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Department of Transportation**

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May 15, 2015

To: Linea Laird, Chief Engineer  
Washington State Department of Transportation

From: Todd Trepanier, Administrator  
Alaskan Way Viaduct Replacement Program  
Washington State Department of Transportation

Re: WSDOT's Response to Recent Settlement Evaluation Reports

In November 2014, Seattle Tunnel Partner's monitoring system detected just over an inch of ground settlement near the SR 99 Tunnel Project's access pit, which is located in Pioneer Square between Jackson and Main streets within the tunnel construction site. Survey data indicated that the magnitude of settlement diminished east of the access pit. After first detecting the ground movement, WSDOT bridge engineers surveyed the Alaskan Way Viaduct and determined that it too had experienced approximately one inch of settlement in some locations. The settlement was generally uniform and has not caused any structural damage to the viaduct or nearby buildings.

Upon confirming the settlement data in early December, we immediately implemented specific actions.

The actions and results:

- Conducted manual surveys of the Alaskan Way Viaduct.
  - *Result:* Settlement of the viaduct was detected; however it was uniform in nature. Uniform settlement has minimal risk to structures like the viaduct. As we have noted before and as the City of Seattle's independent review confirms, the viaduct remains safe for ongoing use.
- Conducted more than 60 assessments of buildings in a focused area within Pioneer Square. We also worked with property owners to offer a more extensive property condition survey, beyond the initial assessments. These condition surveys are ongoing.
  - *Result:* The building assessments identified a handful of buildings with possible cosmetic effects but no signs of structural damage. Uniform settlement has minimal risk to buildings.
- Increased survey and monitoring frequency of the ground surface, Alaskan Way Viaduct and buildings.
  - *Result:* Data shows that the ground settlement experienced over a short period in November has subsided.

- Assessed the overall monitoring effort and built upon it since it was designed to monitor infrastructure along the tunnel alignment.
  - *Result:* Additional ground surface points were established and LiDAR boundaries expanded to better monitor nearby buildings and streets. The frequency of readings was increased.
- Held regular meetings with the City of Seattle and Seattle Tunnel Partners to discuss incoming data.
  - *Result:* Survey results and issues are communicated in a timelier manner.

While some settlement was expected during tunneling, more than an inch was not predicted in relation to non-tunneling construction and project dewatering. Even though the settlement has not caused structural damage, we wanted to better understand the potential causes. We asked Shannon & Wilson, Inc., a local consulting firm with geotechnical expertise, to review the available data related to ground settlement and evaluate various hypotheses regarding potential causes.

Key points from the report:

- Dewatering of the lower aquifer in association with access pit construction has resulted in compression of deep soils and corresponding settlement in the project vicinity.
- The observed settlement caused by deep dewatering activities has a low risk to cause structural damage to infrastructure because it is relatively uniform over short distances.
- There is evidence of settlement in localized areas that may be occurring due to ongoing historical settlement (natural subsidence) or settlement caused by other non-WSDOT construction projects. The data indicates that localized settlement was occurring before tunneling and before project dewatering wells were turned on. Localized settlements have a higher risk of causing differential settlement and damage to infrastructure than the settlement caused by the project dewatering.

As Shannon & Wilson evaluated the monitoring data and potential settlement sources, we checked in with them regularly. Since learning the settlement detected in November was likely caused by lower aquifer dewatering activities, we have been working with STP to manage the situation. Focus areas include:

- **Working on procedures to lower the pumping rate of the dewatering wells.** STP installed a number of dewatering wells including deep dewatering wells in 2014 to control groundwater around the access pit. The deep dewatering wells were turned on in November; ongoing monitoring indicates groundwater levels have been stable since April 2015. Additional settlement is not expected if groundwater levels remain steady. However, if they change, a plan to reduce the pumping rates of the dewatering wells may be implemented. The wells will not be fully turned off until tunneling resumes and the access shaft is decommissioned.
- **Increased observation and monitoring.** WSDOT will continue to look for indications of damage due to dewatering induced settlement. In the event damage is observed, we will take the appropriate steps. Additionally, we have again

expanded our monitoring zone to include survey points as far east as I-5. If additional settlement is detected, WSDOT and STP will evaluate the data and take the appropriate action.

In addition to Shannon & Wilson's evaluation of the settlement data, STP asked their engineering consultant, Brierley Associates, to write a technical memorandum about the November 2014 settlement. They believe the available data indicates that a significant amount of the settlement is due to a continuation of ongoing regional subsidence (historic settlement) and activities affecting the aquifers in the area, not as a result of the access pit's deep dewatering wells.

Both reports illustrate the complexity of the settlement in this area and the number of possible contributing factors. Regardless of the exact proportions each activity is contributing to the settlement, WSDOT will continue to meet with STP and the City of Seattle on a regular basis to review available monitoring data and assess whether additional actions should be taken.

Public safety is our top priority and we will continue to take precautions to protect the traveling public and Seattle's infrastructure as this project moves forward.