Geotechnical Construction Observation Report White Point Landslide Dewatering Drains City of Los Angeles San Pedro District Los Angeles, California

July 2, 2014

SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

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Submitted To:
Mr. Christopher F. Johnson, P.E., G.E.
City of Los Angeles Dept of Public Works
Bureau of Engineering
1149 S. Broadway, Suite 120
Los Angeles, CA 90015

By:
Shannon & Wilson, Inc.
664 West Broadway
Glendale, CA 91204

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1.0 INTRODUCTION

1.1 General

This report summarizes construction of dewatering drains in the eastern flank of the White Point Landslide (Figure 1). This report incorporates our previous conclusions and recommendations described in the following White Point Landslide correspondence with the City of Los Angeles Bureau of Engineering (City):

- Final Geotechnical Report, August 15, 2012 (Final Report)
- Final Addendum Geotechnical Report No. 1, December 19, 2012 (Add-1 Report)
- Plans and Specifications prepared by Wagner Engineering and Survey (WES) originally dated December 19, 2012, with final revisions dated March 11, 2013 (Design Plans)
- Instrumentation Monitoring Status Report through February 5, 2013 (February Status Report)
- Instrumentation Monitoring Status Report through March 6, 2013 (March Status Report)
- Instrumentation Monitoring Status Report through April 19, 2013 (April Status Report)
- Draft Data Report for Boring B-12, April 24, 2013 (Draft B-12 Report)
- Instrumentation Monitoring Status Report through May 29, 2013 (May Status Report)
- Instrumentation Monitoring Status Report through July 1, 2013 (July Status Report)

1.2 Project Description

On November 20, 2011, a 600-foot section of coastal bluff near White Point Nature Preserve experienced a landslide event (2011 Landslide) that collapsed the Paseo del Mar roadway. Geological and geotechnical information on the 2011 Landslide is described in our Final Report. In our Final Report, we recommended immediate mitigation work including construction of a dewatering system to reduce the potential for future landsliding east of the 2011 Landslide. Our

Final and Add-1 Reports conclude that the slope could become unstable during elevated groundwater conditions. Future landslide movements, triggered by high groundwater conditions, could occur during heavy rainfall, as a result of excessive irrigation, and/or from design-level seismic events.

The Add-1 Report and the Design Plans describe installing arrays of parallel gravity-fed drains to intercept groundwater and reduce porewater pressure in the eastern flank area. The proposed drains were horizontally spaced about 20 feet apart, in an upper and lower configuration, and would be constructed using horizontal directional drilling (HDD). The HDD drains targeted the higher permeable zones identified by our subsurface explorations above identified bentonite clay zones, and daylight near the toe of the existing coastal bluff.

Due to the heterogeneity of the bedrock permeability and fracture pattern, we assumed the individual drains would experience differing discharge rates. As a collective sink, we estimated the drain array should develop a groundwater capture zone up to 300 feet wide at the top of the bluff slope.

The City of Los Angeles authorized Hayward Baker, Inc. (HBI) to begin constructing the proposed dewatering drains in January 2013.

1.3 Scope of Services

Our scope of services for construction observation of the dewatering system is described in our proposal dated January 10, 2013. The purpose of our services was to provide geotechnical observation and documentation during construction of the HDD for dewatering of the existing slope east of the White Point Landslide. Our services included:

- Support during bid phase;
- Construction observation during drain installation;
- Review of Request for Information (RFI) and submittals, and;
- Construction observation summary report and as-built survey.

Refer to our proposal for details on our scope of services. HBI authorized our services on January 24, 2013. We prepared a draft of the construction observation summary report on July 2013 for City review. Unless otherwise noted, we have generally concluded our dewatering observations on July 2013, as contained in this report. The Ground Anchor Construction Summary report currently in progress as of this final report date, provides updated observations starting on October 2013.

2.0 SUBSURFACE CONDITIONS

2.1 General

Our Final, Add-1, and Draft B-12 Reports provide detailed descriptions of subsurface conditions and interpretive geologic cross sections. We provide a brief summary below of subsurface conditions for the eastern flank area of the 2011 Landslide in this section, which is the primary zone where HBI installed the dewatering drains.

A relatively thin layer of Quaternary-age Terrace Deposits was typically observed below the Paseo del Mar pavement at borings B-7, B-10, B-11, and B-12. The underlying Altamira Shale consists of interbedded siltstones with claystones and fine grained sandstones. Soft clay beds were observed typically starting about 80 feet below the ground surface. Interbedded siliceous siltstone beds were observed at depth.

2.2 Groundwater

Groundwater level or piezometric head measurements at the site began in December 2011 during the original phase of work for the 2011 Landslide study. We added observation sites in July 2012 (boring B-10 and B-11) and April 2013 (boring B-12). Vibrating wire piezometers (VWPs) are installed in borings B-1, B-3, B-5, B-6, B-7, B-8, B-9, B-10, B-11, and B-12. Each boring with a VWP also contains a datalogger that records hourly groundwater level or piezometric head. Please see our Add-1 and Draft B-12 Reports for additional details.

Details regarding groundwater elevation at individual monitoring points is in our Final and Add-1 Reports and referenced monthly status reports. The following piezometric head data is from our Add-1 and Draft B-12 Reports prior to the start of construction:

- VWPs installed at elevations from +2 to +13 above mean sea level (msl) feet in borings B-1, B-5, B-7 and B-8 had piezometric heads of about +57, +61, +24, and +33 feet msl, respectively.
- The piezometric head in the deepest VWP in boring B-10 (at elevation -7 feet msl) increased since installation in July 2012. In late September 2012, the piezometric head in this VWP was above elevation +100 feet. The piezometric heads in the two shallower B-10 VWPs (at elevations +10.9 and +40.9 feet above msl) were progressively lower at elevations +46 and +40 feet above msl, respectively, indicating confined conditions in the area of B-10.

- In boring B-11, the three VWPs show piezometric heads that varied by less than 10 feet between elevations +49 and +61 feet above msl.
- We completed boring B-12 during dewatering construction as described in the Draft B-12 Report. The three VWPs show piezometric heads between elevations +66 and +80 feet above msl.

3.0 GEOTECHNICAL REQUIREMENTS

The following is an overview of our geotechnical recommendations for the project. Details of our recommendations are provided in our Add-1 Report.

1. We recommended installing arrays of parallel gravity-fed drains targeting the higher permeable zones identified by our borings above an identified bentonite clay zone, and daylight the drains near the toe of the existing coastal bluff. An upper drain alignment was recommended to alleviate perched groundwater conditions and to increase the probability of intersecting fractures. A lower drain alignment was recommended to reduce the piezometric head in confined zones by 15 to 20 feet and to reduce groundwater pressure on critical potential landslide failure surfaces.
2. We recommended installing the drains using HDD, which involved:
   a. Drilling a pilot hole along a designed path from the top of the slope to the exit point at the toe of the slope using a drill rig that pushes the directional drill bit and drill rods into the ground. The drill rods are then pushed into the hole and the rods follow the desired direction of the drill bit.
   b. Using a directional monitoring device located behind the drill bit to measure the position and effectively "steer" the drill bit.
   c. Attaching the product pipe and casing to a pulling assembly at the exit point. Once the bore is complete, pulling the casing pipe back into the hole.
   d. Monitoring hydraulic fracturing, or "frac-out," which is likely to occur when slurry pressure in excess of the total stress in the ground is applied to the walls of the bore. In general, due to the overburden and moderate rock strength in this area, we did not anticipate major frac-outs until near the exit point. Small frac-out volumes did occur near the entry and exit points along existing fractures in the rock.

4.0 CONSTRUCTION PROCEDURES

4.1 General

HBI constructed the dewatering system at White Point Landslide, with subcontractors Ventura Directional Drilling (VDD), ProGuide HDD, and Scientific Drilling. Representatives of the City and Shannon & Wilson (S&W) observed dewatering construction. BonTerra Consulting provided ecological monitoring during the later parts of construction under contract to the City.

S&W observed the dewatering construction performed by HBI and their subcontractors from February 15 to July 9, 2013. We summarized the daily construction observations in field activity reports (FARs) summarized in Table 1 and provided in Appendix A. During the course of the project, we observed the HDD installation, placement of the high-density polyethylene (HDPE) casing, survey of the drainage paths, and monitored the instrumentation. A summary of the construction procedures are presented below. Our opinions on the construction procedures are described in the "Findings and Conclusions" section of this report.

4.2 Equipment On-site

HBI and their subcontractors used the following equipment to perform dewatering construction:

- Ditch Witch JT 8020 Mach 1 Drill
- Ditch Witch JT 3020 Mach 1 Drill
- Wireline Location Equipment
- Microcoil Location Equipment
- Containment Facility Pump
- Bobcat Mini Excavator
- Krupp GMK 5160 Crane
- 5000 Gallon Water Truck
- De-sanding Unit
- CAT 305E Excavator
- McELROY Pipe Welder
- CAT TL 943C Telehandler
- Ditch Witch FX 30
- John Deere Gator HPX 4x4

4.3 HDD and HDPE Pipe Installation

Dewatering construction consisted of drilling and installing 20, 4-inch diameter, 600-foot long HDPE drains using HDD in accordance with the Design Plans. The contractor installed the dewatering drains in the eastern flank area as shown in Figure 2. The dewatering design consisted of an upper and lower drain configuration shown in Figure 3. The work included peripheral components necessary to perform HDD work in local rock conditions on the 120-foot slope. The Design Plans specified HDD accuracy tolerances and environmental restrictions necessary to comply with environmental permits, complete future phases of repair work, and adapt to ground conditions detailed in the Final and Add-1 Reports.

HBI constructed the peripheral HDD components, including HDPE casing pipe fusing and construction of entry/exit facilities. Exit facilities consisted of three temporary containment structures at the beach composed of water-filled K-rails lined with filter fabric, Visqueen liners, and sealed by sandbags. The containment structures collected drilling fluid, drill cuttings, and groundwater concurrent with drilling and during break-out. The structures also provided a staging area for HDPE pipe pullback and grouting of the final 15 feet of the drillhole annulus.

HBI subcontracted VDD to perform the HDD drilling. VDD performed drilling with a Ditch Witch Midi Drill using a spade or tricone bit depending on ground conditions. ProGuide performed the HDD locating services under subcontract to VDD using a wireline location system. The wireline consisted of grid-coil and microcoil components, deployed independently for quality control system accuracy near the slope face. Refer to the Add-1 Report for additional details of the HDD method.

4.4 Survey

The Design Plans required HBI to install drains within ±5 feet horizontally of the two critical points (CP) and the design exit points shown in Figure 2 and Figure 3. The Design Plans, which were amended by subsequent submittals, required HBI to install drains within ±10 feet vertically of CP-1, ±5 feet vertically of CP- 2, and ±2 feet vertically of the design exit points.

HBI submitted wireline and gyro-theodolite (gyro) surveys as as-built surveys of the constructed drains. HBI generated the wireline survey from the ProGuide HDD location data. Scientific Drilling performed the gyro survey of the drains after construction as an accuracy check to the wireline survey. The gyro survey is typically rated at ±0.5 feet accuracy.

Plate 1 illustrates the gyro survey data accepted by S&W as as-built alignments of the dewatering drains. The wireline survey data is presented in Appendix B. S&W used the gyro and wireline surveys to assess the drain installation accuracy. Table 2 summarizes the actual drain installation accuracy in accordance with these specifications.

4.5 Instrumentation and Monitoring

S&W performed instrumentation readings during the dewatering construction as part of the ongoing instrumentation and monitoring program for the project. We summarized our readings during construction in the five instrumentation monitoring status reports listed above in this report. Refer to Section 2.0 above and Section 7.0 below for additional details regarding the instrumentation.

5.0 SCHEDULE

Construction of the dewatering system for the Project began on February 15, 2013. Drilling of the dewatering system started on February 18, 2013 and finished on April 25, 2013. Wireline survey was continuous during the drain installation. Confirmation survey with the gyro system occurred on April 4 and May 10, 2013. Final observation of compacted backfill at the permanent entry structures occurred on June 13 and July 9, 2013.

6.0 CORRESPONDENCE

HBI submitted RFIs during construction concerning:

- Grout mix design,
- Drain D-2 exit point tolerance and CP-1 tolerance,
- Additional groundwater readings,
- Permanent entry structure design,
- Drill path tolerances near monitoring wells B-10 and B-11,
- Downhole gyro surveys, and
- Permanent entry structures.

S&W reviewed the submittals and responded with design modifications as appropriate. Appendix C contains the original HBI correspondence and S&W submittal responses as delivered to the City.

S&W prepared two letters during construction. The first letter clarified the HDPE pipe section of the Design Plans. The second letter stated our opinion of the turbulent discharge observed during the Drain D-2 exit operation. Appendix D contains the letters as submitted to the City.

S&W and the City met twice during construction to address construction issues, instrumentation observations, and future phases of work. Appendix E contains the minutes of these meetings.

The City issued a Notice of Non-Compliance (Notice) to HBI on March 3, 2013 in response to inaccurate installation of Drains C-2, C-5, and D-1 as summarized in Table 2. At the City's request, S&W proposed a resolution to the non-compliant work in a letter dated May 20, 2013. Appendix F contains the Notice and resolution letter.

7.0 FINDINGS AND CONCLUSIONS

7.1 General

We observed the HDD drilling, reviewed survey data, monitored drilling fluid losses, noted HDD drilling techniques, observed breakout and indications of frac out, observed pullback of the HDPE pipe, observed pit excavation and construction of the permanent structure, read instrumentation, and prepared responses to contractor RFI's. We reviewed daily field reports that were prepared following our construction observations. To the best of our knowledge, there are no outstanding construction items that require correction.

Our instrumentation indicates an average pressure head decrease of 13 feet in the dewatered zone following dewatering construction, as summarized in Figure 4. We anticipate that pressure head will continue to decrease in the dewatered zone over time. We continued to monitor instrumentation in accordance with the 2012-2013 White Point Instrumentation and Monitoring Plan.

In our opinion, the geotechnical aspects of the construction described in the following sections were in conformance with the Design Plans and in general accordance with the above referenced geotechnical reports and recommendations. Our opinion is based on our observations, which were made on a full- and part-time basis at the site during construction.

7.2 Drain Installation

During drain installation, we observed correlations between the proximity of drilling activities and rapid increases in local groundwater pressure. It is our opinion that high annular fluid pressure necessary for HDD operations caused the temporary increase in pressure recorded in the VWPs. We recorded small inclinometer casing displacement in borings B-7, B-10, and B-11 that corresponded to increased groundwater pressure and nearby HDD operations. However, we did not observe mass displacement of the slope, nor were there any reported movements of the surface survey points monitored by the City. The Status Reports and the April 8, 2013 meeting minutes (Appendix E) summarize our opinions of the instrumentation readings. As of the July

2013 Status Report, we had not observed discernable displacement in the inclinometer casings since HBI completed the final drain installations.

7.3 Drilling Deviations

As previously described in Section 4.4 and summarized in Table 2, the contractor installed Drains C-2, C-5, and D-1 outside the tolerances required by the contract documents. The City issued the Notice of Non-Compliance in response to these deviations (Appendix F). In a subsequent letter, we recommended the City accept the drains as constructed, because the deviations did not impede the drain function. However, we noted the deviations would likely require design modifications in future project work, including the installation of the western-most ground anchors and slope erosion protection.

7.4 Drain Discharge

We observed drain discharge rates during and after construction. We noted communication between the HDD and previously installed drains during drilling. We provided estimates of drilling mud and groundwater discharge rates from the drains during drilling in our FARs. The volume of groundwater discharged from drains into the containment system ranged between 1,400 and 3,300 gallons per day. HBI is pumping out the discharge from the containment area and disposing of the discharge offsite. Our observation on May 29, 2013 found that 14 of the 20 drains were discharging water. The maximum discharge rate was about 0.7 gallons per minute from Drain A-2 and a cumulative discharge rate from all drains was 2.3 gallons per minute.

The measured drain discharge rates reported in our FARs and Status Reports had changed over time. This increase occurred during the start of the dry season with precipitation between April and July 2013 at less than 0.6 inches. As rainfall did not likely contribute to the increased discharge, we believe this increase may be partially due to gradual breakdown of the filter cake established around the borehole during drilling.

At the City's direction, HBI has been testing the discharge water for turbidity and natural hydrocarbons, presumably associated with naturally occurring petroleum in the formation. We understand that water from Drain D-2 is not considered suitable for discharge onto the beach pending additional testing and reviews being led by the City. We suggest redirecting flows from the other 19 drains that are suitable for discharge onto the beach and out of the containment area. This will considerably reduce the costs associated with pumping and draining. We understand the containment system will be removed upon completion of the ground anchors and installation of rip-rap or Reno mattress at the base of the slope.

7.5 Drain Effectiveness

The installed drains have impacted the hydrogeologic conditions at White Point. We observed these impacts in the form of porewater pressure fluctuations and/or reductions in the VWP head readings, at borings B-3, B-5, and B-7 through B-12. The impacts are graphically summarized in Figure 4.

To maximize the effectiveness of the drains and further break down the filter cake, we prepared a proposal dated June 21, 2013 recommending video surveys and development of the drains to reduce sediment and associated bacteria growth in the drain pipe slots. We recommended the video survey occur before installation of the ground anchors to baseline drain conditions.

We will provide recommendations for the maintenance of the drains, which will be finalized and submitted in the 5-Year Maintenance and Monitoring Plan after the ground anchor installation is completed.

7.6 Discharge Area Protection

Slope erosion protection is proposed at the slope base where the drains are discharging into the containment system. The primary purpose of the protection system is to reduce coastal bluff erosion from undermining the slope and to provide localized stability of the slope toe from drain discharge. The protection is proposed to be installed after completion of the ground anchors.

7.7 Long-Term Slope Stability

The function of the drainage system coupled with the ground anchors is critical for maintaining the improved long-term slope stability of the eastern flank. Periodic monitoring of the instrumentation, drain discharge, and video survey of the drainage system is recommended with the construction of the ground anchors and discharge area protection.

8.0 LIMITATIONS

The professional opinions presented in this report were developed using the degree of care and skill, ordinarily exercised under similar circumstances and at similar locations, by reputable geotechnical consultants. No other warranty, express or implied, is intended as to the professional advice included in this report. The report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

The dewatering work was done to the limits and at the locations indicated by stakes and hubs set by others. The scope of our services did not include the responsibility for either job safety or surveying.

Shannon & Wilson, Inc. has prepared the document, "Important Information About Your Geotechnical/Environmental Report," in Appendix G to assist you and others in understanding the use and limitations of this report.

SHANNON & WILSON, INC.

Dean G. Francuch, P.G., C.E.G.
Associate

R. Travis Deane, P.E., G.E.
Senior Associate

7/2/14

JZB:DGF:RTD/jzb

c: Mr. Christopher Johnson, City of Los Angeles (electronic copy only)
Mr. Pedro Garcia, City of Los Angeles (electronic copy only)

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