



AGENDA REPORT

Meeting Date: September 27, 2011
Item Number: F-6
To: Honorable Mayor & City Council
From: Aaron Kunz, Deputy Director of Transportation
Subject: AMENDMENT NO. 1 TO THE AGREEMENT BETWEEN THE CITY OF BEVERLY HILLS AND SHANNON & WILSON, INC. FOR GEOTECHNICAL ENGINEERING SERVICES AND REVIEW OF WESTSIDE SUBWAY EXTENSION ENVIRONMENTAL IMPACT REPORT

AUTHORIZE A PURCHASE ORDER IN THE AMOUNT OF \$65,000 TO SHANNON & WILSON, INC FOR THE CONSULTANT SERVICES

Attachments:

1. Agreement
2. Professional Experience

RECOMMENDATION

Staff recommends approval of Amendment # 1 to an agreement with Shannon & Wilson, inc. to conduct a peer review of the Westside Subway Extension Final Environmental Impact Statement/Report (FEIS/FEIR) and geotechnical; and authorize a purchase order in the amount of \$65,000.

INTRODUCTION

The Los Angeles County Metropolitan Transportation Authority (Metro) is near completion of the geotechnical and related surveys for the Westside Subway Extension FEIS/FEIR. Metro currently plans for the release of the Westside Subway Extension FEIS/FEIR in Fall 2011 and Metro Board action on the FEIS/FEIR, including selection of the alignment between Beverly Hills and Century City, in Winter 2012. Metro's geotechnical studies regarding the alignment between Beverly Hills and Century City may be provided for the City's review prior to the release of the FEIS/FEIR. While the City may submit comments to the Metro Board, there is not a formal comment period on the FEIS/FEIR. A minimum of 10 days is required between the release of the FEIS/FEIR and Metro Board action.

At its July 7, 2011 Study Session, per the Legislative Committee's recommendation, the City Council agreed to allocate an initial \$350,000 for efforts related to the City's position on the Westside Subway Extension. The City Council agreed this amount could be augmented with additional City funds if deemed necessary. The intent of this allocation is to retain experts related to tunneling as well as geotechnical experts, consultant firms, public relations firms and legal services.

To prepare for Metro's release of the FEIS/FEIR and geotechnical data, Public Works & Transportation staff is recommending the City retain two technical consulting firms: 1) Exponent, Inc. to conduct a peer review of data related to potential impact on Beverly Hills' buildings and infrastructure, and 2) Shannon & Wilson, Inc. for geotechnical peer review of the overall FEIS/FEIR focusing on the potential of seismic fault rupture, seismic hazards, potential for hazardous subsurface gases and hazardous materials, potential impacts from dewatering, and excavation and tunneling obstructions.

DISCUSSION

The City retained Shannon & Wilson, Inc. to provide a geotechnical engineering peer review of the Westside Subway Extension Draft Environmental Impact Statement/Report (DEIS/DEIR) released in September 2010. Shannon & Wilson's comments and recommendations for further study were submitted to Metro as part of the City's comment on the DEIS/DEIR.

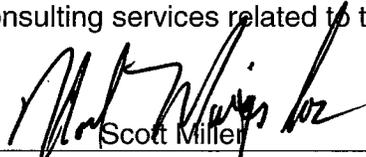
Once Metro releases technical information, staff will be able to refine the scope of services as deemed necessary. At this time, the following work identified for Shannon & Wilson, Inc. to perform includes:

- Review Westside Subway Extension FEIS/FEIR and evaluate the adequacy of the responses to the City comment letter on the Westside Subway Extension DEIS/DEIR.
- Review FEIS/FEIR for the following issues which the Westside Subway Extension could impact the City with specific area of interest in impacts of potential tunneling under Beverly Hills High School:
 - potential for fault rupture,
 - seismic hazards including liquefaction potential,
 - potential for hazardous subsurface gases and hazardous materials,
 - potential impacts from dewatering, and
 - excavation and tunneling obstructions.
- Recommend areas of further study for Metro to conduct as part of final engineering design.

Shannon & Wilson's team for review of the DEIS/DEIR, comprised of an engineering geologist and geotechnical engineer will be augmented with Dr. Roy Shlemon to provide additional experience in earthquake fault analysis.

FISCAL IMPACT

Staff has identified funding up to \$350,000 from the year end FY 2010-11 fund balance for consulting services related to the Westside Subway Extension.



Scott Miller
Finance Approval



David Gustavson
Approved By

Attachment 1

AMENDMENT NO. 1 TO THE AGREEMENT BETWEEN THE CITY OF
BEVERLY HILLS AND SHANNON & WILSON, INC. FOR
GEOTECHNICAL ENGINEERING SERVICES AND REVIEW OF
WESTSIDE SUBWAY EXTENSION ENVIRONMENTAL IMPACT REPORT

NAME OF CONTRACTOR: Shannon & Wilson, Inc.

RESPONSIBLE PRINCIPAL OF CONTRACTOR: Travis Deane, P.E., G.E

CONTRACTOR'S ADDRESS: 706 West Broadway, Suite 201
Glendale, CA 91204-1032

CITY'S ADDRESS: City of Beverly Hills
345 Foothill Road
Beverly Hills, CA 90210
Attention: Aaron Kunz
Deputy Director of Transportation

COMMENCEMENT DATE: Upon written Notice to Proceed

TERMINATION DATE: December 31, 2012

CONSIDERATION: Original Agreement: Not to exceed \$35,000.00, based
on the rates set forth in Exhibit B, including all
reimbursable expenses described in Exhibit B;

Amendment No. 1: Not to exceed \$65,000.00 based
on the rates set forth in Exhibit B, including all
reimbursable expenses described in Exhibit B

Total for Original Agreement and Amendment No. 1:
Not to exceed \$100,000.00

AMENDMENT NO. 1 TO THE AGREEMENT BETWEEN THE CITY OF
BEVERLY HILLS AND SHANNON & WILSON, INC. FOR
GEOTECHNICAL ENGINEERING SERVICES AND REVIEW OF
WESTSIDE SUBWAY EXTENSION ENVIRONMENTAL IMPACT REPORT

This Amendment No. 1 is to that certain Agreement between the City of Beverly Hills (hereinafter called "CITY"), and Shannon & Wilson, Inc. (hereinafter called "CONSULTANT") dated November 16, 2010 and identified as Contract No. 496-10 ("Agreement").

RECITALS

A. CITY entered into a written Agreement, dated November 16, 2010 for geotechnical engineering services and review of the Westside Subway Extension Environmental Impact Report.

B. CITY desires to amend the Agreement to extend the term of the Agreement and increase the Consideration amount for additional services.

NOW, THEREFORE, the parties agree as follows:

Section 1. The Termination Date shall be amended as set forth above.

Section 2. The Consideration shall be amended as set forth above.

Section 3. Section 3 of the Agreement, Compensation, shall be amended to read as follows:

"Section 3. Compensation.

(a) Compensation

CITY agrees to compensate CONSULTANT for the services and/or goods provided under this Agreement, and CONSULTANT agrees to accept in full satisfaction for such services, a sum not to exceed the Consideration set forth above and more particularly described in Exhibit B, attached hereto and incorporated herein.

(b) Expenses

The amount set forth in paragraph (a) shall include reimbursement for all actual and necessary expenditures reasonably incurred in the performance of this Agreement (including, but not limited to, all labor, materials, delivery, tax, assembly, and installation, as applicable). There shall be no claims for additional compensation for reimbursable expenses.

(c) Additional services

CITY may from time to time require CONSULTANT to perform additional services not included in the Scope of Services. Such requests for additional services shall be made by CITY in writing. The City Manager may, by written amendment, increase the compensation for such additional services by an amount not to exceed Fifty Thousand Dollars (\$50,000).

Section 4. Exhibit A, the Scope of Services, shall be amended as attached hereto and incorporated herein.

Section 5. Exhibit B, Schedule of Payment and Rates, shall be amended as attached hereto and incorporated herein.

Section 6. Except as specifically amended by this Amendment No. 1, the Agreement dated November 16, 2010 and identified as Contract No. 496-10 shall remain in full force and effect.

EXECUTED the ____ day of _____ 201__, at Beverly Hills, California.

CITY OF BEVERLY HILLS
A Municipal Corporation

BARRY BRUCKER
Mayor of the City of
Beverly Hills, California

BYRON POPE
City Clerk

[Signatures continue]

CONSULTANT: SHANNON & WILSON, INC.

Handwritten signature of Robert "Red" Robinson in cursive script.

ROBERT "RED" ROBINSON
Senior Vice President

Handwritten signature of Hollie L. Ellis in cursive script.

HOLLIE L. ELLIS
Chief Financial Officer

[Signatures continue]

APPROVED AS TO FORM:



LAURENCE S. WIENER
City Attorney

APPROVED AS TO CONTENT:

JEFFREY KOLIN
City Manager



DAVID D. GUSTAVSON
Director of Public Works & Transportation



KARL KIRKMAN
Risk Manager

EXHIBIT A
SCOPE OF SERVICES

Original Agreement

CONSULTANT shall provide the following services:

- Review adequacy of soil, geotechnical, and tunneling safety chapters/sections of the Westside Subway Extension DEIS/DEIR. Specific areas of interest include tunneling under Beverly Hills High School and residential properties, and constructing a station on Santa Monica Boulevard in Century City, adjacent to an active fault;
- Review of the geologic hazards;
- Review CITY documents related to oil wells located under Beverly Hills High School;
- Identify potential impacts to CITY from the tunneling and potential mitigation measures, including noise and vibrations and hazardous materials;
- Provide recommendations for additional studies for the Final Environmental Impact Statement/Report (FEIS/FEIR);
- Identify areas of further study, surveys, testing soil borings, etc. for Los Angeles County Metropolitan Transportation Authority ("Metro") to conduct as part of the final DEIS/DEIR;
- Summarize reviews, technical comments for CITY's response to the DEIR/DEIS, and other findings in a report, and;
- Present findings at approximately two public meetings.

Details and assumptions of proposed scope of services for the geotechnical design tasks are provided in the following sections.

Review of DEIS/DEIR

Review technical and tunneling aspects of the DEIS/DEIR for the project alignment within the CITY limits. Review includes all five alignments contained in the DEIS/DEIR.

Geologic Hazards

Based on the information provided in the DEIS/DEIR, a review of geologic history, the available subsurface information, and CONSULTANT's previous experience in the area, review site-specific geologic hazards along the alignment. Evaluate seismic hazards including likely ground shaking and the potential for fault rupture and liquefaction. Review the potential for methane gas and tar sands within CITY limits. Review CITY documents relating to oil wells located under Beverly Hills High School that could affect tunneling construction.

Identify Potential Impacts

Identify potential impacts to CITY during and following construction of the project. Typical impacts associated with tunneling include ground settlement, noise and vibrations, ventilation, groundwater level fluctuations, hazardous materials, caving, and obstructions. Provide recommendations to mitigate the impact, where appropriate.

Recommendations for Additional Studies

Based on review of the DEIS/DEIR, provide recommendations for additional geotechnical and/or geologic studies of the alignment. Recommendations could include additional subsurface explorations (soil borings, geophysical testing, etc.), field and laboratory testing, foundation survey, and other appropriate studies for design and construction of the project.

Summary Report

Provide review of DEIS/DEIR, overview of potential geologic hazards and impacts of tunnel construction, and recommendations for additional studies in a geotechnical report. CONSULTANT'S report will contain a listing of comments for incorporation into CITY's response to the DEIS/DEIR. Provide three copies and one electronic copy of CONSULTANT'S report.

Meetings

CONSULTANT shall attend up to two meetings to present its evaluation to the City Council and/or City Council liaisons, assuming four hours for each meeting, including travel time from our Los Angeles office.

Amendment No. 1

CONSULTANT shall also perform the following services:

Final Environmental Impact Study/Report (FEIS/FEIR)

Review FEIS/FEIR and evaluate the adequacy of the responses to the CITY's comment letter on the Westside Subway Extension DEIS/DEIR (CONTRACTOR's comment on the DEIS/DEIR attached to the CITY's comment letter.

Review FEIS/FEIR for same subject matters in this Scope of Services for the DEIS/DEIR. Focus review on the FEIS/FEIR for the following issues which the Westside Subway Extension could impact the CITY:

- Potential for fault rupture
- Other seismic hazardous subsurface gases and hazardous materials;
- Potential for hazardous subsurface gases and hazardous materials;
- Potential impacts from dewatering, and;
- Excavation and tunneling obstructions.

Review adequacy of the geotechnical data prepared for the FEIS/FEIR. Specific areas of interest include the tasks outlined above and tunneling under Beverly Hills High School.

Recommend areas of further study for Metro to conduct as part of the final engineering design, including but not limited to additional subsurface explorations (soil borings, geophysical testing, surveys, etc), field and laboratory testing, foundation surveys and other appropriate studies for design and construction of the project.

Prepare a technical report with a review of the Westside Subway Extension FEIS/FEIR geotechnical report(s) and recommendations for additional studies.

CONTRACTOR and its sub consultant, Dr. Roy J. Shlemon & Associates, shall attend up to 3 meeting(s) with CITY staff, City Council Liaisons, and/or City Council meetings.

The quantity, scope timing of deliverables, including the number of meetings attendance and the scope of the technical report will be modified once Metro releases the FEIS/FEIR and the extent of issues to review are known.

EXHIBIT B

SCHEDULE OF PAYMENT AND RATES

CITY agrees to compensate CONSULTANT on a time and material basis, based on the hourly rates below, for the work described in Exhibit A. CONSULTANT has reviewed the scope of services and confirms that the services can be performed at or below the Maximum Fee of One Hundred Thousand Dollars (\$100,000), including expenses.

The hourly rates shall not exceed:

Senior VP	\$240
Associate	\$175
Senior Principal	\$160
Category III	\$90
Tech/Drafter III	\$70
Accounting	\$110

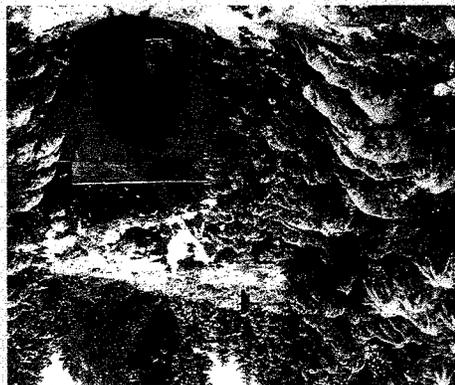
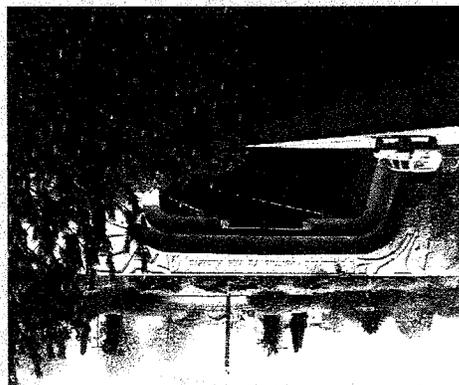
CONSULTANT may bill CITY for the following expenses reasonably incurred in the performance of the Agreement at cost: mileage, subconsultant fees.

CONSULTANT shall submit an itemized statement to CITY on a CITY approved form for its services performed monthly, which shall include documentation setting forth in detail a description of the services rendered and the hours of service. CITY shall pay CONSULTANT within forth-five (45) days of receipt of same provided services were satisfactorily rendered.

Attachment 2

Submitted By:

TUNNELING



Company Profile

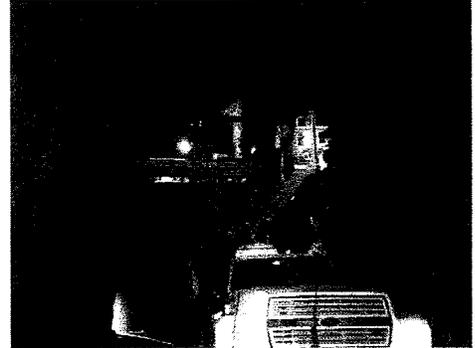
Shannon & Wilson is an employee-owned consulting firm recognized by our clients and peers to be among the leaders in nation in geotechnical and environmental consulting. In-house capabilities include geotechnical engineering and instrumentation; geology and geophysics; rock mechanics and underground engineering; earthquake engineering; and environmental science, engineering, and geohydrology. These services typically support the design and construction of:

- Structure foundations, deep excavations, and retention systems;
- Storm and sanitary sewers, and water and wastewater treatment plants;
- Highways, railroads, and other transportation facilities;
- Tunnels and underground operations;
- Landslide/slope stabilization;
- Dams, levees, locks and dams, and river structures;
- Groundwater management systems; and
- Landfill, hazardous waste, and other environmentally sensitive sites.

In addition to design, Shannon & Wilson routinely provides technical plans and specifications, detailed cost estimating, and construction-phase engineering services.

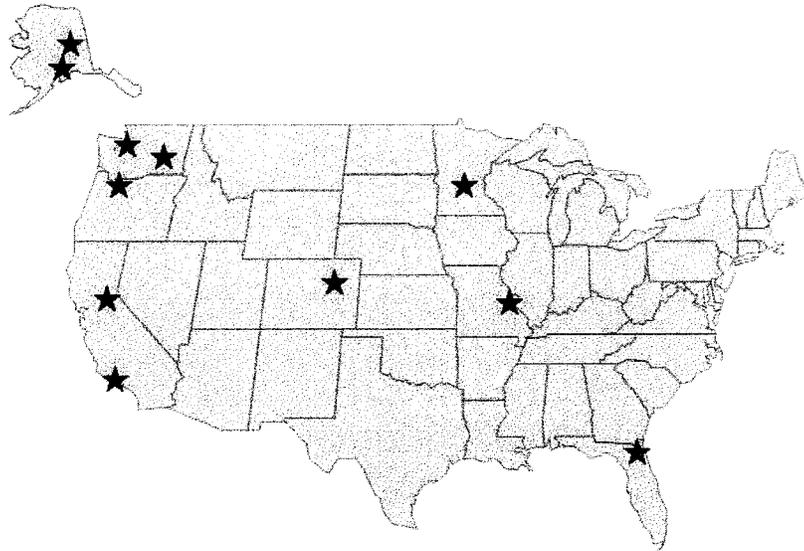
We also provide field support equipment, supplies, and exploration management; a professionally staffed soil and rock testing laboratory capable of physical testing of contaminated samples; extensive computer services and capabilities in both design and production; CADD systems; and one of the most complete geotechnical research libraries in the country.

Since its founding in 1954, the firm has successfully completed nearly 40,000 projects, located in all 50 states and around the world.



Capabilities & Experience

Shannon & Wilson offers a complete staff of professional geotechnical engineers and geologists, technicians, and support personnel. Our personnel are adept at developing project scope and planning exploration programs, directing field drilling and sampling operations, completing laboratory testing, and performing engineering analysis, all of which result in practical design and construction recommendations.



Shannon & Wilson has its Southern California operations in Glendale, California and headquarters in Seattle, Washington. With 11 offices nationwide and a staff of over 300, we combine our local experience and expertise with the specialized expertise and resources of our nationally recognized geotechnical, geological, permitting and environmental engineering services.

We have office throughout the United States:

- Los Angeles and Sacramento, California
- Denver, Colorado
- Anchorage and Fairbanks, Alaska
- Jacksonville, Florida
- Minneapolis, Minnesota
- Portland, Oregon
- Saint Louis, Missouri
- Seattle and Richland, Washington

Tunneling & Excavation

Shannon & Wilson has over 56 years of experience, we combine our knowledge of geologic and subsurface conditions with the expertise of our tunneling specialists to provide exactly the evaluation, design, and construction support required for any tunneling project.

Over the last 30 years, Shannon & Wilson's current underground staff has provided geotechnical services for tunneling on over 900 projects. Our experience encompasses all phases of underground engineering from conceptual design, through design and specification, to construction support. We have state-of-the-practice experience in evaluating and choosing the right tunneling technology for subsurface and construction conditions. Our experience includes working under "live" road conditions and with minimal impact on the environment. Shannon & Wilson's tunneling experience and expertise includes:

- Exploration using a wide range of mapping, geophysical and boring techniques suitable for the various soil and rock conditions at different sites
- Groundwater evaluations to assess dewatering requirements, impacts of dewatering on adjacent structures, and the potential for moving contamination towards the excavation
- Soil and rock property evaluations from field and laboratory tests to provide reliable input for design
- Prediction of soil and rock loads on shafts, tunnels and underground openings using both empirical and computer techniques such as finite difference codes
- Estimation of likely impacts of underground construction on adjacent facilities
- Preparation of technical specifications and plans such as: tunnel excavation, tunnel support, dewatering, portal shoring, and geotechnical instrumentation
- Implementation of field instrumentation systems to measure the loads, stresses, deformations, and groundwater levels associated with underground construction

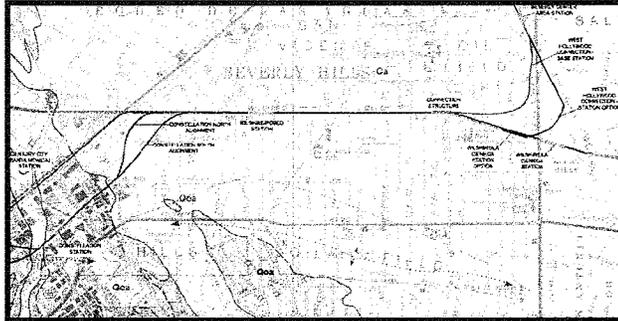
Shannon & Wilson is experienced in a wide range of tunnel excavation methods and the impacts of geotechnical conditions, including: drill and blast excavation, earth pressure and slurry pressure balance tunnel boring machines, jack and bore tunnels, microtunneling, horizontal directional drilling and pipe ramming. We have been involved in the geotechnical aspects of tunnel liner support systems including: grouted dowels and shotcrete, cast-in-place reinforced concrete, bolted and gasketed precast concrete segments, welded and snap together steel pipe sections, gasketed concrete pipe sections, and fiberglass pipe sections. We have worked on trenchless projects ranging from 8-inch diameter horizontal directional drill conduits for utility lines, jack and bore and microtunnels ranging from 24 inch to 16 feet diameter, to the world's largest diameter soft ground tunnel with an outside diameter of 85 ft.

Shannon & Wilson is currently working on over 30 different tunneling projects across the U.S. ranging from 40 horizontal directional drill holes for a utility alignment, to 5 miles of transit tunnels and associated deep mined stations. The following are a few examples of our tunneling experience.

Westside Subway Extension Review | BEVERLY HILLS, CA

CITY OF BEVERLY HILLS

The proposed Westside Subway Extension is proposed by the Los Angeles County Metropolitan Transportation Authority (LA Metro) as a heavy-rail subway connecting to the existing Wilshire/Western station at the Red Line. The proposed alignment travels west along Wilshire Boulevard through Beverly Hills and westward into the Century City and Westwood areas of Los Angeles. Ultimately, the new subway will extend into Santa Monica.



Shannon & Wilson provided geotechnical review of the Draft Environmental Impact Report (DEIR) for the Westside Subway Extension through Beverly Hills. We were retained by the City of Beverly Hills (City) to provide review comments from the DEIR on:

- Seismic hazards including fault rupture and liquefaction;
- Subsidence due to tunneling construction and station excavations;
- Dewatering issues from the station excavations including subsidence and discharge;
- Noise and vibration during construction and operation of the subway;
- Hazardous waste and materials generated from surrounding properties;
- Obstructions during tunneling;
- Hazardous Subsurface gases such as methane and hydrogen sulfide, and;
- Construction traffic including off-haul of material from tunneling and station excavations.

Within the City, the base alignment follows Wilshire Boulevard from San Vicente Boulevard west to Santa Monica Boulevard. The alignment then turns southwest on Santa Monica Boulevard and continues westward into Century City. The base alignment largely occupies the Wilshire and Santa Monica Boulevards right-of-ways. Proposed stations include the Wilshire/La Cienega Station and the Wilshire/Rodeo Station. A station is also proposed on Santa Monica Boulevard in Century City just west of the Beverly Hills city limit.

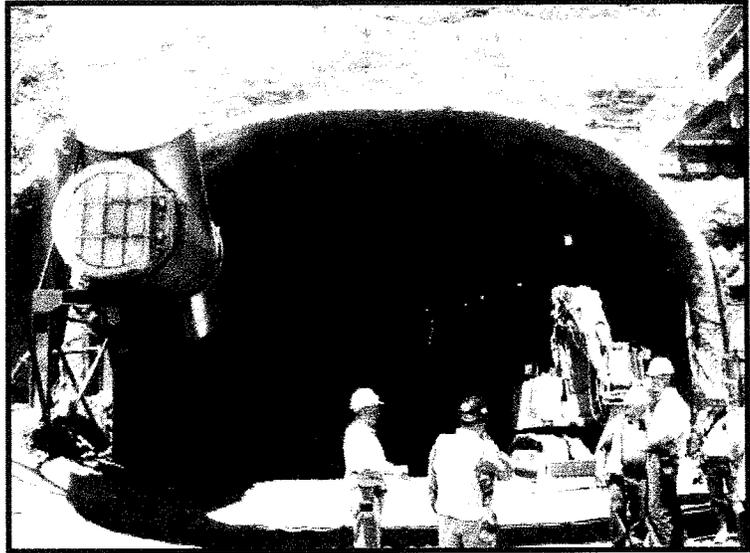
The Santa Monica Fault could possibly pass through the proposed Santa Monica Boulevard station. Based on this and other concerns described in the DEIR, an alternative station (known as the Constellation station) is proposed for the Century City station. The tunnel alignment for the Constellation station would pass under the Beverly Hills High School and neighboring residential areas. This alternative alignment is generally opposed by the City.

We recommended that the City comments include additional studies to identify the presence or absence of the fault trace through the Santa Monica station. This is also identified in the DEIR as requiring additional investigations, and we have been retained by the City to review these future investigations during the final environmental and design processes for the project.

Devil's Slide Tunnel | PACIFICA, CA

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Shannon & Wilson provided geotechnical engineering services in the Type Selection Phase of the Devil's Slide Tunnel along the Coast Highway (SR-1) and provided geotechnical review for the intermediate and final design phases. Our efforts were concentrated on the north and south portal excavations, the south cut, and the disposal area. The north portal is in an area of recent landsliding in clayey soils overlying shales and sandstone. The south portal is in highly weathered granite. Two excavation and support alternatives were developed for the portals and the large approach cut in jointed rock on the south end of the tunnel. Each alternative provided varying degrees of impact and excavation volumes. Layout 1 included massive excavation and less structural support while Layout 2 included more support and less excavation. Engineering analysis and cost estimates were performed for each layout.



Shannon & Wilson also provided recommendations for instrumentation to be utilized during construction and on a permanent basis. Tunnel instrumentation was included in our work. Most instruments will be monitored manually during construction and the relevant instruments will be integrated into an automatic data acquisition system. Instruments included surveying prism targets, multi-point borehole extensometers and inclinometers. In the tunnel, in addition to the above, pressure cells and strain gages will be utilized.

When the site became available for inspection we provided geological reconnaissance of the portals, south cut, and disposal areas. We gathered new information regarding the slides of the north portal and discontinuity orientations of the south portal and south cut. This information was incorporated into the development of the proposed exploration plan. We reviewed the soil and rock samples from the explorations, and evaluated the geologic cross sections and potential impacts of the geology on portal and tunnel construction. We also provided a review of the 90% plans and specifications for the project.

Yerba Buena Island Tunnel | SAN FRANCISCO, CA

CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

The Yerba Buena Island Tunnel connects the eastern and western spans of the San Francisco-Oakland Bay Bridge and is a vital link between the West metropolitan areas of San Francisco and the East Bay (Oakland/Berkeley area). It is an important element in the north-central California transportation network of Interstate 80. The tunnel was built in 1930's and has survived the 1989 Loma Prieta earthquake that had caused serious damages to the bridge.



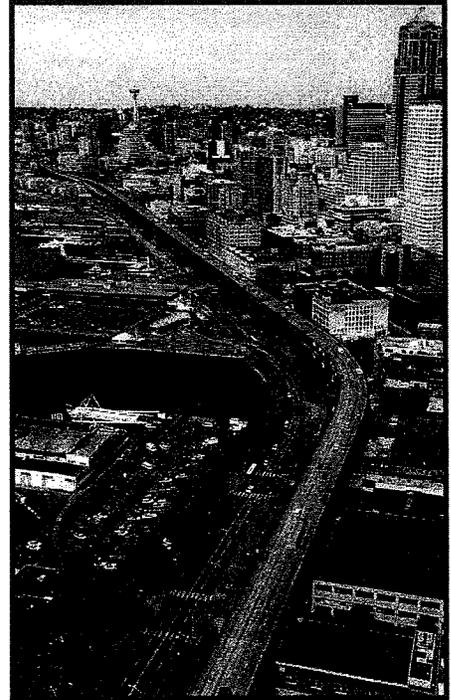
In addition to the various seismic retrofit projects conducted by Caltrans on the bridge to resume its service, Caltrans proposed to build a new bridge to replace the existing one. The proposal called for retrofitting the Yerba Buena Island Tunnel and integrating it into the new system.

Shannon & Wilson was retained by Caltrans to evaluate the portal rock slope stability and the interaction between the portal structures and rock mass during design earthquake event. We developed systematic approach to evaluate the geological and geophysical information and to analyze the stability of the portal rock slopes under static and earthquake conditions. Shannon & Wilson used stereographic analyses of rock joints combined with field observations to identify the potential failure modes. For the critical failure modes, we calculated the factors of safety and probabilities of failure using probabilistic slope stability analyses and sliding block analyses. In addition, we conducted rockfall simulations to estimate the impacts to highways and portal structures of the potential failures. Shannon & Wilson designed and recommended remediation measures including scaling, rock bolting, cable netting, and shotcreting to improve the stability of the portals

Alaskan Way Viaduct & Seawall Replacement Project | SEATTLE, WA

Shannon & Wilson assisted in preparation of the Environmental Impact Statement (EIS) for the replacement of a 2.5-mile long section of SR-99 and the adjacent existing seawall located along Seattle's waterfront. The area faces an urgent need to retrofit, rebuild, or replace the Viaduct and the Seawall because of their age, risk to public safety, seismic vulnerability, deteriorated condition, and critical role in the region's transportation system. Our services have included:

- Geotechnical engineering recommendations for the Viaduct replacement alternatives
- Earthquake engineering studies to evaluate the liquefaction and lateral spreading potential of the soils along the alignment
- Construction dewatering studies
- Evaluating potential impacts from contaminated properties along the alignment



T-REX, I-25 Roadway & Light Rail Corridor | DENVER, CO



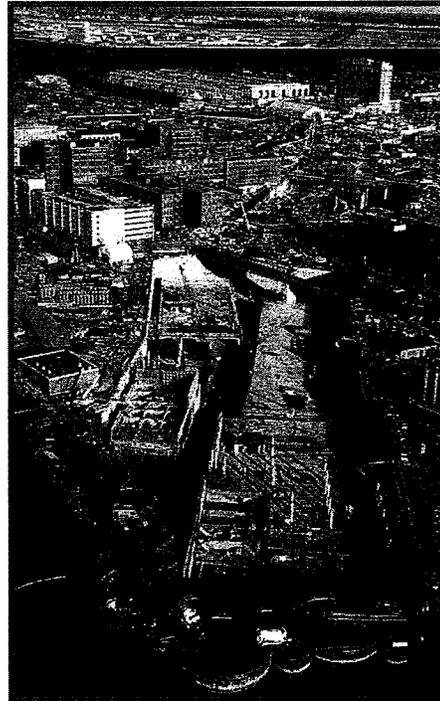
Shannon & Wilson was the geotechnical consultant for the Southeast Corridor Constructors Team (SECC) which was retained by the Colorado Department of Transportation and the Regional Transportation District (RTD) for design-build services for the T-REX project. T-REX is a 19-mile expansion of I-25 and I-225 south of Denver. Shannon & Wilson provided geotechnical services for design of Segment 1.1 of the project, which consisted of:

- Forty retaining walls, up to 30 feet in height
- Twenty sound walls
- Ten new bridges
- Two light rail transit station
- One and six-tenths mile of roadway widening and light rail transit track
- Fifteen-foot-diameter drainage tunnel

I-90 Fort Point Channel Crossing | BOSTON, MA

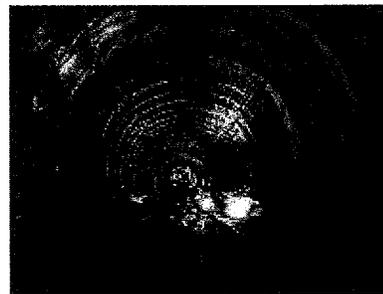
Shannon & Wilson, Inc. performed geotechnical engineering analyses and provided recommendations for the design and construction of the I-90 Fort Point Channel Casting Basin. The project is part of the Central Artery/Ted Williams Tunnel project. The project included constructing the first concrete immersed tube tunnels in the United States. A 60-foot deep excavation supported by slurry walls was constructed to form a casting basin for the immersed tubes. Upon completion of the tubes, the casting basin was flooded and the tubes floated across the Fort Point Channel into position. Project highlights included:

- Designing and installing a unique instrumentation program to monitor the performance of the subway tunnels during the construction period.
- Developed a method for measuring the in situ stresses of the concrete subway tunnel liners.

**Downtown Metro Bus Tunnel | DENVER, CO**

This project included 1.2 miles of twin-bore, 21-foot diameter soft ground tunnels, and 1,200 feet of cut-and-cover tunnel, all beneath city streets and adjacent high-rise buildings. The project included three large underground stations approximately 70 feet deep along the alignment and two terminal surface stations.

Shannon & Wilson provided comprehensive geotechnical studies for project design, and instrumentation monitoring through final construction. We evaluated soil conditions; anticipated ground behavior, design parameters, and alternative construction schemes; and provided geotechnical recommendations for the proposed tunnels, cut-and-cover sections, and stations. We provided construction consultation throughout the project and implemented a major construction monitoring instrumentation program which continuously documented ground and structure behavior to determine sources of ground loss and consequent surface and building settlements, distortion of the new and existing tunnels, deformations and loads in shored excavations, and thus modifies and improves the tunneling, compaction and chemical grouting, dewatering and recharge, and temporary shoring procedures on an hour-by-hour basis.



Mount Baker Ridge Tunnel | SEATTLE, WA



With an inside diameter of 63 feet and an outside diameter of 83 feet, this is the world's largest-diameter soil tunnel. It was designed and constructed using 24 concrete-filled drifts to provide a semi-flexible compression ring liner. The tunnel alignment extends for 1,300 feet beneath a residential area through a ridge of over-consolidated, fissured silts and clays.

Shannon & Wilson provided a comprehensive geotechnical investigation, developed design and construction concepts, evaluated design approaches, prepared plans and specifications, and provided a comprehensive construction monitoring program. The geotechnical investigation included borings, full-scale test shafts and adits, borehole jack and plate bearing tests, finite element studies, model tests, and a laboratory testing program using new testing procedures.

During construction, Shannon & Wilson successfully implemented an extensive instrumentation program. Shannon & Wilson, the State of Washington, and the contractor installed these geotechnical instruments within and adjacent to the tunnel and its portals to monitor the behavior of the stacked drift excavations, the completed compression ring liner, and the surrounding soils. This information was used to monitor and modify the contractor's construction procedures and to evaluate the performance of tunnel support.

This instrumentation program was a key in keeping ground loss, and therefore ground settlement, to a minimum and preserving the integrity of overlying utilities, streets, and residences. The project was completed ahead of schedule and 5% under bid price.

Completeness of the geotechnical studies coupled with innovation in the design approach and risk sharing contractual procedures are credited with reducing the low bid price to half the estimate.

Commuter Rail Station Pedestrian Undercrossing | SOUND TRANSIT

The Sound Transit Tukwila commuter rail station required a pedestrian undercrossing to access both sides of the double track station platform. Shannon & Wilson conducted geotechnical explorations for a proposed 14.5 foot diameter and 65 foot long tunnel. Geologic conditions included fill consisting of gravelly and silty sand, abundant layers of cinders, and broken bricks. Alluvial sediments of clay and silty sand underlay the fill. Perched groundwater was encountered in the fill. The proposed construction method was to jack a 14.5 foot diameter steel pipe in sections from a jacking pit at one end of the undercrossing. A series of jacks reacting from a battered pile frame will provide a thrust of approximately 300 to 400 tons to advance the casing. The pipe will go through a vertical shoring wall to prevent settlement and local instability on the fill slope. A shield was installed at the leading edge of the pipe to mechanically control the excavation and minimize surface settlement.

South 108th Street Grade Separation Projects | TUKWILA, WA

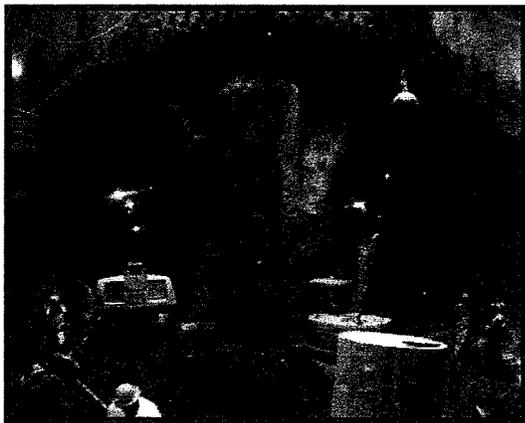
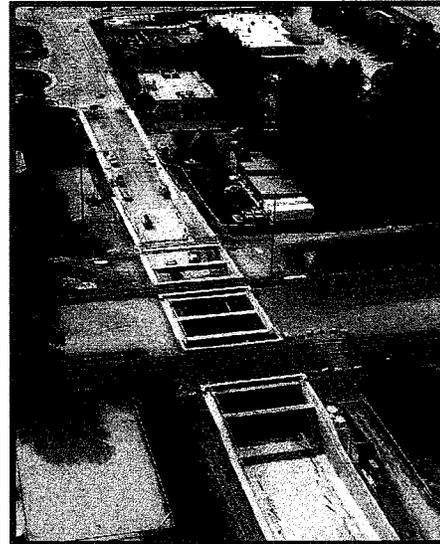
The project provides grade separation between 180th Street and the BNSF and UP Railroad tracks. The project maintained the railways at the same grade and depressed four lanes of traffic, bicycle lanes, and sidewalks in an underpass. The railroad tracks were temporarily relocated onto a shoofly bridge while the permanent bridges were constructed.

Construction of the underpass required sidewalls, railroad foundation supports, and a bottom seal to resist groundwater uplift pressures. The excavation was 25 feet deep.

Overlapping secant pile walls were used as the approximately 800 ft. long sidewalls. At the railroad bridges, the secant pile walls were lengthened to provide vertical capacity. Because the groundwater is about 15 feet above the base of the excavation, the base of the excavation was strengthened and sealed off using cement deep soil mixing methods (CDSM).

During construction, the CDSM temporarily acted as a shoring wall to support the railroad shoofly while the remainder of the underpass was excavated on either side of the railroad tracks.

Using a 30 ft. thick (maximum) CDSM layer to act both as a bottom seal and to resist uplift pressures is a unique, dual-purpose application of CDSM technology in the United States.



Sound Transit, Link Light Rail Beacon Hill Section | SEATTLE, WA

The Beacon Hill project segment consists of about 1 mile of twin 18.9 ft. diameter transit tunnels, a deep underground binocular station with twin 550 ft. long by 36 ft. diameter platform tunnels, one deep main and one deep ancillary ventilation and emergency egress shafts, a headhouse at the top of each shaft, a west portal structure beneath Interstate 5 opening towards the downtown, and an east portal structure that provides access to Rainier Valley. The twin tunnels will be constructed with an earth pressure

balance tunnel boring machine (EPBM) and precast, gasketed, bolted concrete segments. The shafts will be supported with slurry wall panels. The station tunnels will be constructed by the sequential excavation method (SEM), with a variety of ground conditioning and support systems to accommodate the complex glacial soils. A wide range of state of the art field tests, including: downhole pressure meter, downhole seismic velocity, and cross-hole tomography were used to define in situ soil properties.

Shannon & Wilson services included a multi-phased geotechnical exploration program, geotechnical design input for preliminary through final design, preparation and/or review of the plans and specifications, and assistance with construction management and monitoring.

Your Dedicated Project Team

We assemble teams of highly qualified personnel to deliver individualized, client-focused service and solutions that are tailored to meet our clients' needs. Our teams have the experience and technical resources to focus on the critical elements of your projects to accomplish tasks on schedule and within budget and to the satisfaction of all interested parties. We are confident that you will be pleased with the quality of our work.

ROBERT A. (RED) ROBINSON, LEG, - PROJECT CONSULTANT FOR TUNNELING

Red's technical experience has included subsurface exploration, design, plans and specifications, construction monitoring, and expert witness testimony on tunnels, slope stabilization bridges, retaining walls, building foundations, and shafts in soil and rock. Much of his work over the last 30 years has dealt with underground construction on more than 300 tunnels, including: drilled and raised bore shafts; horizontal directional drilling, pipe jacking, microtunneling, earth pressure balanced and slurry pressure balanced machines; 10- to 80-foot-diameter tunnels driven by roadheader, tunnel boring machine (TBM), and drill-and-blast methods; chambers up to 70 feet wide by 600 feet long; and solution mining, all in a wide range of soil and rock conditions. He is currently on several committees including the executive committee for the Rapid Excavation and Tunneling Conference, the tunneling committee for the Association of Engineering Geologists, and the executive committee for the Underground Technology Research Council.

- Yerba Buena Island Tunnel, San Francisco, CA
- Devil's Slide Tunnel, Pacifica, CA
- Southern Pacific Railroad, Tunnel Enlargement, San Francisco, CA
- Interstate 90 Mt. Baker Ridge Highway Tunnel, Seattle, WA
- Westside Corridor Light Rail Transit Tunnel, Portland, OR
- Sound Transit, Link Light Rail Tunnel Project, Seattle, WA

JAMES L. VAN BEVEREN, P.E., G.E.— SENIOR VICE PRESIDENT/GEOTECHNICAL ENGINEER

Jim is a registered civil and geotechnical engineer in California and a registered civil engineer in Nevada. Jim graduated from UCLA in 1964 and immediately began his career with LeRoy Crandall and Associates. When he left Law/Crandall in 1999, he was a vice-president managing the Los Angeles office's geotechnical department. He has over 46 years experience in field investigations, laboratory testing and consultation on some of the highest-profile projects in the Los Angeles area.

His varied experience includes over 2,000 projects. The highlights include the seismic rehabilitation of the Los Angeles County Museum of Art, the LAX Theme Building Restaurant, Morengo Casino and Hotel, the Skirball Cultural Center, the Los Angeles Archdiocese's Cathedral of Our Lady of the Angels, and the Stephen S. Wise Temple Community High School. In addition, Jim is an expert in landslide investigations and stabilization, buttress design and mass grading.

Jim is a former president of the Los Angeles Section-American Society of Civil Engineers and currently serves on the Board of Directors of the American Council of Engineering Companies (ACEC) California. Jim is also on the College of Civil and Environmental Engineering Industrial Advisory Board at California Polytechnic State University at San Luis Obispo, and is a member of the Structural Engineers Association of Southern California Engineers without Borders.

R. TRAVIS DEANE, P.E., G.E. – ASSOCIATE/GEOTECHNICAL ENGINEER

Travis has been providing geotechnical engineering consulting services in California and the Pacific Northwest since 1992. His experience includes geotechnical investigations and construction monitoring for rehabilitation of existing and construction of new alignments for roadways, railroads, and other alignment features. Included in his work experience are geotechnical design for tunnels, subgrade, pavement, bridges, retaining walls, and landslide repairs. Travis also has earthquake engineering experience, including site-specific response analyses, slope stability analyses, liquefaction analyses, and retrofitting and mitigation evaluations.

Travis believes in taking an active role in each project he works on; as such, he commits his technical expertise and experience, in addition to his strong management background, by leading the geotechnical engineering and design efforts for major transportation projects. Travis's recent project experience includes:

- State Route 89, Mousehole Tunnel Replacement Project, Truckee, CA
- Triple Track Project, BNSF Railway, Cajon Pass, CA
- Slide Ranch, Improvements and Expansion of "Urban Educational Farm" Facilities near Highway 1, Marin County Coast, CA

DEAN G. FRANCUCH, C.E.G. – SENIOR ENGINEERING GEOLOGIST

Over the past 23 years, Dean has been actively involved in conducting and managing projects involving geotechnical engineering and engineering geology for transportation developments. He has planned and implemented geologic and geotechnical investigations to characterize soil and rock conditions and has conducted numerous geotechnical investigations to recognize active faults, landslides and other geologic hazards. Dean's professional experience spans the State of California from the southern border to the Bay Area, and includes work within the States of Nevada and Arizona. Recent experience includes:

- I-405 Sepulveda Pass High-Occupancy-Lane Widening Project, Los Angeles, CA
- Golden Valley Road, Santa Clarita, CA
- Copperhill Drive, Valencia, CA
- Lindley Avenue Bridge Widening, Tarzana, CA

VICTOR K. LANGHAAR, P.E., G.E. – ASSOCIATE/GEOTECHNICAL ENGINEER

Victor has practiced in geotechnical consulting since 1993. His project experience includes geotechnical investigations for commercial, hospital, school, government, and historic buildings; bridges, roads, and highways; tunnels, sewers and pipelines; energy transmission structures; stadiums; retaining structures; mass grading; and slope evaluation and landslide repair. Victor has worked on numerous southern California projects with heavily-loaded foundations, and he has worked on numerous environmentally-sensitive projects and historic structures. Victor has extensive experience in the geotechnical earthquake engineering field, including ground motion studies, soil-structure interaction, and determination and mitigation of seismic hazards such as soil liquefaction, lateral spreading, and landslides. His experience also includes forensic and earthquake damage-related assessments. Victor has worked on numerous geotechnical projects beyond Southern California, including coal mine subsidence projects in the Midwest and the Confederation Bridge linking Prince Edward Island with New Brunswick, Canada. He was the lead geotechnical engineer for the investigation of the historic Mission San Miguel Arcángel, a 200 year old adobe structure in California's Central Coast that suffered severe damage in the 2003 San Simeon earthquake.