Statement of Qualifications

Environmental Services

Engineering Analytics, Inc.

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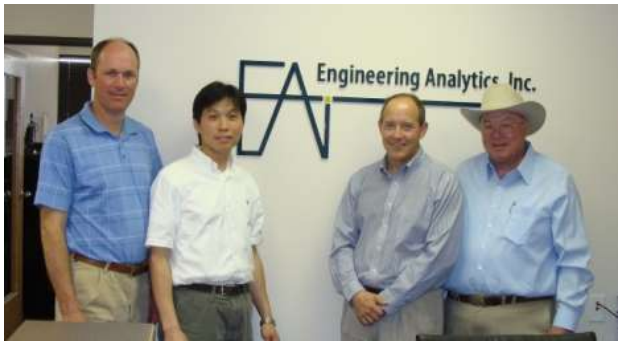
Statement of Qualifications-Engineering Services

Company Overview

Engineering Analytics, Inc. (EA) is an, environmental, civil and geotechnical engineering firm specializing in providing turnkey engineering services to both the public and private sectors. The staff includes approximately 10 engineers, geologists and scientists specializing in environmental, hydrologic, hydrogeologic, reclamation, and geotechnical engineering. Our technical staff forms an exceptionally well qualified and experienced team capable of dealing with the most demanding technical and scientific problems related to site characterization, remediation, construction, operation, reclamation, and closure. EA has recognized expertise in many areas of environmental, remediation, and reclamation engineering. We are experienced, technically outstanding, and conscientious of budgetary constraints, regulatory issues, and client priorities. Our approach to every project is basic: we employ excellent technical personnel who work with our clients to understand their needs and efficiently solve their technical problems. We emphasize common sense and practical approaches, bringing in more sophisticated methodologies only as required.



Qualifications

Environmental Engineering

Engineering Analytics' staff has extensive and diverse experience and expertise in the following range of activities:

Site Assessment and Groundwater Investigations

Engineering Analytics' hydrogeologists and engineers excel in site assessment investigations for both soil and groundwater contamination. EA's staff have performed investigations including:

- Contaminant assessment plans;
- Remedial Investigations;
- Fate and transport analyses of contaminants in both groundwater and soil vapor;
- Surface water sampling and downstream contaminant receptor analysis;
- Design of groundwater and surface water monitoring and sampling networks;
- Single-and-multiple-borehole aquifer tests and tracer tests;
- Dewatering assessments and system design;

Engineering Analytics is experienced in using complex numerical flow and transport models such as MODFLOW, VADOSE/W, TWODAN, SEEP/W, SUTRA/SATRA, and HYDRUS-2D, UNSAT2 and TARGET. EA's staff is experienced in modeling unsaturated flow, interpreting laboratory measurements of unsaturated flow properties, and installing vadose zone instrumentation. We understand the theory, practical application, and limitations of infiltration/seepage codes and can select and apply the appropriate modeling application for your site.

Engineering Analytics' field personnel have experience with most drilling methods, know how to communicate and negotiate with drilling contractors, and understand how to solve the problems that can arise during well installation and development.

Remediation Plans and Activities

Engineering Analytics' staff are experienced in developing corrective action plans, consent orders, reclamation plans, and baseline risk assessments. EA's staff have prepared EPA RI/FS and RD/RA documents. EA's staff have designed and implemented site remedies for contaminants in soil, groundwater, industrial structures and stored wastes. Our contaminant experience ranges from hydrocarbons, halogenated solvents and heavy metals to radionuclides and high explosives.

EA's staff have designed remediation systems capable of handling over 1,200 gpm of contaminated groundwater, thousands of cubic yards of contaminated soil and tens of thousands of drums of stored waste. Methods and processes developed and employed by EA's staff have saved their clients millions of dollars through careful negotiations with regulatory agencies for the use of less expensive remediation technologies while still meeting the requirements of administrative or consent orders.

Engineering Analytics' staff have been responsible for the start up and long-term operation of remediation systems. Performance monitoring, system operation, optimization and routine maintenance are all part of EA's philosophy on system operation. These philosophies are also considered during the design phase of the project so that the client can make educated decisions regarding capital and operational expenditures.

Agency Negotiation

Engineering Analytics' staff have successfully negotiated with regulators from local, state and federal agencies to reduce or eliminate costly requirements on our clients projects. EA's staff are skilled at identifying areas where standard regulatory requirements may not be appropriate. EA's staff have successfully worked with clients and regulatory agencies to develop reasonable approaches to site investigation and remediation while still meeting the project requirements.

Engineering Analytics also provides services in:

- Phase I & II Environmental Assessment Reports
- Site Assessment Investigations & Reporting
- Remediation Design & Construction Oversight
- Environmental Permitting
- Permit and Regulatory Compliance
- Site Closure Reports
- Potable & Wastewater Studies & System Design
- Backflow Prevention Studies

Mining Design and Reclamation

Engineering Analytics provides support and technical expertise for mining clients requiring assistance completing environmental studies, permitting, planning and operational engineering, and reclamation and closure support. EA has the depth and breadth of experience needed to manage projects from planning and development through design, construction, and operation, into monitoring, reclamation, and closure. EA possesses particular expertise in integrating the requirements of both operation, reclamation and site closure into design plans.

Engineering Analytics provides the following services to mining clients:

Mining Operations and Reclamation

Engineering Analytics provides services both directly to mining companies and on projects conducted on behalf of state and federal agencies. Company experience spans the entire life of a mining venture, from exploration and permitting through closure, reclamation and remediation. EA provides a broad spectrum of mining project experience. Specific capabilities are provided in:

- Site Reclamation
- Tailings Impoundments
- Heap Leach Facilities
- Waste Rock Disposal
- Water and Process Fluid Containment
- Roads
- Sediment and Erosion Control
- Pit Stability
- Abandoned Mine Lands

Cover Design for Wastes

Engineering Analytics' engineers have designed cover systems for waste impoundments and disposal areas containing elevated levels of metals and radionuclides. Cover systems are designed with consideration for infiltration control, biointrusion potential, erosional stability, static and seismic stability, establishment of vegetation communities, limiting radon flux, and cost-effectiveness. EA's engineers are experienced in the use of the HELP, SoilCover, VADOSE/W and OPUS programs to model infiltration.

Soil and Liquid Containment

Engineering Analytics' engineers are experienced in the design and permitting of containment facilities, both for solids and liquids. Examples of our containment system project expertise include:

- Mining/Processing Waste Impoundments
- Design of Liner Systems
- Leak Detection Systems
- Geosynthetics and Clay Liners
- Siting and Construction of New Landfills
- Expansion of Existing Landfills
- Landfill Closure

Site Investigation, Construction QA and Field Engineering

Engineering Analytics' staff are capable of conducting both short-term site work and longer term field assignments throughout the US and abroad. Typical field activities that we perform include:

- Site Characterization
- Borrow Material Source Identification and Characterization
- Waste Material Characterization
- Bid Package Preparation and Bid Evaluation
- As-Built Documentation
- Construction Quality Assurance Monitoring and Testing For:
    - Mine Reclamation
    - Mine Waste Storage
    - Heap Leach Facilities
    - Landfills
- Resident Engineer Support for Civil Construction

KEY PERSONNEL

EA has found that our clients return for additional work primarily because of our excellent staff and its reputation for providing what the client wants in a manner that also meets the client's specific project needs. Brief summaries of selected staff members are presented below.

- John D. Nelson, Ph.D., P.E., Principal Engineer
- Daniel D. Overton, P.E., Principal Engineer
- Erik J. Nelson, P.E., Senior Engineer
- Kuo-Chieh (Geoff) Chao, Ph.D., P.E., Senior Engineer
- Michael Malusis, Ph.D., P.E., Senior Engineer
- Adam Hoffman, P.E., Senior Engineer
- Eileen Dornfest, M.S., P.G., C.E.G., Senior Engineering Geologist
- Jason Andrews, P.E., Staff Engineer
- Robert Schaut, P.E., Staff Engineer
- Jong Beom Kang, Ph.D., Staff Engineer
- Denise Weinkauf, Staff Geologist
- Jesse Dunham-Friel, Staff Engineer
- Kristle Hawkins, Staff Engineer
- Keith Morse, Staff Engineer

John D. Nelson, Ph.D., P.E., Principal Engineer

Dr. Nelson was responsible for the development of the Geotechnical Engineering Program, and was formerly the Head of the Civil Engineering Department at Colorado State University. He provides technical direction and senior level review on dam projects. He has worked on numerous dam projects involving safety inspections, geotechnical investigations, raises and repairs. He was involved in many dam design and review projects. Dr. Nelson has also taught graduate level courses and continuing education courses on dam design and operation and maintenance for the past 25 years.

Daniel D. Overton, P.E., Principal Engineer

Mr. Overton has over 23 years of geotechnical and reclamation engineering experience on a diversity of projects. Mr. Overton has served as the project engineer or project manager for many dams and tailings impoundments. Technical specialties include cover design, tailings consolidation, seepage and groundwater analyses, stability analyses, infiltration modeling and determining grading plans, quantities and costs. Mr. Overton has also served as the project engineer or project manager for facilities design of heap leach pads, process solution ponds and waste rock disposal sites. Mr. Overton also has experience in forensic studies, expert witness consultation, expansive soils design, public works projects, foundations for commercial and mid-rise buildings, residential and master planned communities and geotechnical instrumentation.

Erik J. Nelson, P.E., Senior Engineer

Mr. Nelson has over 22 years of experience in site assessment, remediation design and implementation, and geotechnical engineering. He has designed water retention dams and tailings dams for coal, uranium, and copper mine tailings, designed and tested deep foundations for multi-story buildings and grain elevators, been responsible for the design, construction and operation of remediation systems for the treatment of soil and groundwater contamination. He has prepared numerous permit applications including: construction permits, aquifer protection permits, solid waste landfill permits, and environmental resource protection permits. He has also prepared backflow prevention and potable water studies for mines and industrial facilities, prepared remedial investigations, feasibility studies, and remedial designs as well as implementing remedial actions for EPA Superfund sites, and provided construction management services for the construction of large scale remediation systems. In addition, he has provided oversight for large scale grading projects for both commercial and residential projects involving the excavation and placement of up to 44 million cubic yards of soil and the stabilization of large landslide complexes.

Kuo-Chieh (Geoff) Chao, Ph.D., P.E., Senior Engineer

Dr. Chao has over 10 years of geotechnical and reclamation engineering experience on a diversity of projects. Dr. Chao has served as a geotechnical engineer for many dams and tailings impoundments. Technical specialties, including cover design, infiltration modeling, seepage and groundwater analyses, slope stability analyses, tailings settlement/consolidation and liquefaction analyses, hydrologic analyses and other general aspects of geotechnical engineering. Dr. Chao has experience in forensic studies, expert witness consultation, expansive soils design, geotechnical instrumentation and laboratory testing.

Michael Malusis, Ph.D., P.E., Senior Engineer

Dr. Malusis has 15 years of experience in geotechnical/geoenvironmental engineering consulting and research and has specific expertise in the design and performance of geoenvironmental containment systems, including landfill/impoundment liner and cover systems, *in-situ* vertical barriers, and geosynthetic barriers. His expertise includes waste-soil interactions, chemical compatibility testing, clay behavior, contaminant transport through soil and geosynthetic barriers, flow in saturated and unsaturated soil systems, and alternative earthen final covers. Currently, Dr. Malusis is a professor of civil engineering at Bucknell University (Lewisburg, PA) and is a part-time employee for EA. Dr. Malusis previously worked as a project manager and senior engineer for numerous projects involving design, construction, and/or performance analysis of landfills, tailings impoundments, soil-bentonite cutoff walls, and evapotranspirative covers.

Adam Hoffman, P.E., Senior Engineer

Mr. Hoffman has over 20 years of engineering experience. He has specific expertise in site characterization and remediation. Other areas of work experience include engineering design, regulatory negotiations, budgeting, client communications, hiring and management of staff. Mr. Hoffman's areas of study include civil and ground water engineering, as well as environmental law.

Eileen Dornfest, M.S., P.G., C.E.G., Senior Engineering Geologist

Ms. Dornfest has over 8 years of experience in engineering geology and geoenvironmental engineering on a diversity of projects. She has served as senior engineering geologist and project manager for mine reclamation projects, dams, forensic investigations, commercial/industrial development, and residential repair projects. Investigations performed include seepage and slope stability analyses, settlement/consolidation analyses, and other general engineering geologic investigations related to dams, mining, and development.

Jason Andrews, P.E., Staff Engineer

Mr. Andrews has a Masters Degree in Engineering from Colorado State University. He has experience in geotechnical engineering pertaining to mine site remediation, exploratory borings, construction defect litigation, and quality assurance and quality control oversight relating to geotechnical and environmental projects. His areas of emphasis and study include slope stability, laboratory testing, mining projects, settlement analyses, and other aspects of geotechnical engineering.

Robert Schaut, P.E., Staff Engineer

Mr. Schaut has several years of consulting and construction experience in geological engineering as applied to expansive soils, ground water hydrology, characterization of mine and mine waste facilities, and development of mine reclamation plans. His experience includes expansive soil evaluations, slope stability analysis, site investigation and characterization, geologic mapping, field collection of water and soil samples, geotechnical instrumentation, and other general aspects of geotechnical engineering.

Jong Beom Kang, Ph.D., Staff Engineer

Dr. Kang has geo-environmental research experience involved to membrane behavior of GCL with containment system to waste disposal/contaminant transport. He has geotechnical experience including laboratory testing, piping/seepage analyses of embankment, slope stability analyses of soils/rock slope, consolidation/settlement evaluation in soft clayey soils, and expansive soils evaluation related to unsaturated flow/frost modeling, heave predictions, and wetting front migration for surface grading and groundwater mitigation.

Denise Weinkauf, Staff Geologist

Ms. Weinkauf has a Masters Degree in Earth and Atmospheric Science from Purdue University. She has multiple years of research experience in environmental geology, water quality assessment, and natural resource management. She has engineering geology experience relating to exploratory borings, construction defect litigation, and foundation remediation.

Jesse Dunham-Friel, Staff Engineer

Mr. Dunham recently completed his Masters Degree in Civil Engineering with a Geotechnical concentration in expansive soils. He has performed subsurface exploration, monitoring of geotechnical instrumentation, laboratory testing, dam inspection, report writing, and topographical surveys.

Kristle Hawkins, Staff Engineer

Ms. Hawkins is currently completing her Masters Degree in Geoenvironmental Engineering at Colorado State University. She has performed geotechnical laboratory testing, site easement documentation, cost estimating, and budgeting.

Keith Morse, Staff Engineer

Mr. Morse is currently completing his Masters Degree in Civil Engineering at Colorado State University. He brings experience in surveying, field work, and CAD to his position with Engineering Analytics, Inc.

Select Project Experience

Engineering Analytics has performed specialized investigations and design in the key areas outlined below. Detailed project descriptions of some of our staff's projects follow this section.

Infiltration, Seepage and Unsaturated Flow Modeling

- Hot Springs Dam Seepage Analysis
- Design of Retention/Detention Basins, JED Solid Waste Disposal Facility, Osceola County, Florida

Mining Site Operations and Reclamation Permitting

- Umetco Minerals Hot Springs Tailings Dam Raise and Reclamation
- Gas Hills Uranium Mine and Mill Site Reclamation Plan
- APP Permit Pinto Valley Copper Mine, Globe AZ
- APP Permit San Manuel Mine and Smelter Facility

Design of Cover Systems for Mining and Industrial Process Wastes

- Cover Design for Low Level Radioactive Material Disposal Cells, ARE, Ipoh Malaysia
- Cover Analysis of Uranium Tailings Impoundments, multiple sites

Design of Liner and Leak Detection Systems for Solid and Liquid Containment

- Clifton Water District Raw Water Settling Pond Failure Investigation
- Sun Country CDD Landfill, Hillsborough County, Florida

Remedial Action Plans

- Apache Powder Superfund Site, RI/FS, RD/RA, and System Operation, St. David, Arizona
- Chatham Brothers Barrel Yard State Superfund Site, RI/FS, RD/RA and System Operation, Escondido, California
- Montrose Chemical Company, Remedial Investigation and Pilot Testing, Torrance, California

Surface Water Hydrology

- Storm Water Handling System, Green Bay Phosphate Processing Plant, Bartow, Florida
- Storm Water Hydrology Analysis and Site Wide Water Balance, San Manuel Plant Site, San Manuel, Arizona
- Storm Water Handling Facilities, JED Solid Waste Disposal Facility, Osceola County, Florida

Remediation System Design and Implementation

- 600 gpm Groundwater Treatment System, Hughes Aircraft Company, Fullerton, California
- Constructed Wetland Treatment System, Apache Powder Superfund Site, St. David, Arizona

Detailed Project Descriptions

The following are representative projects performed by personnel of Engineering Analytics.

Uranium Mine and Mill Site Reclamation and Closure Plan, East Gas Hills, Wyoming

Engineering Analytics' staff provided consulting services to Umetco Minerals Corporation for reclamation of their uranium mine and mill site at Gas Hills, Wyoming. The project consisted of design for reclamation of an inactive tailings impoundment, two mine ore excavations and two evaporation ponds. EA's staff also performed a site-wide hydrology study, a characterization study of the groundwater and geochemistry and a health risk assessment analysis for clean-up of radiological contaminants.

Consulting Services Provided:

- Analyses of the existing cover system on the inactive tailings impoundment and design of an enhanced cover to provide adequate erosion protection for the 1,000-year design life
- Cover design for the two mine ore excavations and two evaporation ponds, including geotechnical stability analyses, settlement analyses, radon attenuation analyses, infiltration analyses and erosion protection design
- Characterization of subsurface flow conditions and contaminant transport mechanisms
- Groundwater characterization and preliminary assessment of remedial action alternatives
- Radiological investigation and risk assessment to evaluate potential radiological risk to the public and to evaluate the feasibility of remedial action alternatives

Handling and Disposal of Radioactive Wastes, Asian Rare Earth Project, IPOH, Malaysia

Central Malaysia, particularly the State of Perak, at one time was the richest tin mining region in the world. Tin ore known as cassiterite was found in placer deposits located along the rivers in this area. The tin was separated by dredging and hydraulic mining processes. Two other minerals also separated with the tin ore were, monazite and xenotime, both of which are rich in rare earth elements. Between 1976 and 1992 the Asian Rare Earth (ARE) plant processed

monazite and xenotime to remove ytterbium and neodymium.

One of the main byproducts of the ARE process was a paste rich in thorium hydroxide. Thorium hydroxide, which is considered a low level radioactive waste, also contains a significant amount of uranium. Originally the process waste stream from the ARE plant was deposited in a series of settling ponds located near the plant and the supernatant was discharged into the adjacent river. In the mid 1980's the State of Perak declared that it wanted to keep the thorium hydroxide so that it could extract the uranium at a later date for use in a nuclear reactor. Therefore, ARE excavated the thorium hydroxide sediments from the pond and placed it in drums. A long term storage facility (LTSF) was constructed approximately 1.5 km from the plant and the drummed material was transferred to the LTSF. Future process wastes were filter pressed and the resulting paste was drummed and stored in the LTSF.

In 2001 the State of Perak decided that it no longer wanted the thorium hydroxide and ordered ARE to develop a plan to decommission the plant site and to dispose of the drummed wastes. The plant site was decontaminated and decommissioned in 2004 and 2005. In 2004 a study was initiated to identify the number and condition of the drums stored in the LTSF. This study identified that 86,000 drums of radioactive waste material was stored in the LTSF. Furthermore, approximately 30 percent of the drums in the LTSF had rusted and degraded to a point that they were no longer able to be moved or opened using conventional methods. Drum removal, treatment, and disposal and demolition of the LTSF is expected to take 3 to 4 years beginning in 2009.

Engineering Analytics' staff provided engineering expertise in the development of equipment and procedures to safely handle the drums and stabilize the waste materials prior to disposal. This project required the development of innovative methods and specialized equipment to enter into the LTSF, remove the drums and transport them to a drum processing area. Due to the radioactive nature of the materials stored at the LTSF, safety of the site workers is considered a high priority. The methods developed for handling and transporting the drums, first and foremost, took into consideration the safety of the workers inside the LTSF and the drum processing areas. The primary safety method employed is maintaining suitable separation of the worker from the radioactive materials. Therefore, long reach drum handlers, robotic equipment, and moveable shielding were specified or in some cases specially designed.

At the drum processing area each drum will be staged based on surface radiation measurements and a review of original plant records of the drums. Drum cataloging will be performed with bar code readers and stored in an on-site computer database. Each drum will then be transferred to a secure shielded area where that drum can be opened and its contents inspected. Drums containing thorium hydroxide waste will be dumped into v-bottom settling tanks so that free water in the drums can be removed and treated.

Drums containing other waste materials, such as PPE, tools, or other hard materials will be taken directly to the disposal cell.

The thorium hydroxide paste will be allowed to settle for 24 to 36 hours so that the resulting supernatant could be pumped off. The supernatant will then sent to a forced evaporator where any remaining dissolved solids can be removed. The resulting brine solution will then be transferred back to the settling tanks for treatment and disposal. The settled solids will then be removed from the bottom of the V-tanks by a series of augers and transferred to a horizontal mixing table where cement and other admixtures can be added to the paste. The goal of the stabilization process is to provide a solidified mass of soil with a minimum compressive strength of 100 kpa. The stabilized mixture will then be pumped to the disposal cell. After deposition of all the waste materials at the site, the LTSF will be demolished and placed on top of the stabilized waste. A low permeability cover will then be placed over the waste materials and the site fenced off and secured for long term maintenance.

Tailings Dam Improvement and Reclamation Plan, Hot Springs, Arkansas

Umetco Minerals Corporation

Engineering Analytics' staff designed and supervised construction of a reclamation plan and embankment raise for Umetco Minerals Corporation's tailings dam in Hot Springs, Arkansas. The goal was to design a reclamation plan that provided for continued operation while improving the existing drainage system and overall stability of the impoundment. Design controls included maintaining the existing toe of the embankment while excavating the downstream face of the dam to a 3:1 slope and constructing an upsteam raise from the excavated materials. EA's staff provided QA/QC through completion of the project.

Engineering Analytics' staff provided the following services:

- Preliminary subsurface investigation, including a comprehensive sampling program and piezometer installation
- Flood routing and design of two spillways to control basin and impoundment runoff
- Seepage analyses for design of a blanket drain to control the phreatic surface
- embankment stability analyses for static and seismic conditions
- Liquefaction analyses
- Construction specifications and construction oversight

Remediation of Apache Powder Superfund Site, St. David, Arizona

Engineering Analytics' staff provided the engineering expertise to prepare the feasibility study, remedial design, and implementation of the remedial design for the Apache

Powder Superfund Site (APSS), near St. David, Arizona. The APSS is located at an operating ammonium nitrate manufacturing facility. Previous activities at the site included the manufacture of dynamite, primacord, fuse, and nitroglycerin. In addition to APSS's operations, a small TNT reclamation facility was located on the property in the early 1920's. These past manufacturing activities resulted in a several mile long nitrate plume in the shallow aquifer of the San Pedro River, as well as several smaller discrete areas of soil contamination containing, TNT, 2,4 and 2,6 DNT, arsenic, elemental sulfur, PETN, and perchlorate. Engineering Analytics' staff developed excavation, treatment and disposal methods for all of the solid and soil based contaminants. In conducting the site investigation and remediation EA's staff:

- Collected soil and groundwater samples from the different affected areas
- Evaluated chemical analysis of the contaminated media
- Prepared bids for and selected contractors for Unexploded Ordinance (UXO) and Explosives and Ordinance Disposal (EOD) contractors
- Coordinated UXO and EOD site work
- Oversaw removal treatment and disposal activities

The treatment wetland was constructed in a dry wash near the production facility. The system was constructed such that the only power required for operation is that for one extraction well located along the San Pedro River. All remaining treatment is accomplished by biological processes and gravity flow. During design of the constructed treatment wetlands Engineering Analytics' staff provided the following services:

- Geotechnical investigations of potential wetland sites
- Seepage and infiltration analyses of each site
- Design of clay cutoff walls for the selected wetland site
- Hydraulic design of the groundwater extraction and conveyance system
- Hydrologic analysis of the upstream contributing areas and the effects of precipitation contributions to the wetland
- Hydraulic design of the wetland system
- Selection of appropriate plants and location of local sources for transplant
- Startup and operation of the treatment wetlands

To date the treatment wetlands have removed over 450,000 lbs of nitrate from the San Pedro River Aquifer.

Design, Construction and Operation of a Groundwater Treatment System, Fullerton, California

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Engineering Analytics' staff provided the engineering services for the design, construction, and operation of a 600 gallon per minute (gpm) groundwater treatment system at the Hughes Aircraft Company (HAC), Ground Systems Group facility in Fullerton, California. The facility was operated from the late 1950's through the early 1990's for the research, development and fabrication of ground based military tracking systems. As part of the operations at this site, chlorinated solvents were used prior to assembly and painting of the parts and completed units. Several large clarifier units were used at the site to recycle and store these solvents.

Leaks and spills during the operating period of the facility resulted in a large plume of groundwater contamination containing chlorinated solvents. Although the quantity of solvent released was capable of contaminating a large area of groundwater around the site, the velocity of groundwater flow and the depth to groundwater at the site prevented the formation of dense non-aqueous phase liquid (DNAPL) below the site. However, the resulting groundwater plume was approximately one mile in length and was rapidly moving further offsite.

Therefore, HAC decided to implement a groundwater treatment system that would extract the contaminated groundwater, treat it and re-inject the treated groundwater at a location down gradient from the site such that the resulting increase in head in the aquifer would prevent additional down gradient movement of the plume.

The original extraction system envisioned for the site consisted of over 90 vertical extraction wells with the accompanying connective piping, power and control systems. In lieu of installing such an extensive extraction system, a series of 6 intersecting horizontal wells were designed and installed below the contaminated area. An additional 9 vertical wells were also installed in discrete areas where localized high concentrations of contamination were identified. The extraction wells were connected to a groundwater treatment system that consisted of a 43 ft. tall air stripping tower, two 20,000 lb. liquid phase carbon adsorbers, and two 10,000 lb. vapor phase carbon adsorbers. The treated groundwater was then conveyed approximately one-half mile down gradient from the site and re-injected through 4 injection wells.

The system was operated as designed for approximately 5 years after which time contaminant concentrations in the groundwater dropped below levels where the air-

stripping tower was effective. At that time the air-stripping tower was decommissioned and the system currently operates on the liquid phase carbon adsorbers only.

Chatham Brothers Barrel yard, Escondido, California

The Chatham Brothers Barrel Yard was operated from the 1940's until 1981 as a waste oil and solvent recycling facility. Over 56 company and government agencies sent spent solvents and waste oil to the facility. In 1981 the California Department of Health Services shut down the facility when it was discovered that drums stored at the site were leaking chlorinated solvents onto the ground. An emergency removal action performed by the State of California removed approximately 12,000 drums and 11,500 cubic yards of contaminated soil from the site.

Engineering Analytics' staff provided their expertise in developing the remedial investigation for this site and in writing the remedial action report for the site. In addition, EA's staff designed and implemented the remedial actions. The remedial actions included:

- Excavating and disposing of soil contaminated with PCBs, TCE, PCE and heavy metals.
- Closure of the on-site process water storage pond.
- Regrading the site to eliminate ponding.
- Placement of a 2 foot thick soil cover to reduce the potential for contact with site soils or windblown contaminants.
- Off site excavation of PCB contaminated soil.
- Installation of a soil vapor extraction system.
- Installation of a UV-Chemical Oxidation, ground water treatment system.

Implementation of the remedial action involved obtaining construction permits from City, County and State agencies, and obtaining easements from private citizens and both the City and County to excavate soil, construct pipelines and install wells.

Landfill Gas Migration Study, Beulah Landfill, Pensacola, Florida

Engineering Analytics, Inc. staff provided the field sampling and engineering services for a landfill gas study at the Beulah Landfill, located northwest of Pensacola, Florida. The Beulah landfill is a former superfund site that was remediated and removed from the National Priorities List. The site remedy for this landfill included the construction of a low permeability landfill cap and regrading of the landfill surface to promote drainage.

The landfill was originally constructed as an unlined facility and was located in a series of small canyons. The site topography combined with the sandy nature of the underlying soils raised the potential for landfill gas migration. In addition, due to the proximity of residential development, the landfill operator expressed a concern regarding to the possibility for landfill gas migration onto the neighboring properties.

As part of the superfund remediation program a series of perimeter gas monitoring wells were established at the landfill perimeter to monitor for the possibility of offsite migration. Several of these monitoring wells have always had detectable concentrations of landfill gas. Therefore, a program was developed to evaluate the potential for landfill gas migration on to the neighboring properties. Soil gas sampling was conducted using a small, tractor mounted direct push device. A groundwater sampling probe was modified to accept a small diameter teflon tube through which soil gas could be collected. The sampling probe was driven to a depth of 5 feet below the base of the landfill adjacent to the sampling location and soil gas samples were collected and analyzed at 5 foot intervals.

Landfill gas sampling was conducted using hand held monitoring devices, for methane, carbon dioxide, hydrogen sulfide, volatile organic compounds, and oxygen. Tedlar bags were collected from selected locations and sent off site for analysis. Soil gas samples were collected from several areas around the landfill perimeter as well as from more remote areas to provide background soil gas parameters.

As part of this investigation, remedial alternatives to control the migration of landfill gas were also evaluated. Several alternatives were evaluated such as: increasing the number of existing passive landfill gas vents; installing site wide or location specific active landfill gas extraction; constructing cutoff walls around the developed perimeter of the site; and installing offsite subsurface gas vents.

The results of this investigation indicated that the presence of several wetlands between the landfill and the potentially developed areas was providing a natural cutoff wall in the form of surface water infiltration into the groundwater. In addition, the natural decomposition of detritus in these wetlands was found to be the source of methane being detected in the perimeter gas monitoring wells. Therefore, no additional study was recommended and no expansion of the current landfill gas venting system was necessary to prevent offsite migration of landfill gas.

Design and Construction of the JED Disposal Facility, Holopaw, Florida

Engineering Analytics' staff provided the engineering services for the design and construction of the 264 acre, Oak Hammock Disposal Facility, currently renamed the JED Disposal Facility (JED), south of Holopaw, Florida. In 2003, the JED facility was the first new commercial municipal solid waste landfill permitted in Florida in over 7 years. This facility was formally recognized by the Florida Department of Environmental Protection (FDEP) as a state-of-the-art and state-of-the-practice landfill. As such the FDEP provided a permit to construct in only 5 months after the initial design report was submitted.

The JED facility incorporates a double composite liner system comprising primary and secondary liners of 80-mil HDPE underlain by a geosynthetic clay liner (GCL). Drainage on both liners is provided by biplaner geocomposite drainage layers and HDPE collection pipes. Leachate collected in each cell is routed to a sump area that is accessed by vertical collection manholes. The concept of the vertical collection manholes is to provide easy maintenance of the leachate collection pumps and piping systems.

Each sump area was equipped with two 50 percent primary leachate collection pumps and one secondary collection pump. Leachate is pumped through a single collection pipeline to the leachate storage area. Pump control is provided by a series of pressure transducers installed in each sump. These pressure transducers monitor the level of leachate in each sump and provide input to the primary pump controller. The primary pump controller monitors the number of pumps running at any one time and limits the total flow in the leachate transmission pipeline. By monitoring and controlling the number of pumps running simultaneously and the depth of leachate in each sump area, the size of the leachate transmission pipeline was reduced to a much smaller size than would have been required without this monitoring.

The leachate storage area was constructed as a series of four flexible storage containers (FSC). The FSCs provided a cost savings of over 90 percent compared to conventional leachate storage methods.

Storm water diversion and collection is accomplished by a perimeter collection ditch that conveys storm water to a series of retention ponds located on the property. The retention ponds are designed to accommodate the runoff from two 100 year frequency design storms in 7 days. Infiltration and evaporation from the retention ponds will provide sufficient storage capacity for a 3rd 100 year design storm within 30 days. Storm water modeling was performed using the adICPR storm water design model. This model provides integrated calculations of runoff from discrete areas of the landfill with flow routing software that allows two directional flow in the perimeter collection ditch and combines outflow to the retention ponds.

Construction of the first cell was completed in 3 months and approved by FDEP within two weeks of completion. Construction of the second cell was completed 3 months later and the project is currently constructing its 6th cell.

In 2006 Engineering Analytics' personnel prepared a design for a 110 foot vertical expansion of the landfill, which would make it the tallest landfill in Florida.