



**Francisco Barrios, MBA, P.E., QP**  
Sr. Civil Engineer/Project Manager

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## Education

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B.Sc., Civil Engineering, University of Colorado, May 2003

M.Sc., Civil Engineering, University of Arizona, May 2010

MBA, Master of Business Administration, Thunderbird School of Global Management, May 2013

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## Registrations/Certifications

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Professional Engineer Arizona (#50454), Colombia, South America (#25202-195870)

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## Experience Summary

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Mr. Barrios has 17 years of experience in the civil/environmental engineering field for the mining industry. He is experienced in design, planning, construction, and project management for various international mining projects. His engineering and environmental international project experience includes tailings storage facilities (TSF), heap leach pads (HLPs), waste dumps, and site water management at scoping, pre-feasibility (PFS), feasibility, and detail engineering level. His international experience includes projects throughout the United States, Canada, Saudi Arabia, and Latin America (Chile, Colombia, Dominican Republic, Mexico, and Nicaragua).

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## Project Experience

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### ***Tailings Dam***

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#### **TSF TAILINGS STEWARDSHIP IMPLEMENTATION, LOS GATOS MINE | CHIHUAHUA, MEXICO**

Project Manager responsible for Global Industry Standard on Tailings Management (GISTM) compliance assessment and developing the Operations, Maintenance and Surveillance (OMS) Manual and Emergency Action Plan (EAP) documents. (Tierra Group, 2021)

#### **TSF STAGE 2 DESIGN, AND CONSTRUCTION QUALITY ASSURANCE (CQA), LOS GATOS MINE | CHIHUAHUA, MEXICO**

Project Manager responsible for the Stage 2 TSF expansion design and construction. (Tierra Group, 2021)

#### **TSF #3 OMS MANUAL DEVELOPMENT, BUENAVISTA DEL COBRE MINE | SONORA, MEXICO**

Project Manager responsible for developing the OMS Manual for TSF #3. (Tierra Group, 2021)

#### **AB/BC TSF OMS MANUAL DEVELOPMENT, HAYDEN MINE | ARIZONA**

Project Manager responsible for developing the OMS Manual for Hayden AB/BC TSF. (Tierra Group, 2021)

#### **TAILINGS STEWARDSHIP DAM SAFETY REVIEW (DSR), ELDER GULCH RAY MINE | ARIZONA**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2021)

#### **TSF TAILINGS STEWARDSHIP ENGINEERING ANALYSIS, EMPIRE STATE MINE | NEW YORK**

Project Manager responsible for supporting the execution of the geotechnical investigation and analyses to provide a baseline characterization of the state and strength of the placed tailings and dam foundation conditions. (Tierra Group, 2021)

#### **TSF STAGE 1 PHASE 2 DESIGN, AND CQA, LOS GATOS MINE | CHIHUAHUA, MEXICO**

Project Manager responsible for the Stage 2 TSF expansion design and construction. (Tierra Group, 2021)

**TSF STAGE 1 PHASE 2 DESIGN, AND CQA, LOS GATOS MINE | CHIHUAHUA, MEXICO**

Project Manager responsible for the Phase 2 TSF expansion design and construction. (Tierra Group, 2020)

**TAILINGS STEWARDSHIP SERVICES, BURITICÁ MINE | COLOMBIA**

Project Manager responsible for implementing Tailings Stewardship Services (TSS) to ensure best management practices are implemented during construction and operations of the Dry Stack Tailings Facility. Work included third-party oversight during the construction phase and developing a Corporate Tailings Management Standard following International Council on Mining and Metals (ICMM) and Canadian Dam Association (CDA) guidelines. (Tierra Group, 2019 to 2020)

**TAILINGS ASSESSMENT, EMPIRE STATE MINE | NEW YORK**

Project Manager responsible for assisting the client in developing a path forward to expand the existing TSF. The project included reviewing existing data, assessing current dam conditions, providing short-term solutions to existing problems, and proposing a scope of work for future development. (Tierra Group, 2018)

**RIPSEY WASH TECHNICAL ASSISTANCE, RAY MINE | ARIZONA**

Project Manager responsible for managing and overseeing all tasks related to the project and providing technical assistance for the Ripsey Wash TSF. The project included a review of proposed work plans developed by the Engineer of Record (EoR) and assisting with the preparation of Request for Proposals (RFPs) for all work plans (diversion channel, highway, fault, starter dam, and upgradient dam). (Tierra Group, 2018)

**TSF STAGE 1 PHASE 1 DESIGN, AND CQA, LOS GATOS PROJECT | CHIHUAHUA, MEXICO**

Project Manager responsible for managing and overseeing the TSF design from conception to permitting and through construction. (Tierra Group, 2018 to 2019)

**HIGRABA TSF EXPANSION, BURITICÁ PROJECT | COLOMBIA**

Project Manager responsible for managing and overseeing the expansion of an existing TSF design from conception to permitting and through construction. (Tierra Group, 2018)

**TAILINGS STEWARDSHIP DSR, MISSION MINE | ARIZONA**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2016 and 2018)

**TAILINGS STEWARDSHIP DSR, HAYDEN MINE | ARIZONA**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2016 and 2018)

**TAILINGS STEWARDSHIP DSR, RAY MINE | ARIZONA**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2016 and 2018)

**DRY STACK TAILINGS MONITORING, SURVEILLANCE AND OPERATIONS SUPPORT, MORELOS MINE | MÉXICO**

Project Manager responsible for supervising and monitoring the dry stack tailings facility. Work included geotechnical field program, monitoring program, technical analysis, and annual inspection and review. (Tierra Group, 2016 to 2021)

**TAILINGS STEWARDSHIP, MARLIN PROJECT | GUATEMALA**

Review the water management plan and water balance as part of the DSR. (Tierra Group, 2015)

**TAILINGS STEWARDSHIP, PEÑASQUITO | MÉXICO**

Review the water management plan and water balance as part of the DSR. (Tierra Group, 2015)

**TAILINGS STEWARDSHIP, CERRO NEGRO | ARGENTINA**

Review the water management plan and water balance as part of the DSR. (Tierra Group, 2016)

**TAILINGS STEWARDSHIP, CAMPO MORADO | MÉXICO**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2016)

**TAILINGS STEWARDSHIP, TENNESSEE MINES | TENNESSEE**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2016)

**TAILINGS STEWARDSHIP, MYRA FALLS | CANADA**

Review design reports, construction reports, OMS Manual, water balance, annual audit reports, site risk assessment, monitoring reports, EAP, and other relevant information as part of the DSR. (Tierra Group, 2016)

**PRELIMINARY ECONOMIC ASSESSMENT (PEA) LEVEL ANA PAULA TSF | MÉXICO**

Project Manager responsible for the design of the TSF at the PEA level. (Tetra Tech, 2015)

**PFS LEVEL FOR TSF, PIEDRAS VERDES PROJECT | MÉXICO**

Technical Lead and Deputy Project Manager responsible for all technical aspects of the TSF, including site selection, civil design, cost estimate, development of design criteria, and design report. (Tetra Tech, 2015)

**ALTERNATIVES TAILINGS STUDY, SULFUROS SAN ANTONIO | CHILE**

Project Manager responsible for the development of the alternatives study. The project included evaluating CAPEX and OPEX for the different alternatives assessed during the study, assessing the optimal tailings to be used (all in HD, Dry Stack, paste), plant location, transportation methods, and others. (Tetra Tech, 2012)

**IN-PIT TAILINGS MANAGEMENT FACILITY, RABBIT LAKE OPERATIONS | SASKATCHEWAN**

Designed the pervious surround for the proposed North Pit Expansion of the existing Rabbit Lake In-Pit Tailings Management Facility. The pervious surround consisted of several permeable layers with the ultimate goal of providing a seepage path for water during tailings placement, facilitating the dissipation of excess pore water pressure, and promoting the consolidation of the tailings under self-weight. (Tetra Tech, 2009)

**DETAIL DESIGN LEVEL FOR TSF EXPANSION, PIEDRAS VERDES PROJECT | MÉXICO**

Project Engineer and Deputy Project Manager responsible for all technical aspects of the TSF at a detailed design level. The project included site selection, cost estimate, development of design criteria, hydrology, and report. (Tetra Tech, 2011)

**NORTH BLOCK TAILINGS DISPOSAL FACILITY (NBTDF) STAGE 7 RAISE, GOLDSTRIKE MINE | NEVADA**

Assisted with the NBTDF Stage 7 design raise. The project included civil design of the tailings dam, diversion channel, and other related structures. Work also included construction oversight and operational monitoring support. (Vector, 2004 to 2007)

**NBTDF STAGE 8 EXPANSION, GOLDSTRIKE MINE | NEVADA**

Preliminary design support for the NBTDF Stage 8 raise. The project included civil design of the tailings dam and operational monitoring support. (Vector, 2004 to 2007)

**GEOTECHNICAL MONITORING SUPPORT, GOLDSTRIKE MINE | NEVADA**

Monitored weekly inclinometers and piezometers for the tailings dam. Assisted with preparing quarterly reports, which included analysis and recommendations while NBTDF Stage 8 was being built. A monitoring plan which included the implementation of new piezometers on the buttress was also executed. (Vector, 2004 to 2007)

**NBTDF DEPOSITION DESIGN, GOLDSTRIKE MINE | NEVADA**

Project Engineer responsible for the simulation of tailings deposition for 3 years. Analyzed several deposition options, such as reversing the slope of the tailings, continuing with the same deposition rate for the first quarter but with a 50% reduction in the production from the east leg, Roaster tailings deposited

from the north and the east, and decreasing the production rate to 6.5 million tons (Mt) per year. (Vector, 2004 to 2007)

**SANTA ROSA TAILINGS DAM EXPANSION, EL LIMON MINE | NICARAGUA**

Resident Engineer responsible for the construction oversight and quality assurance of a 3-meter (m) tailings dam crest raise. A unique design utilizing geogrid reinforced earth allowed the crest to be raised at a near vertical upstream slope, which reduced the downstream rockfill volume by 40% over a conventional downstream raise significantly reducing the time and cost for construction. (Vector, 2004)

**NBTDF DAM EXPANSION, GOLDSTRIKE MINE | NEVADA**

Project Engineer assisting in the construction oversight and quality assurance of NBTDF Stage 7 downstream dam crest raise. The project included placement and testing of waste rock, drain rock, and seal zone materials plus linear low-density polyethylene (LLDPE) liner/geotextile installation. (Vector, 2004)

***Heap Leach***

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**NI 43-101 HEAP LEACH DESIGN, MEXICAN HAT PROJECT | ARIZONA**

Qualified Person (QP) responsible for Sections 17.5, 21.1.9, 21.1.10, and 26.3 and corresponding Sections 1, 25, and 26 related to Mexican Hat HLP. (Tierra Group, 2020)

**IFC HEAP LEACH DESIGN AND CQA, SAPUCHI MINE | MÉXICO**

Technical Lead and Project Manager responsible for the execution of the Sapuchi HLP. (Tierra Group, 2020 to 2021)

**EPCM HEAP LEACH DESIGN, CAMINO ROJO MINE | MÉXICO**

Technical Lead and Project Manager responsible for executing the EPCM of Camino Rojo HLP. (Tierra Group, 2020 to 2021)

**DETAILED HEAP LEACH DESIGN AND CQA PHASE 3, LA INDIA MINE | MÉXICO**

Technical Lead responsible for the heap leach facility (HLF) design and CQA. (Tierra Group, 2020 to 2021)

**HEAP LEACH ENGINEERING REVIEW AND EOR SERVICES, VELADERO MINE | ARGENTINA**

Technical Lead responsible for reviewing the facility design for Phases 1 through 5. The final deliverable included a Root-Cause analysis. (Tierra Group, 2020 to 2021)

**LEAK DETECTION, SAN FRANCISCO MINE | MÉXICO**

Assisted the Project Manager during the field investigation. The project included identification of leak location and detection on three-lined facilities, including ponds and channels. (Tierra Group, 2017)

**CONCEPTUAL HEAP LEACH DESIGN PHASE 3, LA INDIA MINE | MÉXICO**

Technical Civil Lead responsible for the HLF design at the conceptual level. (Tierra Group, 2018)

**DETAILED HEAP LEACH DESIGN PHASE 5, MASCOTA MINE | MÉXICO**

Technical Lead responsible for the HLF design. (Tierra Group, 2018)

**DETAILED HEAP LEACH DESIGN PHASE 4, MASCOTA MINE | MÉXICO**

Technical Lead responsible for the HLF design. (Tierra Group, 2015)

**HEAP LEACH STACKING PLANS, CERRO SAN PEDRO MINE | MÉXICO**

Project Engineer, responsible for designing the stacking plan for a 100-Mt gold heap leaching project located in Central Mexico. The design included grading the pads to accommodate stacking plans considering ore production and leaching time cycles provided by the client. (Tetra Tech, 2007 to 2015)

**HLP PFS DESIGN, ROSEMONT COPPER MINE | ARIZONA**

Technical Lead responsible for the HLP design for Phases 1 and 2. The project included the preparation of the design report, drawing set, technical specifications, and technical analysis. (Tetra Tech, 2007 to 2015)

**HLP FEASIBILITY DESIGN, ROSEMONT COPPER MINE | ARIZONA**

Technical Lead responsible for the HLP design at the feasibility level. The project included the preparation of the design report, technical specifications, and drawing set. Engineering duties included heap leach layout and grading, solution management, site hydrology/hydraulic, and others. (Tetra Tech, 2007 to 2015)

**HEAP LEACH STACKING PLANS, ROSEMONT COPPER MINE | ARIZONA**

Designed the detailed stacking plan for Phases 1 and 2 for a 65-Mt copper heap leaching project. (Tetra Tech, 2007 to 2015)

**HEAP LEACH EXPANSION PAD 7, MESQUITE MINE | CALIFORNIA**

Interim Technical Lead and Project Manager responsible for developing the design criteria and early drawing set. During the interim position, assisted in finalizing the project management plan and budget. (Tetra Tech, 2007 to 2015)

**HEAP LEACH PFS DESIGN, MAGINO MINE | CANADA**

Technical Lead responsible for the design of the HLF. Engineering duties included solution management, site water management, design criteria, drawings, etc. (Tetra Tech, 2007 to 2015)

**HEAP LEACH PFS LEVEL DESIGN, BREWERY CREEK MINE | CANADA**

Technical Lead responsible for the design of the expansion of the HLF for Brewery Creek Mine. The project included site water management, design report, technical specification, design criteria, stacking plans, and development of capital and operating costs for the facility and others. (Tetra Tech, 2007 to 2015)

**DETAILED HEAP LEACH DESIGN AND CQA PHASE 2, LA INDIA MINE | MÉXICO**

Technical Lead responsible for the HLF design and CQA. (Tierra Group, 2015)

**HEAP LEACH DETAIL DESIGN PHASE 3, MASCOTA MINE | MÉXICO**

Technical Lead responsible for the HLF detailed design. The project included preparing the detailed design report, engineering analysis, drawing set, design criteria, and technical specifications. (Tetra Tech, 2007 to 2015)

**HEAP LEACH FEASIBILITY LEVEL DESIGN, BREWERY CREEK MINE | CANADA**

Technical Lead responsible for the design of the HLF expansion for Brewery Creek Mine. The project included site water management, design report, technical specification, design criteria, stacking plans, development of capital and operating costs for the facility, and design of the overall project. (Tetra Tech, 2007 to 2015)

**HEAP LEACH DESIGN AND CQA CELL 11, MINERA SAN XAVIER | MÉXICO**

Project Manager responsible for the Cell 11 HLF design and CQA. (Tetra Tech, 2007 to 2015)

**HLP LEAK DETECTION PROGRAM, MINERA SAN XAVIER | MÉXICO**

Project Manager over Leak Detection activities associated with all the HLFs (Tetra Tech, 2007 to 2015)

**HEAP LEACH CONSTRUCTION DESIGN PHASE 2, LA INDIA MINE | MÉXICO**

Technical Civil Lead responsible for the HLF design at the construction level. (Tetra Tech, 2007 to 2015)

***Civil Design***

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**PRELIMINARY DESIGN OF TOWNSITE STORMWATER DRAINAGE COLLECTION POND, MORENCI MINE | ARIZONA**

Prepared a preliminary design and presented two options for a lined and unlined drainage collection pond. Both options collected stormwater from the townsite area, 2-E, and 3-E Tailings Impoundments. Land Desktop and Civil Design software were used for the grading, calculation of earthwork, and stage-storage curve of the pond. (Tetra Tech, 2007)

**WASTE DUMP DESIGN, LA BODEGA PROJECT | COLOMBIA**

Technical Lead responsible for designing the waste dump facility at the PFS level. The project included data review and initial site selection, site reconnaissance, geotechnical investigation, geometric layout, site condition, design criteria, and site water management. (Tetra Tech, 2011)

**CIVIL/GEOTECHNICAL SUPPORT, LA BODEGA PROJECT | COLOMBIA**

Project Manager responsible for all activities associated with the design and investigation as part of the waste dump and tailings alternative analysis (Tetra Tech, 2012)

**BRUSH CREEK DIVERSION DESIGN, GOLDSTRIKE MINE | NEVADA**

Designed a water diversion channel totaling approximately 5 miles in length. The design included grouted riprap drop structures for grade control and to limit erosion during 100-year flows. Earthwork needed to be balanced to provide the most cost-effective solution. Used HEC-RAS to model the diversion and Civil Design for the earthwork computations and grading. (Vector, 2004 to 2007)

**WILLOW CREEK SPILLWAY DESIGN, GOLDSTRIKE MINE | NEVADA**

Design modifications of the overflow spillway at the Willow Creek Dam to increase the volume of water stored behind the dam that could be used for late-season downstream irrigation. (Vector, 2004 to 2007)

**DOWNSTREAM CHANNEL IMPACTS IMPROVEMENTS, GOLDSTRIKE MINE | NEVADA**

Prepared a set of plans which included road and culverts graded along with profiles and sections of improvements. These improvements extended two 65-inch diameter ID RCP culvert pipes and added an additional 65-inch diameter ID RCP pipe. A 72-inch diameter CMP culvert pipe was added at the guard shack and raised the road 4.2 feet to prevent overtopping. Land Desktop and Civil Design were used for the completion of the study. (Vector, 2004 to 2007)

**RODEO CREEK REALIGNMENT DESIGN, GOLDSTRIKE MINE | NEVADA**

Preliminary design of Rodeo Creek. Work consisted of re-routing the Rodeo Creek Diversion channel to the east and north of the ultimate limit of the Betze-Post open pit, returning the diverted flow to the original stream channel downstream of the pit. North and South alignment options were presented on a drawing set, including plan and profile sheets, typical cross-sections, and details for the channel. (Vector, 2004 to 2007)

***Closure and Reclamation***

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**MORENCI RECLAMATION DESIGN, MORENCI MINE | ARIZONA**

Assisted in the reclamation design of the Columbine Reclamation Project, Reed Lake Reclamation Project, Glory Hole Drainage Project, Railroad Tunnel Drainage Project, and the FMCOP Reclamation Project. These projects included site grading and capping of tailings and process areas, stormwater drainage control, process line relocations, and the installation of stormwater pumping and piping systems. (Tetra Tech, 2008)

**SIERRITA NO. 4 TAILINGS RECLAMATION DESIGN, TWIN BUTTES MINE | ARIZONA**

Assisted in the reclamation design of the No. 4 Tailings Dam associated with the Twin Buttes mine site. The project included stormwater detention ponds construction and as-built documents. (Tetra Tech, 2008)

**ROSEMONT RECLAMATION PLAN, ROSEMONT PROJECT | ARIZONA**

Assisted in designing and preparing documents associated with the reclamation and closure plan. The project included conceptual grading plans and a site water management plan for reclamation activities, visual modeling using ArcGIS, and hydrology calculation. (Tetra Tech, 2009)

**NBTDF CLOSURE DESIGN, GOLDSTRIKE MINE | NEVADA**

Assisted in preparing the closure and reclamation plans for the tailings impoundment. Work included grading the dam embankment, tailings, and spillway using Land Development Desktop and Civil Design software. (Vector, 2004 to 2007)

**AA TSF CLOSURE DESIGN, GOLDSTRIKE MINE | NEVADA**

Assisted in preparing plans and technical specifications for the closure and reclamation of the tailings impoundment. Work included grading of tailings and spillway using Land Development Desktop and Civil Design software. (Vector, 2004 to 2007)

**MORENCI TAILINGS RECLAMATION DESIGN, MORENCI MINE | ARIZONA**

Assisted in the reclamation design of four tailings impoundments at the Morenci Mine site. The project consisted of grading the 2-E, 3-E, SW-2, and 1-W embankments, calculating quantities and cost estimates, and associated stormwater control structures for the reclaimed surface. (Tetra Tech, 2007)

## ***Water Resources and Management***

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### **STORMWATER RESIDENT ENGINEERING, MISSION MINE | ARIZONA**

Project Manager responsible for the construction of the stormwater channel. The project included hydroturn installation, resident engineering, and final as-built submittal to government agencies. (Tierra Group, 2020)

### **STORMWATER DESIGN, MISSION MINE | ARIZONA**

Project Manager responsible for the stormwater design. The project included reviewing the existing design and providing alternative solutions by ranking alternatives based on a qualitative and quantitative scoring system. The preferred alternative was selected and advanced to final design and issued for construction. (Tierra Group, 2018)

### **2D HYDRODYNAMIC MODEL, BURITICÁ PROJECT | BURITICÁ, COLOMBIA**

Project Manager and reviewer of 2D hydrodynamic modeling for the Buriticá Project. (Tierra Group, 2017)

### **BASELINE STUDY, ROSEMONT COPPER MINE | ARIZONA**

Conducted and prepared quarterly/annual reports for the stormwater sampling program, part of the baseline study for Rosemont Copper Mine. Performed the installation and programming of two ISCO 6712 Portable Sampler units, rain gauges, flowmeters, and oversaw the installation of a U.S. Geologic Survey gauging station. Collected and analyzed rainfall/flow level data weekly and included it on the technical memorandum. Some objectives were to provide a framework for establishing baseline surface and seasonal first flush stormwater quality, assessing if individual project watersheds required separate assessments due to phased site development, providing methods and locations for re-sampling perennial reaches under varying conditions, and providing proposed sampling locations prior to permit acquisition. (Tetra Tech, 2007 to 2015)

### **SITE WATER MANAGEMENT STUDY, ROSEMONT COPPER MINE | ARIZONA**

Performed the hydrologic modeling for the site water management using HEC-HMS and Watershed Management System (WMS) software. The project included the preparation of a technical memorandum that presented different hydrologic methodologies and design floods used in the modeling, along with recommendations and final results. (Tetra Tech, 2007 to 2015)

### **SITE DRAINAGE ANALYSIS, MORENCI MINE | ARIZONA**

Conducted hydrology and hydraulics calculations for the railroad, Laydown Yard, Reed Lake, FMCOP, and Columbine drainages using HEC-HMS and HEC-RAS. Analysis was performed using the rational method and TR-55. WMS 7.0 software was used to elaborate hydrographs. Work also included the preparation of technical memorandums for all sites. (Tetra Tech, 2007 to 2015)

### **PUMP ASSISTANCE DESIGN, MORENCI MINE | ARIZONA**

Conducted hydraulics calculations to size pipes for Reed Lake, Laydown Yard, Metcalf, and Core Shed areas using HEC-HMS. The project was intended to assist the client with the pump design for each area under different scenarios. EPANET software was used to model different pump scenarios. (Tetra Tech, 2007 to 2015)

### **B POND DESIGN, AQUIFER PROTECTION PERMIT (APP) AMENDMENT APPLICATION, SIERRITA MINE | ARIZONA**

Responsible for hydraulic and hydrologic analyses of B-Pond Facility. Services included the design of spillways and diversion channels, preparing hydrology and hydraulics reports for the facility, and computing earthwork quantities and materials for a preliminary design cost estimate. The pond embankment was designed to be exempt from the Arizona Department of Water Resources (ADWR) jurisdiction for a dam. The Arizona Department of Environmental Quality (ADEQ) approved the APP Amendment without requests for additional information. (Tetra Tech, 2007 to 2015)

### **STORMWATER ANALYSIS, APP AMENDMENT APPLICATION, HAYDEN OPERATIONS | ARIZONA**

Assisted with developing the watershed model and analysis for assessing the adequacy of the current stormwater retention system at the Hayden project site. The project included building an HMS model to determine the runoff volume from the 100-year, 24-hour storm event for all contributing watersheds and assessing the adequacy of impoundment holding capacities to retain this event; which is the Best Available Demonstrated Control Technology (BADCT) design event for the APP Program. (Tetra Tech, 2007 to 2015)

**APP TECHNICAL ASSISTANCE, ROSEMONT COPPER MINE | ARIZONA**

Assisted in the design of several facilities which were part of the technical APP submittal to ADEQ. The facilities were designed to conform with BADCT, including non-stormwater ponds, process ponds, and an HLF. (Tetra Tech, 2007 to 2015)

**FLOODPLAIN ANALYSIS, ROSEMONT COPPER MINE | ARIZONA**

Conducted hydrologic and hydraulic calculations for the floodplain analysis around the heap area using RiverCAD, WMS 8.0, and HEC-HMS. The study also included the preparation of a technical memorandum. (Tetra Tech, 2007 to 2015)

**PIT DIVERSION CHANNEL, ROSEMONT COPPER MINE | ARIZONA**

Preliminary design of the pit diversion channel. Work included hydrologic and hydraulic calculations using WMS 8.0, HEC-HMS, and HEC-RAS software. A preliminary technical memorandum was prepared for the preliminary study, which included the design of a multi-plate culvert. (Tetra Tech, 2007 to 2015)

**FLOW THROUGH-DRAINS, ROSEMONT COPPER MINE | ARIZONA**

Conducted preliminary design of the flow-through drains, which were part of the Site Water Management Plan. Work included hydrologic and hydraulic analysis using HEC-HMS and Land Development Desktop 2009. (Tetra Tech, 2007 to 2015)

**DETENTION BASINS DESIGN, ROSEMONT COPPER MINE | ARIZONA**

Conducted preliminary design of several detention basins and conducted the overflow analysis. Work included hydrologic analysis using HEC-HMS. (Tetra Tech, 2007 to 2015)

**FLOODPLAIN ANALYSIS USING FLO-2D (THESIS) | SAHUARITA, ARIZONA**

Conducted the floodplain analysis for the town of Sahuarita using FLO-2D. The project included hydrologic and hydraulic calculations, alternative analysis, hydrologic parameter calibration, 2D model simulation of over 30 events, including different storm events, channel size and curve number, and report. (Tetra Tech, 2010)

**PFS WATER MANAGEMENT PLAN, AMERICAN MANGANESE PROJECT | ARTILLERY PEAK, ARIZONA**

Responsible for the design of the Water Management Plan for the proposed manganese project. Work included identifying control structures needed as mining progresses, making recommendations, and determining the studies required to take the PFS to a feasibility-level study. In addition, provided a preliminary cost estimate (30%) to supplement the conceptual water management plan structures proposed for Years 1, 2, 6, 10, 15, 21, and at closure. (Tetra Tech, 2007 to 2015)

***Mining & Environmental***

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**CYANIDE SPECIATION, BURITICÁ PROJECT | COLOMBIA**

Project Manager responsible for overseeing the cyanide speciation study for the Buriticá Project. (Tierra Group, 2019)

**PFS INVESTIGATIVE SERVICES, RHYOLITE RIDGE PROJECT | NEVADA**

Project Manager responsible for the hydrological, hydrogeological, and geotechnical activities in support of the PFS level study for the Rhyolite Ridge Lithium-Boron Project. (Tierra Group, 2018)

**GEOTECHNICAL INVESTIGATION PLANT SITE, LOS GATOS PROJECT | CHIHUAHUA, MEXICO**

Project Manager responsible for the geophysical and geotechnical investigation, laboratory testing, and geotechnical analyses to provide recommendations for foundations and civil works. (Tierra Group, 2018)

**TECHNICAL ADVISORY SERVICES, BURITICÁ PROJECT | COLOMBIA**

Provided technical advisory services to EPCM Team and management during construction. The project included assisting the Project Manager during construction to ensure the project is built in compliance with permit requirements, assisting the development of a site-wide water balance model in GoldSim that could be used for operations, designing the expansion of an existing tailings facility, developing a long-term water supply solution for the project, and supporting management in critical areas to maintain a smooth transition from the development phase through commissioning and operations. (Tierra Group 2017 to 2018)



**PERMITTING AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) SUPPORT, BURITICÁ PROJECT | COLOMBIA**

Project Manager and Technical Lead responsible for supporting several aspects of the EIA process. The project included writing several sections of the EIA to comply with ANLA's terms of reference, reviewing the project EIA submittal, assisting in the technical meeting with a government agency (ANLA), and reviewing the water management areas associated with the project. Work also included preparation of permit amendment and submittal to ANLA. (Tierra Group, 2015 to 2016)

**CONFIDENTIAL PROJECT | ARIZONA**

Project Manager responsible for managing the project and deliverables to the client on time and within budget. Prepared the technical report, which included pit optimization, mine planning, and schedule. Assisted in the pit optimization modeling using Whittle and Gemcom and prepared a conceptual design of the heap leach and waste dump for the scenario. The overall goal of this project was to develop alternative mining plans to minimize up-front capital for future potential reclamation work. (Tetra Tech, 2007 to 2015)

**TRADE-OFF MINE EQUIPMENT, GRAMALOTE PROJECT | COLOMBIA**

Project Manager and Sponsor responsible for leading cross-functional teams to complete the Trade-off Study for a proposed gold mine in Colombia. The objective of this study was to compare (trade-off) and analyze the suitability of contracted services or own in the stages of pre-operation and operation. This also included an analysis of the opportunity to use electrical equipment versus diesel. Each analysis had technical and economic sustenance by generating a detailed CAPEX and OPEX of each service. In addition, the study included an in-country analysis of the benefits and risks of using potential suppliers. (Tetra Tech, 2007 to 2015)

**BENCHMARKING STUDY, GRAMALOTE PROJECT | COLOMBIA**

Project Manager and Sponsor responsible for leading cross-functional teams in completing the Benchmarking study. The purpose of this study was to compare Gramalote's proposed mining costs, shown in the PFS, with mines of similar characteristics. A total of six projects were identified and used for comparison. The benchmarking cases either used existing mines or Greenfield projects having a feasibility-level study completed and available for reference. These operational costs represented the basic operations of mining, including drilling, blasting, loading, haulage, auxiliary costs (maintenance, pit dewatering, roads and water, reclamation), and other costs (mine G&A, misc.). (Tetra Tech, 2007 to 2015)

**DUE DILIGENCE, ANGOSTURA PROJECT | COLOMBIA**

Project Manager and Sponsor responsible for leading cross-functional teams in completing the Due Diligence Technical Report. The main objective of this effort was to identify weaknesses and bottlenecks that could potentially limit the mine plan and production capacity and negatively impact the economics of the Project's PFS. (Tetra Tech, 2007 to 2015)

**PERMITTING AND ENVIRONMENTAL MANAGEMENT SYSTEM (EMS), BALD MOUNTAIN MINE | NEVADA**

Conducted and prepared quarterly reports for the monitoring and sampling of wells, springs, and seeps in the Bald Mountain/Alligator Ridge area. Scope of work included measuring the water level of existing wells, water quality analyses for NDEP Profile I constituents, and implementing a monitoring plan for the baseline study. (Vector, 2004 to 2007)

**EMS IMPLEMENTATION, PUEBLO VIEJO MINE | DOMINICAN REPUBLIC**

Technical Lead responsible for implementing the EMS program for Pueblo Viejo Dominican Corporation (PVDC) using Barrick's RIMS software. The project included preparing and revising the environmental management plans, identifying and entering environmental obligations in RIMS by revising all pertaining documentation like permits, Environmental Impact Statement documents, and lenders documents. In the end, about 3,700 obligations were entered in the EoR and assigned to their respective plans. (Tetra Tech, 2007 to 2015)

**EMERGENCY PREPAREDNESS AND RESPONSE MANAGEMENT PLAN, PUEBLO VIEJO MINE | DOMINICAN REPUBLIC**

Project Manager responsible for supervising and assisting the consultants accountable for preparing the Construction Management Plan for PVDC. (Tetra Tech, 2007 to 2015)

**SLIP DOCUMENT SUPERVISION AND CONSULTANT SUPERVISION, PASCUA LAMA MINE | CHILE**

Client Liaison, responsible for supervising all consultants' work associated with the Supplemental Lenders' Information Package. Serving as the owner's representative, one of the main functions was ensuring that

the project scope was being met within budget and on time, establishing internal/external client communication, reviewing and giving comments on invoices and change orders, and securing final acceptance of the project. (Tetra Tech, 2007 to 2015)

**HCIS, BARIQ CONSTRUCTION PROJECT, GOLD CORPORATION | JABAL SAYID, SAUDI ARABIA**

Project Manager and Technical Lead responsible for evaluating the preliminary design of the Bariq Construction project located in the Kingdom of Saudi Arabia in accordance with the High Commission for Industrial Security Safety and Fire Protection requirements (HCIS). The final work included submitting the Red Package to HCIS, which included establishing a scope of documentation or submissions to HCIS, verifying compliance of document contents related to the HCIS requirements, and providing guidance and comments on the makeup contents of the items required for Amber and Green submission. (Tetra Tech, 2007 to 2015)

**Landfills**

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**BUENA VISTA LANDFILL | AMADOR COUNTY, CALIFORNIA**

Prepared a set of plans for the Phase 2 and 3 final closure. Drawings included waste cut and fill areas, clearing and grubbing, geomembrane grades and limits, final grades, and the landfill gas system details. Volume computations and grading were performed using Land Development Desktop 2007 and Civil Design. (Vector, 2004 to 2007)

**PACHECO PASS LANDFILL | SANTA CLARA COUNTY, CALIFORNIA**

As part of the drainage improvements, designed a compost pad containment pond and landfill detention basin for Pacheco Pass Landfill. The project consisted of grading ponds, creating stage-storage curves, grading access roads, and placing new discharge pipes and culverts due to improvements. (Vector, 2004 to 2007)

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**Professional Affiliations**

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- American Society of Civil Engineers (ASCE)
- Society for Mining, Metallurgy, and Exploration, Inc. (SME); Member
- Project Management Institute (PMI)
- Association of State Dam Safety Officials (ASDSO)

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**Publications / Presentations**

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- Silva M, **Barrios F**, 2016. Stress Redistribution of Adjacent Solution Collection Pipes (co-author), Proceedings of Heap Leach Mining Solutions, Lima, Perú, 18 – 20 October 2016.
- Silva M, **Barrios F**, 2016. Solution Collection Pipes on Slopes (co-author), Proceedings of Heap Leach Mining Solutions, Lima, Perú, 18 – 20 October 2016.
- Barrios F**, 2016. Estrategia Corporativa para la administración de presa de jales. XII Seminario Internacional Minero Sonora. Hermosillo, Sonora October 2016.

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**Employment History**

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<b>CURRENT EMPLOYER</b>	<b>TIERRA GROUP INTERNATIONAL, LTD.</b>
<b>POSITION</b>	Sr. Civil Engineer / Project Manager
<b>YEARS</b>	2015 to Present
<b>EMPLOYER</b>	<b>TETRA TECH, INC.</b>
<b>POSITION</b>	Manager Business Development / Civil Project Manager
<b>YEARS</b>	2014 to 2015

<b>EMPLOYER</b>	<b>TETRA TECH, INC.</b>
<b>POSITION</b>	Colombia Country Manager
<b>YEARS</b>	2010 to 2014
<b>EMPLOYER</b>	<b>TETRA TECH, INC.</b>
<b>POSITION</b>	Project Civil Engineer / CQA Project Coordinator (Latin America)
<b>YEARS</b>	2007 to 2010
<b>EMPLOYER</b>	<b>VECTOR NEVADA, LLC</b>
<b>POSITION</b>	Staff Civil Engineer
<b>YEARS</b>	2004 to 2007

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### Language Proficiency

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Spanish: Native  
English: Fluent (spoken and written)