jersey Department of Transportation. Project Engineer inspecting and preparing evaluation reports for Stage I - Screening and Prioritization of New Jersey bridges. Inspected and evaluated more than 160 bridges in five counties.

Saltlick Dam Rehabilitation, Johnstown, PA, Greater Johnstown Water Authority. As Project Engineer, provided modifications to the 110-foot-high, 835-foot-long Saltlick Dam. Performed a feasibility study, final design bidding services, and general construction inspection services for building two new roller-compacted concrete (RCC) emergency spillways; raising the dam; and repairing various appurtenances. Construction costs for this work were approximately \$5.2 million.

Plymouth Creek Flooding Study and Litigation Support, Philadelphia, PA, Southeastern Pennsylvania Transportation Authority (SEPTA). Civil/Hydraulic Engineer researching and preparing a hydraulic study of the Plymouth Creek in Conshohocken. Researched and determined the cause of flooding at SEPTA's R-6 Regional Rail Line and developed remedial measures. Provided expert testimony and litigation support as a Hydraulic Engineer in a related court case involving SEPTA.

Seepage Reduction Modifications to Lynchwood Lake Dam, Tobyhanna, PA, Lynch Corporation. As Project Engineer, provided seepage-reduction modifications to the Lynchwood Lake Dam. Performed study, design, and construction-phase services for remedial measures related to seepage control and slope stability on this 23-foot-high, 1,600-foot-long earthfill dam.

Quantifying the Cost of Upgrading Nonfederal Earth Embankment Dams, Camp Hill, PA, Association of State Dam Safety Officials. Project Manager for developing a relational computer database containing data from 75 dam rehabilitation projects. Deliverables included a user-friendly program and support documentation for general distribution.

Codorus Creek Local Flood Protection Project, York, PA, U.S. Army Corps of Engineers, Baltimore District. As Project Engineer, provided a feasibility study, preliminary conceptual design, and general inspection for the rehabilitation of a local flood protection project. Conducted inventory of drainage structures; surveyed sediment deposits; and performed a feasibility study for closing gaps in the line of protection.

Remedial Studies for Flood Protection Projects, York, PA, and Hornell, NY, U.S. Army Corps of Engineers, Baltimore District. Civil/Hydraulic Engineer tasked with providing the remedial studies, preliminary design, final design, and general inspection of two flood protection projects. The studies included a detailed inspection of each project and selection of remedial measures to correct conditions of deferred maintenance. Estimated the quantities and costs for the remedial measures. Prepared plans, specifications, and cost estimates (PS&E) and provided construction services for the remediation of the York Flood Protection Project and for Phase I of the Hornell Flood Protection Project subsequent to remedial studies.

Emergency Evacuation Plan, Holmes Run Dam, Fairfax, VA, Fairfax County. As Hydraulic Engineer, prepared an emergency evacuation plan. Analyzed dam failure using the NWS DAMBRK model to compute the translation of various flood waves downstream.

Dam Inspections, PA, VA, NJ, and NY, Various Clients. As Civil/Hydraulic Engineer, provided field inspection and prepared annual and biannual inspection reports for more than 30 dams in Pennsylvania, Virginia, New Jersey, and New York as required by regulatory agencies.

Flood Protection Study, Lackawanna River, Scranton, PA, U.S. Army Corps of Engineers, Baltimore District. As Civil/Hydraulic Engineer, provided engineering investigations of local flood protection measures as part of the reconnaissance study of the Lackawanna River near Scranton. Studies involved conducting hydraulic investigations using HEC-2; designing flood protection structures; and preparing cost estimates for various plans to improve the existing project.

Financial Planning Model for Small Community Water Systems, Pennsylvania Department of Environmental Protection. As Civil Engineer, developed and programmed a computerized financial planning model for small community water systems. The final deliverable, "PAWATER," is a prefeasibility, cost-estimating program for use in computing total costs applicable to planning, design, construction, administration, and maintenance of typical small water systems.

Water Needs Assessment for the Susquehanna River Basin, U.S. Army Corps of Engineers, Baltimore District. Civil/Hydraulic Engineer conducting an assessment of the water supply needs in the Susquehanna River Basin for large municipal, industrial, and agricultural water users. Also prepared estimates of current and future demands, supply shortages, diversion flows, and consumptive uses.

Dam Feasibility Study on the Chemung River, Corning, NY, Three Rivers Development Foundation, Inc. As Hydraulic Engineer, provided a dam feasibility study involving site inspections; investigated the Chemung River hydrology, hydraulics, and morphology; inspected and assessed the existing flood control project condition; evaluated various dredging alternatives to provide a suitable recreation lake; and prepared construction cost estimates for alternative project plans.

Christian E. Siegrist Dam, Lebanon, PA, City of Lebanon Authority. As Project Engineer, provided a quality assurance review of hydrologic analyses and hydraulic design of outlet works and spillway for a new 125-foot-high, 600-foot-long roller-compacted concrete (RCC) gravity dam.

Indefinite Delivery Contract, Analysis of Potential Flood Control Reservoirs, Petersburg and Moorefield, WV, U.S. Army Corps of Engineers, Baltimore District. Civil/Hydraulic Engineer providing analysis of potential flood control reservoirs. The project included inspecting two dam sites in West Virginia and preparing construction cost estimates for each project.

Hills Point Road Shoreline Erosion Protection, Dorchester County, MD, U.S. Army Corps of Engineers, Baltimore District. Civil/Hydraulic Engineer tasked with final design of the shoreline erosion control project. Provided construction specifications and drawings and prepared plans and specifications for a series of segmented breakwaters and a reach of bank stabilization fill. Estimated quantities and construction costs for the project.

Reservoir Modifications, Susquehanna River Basin, U.S. Army Corps of Engineers, Baltimore District. As Civil/Hydraulic Engineer, prepared preliminary design and cost estimates for raising the conservation pools of six major reservoirs located in the Susquehanna River Basin. Estimated costs for replacing recreation facilities and modifying dams and appurtenant structures on this project.

Hydraulic Structures Design and Value Engineering Study for Lowes Island Golf Course, Loudoun County, VA, Kettler & Scott. As Civil/Hydraulic Engineer, reviewed proposed designs and subsequently redesigned a storm sewer with flood gates for the 90-acre golf course.

EXPERIENCE PRIOR TO GANNETT FLEMING:

Flood Insurance Studies, Forsyth County, GA, U.S. Department of Homeland Security, Federal Emergency Management Agency. Hydraulic Engineer conducting flood insurance studies of various streams. Used HEC-2 to determine water levels for various return periods.

Flood Insurance Study, Broward County, FL, U.S. Department of Homeland Security, Federal Emergency Management Agency. Hydraulic Engineer conducting a flood insurance study of a system of canals. Applied unsteady-flow modeling techniques.

Kinley Creek Channel Improvement, Columbia, SC, U.S. Army Corps of Engineers, Charleston District. As Hydraulic Engineer, used HEC-2 to perform hydraulic computer modeling for this improvement study.

Hydraulic/Sedimentation Study, Petitcodiac Estuary, New Brunswick, Canada. Project Engineer investigating mathematical modeling of estuarine sedimentation for well-mixed estuaries in response to man-made changes. Used the NWS DWOPER Model to estimate the hydraulic environment of the Petitcodiac Estuary before and after the construction of a causeway. Applied the results of the model to describe the cohesive sediment transport process and to determine the significance of key hydraulic parameters associated with sediment transport predictions. Outlined a suitable solution procedure for a cohesive sediment transport model.

PROFESSIONAL AFFILIATIONS:

Association of State Floodplain Managers (ASFPM)

United States Society on Dams (USSD)

Hydraulics and Spillways Committee

Committee for Dam Rehabilitation Using RCC

Association of State Dam Safety Officials (ASDSO)

Technical Training Program Committee

Affiliate Member Advisory Committee

Distance Learning Subcommittee

Chairman of Public Safety at Dams Committee

Technical Advisor for Natural Resources Conservation Service (NRCS) Study Work Group

Evaluate Design Tools for Roller-Compacted Concrete Stepped Spillways and Roller-Compacted Concrete Stepped Embankment Armoring

Federal Emergency Management Agency (FEMA) Dam Safety Review Board Private Sector Representative (2009-2011)

PRESENTATIONS AND PUBLICATIONS:

Foos, William F, Paul G. Schweiger and Frank Calcagno. "Safety and Security at Dams is Not Mutually Exclusive." 2016 USSD Annual Conference, April 2016, Denver Colorado.

Schweiger, P.G., Jim Nadeau and Darin Shaffer. "The ABCs of ACBs Part III - ACB Armoring Failure Modes at Dam Embankments and Spillways." 2016 ASDSO National Conference, Philadelphia, PA, September 2016.

Schweiger, Paul G., Gregory L. Richards, Eric Neast, and Amanda J. Hess. "Approaches to Meet Conveyance Capacity Requirements at Dams." Presented at the Canadian Dam Association (CDA) 2016 Annual Conference, Halifax, NS, October 2016.

Aulenbach, Kate E., Paul G. Schweiger, Gregory L. Richards, and Michele Lemieux. "You Never Fail Until You Stop Trying – Developing a Dam Emergency Intervention Toolbox." *The Journal of Dam Safety*, ASDSO, August 2016.

Schweiger, Paul G., Benjamin Israel-Devadason, and Amanda J. Hess. "Reassessing Dam Hazard Classification Consequence Evaluation Using State-of-the-Art Hydraulic Modeling Tools." Presented at the 2015 Canadian Dam Association (CDA) Annual Conference, Mississauga, Ontario, Canada, October 5-8, 2015.

Schweiger, Paul G., Michele Lemieux, Gregory L. Richards, and Kate E. Aulenbach. "You Never Fail Until You Stop Trying – Developing a Dam Emergency Intervention Toolbox." Presented at the Annual ASDSO Dam Safety Conference 2015, New Orleans, LA, September 13-17, 2015.

Schweiger, Paul G. and Benjamin Israel-Devadason. "1-D versus 2-D Hydraulic Modeling" and "Dam Hazard Classification Using 2D Hydraulic Modeling." Presented at the National Dam Safety Technical Seminar No. 22 – Dam Breach Modeling and Consequence Assessment, February 18-19, 2015.

Schweiger, Paul G. "Conveying Lessons Learned from Dam Incidents and Failures." Presented at the 2014 CDA Annual Conference, Banff, Alberta, Canada, October 4-9, 2014.

Schweiger, Paul G. "Elkwater Fork Dam – An RCC Dam Case Study with Unique Design and Construction Challenges." Presented at the 2014 CDA Annual Conference, Banff, Alberta Canada, October 4-9, 2014.

Schweiger, Paul G., Gregory L. Richards, Arthur Miller, James E. Demby, Martin W. McCann, Dean Durkee, Robert A. Kline, Amanda J. Hess, and Kate E. Aulenbach. "Conveying Lessons Learned from Dam Incidents and Failures." Presented at the Annual ASDSO Dam Safety Conference 2014, San Diego, CA, September 2014.

Richards, Gregory L., Arthur Miller, Paul G. Schweiger, James E. Demby, Jr., and Amanda J. Hess. "Selecting and Accommodating Inflow Design Floods for Dams: Beyond the Guidelines." *The Journal of Dam Safety*, Volume 11, Issue 4, ASDSO, January 2014.

Israel-Devadason, Benjamin, Amanda Hess, and Paul Schweiger. "Reassessing Dam Hazard Classifications: Part II Consequence Evaluation Using State-of-the-Art Hydraulic Modelling Tools." Presented at the 2013 National Conference of the Association of State Dam Safety Officials, Providence, RI, September 2013.

Schweiger, P.G., and Darin Shaffer. "The ABCs of ACBs – What Have We Learned 12 Years Later, Armoring Embankment Dams and Earth-Cut Spillways with ACBs." 2013 ASDSO National Conference, RI, September 2013.

Hallahan, Christopher, Paul G. Schweiger, Robert Saber, and Brad Iarossi. "The Devils in the Details at Devils Kitechen Dam." 2013 ASDSO National Conference, RI, September 2013.

Roarabaugh, Donald P., Paul G. Schweiger, Rodney E. Holderbaum, Cari Beenenga, Andy Deichert, and Jeff McClure. "New Life for New Creek Site 14 Dam – A Comprehensive Rehabilitation of an Aging NRCS High-Hazard Earthfill Dam." Paper presented at the 2013 Annual ASDSO Conference, Providence, RI, September 2013.

Richards, Gregory L., Paul G. Schweiger, Arthur Miller, James E. Demby, and Amanda J. Hess. "Selecting and Accommodating Inflow Design Floods for Dams: Behind the Guidelines." Presented at the ASDSO Dam Safety Conference, Providence, RI, September 2013.

Miller, Arthur, Paul G. Schweiger, Amanda J. Hess, Rodney Holderbaum, Robert Kline, Don Roarabaugh, Dennis Dickey, and Gregory L. Richards. "Selecting and Accommodating Inflow Design Flows for Dams" (FEMA 94). Federal Emergency Management Agency, Washington, DC, September 2013.

Miller, Arthur, Paul G. Schweiger, James E. Demby, Jr., Amanda J. Hess, and Gregory L. Richards. "Hydrologic Design of Dams in the United States – Past, Present, and Future." *The Journal of Dam Safety*, ASDSO, April 2013.

Miller, Arthur, Paul Schweiger, James Demby, Amanda Hess, and Gregory Richards. "Hydrologic Design of Dams in the United States, Past, Present and Future." *The Journal of Dam Safety*, Volume 10, Issue 4, 2012.

Schweiger, P.G., Robert T. Saber, and Andrew Deichert. "Elkwater Fork Dam – An RCC Dam Case Study with Unique Design and Construction Challenges." 2012 ASDSO National Conference, Denver, CO, September 15-20, 2012.

Bell, Joseph R., P.G. Schweiger, and Constantine J. Pappas. "Addressing a Moving Outlet Conduit at Stang Lake Dam." 2012 ASDSO National Conference, Denver, CO, September 15-20, 2012.

Israel-Devadason, Benjamin, P.G. Schweiger, and Amanda J. Hess. "Reassessing Dam Hazard Classification: Consequence Evaluation Using State-of-the-Art Hydraulic Modeling Tools." 2012 ASDSO National Conference, Denver, CO, September 15-20, 2012.

Schweiger, P.G., Arthur Miller, Amanda J. Hess, Rodney Holderbaum, Robert Kline, Donald Roarabaugh, and Gregory L. Richards. "Federal Guidelines for Dam Safety: Selecting and Accommodating Inflow Design Floods for Dams (Draft)." U.S. Department of Homeland Security, FEMA, Washington, DC, August 2012.

Paul G. Schweiger, PE, PEng, CFM**RESUME**

Schweiger, P.G., Arthur Miller, Amanda J. Hess, Rodney Holderbaum, Robert Kline, Donald Roarabaugh, and Gregory L. Richards. "Federal Guidelines for Dam Safety: Summary of Existing Guidelines for Hydrologic Safety of Dams." U.S. Department of Homeland Security, FEMA P-919, Washington, DC, July 2012.

Miller, Arthur, Paul G. Schweiger, Amanda J. Hess, Rodney Holderbaum, Robert Kline, Don Roarabaugh, and Gregory L. Richards. "Summary of Existing Guidelines for Hydrologic Safety of Dams." (FEMA P-919). Federal Emergency Management Agency, Washington, DC, July 2012.

Miller, Arthur, Paul G. Schweiger, Amanda J. Hess, and Gregory L. Richards. "Harmonizing the Hydrologic Guidelines for Dam Safety." Presented at the Association of State Floodplain Managers 2012 Annual National Conference, San Antonio, TX, May 2012.

Schweiger, P.G. "Saving Lives While Improving Fish Passage At Killer Dams." *The Journal of Dam Safety*, Volume 9, Issue 2, 2011.

Schweiger, P.G. "Do Yesterday's Designs Meet Today's Standards? An assessment of More Than 100 Aging Earthen Dams." Paper presented at the 2011 ASDSO National Conference, Washington, DC, September 25-29, 2010.

Schweiger, P.G., L. Aadland, D. Roarabaugh, E. Neast, and C. Hoover. "Improving Fish Passage and Public Safety at Low-Head Dams." Paper presented at the 2011 USSD Annual Conference in San Diego, CA, April 2011 and the 2010 ASDSO National Conference, Seattle, WA, September 20-22, 2010.

Johnston, T.W., E.J. Comoss, R.E. Holderbaum, and P.G. Schweiger. "OK, You Built It, Now Show Me That It Will Work." Technical Paper presented at the ASDSO 2009 Annual Dam Safety Conference in Hollywood, FL, September 27-October 1, 2009, and published in the *ASDSO 2009 Annual Dam Safety Conference Proceedings*, October 2009.

Schweiger, P.G., and D. Durkee. "Dam Operation and Maintenance – Pay a Little Now or Pay Dearly Later." Paper presented at the 2009 ASDSO National Conference, Hollywood FL, October 2009, and the Eastern Regional Conference, State College, PA, June 2009.

Schweiger, P.G., and E. Neast. "Solutions for Improving Public Safety at Low Head Dams." Paper presented at the 2009 ASDSO Eastern Regional Conference, State College, PA, June 2009.

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Schweiger, P.G., and M.A. Morrison. "Saving Lives at Killer Dams – Improving Public Safety at Low Head Dams." 2007 46th Annual Conference & Exposition (ACE), Missoula, MT, and 2006 ASDSO Annual Conference, Boston, MA, September 10-14, 2006.

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Kline, R.A., Jr., and P.G. Schweiger. "Grass-Lined Emergency Spillways – How Safe are They in an Emergency?" Paper presented at the ASDSO Southeast Regional Conference, Norfolk, VA, April 19, 2004.

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Hess, Amanda J., and Paul G. Schweiger. "Doing More With What You Have - Using Custom Daily Flow Models for Source Water Investigations." *Proceedings of the American Water Works Association 2002 Annual Conference*, June 16-20, 2002.

Schweiger, P.G. "Timber-Faced RCC Dam - An Historic Look with State-of-the-Art Technology." Portland Cement Association, *RCC Newsletter*, January/February 2002.

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Schweiger, P.G., and R.A. Kline. "Concrete Solutions for Dam Engineers." *The Georgia Engineer*, August/September 2001, pp. 55-56, 2001.

Schweiger, P.G., and R.E. Holderbaum. "The ABCs of ACBs, An Assessment of Articulating Concrete Blocks for Embankment Overtopping Protection." 2001 USSD Annual Meeting and Lecture, Denver, CO, July 30 - August 3, 2001.

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Schweiger, P.G., and A.J. Hess. "Designing Low-Head Dams on Large Rivers in the 21st Century." 2000 ASDSO Annual Conference, Providence, RI, September 25-30, 2000.

Schweiger, P.G., and A.J. (Graham) Hess. "Doing More With What You Have - Using Daily Flow Models for Safe Yield Analyses." American Water Resources Association, Mid-Atlantic Regional Conference, Matamoras, PA, April 26-27, 2000.

Holderbaum, R.E., and P.G. Schweiger. "Roller-Compacted Concrete Guide Specifications and Commentary for Dam Embankment Overtopping and Emergency Spillway Projects." Prepared for the Portland Cement Association, February 2000.

Schweiger, P.G., T.L. Dreese, D.M. Burdick, and V. Tucker. "Evaluating the Performance and Erodibility of Earth Cut Emergency Spillways." Paper presented at the 1999 Annual ASDSO Conference in St. Louis, MO, October 10-15, 1999.

Schweiger, P.G., J.A. Andrews, and W.B. Bingham. "Replacement of a Deteriorated Earthfill Dam With an RCC Gravity Dam - The Penn Forest Dam Replacement Project." Paper presented at the 1999 United States Committee on Large Dams (USCOLD) Lecture Series on Dealing with Aging Dams in Atlanta, GA, May 17-25, 1999.

Schweiger, P.G., R.E. Holderbaum, and W.B. Bingham. "Facing Systems for Roller-Compacted Concrete Dams." Paper presented at the 1998 ASDSO Annual Conference in Las Vegas, NV, October 11-14, 1998.

Schweiger, P.G., J.A. Andrews, and W.B. Bingham. "Modifying Operation of A Large Water Supply System Due to A Threatening Dam Failure." Paper presented at the 1998 USCOLD Lecture Series on Public Awareness, August 10-14, 1998.

Bingham, W.B., and P.G. Schweiger. "The Penn Forest RCC Replacement Dam, USA." *The International Journal on Hydropower and Dams*, Volume Four, Issue Five, pp. 66-68, 1997.

Schweiger, P.G., W.S. Sherman, and R.E. Holderbaum. "Risk Assessment and Design of Temporary Diversion Works for Dams." Paper presented at the 1997 ASDSO Annual Conference in Pittsburgh, PA, September 7-10, 1997.

Schweiger, P.G., S.A. Runkle, and J.A. Andrews. "Modifying Lake Management for a Large Water Supply System due to a Threatening Dam Failure." Paper presented at the 1996 ASDSO Mid-Atlantic Regional Conference, Hershey, PA, June 6-8, 1996.

Schweiger, P.G., and W.B. Bingham. "Quantifying the Cost of Upgrading Non-Federal Earth Embankment Dams." Paper presented at the ASDSO Eleventh Annual Conference, Boston, MA, September 11-14, 1994, and at the 1995 Virginia Dam Safety Conference, Charlottesville, VA, September 7, 1995.

Schweiger, P.G., and S.F. Talian. "PAWATER, A Financial Planning Model for New, Small Community Systems." Paper presented at the 1993 American Water Works Association (AWWA) Annual Conference, San Antonio, TX, April 1993 and at the 1994 AWWA Annual Conference in New York City, NY, June 1994.

Schweiger, P.G., and S.F. Talian. "PAWATER - Financial Planning Model For New, Small Community Water Systems." Paper/Demonstration presented at the Small System Viability Conference II, Colorado Springs, CO, September 14-15, 1991, and at U.S. EPA/AWWA/NEWWA Small System Viability Conference, Durham, NH, December 7-8, 1992.

Schweiger, P.G., W.B. Bingham, and R.E. Holderbaum. "Three Innovative Approaches to Modify the Spillways of Existing Embankment Dams to Accommodate Larger Floods Using RCC." Paper presented at the 1992 USCOLD Lecture Series on Spillway Modifications and Additions to Accommodate Larger Floods, Fort Worth, TX, April 29, 1992.

Schweiger, P.G., and W.B. Bingham. "Rehabilitation of Saltlick Dam." Paper presented at the ASDSO RCC for Dams Conference, Johnstown, PA, July 18-19, 1991.

Bingham, W.B., and P.G. Schweiger. "Rehabilitation of Saltlick Dam, A Case Study in Dam Rehabilitation." Paper presented at the ASDSO Seventh Annual Conference, New Orleans, LA, October 14-18, 1990.

Schweiger, P.G., and Dr. D.I. Bray. "Mathematical Modeling of Unsteady Tidal Flows in a Well-Mixed Estuary to Evaluate the Probable Response Due to the Construction of a Causeway." Paper presented at the 6th Canadian Society of Civil Engineering/Canadian Water Resources Association Atlantic Region Hydrotechnical Conference, Charlottetown, Prince Edward Island, Canada, June 24-25, 1986.

AWARDS:

HydroVision 2016 Technical Papers of the Year (First Place) – Security and Public Safety Around Dams Is Not Mutually Exclusive

President's Award, Association of State Dam Safety Officials, 2014

"National Award of Merit." Presented by the Association of State Dam Safety Officials (ASDSO), September 2005, in recognition of outstanding record of leadership and service in the support of the goals and activities of ASDSO.

FOREIGN LANGUAGE PROFICIENCY:

French (verbal and written)

RESUME

NAME: JOHN K. EGBERT, P.E.

EDUCATION: Master of Science – Civil Engineering
Stanford University – 1964

Bachelor of Science – Civil Engineering
University of California, Berkeley – 1963

PROFESSIONAL STATUS:

Registered Professional Engineer
Oregon, Certificate No. 7076 (Retired)
Washington, Certificate No. 13649
CA Class "A" Contractors License #503740 (Retired)

TEACHING EXPERIENCE:

August 2007 to May 2010
Department of Construction Management
CSU Chico
Chico, CA
Lecturer: Soils Engineering & Soils Labs
Heavy Construction Estimating
Strength of Materials

PROFESSIONAL EXPERIENCE INCLUDING MAJOR PROJECTS:

- I. June 1996 to September 2007
NORDIC INDUSTRIES, INC. (Nordic)
Vice-President – Operations

Nordic is a major rock supplier in Northern CA supplying and placing riprap and other rock products from its own quarries. Nordic, also a general contractor, is experienced in levee construction including the installation of SCB slurry walls. Nordic, in an environmentally sensitive project, removed Clear Creek Dam near Redding CA.

Nordic had continual IDIQ contracts requiring emergency flood fighting response.

- II. January 1987 to May 1996
GIBBONS & REED COMPANY (G&R)
1111 Brickyard Road
Salt Lake City, Utah
Vice President and General Manager
Heavy-Highway Division

G&R constructed Smith and Moorehouse Dam, an earth and rockfill dam, near Kamas, UT.

- III. February 1981 to January 1987
RIEDEL RESOURCES, INC. (Riedel)
4555 No. Channel Avenue
Portland, Oregon

- A. President
Roadway Constructors Corp.
- B. Group Vice President
Western Pacific Dredging Co.
Division of Riedel International, Inc.

Riedel repaired the structural failure of the riverside lock wall at the John Day Dam. This involved precision drilling 10 inch diameter holes through the lock wall concrete into solid rock underlying the lock. Subsequently, tendons were installed and post tensioned to 2,200 tons.

There were 95 drill holes 180 feet deep (+/-). Major concrete repairs were required to the lock wall and to the floor of the lock chamber.

I was the Estimator and on site Project Manager.

Itaipu Dam: Parana River, Brazil and Paraguay.
Riedel did several projects at Itaipu.
I was involved in estimates, contract negotiations and trips to Brazil but not daily management.

Nassariah, Iraq: Channel dredging.
Riedel was a subcontractor to Mendes JR.; the prime Contractor at Itaipu. I estimated, negotiated and actively managed this contract. The on site PM reported to me and I traveled to Iraq often.

IV. April 1977 to June 1980
E.R. FEGERT, INC.
Othello, Washington
General Construction and Engineering Manager

V. 1964 to April 1977
GIBBONS & REED COMPANY
Northwest Division
Portland, Oregon
Assistant Division Manager
Division Engineer and Chief Estimator

John Day Dam: Several Highway and Railroad Relocation projects.

Mossyrock Dam: SW Washington.
Downstream channel alignment and rock slope protection.

Grand Coulee Dam: Third Power Plant Construction.
1. Drill, blast and excavate left abutment concrete from inside a dam gallery.
2. Drill, blast and excavate 30 foot tunnel through granite on a 3:1 slope at the left abutment.

3. Saw cut and remove massive slabs of existing wall concrete from within the existing left power plant.
4. Produce, haul and place rock slope protection downstream on the left abutment; rock size 5,000 lb. plus.

Lower Monumental Dam (Snake River):
Fields Gulch drainage tunnel and rock slope protection.

Ririe Dam (Idaho):
Earth and Rockfill Dam.
150 ft. high concrete Intake Tower with mechanical slide gates and stop logs.
Two span prestressed beam bridge from left abutment to access the Intake Tower.
Drilled, blasted and excavated vesicular basalt for the overflow spillway.
Concrete lining was placed over the base and walls.
A concrete ogee structure was built incorporating steel radial gates to control lake level and flow.
Due to major differing site conditions resulting in significant change orders, I was assigned to the project site full time to handle the change orders, engineering and project management.

Stadium Freeway; I-405 through downtown Portland.
This project included 19 bridge structures and 55 retaining walls (100,000 CY of concrete) in 0.9 miles.

ADDENDUM TO RESUME

JOHN K. EGBERT

Vice President – Operations
Nordic Industries
June 1996 to September 2007

OVERVIEW

I was Vice President – Operations for Nordic Industries, Inc. and reported directly to the President.

Nordic is a general engineering contractor specializing in civil site work, grading and earthmoving, levee construction, land fill construction, pipework, slurry walls and custom crushing. Nordic operates two rock quarries producing a variety of riprap and crushed rock products. In addition, Nordic performs emergency levee repairs during flood events and has several long term contracts for such services.

Nordic is headquartered in Marysville, CA and operates in the western states.

ESTIMATING

CONTRACT ADMINISTRATION

CONSTRUCTION OPERATIONS

My responsibilities in these three areas were similar to those detailed in the “Addendum to Resume” detailing my employment at Gibbons and Reed Company which is included in this package.

EQUIPMENT OPERATIONS

Nordic’s equipment is managed by its General Equipment Manager who is a part owner of Nordic and my involvement in equipment purchasing and shop operations was limited.

I was fully involved with:

- Equipment selection for projects
- Renting equipment
- Set up of Vendors for projects
- Monitoring equipment costs
- Equipment rates
- Environmental regulations

OTHER

Claims and change orders:

I handled all change orders and claims for Nordic

Union/Non-union

Nordic operates as an open shop contractor and I become involved with the Operating Engineers Union when dealing with apprentices.

Financial Reports:

Nordic uses Maxwell as its accounting software. I monitored all financial and cost reports as they related to the projects.

Safety/EEO

I was responsible for Safety on Nordic's projects and was the Company EEO officer.

ADDENDUM TO RESUME

JOHN K. EGBERT

Vice President and General Manager
Heavy Highway Division
Gibbons and Reed Company
Salt Lake City, Utah

OVERVIEW

I was Vice President and General Manager of the Heavy-Highway Division (HHD), as well as an Officer and Director of Gibbons and Reed Company, from January, 1987 through May, 1996. I reported directly to the President.

The HHD operated as a profit center and had its own pool of equipment. I had full responsibility for all estimating, engineering, contract administration, construction operations and equipment operations for the division. A management team comprised of a Chief Estimator/Engineer, an Operations Manager, a General Equipment Manager, and an Office Manager reported to me and together we handled all activities of the HHD. In addition, our Arizona Area Manager reported to me and worked closely with this management team.

The Heavy-Highway Division performed virtually all types of heavy and industrial construction work including, but not limited to, earthwork, rock excavation, open pit mining, concrete structures, all types and sizes of underground pipe, surfacing including crushing and paving, environmental remediation and occasional mechanical work. We did not perform commercial building or residential construction except for civil site work. We worked for both public and private clients in the following states: California, Nevada, Arizona, Utah, Idaho, Wyoming, Colorado and New Mexico.

The HHD was headquartered in Salt Lake City, Utah and had an area office in Tempe, Arizona.

Gibbons and Reed Company was purchased by Granite Construction Incorporated in 1995.

Addendum to Resume

John K. Egbert

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ESTIMATING

I had hands on involvement in all estimates prepared by the HHD. My involvements included the following:

- Review of contract documents, site visits, pre-bid meetings and site investigations
- Input during estimate preparation regarding methods, productions, equipment and schedule
- Bid reviews – these were extensive and involved a page-by-page review of the estimate

Subsequent to the final bid review, the Chief Estimator, the President and myself meet to finalize the bid. This meeting included an equipment analysis, allocation of division overhead, analysis of risks and/or contingencies and established the bid profit.

I signed all bids, proposals, and drafted proposal letters when private clients were involved.

The Chief Estimator, the General Equipment Manager and myself established the equipment ownership and operation rates to be used in the estimates.

CONTRACT ADMINISTRATION

When we were the successful low bidder, our estimators would normally buy out the jobs, write the purchase orders for permanent materials and complete the subcontracts. I signed off on drafts of these documents and eventually signed the actual purchase order and/or subcontract. I took an active part in drafting the language we put on the purchase orders and in the subcontracts.

Our estimators also set up the cost controls for the job including the chart of accounts and control budget. I signed off on both of these project control items.

Addendum to Resume

John K. Egbert

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We generated monthly cost reports for each project. I worked with the Office Manager developing these reports.

In addition, on a monthly basis we reported job cost status for each project, which included the estimated cost to complete and the projected job profit. Review and analysis of these two documents was a priority.

I instituted a system of daily cost reporting and production reporting for each project. We also gathered final job production reports for use in future estimating.

I was also directly involved with our Monthly Progress Payment Estimates submitted to the owners on each project and closely monitored cash flow.

I took an active role in our relationship with owners and was a firm believer in the Partnering concept. We developed relationships with several private owners where we became their exclusive sole source contractor.

CONSTRUCTION OPERATIONS

I met with our management team to initially set up each project.

I visited each job site often and used an extensive check off list to monitor everything that was happening on the job. I particularly focused on methods, schedule, productions and productivity studies and safety. It was not unusual to be on the road three to four days per week.

I utilized these schedule techniques on projects and spent considerable time analyzing all three. They are as follows:

1. The project CPM. This schedule was updated monthly.
2. A three to four week look ahead schedule. This was a bar chart that could be easily understood by anyone.
3. A two week look ahead schedule that was manpower and equipment loaded . These were developed so our foremen could better schedule crews with back-up options.

Addendum to Resume
John K. Egbert
Page 4

During job visits I also studied equipment utilization, needs, applications and repairs.

I met and/or talk daily with the Operations Manager who handled and looked after the day-to-day nuts and bolts and interfaces between projects.

EQUIPMENT OPERATIONS

I was responsible for all equipment owned and/or leased by the Heavy-Highway Division. We had an extensive fleet of cats, scrapers, loaders, trucks, backhoes, drills rollers, etc.

The General Equipment Manager (who reported to me), the Chief Estimator and myself set the ownership and operation rates which were used both for bidding and for charging to the projects on an hourly basis. The goal was to keep the ownership and operation variances (the difference between actual costs and charge out rates) close to break even.

The General Equipment Manager and myself also worked together as follows:

- Equipment selection for projects
- Set up of vendors for projects
- Set up preventative maintenance and repair programs
- Monitoring equipment costs
- Compliance with all environmental regulations

In addition, we were responsible for running our main company shop which handled equipment repairs and servicing for all divisions.

Finally, I was directly involved in equipment purchases and leased equipment decisions.

Addendum to Resume
John K. Egbert
Page 5

OTHER

Claims and Change orders:

I have an extensive knowledge and experience involving claims and change orders. I continually monitored contract documents and the projects to ensure we were being treated fairly and equitably.

Environmental:

I kept current with environmental rules and decisions.

I moved the Heavy-Highway Division into the environmental remediation market quite successfully.

I was a member of the National AGC Hazardous Waste Committee and am Haz Mat Trained. I set up a school in Salt Lake City to teach Haz Mat Training and am certified to teach Maz Mat Training and supervise Haz Mat Remediation work.

Union/Non-Union:

The Heavy-Highway Division operated both union and union free, depending upon the state in which we were operating.

I have negotiated site specific union agreements favorable to us and have successfully resisted union organizing efforts in several states.

I was a trustee for the Carpenters/Cement Masons Pension and Health & Accident Trusts in Utah.

AGC:

I attended the AGC 10-day Advanced Management Program in Dallas in 1993.

Addendum to Resume
John K. Egbert
Page 6

Financial Reports:

We used JD Edwards as our accounting software.

I utilized the following financial and costs reports to monitor the HHD activities:

Daily costs generated by each job

Weekly cost summaries generated by each job

Weekly payroll reports

Monthly cost reports

Monthly job status and job end forecast report

Monthly equipment ownership and operating cost reports together with variances

Quarterly financial statement

Yearly financial statement

Annual audited statement

Financial Results/List of Projects

A yearly accounting of the financial results for the Heavy-Highway Division and/or a list of projects completed during my tenure can be made available for review. These are confidential and, therefore, not available to copy.

Document Content(s)

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