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February 8, 2013

Mayor Kovash and City Council  
City of West Linn  
22500 Salamo Road  
West Linn, Oregon 97068

Dear Mayor Kovash and Councilors:

I am writing you on behalf of the Lake Oswego-Tigard Water Partnership. This cover letter is part of the applicant's response to the materials provided by other parties to these proceedings in the seven-day period provided by Council. Those responses are attached to this letter, in the document titled, Response to New Submissions as of February 4, 2013.

The Partnership will not introduce new evidence and will rely on the existing record to address statements made during the most recent proceedings, including those received in the seven-day open record period. We have attached copies of other relevant documents previously placed in the record to this letter.

There was considerable discussion by the Council over the meaning and application of the phrase "overall needs of the community." Councilor Jones suggested that there are four communities at issue, two of whom had their needs met, the region and the city, but that the needs of two communities, the Robinwood Neighborhood and the Highway 43 business community had not been met. We believe the additional conditions suggested by Council on January 28, 2013 will ensure that all community needs can be reasonably met. We look forward to refining these with your staff for your ultimate adoption.

To help ensure that the needs of the immediate neighborhood are met, the applicant will agree to amendments to the construction management plan as contained within the findings presented by West Linn staff. These can include additional measures to address special needs individuals during open cut pipeline construction, implementation of a 24X7 staffed hotline, and the imposition of penalties by the City of West Linn if the commitments made in the construction management plan are not met. These mitigations will ease the burden on our immediate neighbors.

The Partnership believes that our benefits to the immediate neighborhood far outweigh any temporary construction related impacts. Some of these benefits include a pedestrian/emergency



access trail, which will provide connectivity between Kenthorpe and Mapleton for emergency vehicles and residents alike. The neighborhood will enjoy new improved and expanded open space and the more attractive building designs and landscaping will enhance the overall appearance of the neighborhood. The existing asbestos cement pipelines will be replaced and entire road surfaces will be renewed greatly extending their life. Finally, and perhaps most importantly, the seismic risks inherent in the current plant and pipeline, will be fully remedied. In the aftermath of a major earthquake the plant will continue to produce water for over 100,000 people while providing shelter to our most immediate neighbors.

We share Council's concern about the potential impacts to the Highway 43 business community. Nighttime construction and ODOT requirements assuring that the roadway will be fully functional between the hours of 5AM and 8PM will go a long way to reduce business impact. Still we recognize that more should and can be done to support businesses along the highway during the pipeline construction period.

Attached please find the business promotion plan we created over the past month as we spoke to many Highway 43 business owners and their representatives. Following approval of the project we are committed to work closely with the City's Economic Development Director and the business community. Together, we will refine, adopt and implement a robust business promotion plan. While this may not completely eliminate all the challenges businesses may face during construction, we believe it will significantly offset the temporary inconvenience for customers during the five months of pipeline construction. In addition, the long-term benefit of increased water reliability and infrastructure cost savings (which translate directly to rates) will help advance West Linn's economic development goals of greater business retention and formation.

The Planning Commission's findings suggested we take additional steps to evaluate expert geotechnical findings regarding the suitability of the site for our pipeline and plant. We asked Dr. Scott Burns, Professor at Portland State University and our region's foremost Engineering Geologist, to independently peer-review the work of our geotechnical team. Dr. Burns' review, dated January 3, 2013, states, "Based on comparisons of the soils and landslides in the area, the risk of seismically and climatically induced landslides on the pipeline and treatment plant is very low." The letter from Dr. Burns is attached.

We further asked Dr. Stephen Dickenson, former Oregon State University professor and now President of New Albion Geotechnical in Corvallis, to conduct a second independent peer review of our geotechnical studies. His report (see attached) reviewed all expert evaluations of seismic hazard and ground motion characterization required for liquefaction triggering evaluation, liquefaction assessment, post liquefaction ground settlements, and possible lateral spreading hazards related to the placement of the proposed pipeline and plant construction. Dr. Dickenson found, "Practical mitigation techniques including ground treatment, deep foundation support, and structural details that provide system flexibility have been proposed. These methods have been employed to improve the seismic resiliency of important civil works projects throughout the



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Pacific Northwest.” We are pleased he concluded that with our proposed design and safeguards that “...the project is feasible...”

The additional peer reviews by Dr. Burns and Dr. Dickenson, neither of which had any previous connection to our project, provide even more assurance about the seismic suitability of the plant site and pipeline route. Similarly, we hope their work increases public confidence that our design team has taken all steps necessary to ensure the safety of the facilities and the neighborhood in the event of a major earthquake.

Since your last proceedings on our appeal, we believe we have dealt with the concerns over the eminent domain cases, so that these are no longer an issue.

We stand ready to respond to your questions and concerns, without adding new evidence to the record. Thank you for your consideration.

Sincerely,

EDWARD J. SULLIVAN

Enclosures

PDX\_DOCS:497178.1

## Response to New Submissions as of February 4, 2013

The following are the appellant's brief responses to new materials placed in the record as of February 4, 2013, but not including those items to which response has previously been made:

1. Alleged Bias of the Mayor – The Mayor, and all sitting councilors, made statements of their views on the proposed project. These statements were made on January 28, 2013, following the close of the record, but prior to a decision of the Council. That is what these elected officials are called upon to do – take a position, deliberate and ultimately come to individual and collective decisions on public policy matters. Those activities do not constitute bias.

2. Response to Ex Parte Contacts – The Council elected to respond to the Mayor's ex parte contact by leaving the record open for response. That is exactly what the law requires. ORS 227.180(3) provides:

No decision or action of a planning commission or city governing body shall be invalid due to ex parte contact or bias resulting from ex parte contact with a member of the decision-making body, if the member of the decision-making body receiving the contact:

(a) Places on the record the substance of any written or oral ex parte communications concerning the decision or action; and

(b) Has a public announcement of the content of the communication and of the parties' right to rebut the substance of the communication made at the first hearing following the communication where action will be considered or taken on the subject to which the communication related.

The substance of the contact was placed in the record<sup>1</sup> and rebuttal was offered in the 7 day period.<sup>2</sup> This fully meets the legal standard. The law does not provide for cross-examination. If anyone wished to challenge the mayor's statements that he did not believe that 7 neighborhood associations opposed the project, they could do so, as Mr. Froode did.

3. Payment of Funds to Property Owners – Help Save West Linn suggested that residents and businesses are entitled to some direct remuneration to offset the impacts from construction. The appellant is subject to a proposed \$5 million payment for use of West Linn right of way, a sum recommended by the person hired by the City of West Linn to negotiate this matter. The appellant requests only that this sum be used for water system-related matters. The City of West

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<sup>1</sup> The Mayor, according to his statement in the record of this case, said that he spoke with two people – One was concerned that "LOT treat WL citizens right" and the other "knew nothing about LOT." Mayor Kovash email dated February 5, 2013. That is sufficient.

<sup>2</sup> Mr. Froode took advantage of this opportunity in his email of February 4, 2013 to say that one of the supposed opposition neighborhood associations did not, in fact, oppose and that those who did, did so "in one form or another" (such as, perhaps, to urge further discussions). Moreover, he suggests that not all such associations "had quorums or are active" as well. The Mayor's point appears to be well-taken.

Linn does not pay nearby landowners for proximity to its own public works projects, nor has this been shown to be a requirement or practice in Oregon. If the City of West Linn finds such payments to be water-related, it may do so. However, the Council might think of the resulting precedent. Moreover, those property owners in the Maple Grove plat who took payments from Lake Oswego were compensated in their settlement for any damage or inconvenience over the waiver of their covenants to allow the placement of the water treatment plant on the City of Lake Oswego's property. They should not be paid twice.<sup>3</sup>

4. Amendment for Changed Project – Gary Hitesman suggests that CDC 99.120, Amendments, applies to this situation. This provision only applies to amendments to approved projects. It does not apply in this case.

5. Pipeline through WRA Overlay Zone -- Public testimony was submitted by Pat and Vicky Smith via email on February 4, 2013 with respect to the impacts and compliance of the Partnership's approach and West Linn Staff's response to two Water Resource Area (WRA) crossings on Mapleton Drive, namely Trillium Creek and Heron Creek.

The 60 percent Raw Water Pipeline (RWP) and Finished Water Pipeline (FWP) alignment drawings have previously been submitted in the record and show the pipeline alignment through each of these two WRAs. David Evans and Associates submitted a technical memorandum which included a characterization of Trillium Creek (WR-4) and Heron Creek (WR-5), a description of the work to be conducted, and an evaluation of the potential project impacts on both WRAs. See Water Resource Area (WRA) and Habitat Conservation Area (HCA) Technical Memorandum, David Evans and Associates, Inc., May 14, 2012, RWP/FWP Application Section 5. The Partnership stands behind its original representation that the proposed RWP and FWP will not disturb any known WRA. At pages 53-61 of the staff report on the pipeline, the staff concurs with the approach taken by the Partnership. *See especially* findings 32, 34, and 35 of the staff report.

Trillium Creek – The Partnership proposed that the FWP be tunneled underneath the Trillium Creek culvert in the Mapleton Drive right-of-way to avoid any disturbances to this resource. Entry and exit bore pits for the pipeline tunnel will be located on either side of the creek, at a sufficient distance to ensure that there will be no surface impacts to the resource. The FWP alignment (as shown in the 60 percent alignment drawings) and the bore pits required for the tunnel will be completely located within areas already disturbed (i.e., pavement and parking) in the Mapleton Drive right-of-way. There will be no impacts on adjacent storm drainage channels, streamside vegetation, and water quality or water quantity as a result of the proposed pipeline installation therefore, the proposed pipeline crossing is consistent with West Linn CDC Section 32. See RWP/FWP Application, Section 5, page 7.

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<sup>3</sup> The complaints of some of those who filed statements that they were “bullied” into settlement and that the judge was biased fails to take into account that these property owners were represented by counsel. Prior to rendering the settlement decision, the judge provided each defendant represented by counsel an opportunity to voice their opposition to the terms of the settlement. No opposition was voiced and thus each property owner accepted payment including attorney's fees for the lifting of certain restrictive covenants from Lake Oswego's properties.

Heron Creek – The Partnership has proposed that the RWP be installed over the top of the Heron Creek culvert via open-cut construction methods in the Mapleton Drive right-of-way to avoid any disturbances to this resource. The RWP alignment (as shown in the 60 percent alignment drawings) is completely contained within paved areas in the Mapleton Drive right-of-way. There will be no impacts on adjacent storm drainage channels, streamside vegetation, and water quality or water quality as a result of the proposed pipeline installation; therefore the proposed pipeline crossing is consistent with West Linn CDC Section 32. See RWP/FWP Application, Section 5, page 7.

CDC 32.050(C) requires that “development shall be conducted in a manner to minimize adverse impact on water resource areas. Alternatives which avoid all adverse environmental impacts associated with the proposed action shall be considered first.” After review of the project proposal, David Evans concluded that the FWP construction will not adversely impact the Trillium and Heron Creek WRAs. Therefore, by selecting an alignment which “avoid(s) all adverse environmental impacts” the Partnership’s obligation to conduct any additional alternatives analysis regarding WR-4 and WR-5 ceased.

6. The Existing vs. the Proposed Intergovernmental Agreement – The existing intergovernmental agreement must be amended to include Tigard, which is now a partner with Lake Oswego and who now owns assets that are used to supply water to West Linn. Incidentally, it is this partnership with Tigard that allows the appellant to meet the needs identified in the Water System Master Plan, which is part of the West Linn Comprehensive Plan, to secure water supply to 2041 and secure the funds to apply to West Linn’s water system. If both the appellant’s proposal and the meeting of the West Linn water needs are to go forward, this agreement must be entered into by all parties, including South Fork Water Board.

Mr. Michael Monical submitted public testimony via email on February 4, 2013 with respect to the existing emergency water intertie and intertie agreement. In his testimony Mr. Monical asserts the intertie facility is “...a mutually beneficial facility and CANNOT be removed without abrogating our existing inter Governmental Agreement (IGA); an event which would justify a lawsuit by West Linn if LOT tried to remove it.” Mr. Monical later asserts “...the intertie will continue in any scenario and will supply water to West Linn (and vice versa) in an emergency, IF excess supply exists.”

Mr. Monical is correct that the intertie facility provides mutual benefits to the parties that are signatories to the 2003 agreement. However, as stated in the appellant’s oral presentation on January 14, 2013, the value and reliability of the intertie is only as good as the systems that supply water to it. Furthermore, that testimony went on to state that absent the expansion and modernization of the Partnership’s plant and pipeline coupled with an update to the 2003 agreement and absent replacement of West Linn’s Bolton reservoir or, construction of a new, parallel water transmission main, continued reliance on the intertie by either West Linn or Lake Oswego should be reconsidered. Without the proposed expansion and seismic upgrades to plant and pipelines, and coupled with an updated intertie agreement, the value of the intertie facility, will continue to decline. The growing inability of the parties to the intertie facility to reliably deliver water at all times in the year reduces the practical value of the facility and the agreement

which allows its use. The continuation of the intertie is a benefit, but only if the applications to expand the plant and add the necessary additional infrastructure are approved.

Contrary to Mr. Monical's assertions that no party can walk away from the IGA, the facts are clear. The 2003 IGA, which is the currently operative agreement, allows any party, with 36 months notice to the other parties, to terminate the agreement. At the public hearing on January 15, 2013, Mayor John Kovash asked the appellant if a condition of approval not allowing termination prior to 2041 would be acceptable. The appellant indicated it would accept such a condition. Only through the imposition of this condition and execution of an update to the 2003 agreement with this provision can this benefit to West Linn be realized.

7. Construction of new Bolton Reservoir is dependent upon the intertie. Mr. Michael Monical submitted public testimony via email on February 4, 2013 asserting that the appellant has testified falsely in these proceedings that future replacement of the existing Bolton Reservoir is dependant upon the intertie. In this most recent testimony, Mr. Monical asserts "...the intertie might possibly make the work on Bolton easier..." and "The city is able to take Bolton off line at any time and continue to provide water to residents of West Linn."

The appellant agrees with Mr. Monical's statements but asks the Council to consider the facts and conclusions found in your own adopted Water Master Plan and the August 31, 2012 Technical Memorandum prepared by Murray, Smith & Associates, Inc. The facts, professional opinions, and conclusions of this Plan and Memoranda quoted in relevant part, are:

1. Reservoir storage in West Linn (including Bolton) is 5.5 million gallons (MG)
2. Of this total, 2.5 MG (45%) is contained in Bolton Reservoir.
3. With Bolton off line, total system storage is 3 MG
4. On an average day, water demands in West Linn are 4 million gallons per day (mgd) and peak day demands approach 8 mgd.
5. West Linn will be without the Bolton storage volume of 2.5 MG for approximately one year while the new Bolton Reservoir is being constructed.
6. During this one year period of time, loss or reduction of current supply capacity from the South Fork system, like that which occurred in January 2012, could potentially leave West Linn with little more than one day of water supply. Loss or interruption of supply during warm weather months could reduce available supply to as little as one-half day.

The appellant strongly disagrees with Mr. Monical's assertion that the Partnership offered false testimony as to the value of the intertie to the City while it undertakes a replacement of the Bolton Reservoir. The question before the Council is whether or not, the intertie supplied from an expanded, seismically hardened plant and pipelines being offered by the Partnership through approval of these applications will significantly reduce the emergency supply and fire suppression risks the City will face, while its largest reservoir is out of service for at least 12 months. See attached October 16, 2012 letter in the record from Murray, Smith & Associates, Inc., Engineers/Planners to Mr. Lance Calvert, City of West Linn Public Works Director.

8. The Role of the Master Plan. - Mr. Michael Monical submitted public testimony via email on February 4, 2013 asserting that claims made by the appellant that approval of AP 12-02

and AP 12-03, if approved, support the 2008 Water Master Plan, are "...in general incorrect and in some cases false or deliberate misrepresentations."

In this testimony Mr. Monical asserts:

1. "The water master plan directs the connection to Portland's Water System, not support for another connection to the Clackamas River"

The appellant in testimony before the Planning Commission stated that existing hydraulic constraints in the piping between the Tigard and Lake Oswego water systems that would allow water from Portland to pass into Lake Oswego is constrained to only 2 million gallons per day. The 2008 West Linn Water Master Plan identifies that pursuing this option would involve negotiating new intergovernmental agreements and "...probable participation in funding a portion of the transmission system intertie improvements." The water master plan included an estimated cost of \$2.2 million dollars (2006 dollars) for this connection. In subsequent testimony to the Council, the Partnership has testified it is ready to provide a more reliable source of back-up and emergency water of at least 4 mgd of water through 2041 and access to multiple sources of supply at NO COST TO WEST LINN.

2. "An \$11 million savings to West Linn does not and never has existed: it is a fabrication on the part of LOT to claim benefits which do not exist."

The appellant directs the Council's attention to Figure ES-1 on page ES-6 of the 2008 Water Master Plan. In this figure Solution Approach B would involve construction of a new parallel water transmission main crossing the Willamette River. The cost of that solution is estimated at \$8 million dollars (2006 dollars). This was updated in the October 16, 2012 letter from Murray Smith & Associates to a current value of \$11.6 million dollars. The assertions by Mr. Monical are false, misleading, and contradicted by West Linn's consulting engineers and Public Works Director.

3. "Reliance on Lake Oswego for emergency supply is detrimental to West Linn, not a benefit. It delays the construction of our needed storage, storage that EVERY other jurisdiction in the area has."

There is no evidence, testimony or facts supporting Mr. Monical's assertion that approval of AP 12-02 and AP 12-03 will delay construction of any water system improvements recommended in the City's approved Water Master Plan. On the contrary, the \$5 million dollars that the City intends to assess the appellant for use of its right of way, if the applications are approved, could be used to fund over 56% of the cost of a new 4 MG gallon Bolton Reservoir<sup>4</sup>, which could start immediately rather than depend on the outcome of a future bond measure that would have to be approved by voters due to the City's water rate charter limitations.

9. 'Violations' of the CDC. - The "Help Save West Linn" PowerPoint identifies a number of alleged "violations" of the Community Development Code. Use of the term "violation" in this

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<sup>4</sup> City of West Linn, 4.0 Million Gallon Bolton Reservoir Project Conceptual Siting Analysis; Technical Memorandum, August 31, 2012; Murray, Smith & Associates, Inc., pg. 8 of 9.



proceeding is misleading and incorrect. The purpose of this proceeding is to determine if the applicable plan and regulations are satisfied. A “violation” of the code occurs when something is built or developed without obtaining the proper land use approval. CDC 106.020. There is no indication that the appellant’s existing activities are in violation of the CDC (a different proceeding would address such concerns, if they did exist) and asking the City Council to review the Planning Commission’s decision represents the proper procedure.

10. “Perpetual” use of the intertie. - The “Help Save West Linn” PowerPoint goes on to assert that the provision of water through the intertie must be ‘perpetual.’ The appellant is amenable to a condition of approval that provides: The intergovernmental agreement between the applicant and the City of West Linn regarding the intertie shall be modified to provide that it may not be terminated or renegotiated prior to December 31, 2041, without the written consent of both parties. Beyond that date, the Partnership is willing to, in effect, create a “perpetual” back up water supply benefit by providing West Linn additional water supplies from the region through the Partnership’s transmission system.

11. Nixon and Mapleton Intersection Safety. - The “Help Save West Linn” PowerPoint challenges the Green Light Engineering findings regarding the site visibility at the intersection of Nixon and Mapleton citing safety concerns. The appellant is amenable to conditions of approval requiring: 1) no construction traffic will use this intersection and this obligation must be incorporated within construction contracts and violators will be subject to fine pursuant to the City’s enforcement regulations; and (2) before the appellant commences any open cut pipeline construction on Mapleton Drive, the West Linn Public Works Director shall evaluate the applicant’s proposed traffic control and safety plan for the intersection of Nixon Avenue and Mapleton Drive. If the Public Works Director determines additional traffic control and safety measures are needed, those measures shall be implemented by the applicant.

12. Claims of compensation for future property value and business losses

Compensation claims for future, but as yet unknown economic losses, have been asserted by property and business owners throughout these proceedings. None of these claims can be supported by statistical data, expert testimony, or any suggestion of how the applicant could reasonably calculate economic loss before the project begins and the business promotion plan is implemented. No one can foretell the future and this, in part, is precisely why your own code affords special recognition to construction activities.

Broad claims for compensation for undefined prospective damages are not an abstract problem for West Linn given the statements in the record by Mr. William More. In his letter dated February 4, 2013, Mr. More states, “I urge you to please reject this ill-conceived plan that does much harm to our businesses and residents. Let’s put this behind us, and then let’s immediately commence to work with all of the citizens of West Linn to bring about a Master Plan that works for all.” In asserting this, Mr. More does not demonstrate how a new Water Master Plan he pledges to support will avoid precisely the same construction impacts he cites as his primary reason for opposition to the applicant’s plans.

West Linn’s water plans, as represented in the record of this proceeding and supported by staff testimony to the Planning Commission and the Council, make it clear that the replacement of all

pipelines and the Bolton Reservoir are high priorities. Mr. More fails to suggest how these activities can be accomplished without significant disturbance to Highway 43, its businesses and surrounding city neighborhoods.

Similarly, opponents do not identify an alternative West Linn site for a new reservoir if the current Bolton Reservoir must be replaced with a larger facility. If the City accepts the assertions by Mr. More that the Partnership must recognize as yet undemonstrated economic losses, West Linn itself may inevitably confront similar claims for damages that may or may not occur in the future and that may or may not have a demonstrable link to City-sponsored activities.

January 7, 2013

Brown and Caldwell  
6500 SW Macadam Avenue, Suite 200  
Portland, OR 97239

Attention: Mr. Pete Oveson

**Geotechnical Engineering Services**  
Lake Oswego-Tigard Water Partnership  
West Linn Planning Commission – Final Notice CUP-12-02/DR-12-04 and DR-12-14  
West Linn, Oregon  
GeoDesign Project: BrownCald-49-20

## **INTRODUCTION**

This letter is our response to the West Linn Planning Commission’s Final Decision Notice CUP-12-02/DR-12-04 and DR-12-14 in the matter of the proposal for a conditional use permit and Class II design review for the proposed expansion of the City of Lake Oswego Water Treatment Plant (WTP) at 4260 Kenthorpe Way and Installation of a water transmission line in the city limits of West Linn.

The Planning Commission finds that the application is not consistent with CDC Section 60.070(A)(2) – *“The characteristics of the site are suitable for the proposed use considering size, shape, location, topography and natural features.”* The reasons provided by the Planning Commission are that the area is prone to seismically induced liquefaction, lateral spreading, as well as the potential for a deep-seated landslide. The Planning Commission is concerned that the steep slopes and landslides mapped by the State of Oregon Department of Geology and Mineral Industries northeast of the WTP as shown on Figure 2A of the August 23, 2012 Kleinfelder report will fail during a seismic event and impact the WTP and pipe. Those landslides are shown on Figure 1. The Planning Commission is also concerned that liquefaction and lateral spreading will impact the facilities during a design seismic event and will not withstand a magnitude 9.0 earthquake on the Cascadia Subduction Zone.

## **SEISMIC STUDIES USED IN DESIGN**

The proposed facility will be designed using the 2009 International Building Code, which prescribes that all structures be designed using design levels of ground shaking associated with

a probability of exceedance in a 50-year period. Shannon & Wilson (S&W) and Kleinfelder both used the ground motions computed using the U.S. Geological Survey's 2008 maps, which includes ground shaking from various sources including a magnitude 9.0 event on the Cascadia Subduction Zone. Seismic hazards were assessed using ground shaking levels associated with the maximum considered earthquake noted above.

S&W conducted a geotechnical engineering study at the WTP site. The findings of that study are presented in a geotechnical engineering report dated September 2012<sup>1</sup>. S&W predicts between 5 and 9 inches of ground surface settlement associated with liquefaction. They also conclude that lateral spreading hazard is low due to the distance of the WTP to the Willamette River, the relatively deep groundwater table, and the flat topography. To mitigate the effect of liquefaction, S&W has recommended that the facility be supported on auger cast piles that extend through liquefiable soil and transfer all foundation loads to the competent underlying gravel unit. S&W also identifies relative vertical movement between the structures that do not settle and the adjacent ground that undergoes liquefaction settlement. Flexible connections and joints will be used in such cases. Flexible steel pipe with specially designed connections that can tolerate the predicted settlement will be used for the raw and finished water pipelines. The proposed methods of mitigating the hazard are standard in the industry and, in our opinion, are adequate.

An additional seismic study was conducted by Kleinfelder that is documented in an August 23, 2012 letter report<sup>2</sup>. The study focuses on the proposed pipe alignment and identifies the potential for liquefaction in the area and predicts 2.5 to 3.5 inches of liquefaction settlement along portions of the proposed alignment designated Reach 2, east of the WTP, and Reach 4, west of the WTP. They conclude that there is no liquefaction potential in Reach 1, closest to the Willamette River. This is due to the presence of weathered basalt material encountered in borings MA-1, MA-2, and MA-3. The logs of those borings are presented in the GeoDesign March 18, 2011 geotechnical data report<sup>3</sup>. Kleinfelder also concludes that the risk of lateral spreading is low.

## INDEPENDENT STUDIES

The Lake Oswego-Tigard Water Partnership engaged the expertise of Professor Scott Burns of Portland State University to study the slopes to the west of the WTP and provide an opinion on their stability under seismic conditions. Professor Burns concludes that a mapped ancient landslide was caused at the end of the Missoula Floods, approximately 15,000 calendar years ago and endured 30 megathrust earthquakes on the Cascadia Subduction Zone since. His opinion on the smaller historic landslide mapped on Figure 2A of the August 23, 2012 Kleinfelder report is that it was induced by heavy rainfall in 1996 where 8 inches of precipitation occurred in a four-day period. We note that the mapped landslide is also upslope of a cut made for Nixon Avenue, which had a destabilizing effect. Professor Burns further concludes that the slopes to the east of the WTP are steep but have not shown large displacements in the last

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<sup>1</sup> Shannon & Wilson, *Geotechnical Engineering Report; Lake Oswego - Tigard; Water Treatment Plant; West Linn, Oregon*, dated September 2012.

<sup>2</sup> Kleinfelder, *West Linn Land Use Application; Seismic and Geologic Hazards; LOTWP, Raw & Finished Water Pipelines; Lake Oswego, Oregon*, dated August 23, 2012.

<sup>3</sup> GeoDesign, Inc., *Geotechnical Data Report; Lake Oswego Raw Water Pipeline; Clackamas County, Oregon*, dated March 18, 2011.

15,000 years in which period 30 megathrust earthquakes have occurred at the Oregon coast on the Cascadia Subduction Zone, with magnitudes of more than 9.0. We also note that these slopes have also been subjected to large precipitation events and have not shown displacements where they have not been graded. The findings of Professor Burns' study are presented in a letter report attached to this document.

Dr. Steven Dickenson of New Albion Geotechnical, Inc. and formally a professor at Oregon State University has reviewed the liquefaction and lateral spreading studies. He concludes that liquefaction and lateral spreading at the ground displacements have been well identified by the design team and appropriately mitigated. A letter report documenting his study is presented in the attachment to this letter report.

## CONCLUSIONS

It is GeoDesign's opinion that seismic hazards have adequately been identified by the design engineers and effective mitigating measures implemented. Our position is further supported by the independent studies conducted by Professor Burns and Dr. Dickenson. As noted above, the WTP structures will be supported on piling, which prevents structures from settling by transferring foundation loads down to the competent dense gravel layer. Flexible connections and joints will be used where vertical displacement is expected between structures that settle and the adjacent ground surface. Flexible steel pipe with specially designed connections that can tolerate the predicted settlement will be used for the raw and finished water pipelines.

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We trust that this information meets your requirements. Please contact us if you have any questions or require additional information.

Sincerely,

GeoDesign, Inc.



Brett A. Shipton, P.E., G.E.  
Principal Engineer



BAS:kt

Attachments

One copy submitted (via email only)

Document ID: BrownCald-49-20-010713-geol-Planning\_Commission-Final.docx

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**College of Liberal Arts and Sciences**

Department of Geology      Scott F. Burns

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January 3, 2013

Brett Shipton  
Geodesign Inc.  
15575 SW Sequoia Parkway, Suite 100  
Portland, Oregon 97224

Dear Brett –

You have asked me to review the landslides and potential for reactivation related to the LOTWP Raw and Finished Water Pipelines project. This report summarizes what I have found. Based on comparison of the soils and landslides of the area, the risk of seismically and climatically induced landslides on the pipeline and treatment plant is very low. I have divided my analysis into two types of landslides: seismically induced landslides (especially the subduction zone megathrust landslides) and climatically induced landslides from a huge precipitation event. I have attached a map that shows the three landslides I have investigated. They are numbered 1 (climatically controlled) and 2 and 3 (originally formed from the Missoula Floods, but what are the chances of seismically reactivating them).

**Seismically induced landslides:**

I specifically investigated the chances of reactivation and the production of lateral spread of the two ancient landslides (slides 2 and 3) and one historic landslide (slide 1). All three of these landslides are on the bluff to the northeast of Kenthorpe Way in West Linn. The question is: What are the chances of these landslides being seismically reactivated if a subduction zone megathrust earthquake occurs.

The two ancient landslides that I visited in the field on December 28<sup>th</sup> both are in a group of landslides we consider to have been produced at the end of Missoula Floods, approximately 15,000 calendar years ago. All of the materials on Mapleton and Kenthorpe Streets are sediments laid down during the Missoula Floods – the fine grained facies. We have mapped many landslides in the West Linn-Oregon City area with similar

characteristics. We feel that they all have similar origins 15,000 years ago when the water saturated slopes failed as the floodwaters decreased. The flood waters from these great floods were over 400 feet deep at the site and saturated the slopes. We see little evidence of major reactivation from seismic induction since that time and a retrogression of the head scarp by lateral spread at the top of the slopes, and we have had over 30 megathrust quakes (over 9.0 along the coast) since they formed. I see little danger posed to the pipeline and water treatment plant from lateral spread related to these landslide slopes or even the steep slopes of the area that have no landslides on them. To have a lateral spread, one needs to have water saturated soils from high ground water tables, and these Missoula Flood sediments are basically well drained.

Can these two ancient landslides (2 & 3) reactivate? Yes, they can, and we have noted reactivation of nearby slides from local over-steepening from excavations, undercutting from streams, and dumping of large amounts of water onto the slopes, though. I really do not see these things happening on these slopes related to the pipeline and the treatment plant. Both of these ancient slides have homes over them so I make recommendations to the homeowners that they control the water on the slopes and they restrict their excavations, and they should not see any movement. I do not feel that subduction quakes, or localized fault activity on Portland's faults would reactivate these landslides, especially the head scarps. We would see evidence locally of past events.

### **Climatically Induced Landslides:**

The small historic landslide (slide 1) was a climatically induced landslide which is typical in the Portland area from large amounts of rainfall in short periods of time. They occur on steep slopes just like this one. We mapped over 300 of these in 1996 in the Portland area that occurred from the February climatic event where we had 8 inches of rain in four days. Their sizes are generally less than 200 cubic yards of material. This landslide is what we might expect from a climatic event, not a seismic event.

Will climatic events in the future affect the pipeline and the treatment plant? Very small landslides (<250 cubic yards) will be produced periodically along the large scarp at the Kenthorpe Way. Will these small events affect the pipeline or the treatment plant – no. They will not cause any lateral spread or large migration of the scarp. Their effects will be minimal.

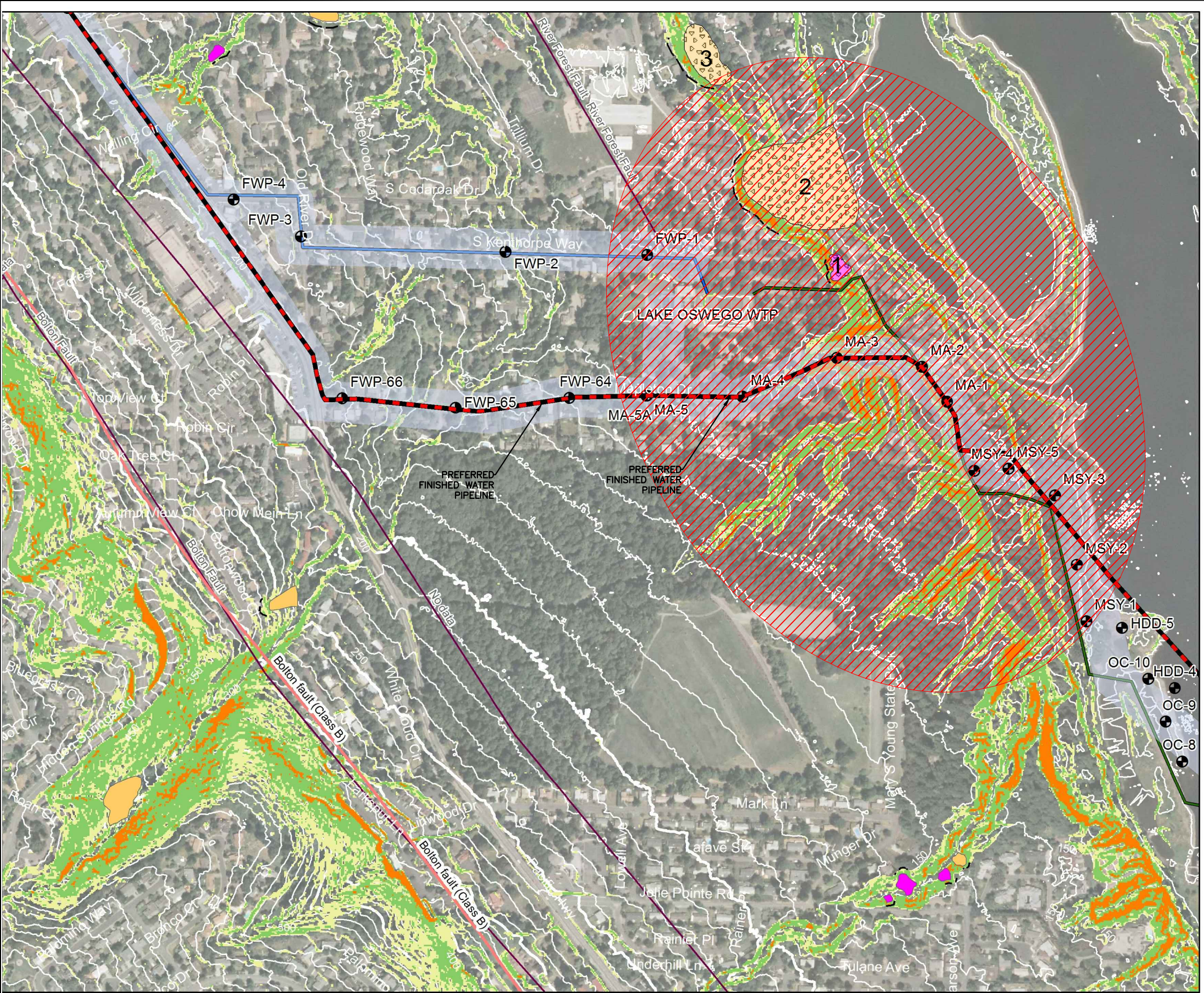
The slopes to the east of the water treatment facility are steep, but they have not shown large displacements in the last 15,000 years which would be expected from subduction zone quakes. Lack of many landslides on these steep slopes points to the well-drained nature of the soils. The slopes do not pose large dangers to the pipelines and the treatment plant.

Sincerely,

Scott Burns, Professor of Geology  
Portland State University  
Consulting Geologist, RG, CEG



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 File Name: J:\A-D\BrownCald\BrownCald-49-20-SP01.dwg | Layout: FIGURE 4A



**LEGEND**

- FWP-1 BORING
- EXISTING FINISHED WATER PIPELINE
- EXISTING RAW WATER PIPELINE
- QUATERNARY FAULTS (USGS)
- FAULTS (ODGC)
- PREFERRED ALIGNMENT
- PREFERRED ALIGN

**PERCENT SLOPE**

- <24%
- 24% - 33%
- 33% - 50%
- 50% - 100%
- >100%

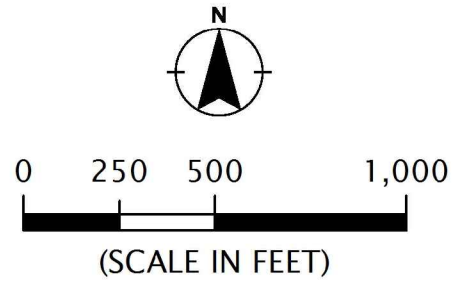
— LANDSLIDE SCARP

**LANDSLIDE FAILURE DEPTH**

- DEEP-SEATED (>4.5 M)
- SHALLOW-SEATED (<4.5 M)

**LANDSLIDE ACTIVITY**

- HISTORIC (<150yrs)
- PRE-HISTORIC (>150yrs)
- AREA OF STUDY



LANDSLIDE DATA FROM DOGAMI LANDSLIDE INVENTORY (2010)  
 ORTHOPHOTO FROM OREGON IMAGERY EXPLORER  
 QUATERNARY FAULT DATA DERIVED FROM USGS (2009) ONLINE DATABASE

10-FOOT TOPOGRAPHIC CONTOURS DERIVED FROM 2007 OREGON LIDAR CONSORTIUM  
 BORING LOCATIONS SURVEYED BY WESTLAKE CONSULTANTS OF LAKE OSWEGO, OREGON, OR FIELD  
 LOCATED BY GEODESIGN PERSONNEL

<b>BROWNCALD-49-20</b> BROWN CALD 49-20	<b>SITE PLAN</b> LAKE OSWEGO-TIGARD WATER PARTNERSHIP WEST LINN, OR	<b>FIGURE 1</b>
	JANUARY 2013	
 15575 SW Sequoia Parkway - Suite 100 Portland OR 97224 Off 503.968.8787 Fax 503.968.3068		



**NEW ALBION  
Geotechnical, Inc.**

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Corvallis, Oregon 97333  
541-602-0984  
sed@newalbiongeotechnical.com

January 7, 2013

Mr. Brett A. Shipton  
GeoDesign, Inc.  
15575 SW Sequoia Pkwy, Suite 100  
Portland, OR 97224

Subject: External Review of Seismic and Liquefaction Hazards Evaluations Associated with;  
Geotechnical Engineering Services  
Lake Oswego-Tigard Water Partnership  
West Linn Planning Commission – Final Notice CUP-12-02/DR-12-04  
West Linn, Oregon  
GeoDesign Project: BrownCald-49-20

Dear Mr. Shipton:

As requested, New Albion Geotechnical, Inc. (New Albion) has completed the technical review of the project documentation addressing; geotechnical site characterization, seismic hazard analyses, and potential hazards associated with liquefaction and lateral spreading. The primary focus of this review included: seismic hazard and ground motion characterization required for liquefaction triggering evaluation, liquefaction assessment, post-liquefaction ground settlements, and possible lateral spreading hazards. The review focused on the portion of the proposed water distribution system located in the City of West Linn, and included portions of the alignments of both the raw water pipeline and finished water pipeline, as well as the Lake Oswego Water Treatment Plant (LOWTP) site.

**EXECUTIVE SUMMARY**

New Albion has completed its external peer review of pertinent engineering documents addressing seismic and liquefaction hazards along the alignment of the proposed water transmission line within the limits of the City of West Linn, Oregon. The specific reports provided for review by New Albion are listed in the following section “Scope of Review” and include recent documents prepared by GeoDesign, Inc., Kleinfelder, and Shannon & Wilson, Inc. These three consultancies have characterized the design-level seismic ground motions, the potential for earthquake-induced degradation of soil strength (*liquefaction*), and the post-liquefaction behavior of the soil using analysis procedures that have been widely adopted in North American engineering practice. Overall, the seismic and liquefaction hazards analyses have been executed following regional standards of practice and at a level commensurate with

the importance of this critical lifeline project. The methods of analyses and conclusions reached by each consultancy may differ slightly due to reasonable differences in professional judgment concerning complex aspects site characterization and cyclic soil behavior; however, taken collectively the conclusions are in reasonable agreement when evaluated in light of the ground motion amplitudes used as the basis for respective analyses. The pipeline, ancillary components, and foundation soils have been evaluated for seismic ground motions having an average return period of 2,475 years, consistent with the design of important lifeline structures.

The seismic and geologic hazards have been well-identified and evaluated by GeoDesign, Kleinfelder, and Shannon & Wilson. Liquefaction hazards have been identified along portions of the proposed water transmission line and reasonable measures recommended for addressing these concerns. Practical mitigation techniques including ground treatment, deep foundation support, and structural details that provide system flexibility have been proposed. These methods have been employed to improve the seismic resiliency of important civil works projects throughout the Pacific Northwest. Collectively, the conclusions and recommendations provided by these consultancies indicate that, from a geotechnical engineering perspective, the project is feasible using methods of construction routinely utilized in the Pacific Northwest

#### **SCOPE OF REVIEW**

The specific materials and documents provided by GeoDesign, Inc. (GeoDesign) for review by New Albion included the following;

1. GeoDesign, Inc., Geotechnical Data Report, Lake Oswego Finished Water Pipeline, Clackamas County, Oregon, for Brown and Caldwell, February 7, 2011.
2. GeoDesign, Inc., Geotechnical Data Report, Lake Oswego Raw Water Pipeline, Willamette River Crossing, Clackamas County, Oregon, for Brown and Caldwell, March 10, 2011.
3. GeoDesign, Inc., Geotechnical Data Report, Seismic Hazard Assessment, City of Lake Oswego and Tigard Joint Water Supply System, Clackamas County, Oregon, for Brown and Caldwell March 11, 2011.
4. GeoDesign, Inc., Geotechnical Data Report, Lake Oswego Raw Water Pipeline, Clackamas County, Oregon, for Brown and Caldwell, March 18, 2011.
5. GeoDesign, Inc., Geotechnical Data Report, Expansion of City of Lake Oswego Water Supply System, Supplemental Explorations for Seismic Hazard Evaluation, Finished Water Pipeline, Clackamas County, Oregon, for Brown and Caldwell, August 2, 2012.
6. Degenkolb Engineers, Technical Memorandum, Seismic Design Memorandum (Final), Lake Oswego Seismic Pipeline Design, prepared by Don Ballantyne for Lake Oswego (Joel Komark and David Prock), August 3, 2012.
7. Kleinfelder, Letter report, West Linn Land Use Application, Seismic and Geologic Hazards, LOWTP Raw & Finished Water Pipelines, Lake Oswego, Oregon, prepared by Chad Lukkarila and Mark Swank, for Kennedy-Jenks Consultants (Brad Moore), August 23, 2012.

8. Shannon & Wilson, Inc., Geotechnical Engineering Report, Lake Oswego – Tigard Water Treatment Plant, West Linn, Oregon, for MHW Americas, Inc., September, 2012.

### **SEISMIC PERFORMANCE ISSUES OUTSIDE THE SCOPE OF THIS REVIEW**

This review focuses on liquefaction hazards in the West Linn portion of the project. The review did not address the following issues, which were outside the scope of services;

- The stability and seismic performance of ancient landslides. This topic has been addressed by Dr. Scott Burns, Portland State University.
- The seismic performance of the pipeline, dynamic soil-pipeline interaction, and water system fragility. A preliminary assessment of these issues has been made by Mr. Donald Ballantyne, Degenekolb Engineers.
- Analysis and design of ground treatment alternatives for mitigation of liquefaction hazards at the LOWTP. This evaluation has been performed with recommendations provided by Shannon & Wilson, Inc.
- Analysis of the seismic performance of auger cast piles for deep foundation support of the proposed LOWTP expansion. This analysis and preliminary design recommendations was also provided by Shannon & Wilson, Inc.

### **CONCLUSIONS AND RECOMMENDATIONS**

Seismic Hazards and Ground Motions - The seismic hazard evaluations have been prepared at a level commensurate with the importance of the project. The seismic hazard evaluations performed by GeoDesign, Kleinfelder, and Shannon & Wilson followed the regional standard of practice and make use of some of the latest scientific information available on seismicity in the Pacific Northwest. The characterization of the regional seismic sources, the ground motion predictive equations used, and the PSHA methodology appear to be well-founded on the basis of the results of recent paleoseismic and geologic investigations, and engineering seismology addressing ground motion characterization in subduction zone settings (USGS 2012). All three investigations made use of existing, widely-adopted sources for seismic hazard analysis (e.g., USGS NSHMP 2002 and 2008).

Liquefaction Resistance of Sand-Like Soils - The assessment of liquefaction susceptibility and triggering in soils along the raw water pipeline and finished water pipeline employed the well-established procedures for “sand-like” soils, after applying the soil screening recommendations of Boulanger and Idriss (2006), and Idriss and Boulanger (2008). The evaluation of liquefaction potential for sand-like soil was thus conducted following widely-adopted, standard-of-practice methods. The evaluations performed to date appear to be consistent with the regional standard of practice and have demonstrated the portions of the pipeline alignment where the potential for liquefaction hazards warrant mitigation measures. It is again noted that the liquefaction hazard assessment conducted by Kleinfelder is considered slightly- to moderately-conservative due to the earthquake magnitude and ground surface PGA used in the analysis.

The liquefaction potential at the LOWTP was evaluated using a well-known, commercially available numerical model (D-MOD2000) for site-specific dynamic response analyses. This model includes an algorithm for computing excess pore pressure generation and the results of the analyses indicated that an extensive portion of the lower Fine-Grained Flood Deposits is liquefiable under the design level ground motions. The liquefaction hazard has been identified and measures proposed for mitigating the effects of liquefaction on the pipeline and appurtenant structures.

Liquefaction Resistance of Clay-Like Soils - At the high seismic load levels used in analysis and design it is anticipated that nominal cyclic degradation in the stiffness and strength of the saturated, soft to medium stiff, NP to low-plasticity silts may occur. The potential for cyclic degradation of saturated portions of the silt deposits should be evaluated along portions of the alignment where sloping ground could contribute to deviatoric strains and permanent ground deformation. These areas appear to be localized and of limited extent along the pipeline alignment in West Linn. Evaluation of the silt may include a review of existing cyclic laboratory testing data on regional fine-grained soils, and if hazardous conditions are indicated cyclic laboratory testing of high quality specimens of the soil.

#### Post-Liquefaction/Post-Cyclic Loading Settlement of Sand-Like and Clay-Like Soils -

Estimates of post-liquefaction settlement in sand-like soil have been made using widely-adopted, practice-oriented procedures for one-dimensional volumetric strain. The range of settlement values in each pipeline Reach is considered reasonable at the locations of the borings and CPT soundings. The differential settlement along Reaches 1, 2, and 4 may be accommodated by the use of welded steel pipe and appropriate connection details based on current seismic design guidelines (Degenkolb Engineers 2012).

At the LOWTP the thickness of the liquefiable layer will require mitigation measures in the form of remedial ground treatment to increase the cyclic resistance of the soil and/or structural applications such as deep foundations to transfer structural loads into underlying competent layers and support the pipeline.

#### Lateral Spreading Hazards

Lateral spreading hazards have been evaluated by GeoDesign, Kleinfelder, and Shannon & Wilson. Similar conclusions have been reached by each consultancy and are briefly summarized;

1. The lateral spreading hazard is considered very low along Reach 1 due to the limited extent of potentially liquefiable soils.
2. Along Reach 2 the lateral spreading hazard has been conservatively assumed to be moderate in Reach 2; however, additional site investigation may be required to ascertain the extent of potentially liquefiable soils along the sloping portion of Mapleton Drive.
3. Although the potentially liquefiable portion of the Fine-Grained Flood Deposits in Reach 3 (LOWTP) is laterally extensive across the LOWTP site the potential for damaging lateral spreading is considered minor due to the nearly horizontal grade across the site and the

distance (roughly 300 to 400 feet) to significant slopes to the east and southeast of the proposed improvements.

4. The potential for later spreading is considered low along most of the pipeline alignment in Reach 4. This is due to the interlayered nature of the sandy soil and fine-grained deposits, the relatively thin layers of liquefiable soils (generally less than 5 ft) with unknown lateral extent, the minor slopes along much of Highway 43, and the depth to the static groundwater table. Localized lateral spreading and ground deformation hazards may be associated with embankments and filling adjacent to incipient gullies and minor creeks (Arbor Creek, Robinwood Creek, Fern Creek, Robin Creek).

The seismic and geologic hazards have been well-identified and evaluated by GeoDesign, Kleinfelder, and Shannon & Wilson. Collectively, the conclusions and recommendations provided by these consultancies indicate that, from a geotechnical engineering perspective, the project is feasible using methods of construction routinely utilized in the Pacific Northwest and with appropriate consideration of the following issues;

- Mitigation of the liquefaction hazards identified in the vicinity of the proposed Lake Oswego Water Treatment Plant expansion. Proposed mitigation schemes include ground treatment methods that have been used throughout the Pacific Northwest to reduce the liquefaction susceptibility of the soil via densification or cementation, and deep foundation options that provide support through potentially liquefiable soil. These ground treatment and deep foundation options are reasonable and have been implemented on numerous projects throughout the region.
- Pipeline flexibility at transitions between relatively soft and stiff geologic units (e.g. Columbia River Basalt and alluvial soils, dense sands and gravels grading into soft silts and clays, and cut and fill slopes).
- Pipeline and system flexibility at transitions between pile-supported structures and “free-field” ground conditions.

#### **COMMENTS RELATED TO THE SEISMIC HAZARD ANALYSES**

New Albion has reviewed the seismic hazard evaluations prepared by GeoDesign (2011), Kleinfelder (2012), and Shannon & Wilson (2012). The assumptions, methods, and conclusions were reviewed for consistencies and possible variations to other pertinent regional seismic hazard assessments (i.e., U.S. Geological Survey National Seismic Hazard Mapping Project [NSHMP], 2008, Petersen et al, 2008, and Geomatrix, 1995). These references were supplemented with materials from the proceedings of the U.S. Geological Survey “Pacific Northwest Workshop for the Update of the National Seismic Hazard Maps (2012).”

The seismic source characterization has been well outlined in all three reports and highlights the primary hazards associated with; relatively shallow crustal earthquakes, deep intraslab subduction zone earthquakes, and interface subduction earthquakes along the Cascadia Subduction Zone (CSZ). The source characterization for the both the individual crustal faults and gridded seismicity associated with

crustal sources is consistent with the USGS NSHMP (Petersen et al, 2008). The source characterization for the deep intraslab subduction earthquakes in the Portland-Willamette Valley region is consistent with the most recent seismic hazard modeling performed by the USGS NSHMP (Petersen, 2008).

All three reports made use of the seismic hazard de-aggregation presented by the USGS NSHMP (2002 and 2008 editions) therefore rely on the same PSHA methodology. The GeoDesign hazard assessment (2011) was initially made for ground motions having a 5% probability of exceedance in 50 years (975 year average return interval). The seismic hazard used as the basis for analysis and design of the water distribution system was subsequently amended to the 2% probability of exceedance in 50 years (2,475 year average return period) thus the design ground motion levels were significantly increased. The design ground motion levels provided in all three reports are considered appropriate for the specific seismic hazard levels evaluated by each consultancy. The influence of ground motion parameters on aspects of dynamic soil response, triggering of liquefaction or soil degradation, and the seismic performance of slopes and retaining walls should be evaluated using the results of the 2008 USGS NSHMP applied for ground motions having a 2% probability of exceedance in 50 years with appropriate consideration of the magnitude and source-to-site distance for each of the predominant seismic sources considered.

On the basis of the PSHA deaggregation for ground motions having a 2% probability of exceedance in 50 years, liquefaction hazards should be evaluated for two scenarios;  $M_w$  9.0 megathrust earthquake along the Cascadia Subduction Zone, and a roughly  $M_w$  6.5 to 7.0 shallow crustal event in the Portland metropolitan region. These scenario earthquakes have been adequately addressed in all three reports.

## **COMMENTS RELATED TO THE LIQUEFACTION POTENTIAL OF PREVALENT SOILS**

Evaluating the potential for liquefaction of native foundation soils requires the characterization of both the seismic loading and the cyclic resistance of the soil. This review has considered both facets of the liquefaction hazard assessment, with specific consideration of the following;

1. Geotechnical site characterization.
2. Cyclic loading of foundation soils.
3. Cyclic resistance of "sand-like" soils.
4. Cyclic degradation potential for "clay-like" soils.

Review comments addressing specific aspects of each of these topics are provided as follows.

### Geotechnical Site Characterization

Data reports covering the geotechnical site investigations have been prepared by GeoDesign (2011, 2012) and Shannon & Wilson (2012). Pertinent aspects of the investigation methods, drilling and sampling procedures, and the laboratory testing programs have been well addressed in each report.

Overall, the geotechnical investigations are considered appropriate for the following applications;

- The Shannon & Wilson (2012) geotechnical investigation at the Lake Oswego Water Treatment Plant (LOWTP) site is comprehensive and appropriate for this critical lifeline facility. The composition and variability of the prevalent soil units have been well demonstrated. The static groundwater conditions have also been well addressed with consideration of perched conditions and anticipated ranges in the seasonal fluctuation of the piezometric surface.
- The GeoDesign (2011, 2012) geotechnical investigations along the proposed pipeline alignments provide the following;
  - The soil conditions along the alignment of the existing raw water pipeline from the Willamette River to the LOWTP have been evaluated with borings made on roughly 200 ft to 500 ft spacing.
  - The soil conditions along the alignment of the finished water pipeline from the Lake Oswego Water Treatment Plant to the limits of the City of West Linn (near the Pacific Highway [Oregon Route 43] and Arbor Drive) have been evaluated on the basis of borings spaced roughly 100 ft to 1,400 ft apart, with an average spacing of approximately 600 ft.
  - The extensive in situ investigations, supplemented with laboratory testing, provide adequate geotechnical information for evaluating the broad extent of potential liquefaction hazards along the pipeline alignment and representative ranges of the estimated post-liquefaction settlements that may occur following design-level ground motions.

#### Cyclic Loading of Foundation Soils

The cyclic loading associated with the design-level ground motions (2% probability of exceedance in 50 years) has been addressed in the Shannon & Wilson (2012) and Kleinfelder (2012) reports for the LOWTP and Raw Water Pipeline, respectively. Shannon & Wilson and Kleinfelder both adopted the ground motions computed by the USGS (2008) for firm soil/weak rock conditions (Site Class B/C boundary) therefore similar values were used. The influence of the dynamic response of the overlying soil deposits on the ground motions was evaluated using two different approaches; (i) Shannon & Wilson performed site-specific soil response analyses at the LOWTP site providing a very thorough assessment of site effects, and (ii) Kleinfelder used code-based soil amplification factors for a more general assessment of dynamic soil response. Both methods are considered appropriate for the portions of the water distributions system evaluated.

For application at the LOWTP, site-specific dynamic soil response analyses were performed using the program D-MOD2000 to model fully nonlinear effective stress soil behavior. Effective stress analyses were performed for one soil profile, with input excitation provided by a collection of eight acceleration time histories scaled to the Peak Ground Acceleration (PGA) from the PSHA for firm soil/weak rock conditions. The material properties used as input for the D-MOD2002 model were based on the Shannon & Wilson site investigation, which included synthesis of the laboratory testing data, correlations with soil index properties and in situ testing data (SPT and CPT), and professional judgment established on similar projects in the Portland-Willamette Valley region. Shear wave velocity ( $V_s$ ) measurements were provided by one seismic CPT sounding. The computed output from the D-MOD2000 analyses includes excess pore pressure generation for coupled assessment of the liquefaction



hazard. The estimates of cyclic loading at the LOWTP are considered reasonable and the methods of evaluation reflect the regional standard of practice for critical lifeline facilities.

The cyclic loading parameters used by Kleinfelder for liquefaction hazard evaluations for portions of both the raw- and finished-water pipeline alignments were developed using more general, code-based procedures. The ground motions established for the firm soil/weak rock transition (Site Class B/C boundary) were adjusted for site effects using code-based amplification factors providing an approximate estimate of the PGA for use in subsequent liquefaction hazard analyses.

### Cyclic Resistance of "Sand-Like" Soils

Aspects of the liquefaction hazard evaluation for sandy soils have been addressed in the reports prepared by GeoDesign (2011, 2012), Kleinfelder (2012), and Shannon and Wilson (2012). Several widely-adopted procedures for evaluating the potential for triggering of liquefaction in sandy soil have been applied on this project (i.e., Idriss and Boulanger 2008, Cetin et al 2004, Moss et al 2006, Robertson and Wride 1997, Youd et al 2001).

Soils potentially vulnerable to liquefaction have been generally defined following the recommendations of Boulanger and Idriss (2004) and Idriss and Boulanger (2008) as predominantly sand and/or silt with  $PI < 7$  to  $8$ . The intensity of the cyclic loading (Cyclic Stress Ratio, CSR) used in these "Simplified Liquefaction" procedures has been computed using the peak ground acceleration from the simplified code-based procedures for a specified Site Class and the straightforward formulation;

$$CSR_{M=7.5, \sigma'_{vc}=1 \text{ atm}} = (0.65 a_{\max} \sigma_{vc} r_d) / (g \sigma'_{vc} MSF K_{\sigma} K_{\alpha}) \quad (1)$$

Where:

$a_{\max}$	=	Maximum horizontal acceleration at the ground surface
$g$	=	acceleration due to gravity
$\sigma_{vc}$	=	geostatic vertical total stress
$\sigma'_{vc}$	=	geostatic vertical effective stress
$r_d$	=	shear stress reduction factor
MSF	=	Magnitude Scaling Factor
$K_{\sigma}$	=	correction factor for overburden stress
$K_{\alpha}$	=	correction factor for static horizontal shear stress

The CSR values at the depths of interest were computed using this formulation in the liquefaction hazard assessments prepared by GeoDesign and Kleinfelder. This is opposed to the procedure followed by Shannon & Wilson wherein the CSR and excess pore pressure generation in the vulnerable soils were computed directly using D-MOD2000 effective stress analyses. Both procedures are applicable and follow regional standards of practice for evaluating liquefaction potential.

Several comments are warranted regarding the liquefaction hazard evaluations presented by the three consultancies;

1. The practice-oriented procedures used on this project to evaluate liquefaction potential are commonly performed using spreadsheets. The spreadsheets (i.e., cell formulas) and/or computational software used by the three consultancies were not provided in their respective reports precluding a thorough review of the specific computations.
2. The liquefaction triggering analyses performed by Kleinfelder (2012) are deemed very conservative due to the magnitude and ground motion amplitude used in the analyses. While the  $M_w$  9.0 Cascadia Subduction Zone scenario is well supported by the USGS PSHA deaggregation, the corresponding use of the Uniform Hazard PGA value of 0.55g applies cyclic loading that is considered much greater than ground motions representative of a  $M_w$  9.0 earthquake occurring roughly 100 km from the site. The PGA value of 0.55g is much more appropriately applied for the shallow, local crustal earthquake having a magnitude of 6.5 to 7.0. The large PGA value used with the Magnitude Scaling Factor for a  $M_w$  9.0 event (Equation 1) is considered overly-conservative, resulting in a slightly- to moderately-larger extent of liquefiable soil and greater estimated post-liquefaction settlement.
3. The LOWTP investigation prepared by Shannon & Wilson noted the following general site conditions;

*"In general, the Artificial Fill unit was about 1.5 to 5 feet thick and was encountered in the existing WTP, either near existing buildings or structures, or underneath pavement. The unit consisted of pavement sections, base course materials, medium- dense sandy silty gravel, and very soft to medium-stiff clayey silt to sandy silt. The Fine-Grained Flood Deposits unit was either encountered underlying the Fill within the existing WTP or at the ground surface within the Mapleton Property. The Fine-Grained soil unit consists of soft to stiff clayey silt and sandy silt to approximately 25 feet in depth, followed by approximately 25 to 30 feet of very loose to medium-dense silty sand to sand to a total depth of 52 to 57 feet. Underlying the Fine-Grained soil unit was the Older Sand and Gravel Alluvium unit. This unit consists of very dense sandy gravel to gravelly sand."*

The 25 to 30 foot thick layer of very loose to medium-dense silty sand to sand has been evaluated by Shannon & Wilson as liquefiable under the design level ground motions. This portion of the Fine-Grained Flood Deposits has been treated in subsequent foundation analyses as fully liquefied, which is a slightly conservative assessment given the interlayered nature of the sands and more silt-rich soils that may not be as vulnerable to cyclic degradation and liquefaction.

4. The soil parameters used by Shannon & Wilson in the D-MOD2000 effective stress analyses were not available for review therefore pertinent aspects of the excess pore pressure modeling could not be evaluated. Given the lack of site-specific cyclic test data on the potentially liquefiable soils (specifically silty sand, sandy silt, and NP silt) a range of modeling parameters is often used to assess the sensitivity of the computational results on this input. It is not apparent that this type of

sensitivity analysis was performed. Irrespective of the breadth of the numerical modeling, Shannon & Wilson have treated the entire 25 to 30 feet of very loose to medium-dense silty sand to sand as potentially liquefiable, an appropriately conservative assessment based on the in situ test data (SPT and CPT).

5. The water distribution system in the City of West Linn has been subdivided by Kleinfelder into four sections, or Reaches. General conclusions regarding liquefaction hazards in each of the sections are provided as follows;
  - a. Reach 1 (Raw Water Pipeline: HDD crossing, lower portion of Mapleton Drive slope) – The liquefaction potential is classified as “None to very low” by Kleinfelder. This assessment is supported by the site investigation performed by GeoDesign. The location of the transition from HDD in competent soil and rock to the open cut and cover portion of the Raw Water Alignment has not been determined. The potential for minor differential soil deformations at this transition in excavation methods and/or soil type should be considered in design of the pipeline.
  - b. Reach 2 (Raw Water Pipeline: Middle of Mapleton Drive slope to within 300 ft of the WTP) – The liquefaction hazard is classified by Kleinfelder as “Moderate to High” along this roughly 400 ft to 500 ft section of the alignment. This assessment was apparently made from the following information; (i) soil boring MA-4 (GeoDesign) located approximately 500 feet to the west that extended through soft- to medium-stiff silt (Upper Fine-Grained Flood Deposits) to a depth of 13.5 ft, and (ii) characterization of the underlying, presumably liquefiable soil, based on lateral extrapolation of the soil profile from the LOWTP located approximately 400 feet to the north, specifically in situ information (B-5, CPT 7) obtained by Shannon & Wilson. While extrapolation of the in situ data from the LOWTP may support the generalization of liquefiable soils at depth along Reach 2, the depth and lateral extent of the liquefiable soil at this location is not known. The geomorphology along the portion of Mapleton Drive between borings MA-4 and MA-3 suggests that a transition in the soil profile from that assumed at MA-4 (based on data from the LOWTP) to the shallow soil profile at MA-3 is possible. The acquisition of additional in situ information between these two locations, and extended to dense underlying material, may reveal conditions that are more favorable than indicated by the “Moderate to High” liquefaction hazard currently assumed by Kleinfelder.
  - c. Reach 3 – (Mapleton Drive within 300 feet of the WTP to east and west) – The high liquefaction susceptibility of the saturated, sandy portion of the Fine-Grained Flood Deposits subjected to design level ground motions has been identified and highlighted by GeoDesign, Kleinfelder, and Shannon & Wilson. The liquefaction hazard has been thoroughly evaluated by Shannon & Wilson using both site-specific modeling, and more general, practice-oriented methods consistent with the procedures used by GeoDesign and Kleinfelder. Ground treatment and deep foundation strategies have been proposed to mitigate the potential for extensive damage to the proposed pipeline and structures. The measures proposed by Shannon & Wilson at this early stage of design are reasonable and have been employed on numerous large civil works projects in the Portland-Willamette Valley region and throughout the Pacific Northwest.

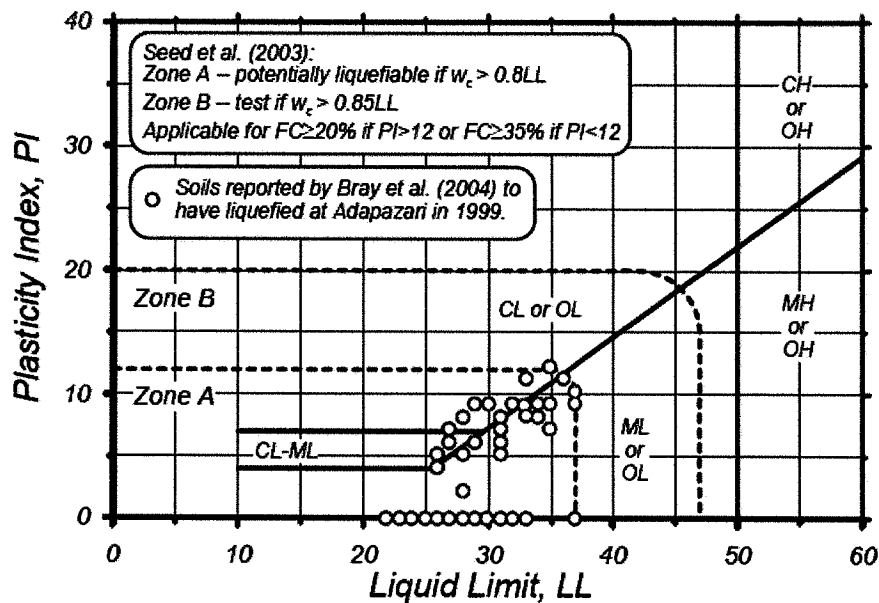
- d. Reach 4 – (Finished Water Pipeline: Mapleton Drive 300 feet west of WTP, along HWY 43, to Arbor Drive) – The liquefaction potential along this portion of the alignment has been generally classified by Kleinfelder as “*Moderate except low potential at the borings including FWP-5, -7, -8, and -65.*” A review of the boring logs for explorations made along the Reach 4 (GeoDesign 2011, 2012) alignment indicate interbedded layers of soft to very stiff silt and loose to medium dense sand to silty sand. The static groundwater table has been observed in two relatively deep piezometers at depths below current grade along Highway 43 of roughly 25 ft. Perched groundwater conditions have been noted on several of the soil borings. The seasonal nature of the perched groundwater elevation has not been evaluated therefore assumptions have been made regarding the extent of saturated soils in liquefaction hazards analyses. Kleinfelder assumed a depth to groundwater of 10 ft and evaluated all soils beneath this depth for liquefaction potential. GeoDesign used data from the deeper observation wells and supporting documentation (Snyder 2008) to establish the static groundwater table at a depth of roughly 25 ft below existing grade. This is consistent with the data obtained at the LOWTP by Shannon & Wilson, and used as the basis for their liquefaction hazard evaluations. The potentially liquefiable soils in this reach appear to be relatively thin layers (generally < 5 ft thick) and interbedded with non-liquefiable fine-grained soils. The lateral spreading and post-cyclic settlement hazards associated with these layers appear to be minor along the relatively flat alignment.
- e. The elevation at the base of proposed excavations for the finished water pipeline was not available at the time of this review. The process of excavation for the pipeline and back-filling with free-draining soil will likely affect the perched groundwater conditions observed at shallow depth adjacent to the pipeline and this should be accounted for in liquefaction hazard assessments.

#### Cyclic Resistance of “Clay-Like” Soils

Silt-rich soils are prevalent in the upper portions of the Fine Grained Flood Deposits. The consistency of the silt varies between non-plastic to high-plasticity (ML-MH) therefore the cyclic resistance and post-cyclic loading behavior of the soil will vary substantially. The “Simplified Procedures” used for evaluating liquefaction potential are not applicable for the silt-rich soil, therefore the evaluation of seismic degradation relies on refined methods of analysis. Fine-grained soils, termed “Clay-like” soils due to their cyclic behavior, have been defined on the basis of the Plasticity Index (PI) following the recommendations of Boulanger and Idriss (2004, 2006). A binary “liquefiable/non-liquefiable” classification has been adopted on this project by GeoDesign, with  $PI > 8$  used as the criterion for indicating that the soil is not susceptible to liquefaction. These soils have been shown in numerous investigations to have a cyclic resistance that is greater than “sand-like”; however, this is a function of soil and site-specific conditions (e.g., geostatic stresses, stress history of the soil, age and fabric of the soil).

The screening criteria of Bray and Sancio (2006), for example, identify possibly liquefiable soils as having PI as high as 12, if the in situ water content exceeds the product of  $(0.85 * \text{Liquid Limit})$ . Laboratory

testing is encouraged for fine-grained soils with PI as high 20 when the water content exceeds  $0.85 * \text{Liquid Limit}$ . This screening guideline is shown graphically on the Plasticity Chart in Figure 1. The laboratory data provided by GeoDesign (2011, 2012) and Shannon & Wilson (2012) demonstrates a broad range of PI values in the upper alluvial silt layers varying from NP to 60. A significant percentage of the specimens obtained from beneath the static groundwater table exhibit moisture contents greater than  $0.85 * \text{Liquid Limit}$ . On the basis of the simplified screening criteria and consideration of the high-amplitude, long-duration motions being used for analysis and design it appears that there is potential for strength loss in portions of the saturated alluvial silt deposits during seismic loading. A more complete assessment of the potential for cyclic degradation and shear strain mobilization should consider the following project-specific factors for the fine-grained soils; geostatic stresses, stress-history (OCR), static shear stress imposed on the foundation soil after proposed construction, high-amplitude and long-duration ground motions, ratio of the static undrained shear strength to the imposed cyclic shear stress, and post-cyclic shearing resistance. This could be efficiently assessed by way of; (i) cyclic laboratory testing of high quality soil samples obtained along the pipeline alignment, (ii) estimating the post-cyclic, stress-strain behavior of the alluvial silts based on data from other sites in the region, or (iii) general relationships developed for a broad database of fine-grained soils (e.g., Boulanger and Idriss, 2007).



**Figure 1: Plasticity chart showing recommendations by Seed et al. (2003) regarding the assessment of “liquefiable” soil types, with data from liquefaction sites compiled by Bray et al (2004). Figure from Boulanger and Idriss (2004).**

Although the alluvial silt deposits may not be susceptible to strength loss due to full liquefaction the potential may exist for cyclic degradation of shearing resistance, resulting in a reduction in strength and associated earthquake-induced deformations adjacent to sloping portions of the pipeline alignment.

This aspect of cyclic behavior has not been extensively evaluated for the near-surface silt deposits. A primary reason for this is due to considerations of the static, year-round groundwater elevation and the degree of saturation of the near-surface silt deposits. As with “sand-like” soil, the potential for cyclic degradation is largely dependent on the degree of saturation of the soil. Saturation is required for cyclic degradation leading to “liquefaction” or “cyclic failure” of the silt. In addition, the very minor slope along much of the alignment minimizes the need for extensive cyclic testing and analysis of permanent ground deformation.

## **COMMENTS RELATED TO THE SETTLEMENT OF SOILS FOLLOWING CYCLIC LOADING**

### Sand-Like Soils

Estimates of the surface settlement associated with re-consolidation of liquefied sand after seismic loading have been made by all three consultancies using procedures that are widely adopted and considered standard of practice methods of analyses (Tokimatsu and Seed 1992, Zhang 2002, Idriss and Boulanger 2008). These procedures use SPT and CPT data in the estimation of settlement due to 1-dimensional volumetric strain. The settlement estimates do not account for the vertical component of soil deformation associated with slope deformation (deviatoric strain). The total computed settlement is computed at the location of the boring or CPT sounding and differential settlement is commonly estimated from one of two methods;

1. The differential settlement is defined as a specific percentage of the total computed settlement (generally 30% to 75% depending on the variability of the soil deposits), or
2. The differential settlement is computed as the difference in total computed settlement between adjacent borings or CPT soundings. This approach was adopted at the LOWTP.

The effect of post-liquefaction volumetric strain and differential settlement on the pipeline and surface structures is a function of the thickness of the liquefiable layers, the depth of the layers and extent of overlying non-liquefiable soil, the depth of embedment of the buried structure, and the distance between the points over which the differential settlement occurs (i.e. angular distortion). It is common to assume that variability in the settlement profile (i.e. differential settlement) at the ground surface, or base of the pipeline trench, is reduced with increasing depth to the liquefiable layer(s). This has been noted by all three consultancies and incorporated into the estimates of differential settlement.

The ranges of post-liquefaction settlement due to 1-D volumetric strain are considered reasonable using the standard of practice methods applied on the respective portions of the project alignment.

It is noted that Shannon & Wilson has assumed that for the deeply embedded structures that are founded very close to the liquefiable soils the differential settlement may be equivalent to the maximum, total settlement. This assumes that the settlement across the foundation will vary from the total computed at one location to essentially zero. This is considered a very conservative assumption. All portions of the liquefiable layer are assumed to settle to some degree due to re-consolidation of the

sandy soil after cyclic loading therefore the differential settlement will not likely be equivalent to the total computed at one point of the foundation.

Non-Plastic to Low-Plasticity Silt

The methods developed for estimating 1-D settlement in sand due to volumetric strain are not applicable for silt-rich soils. While it has been shown in cyclic laboratory tests on a variety of silts from the Portland-Willamette Valley region that these soils will undergo volumetric strain if loaded such that high excess pore pressures are achieved, the cyclic resistance of these soils is generally greater than that of clean- to silty-sands. The ground settlement due to volumetric strain development in the upper, silt-rich portion of the Fine-Grained Flood Deposits is considered very minor to negligible.

In their initial seismic hazard assessment of the existing water supply system GeoDesign (2011) conservatively treated silt-rich soils with  $PI < 8$  as "sand-like" to the sake of estimating seismically-induced settlements. This approach is considered reasonable yet leads to slightly- to moderately-conservative estimates of total settlement and associated differential settlement.

The settlement hazards posed to the pipeline by seismic loading of non-saturated fine-grained soils, and saturated medium stiff to stiff fine-grained soils is considered negligible.

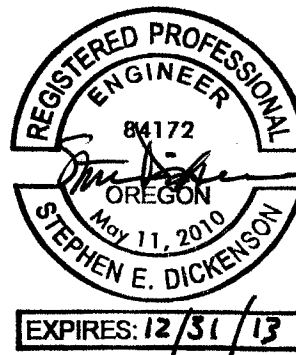
This review is submitted to GeoDesign for consideration by the LOTWP project team and further discussion. If you have any questions pertaining to the comments provided in this letter please do not hesitate to contact me. I look forward to assisting with additional review of seismic and geologic hazards, as well as seismic geotechnical design considerations should this be required by GeoDesign and the project team.

Respectfully submitted,  
NEW ALBION GEOTECHNICAL, INC.



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Stephen Dickenson, Ph.D., P.E.  
Principal Engineer



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## Shop Local Campaign Robinwood Business District

The Lake Oswego Tigard Water Partnership will develop a marketing campaign for Robinwood area businesses with the understanding that some owners have concerns about the planned pipeline installation on HWY 43 affecting their businesses.

Plans include:

- Campaign branding (logo, imaging)
- Newspaper ad design and placement in *The West Linn Tidings*
  - Glossy, multi-page, color insert featuring multiple businesses (2 over the 4-5 month construction period)
  - Black and white 1/8<sup>th</sup> page ad featuring a randomly selected business every other week
- Short-length video production
  - Videos of featured businesses will be posted on the Partnership's Facebook page
  - Videos will be given to business owners to use in their own social media efforts
- Promotional items (logo shopping bags, etc.) provided by home-based business in West Linn

The Partnership will hold public meetings every other week in a local business to share information about the construction project. All catering will be purchased from Robinwood businesses.

The Partnership will also encourage its project team and contractors to shop and dine at local businesses. The team will partner with business owners to fund a discount coupon process or buy gift cards for contractors.

Partnership staff views the campaign as a stand-alone program that can be implemented locally again and again, long after the pipeline is installed.

# Taking Care of Businesses During Construction



Lake Oswego · Tigard  
Water Partnership  
*sharing water · connecting communities*

The Lake Oswego Tigard Water Partnership's highest priority during construction of its pipeline on Hwy 43 is to make sure customers can reach their favorite businesses. The Partnership promises to keep the Robinwood Business District "Open for Business" during construction and respond promptly with solutions to business and neighbor concerns.

## Customer Access

The Partnership's contractors will coordinate construction work to minimize impact to businesses.

- ✓ All traffic lanes on Hwy 43 will be open during the business day. All pipeline construction will be at night—from 8:00 p.m. to 5:00 a.m. when most businesses are closed.
- ✓ Traffic will be directed to alternate driveways for businesses open during construction hours.
- ✓ Businesses will be given advance notice of construction activity.
- ✓ The construction schedule will be maintained—progressing about 50 feet per night.
- ✓ Contractors will make sure regular nighttime delivery and garbage collection schedules are not interrupted
- ✓ Flagger will be provided for any short-term nighttime street blockages.
- ✓ Pedestrians, transit and vehicles will always have clearly marked access to businesses.

## Making Sure You are "Open for Business"

The Partnership will provide communication and marketing support to let customers know you are "Open for Business." There should be no impact to most businesses because all existing Hwy 43 lanes and driveways will be open during the day.



*The Partnership works closely with businesses to help them thrive during construction.*

As construction approaches the Partnership will make sure your business is accessible if you are open during construction hours. Custom signs with your logo will be provided to help guide customers to your door.

Open businesses will always have at least one accessible driveway at night when construction occurs.

***"Robinwood business owners appreciate knowing what to expect during construction projects. The Partnership's careful planning and collaboration gives businesses more control."***

## Shop Local Campaign

Project construction will generate over two thousand jobs and additional spending from patronage of local shops and restaurants.

The Partnership and its contractors have identified local businesses along the corridor to channel work to during construction, such as sign makers, restaurants, coffee shops, print shops and other small businesses. This effort keeps dollars within the local economy.

Business promotional activities will also encourage neighbors to buy local.

## Attracting Customers

A Partnership-sponsored, branded marketing campaign will help build awareness of local businesses.

With a marketing mix of discount programs, advertisements in *The West Linn Tidings*, and video ads for social media, businesses will enjoy increased exposure and an opportunity to attract more customers.

## Keeping You Informed

The Partnership will work hard to help your business to thrive during the construction period. We will stay in touch with property owners and business managers along the pipeline alignment. During construction our representatives will stay in touch with businesses to make sure any problem is solved quickly.

The Partnership website provides current information to the public on an on-going basis. The site address is [lotigardwater.org](http://lotigardwater.org). The "In Your Area" tab will list what is happening and what to expect along Hwy 43.

During construction, regular email updates will also be sent to anyone who subscribes to the project email list at [lotigardwater.org/contact](http://lotigardwater.org/contact).



*The Partnership will use local businesses when catering outreach events in West Linn.*

## Project Hotline

Before and during construction, the Partnership provides businesses and property owners/managers with a 24-hour, 7 days-a-week emergency construction hotline to get issues resolved and questions answered. The project phone line is 503-697-6502.

***"The Partnership's targeted approach ensures that Robinwood's vitality and economic well being will be preserved, if not enhanced, both during construction and over the long term."***

*—Chris Kerr, Economic Development Director  
City of West Linn*



### CONTACT INFORMATION

503-697-6502

[LOTwater@ci.oswego.or.us](mailto:LOTwater@ci.oswego.or.us)

[lotigardwater.org](http://lotigardwater.org)

*This information is provided through a partnership between:*



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## West Linn's Robinwood Businesses

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- 198** Weight Watchers® Cream Cheese Spread • 8 oz.
- 348** Activia® Breakfast Blends Yogurt 4-Pack • Four 6-oz. cups
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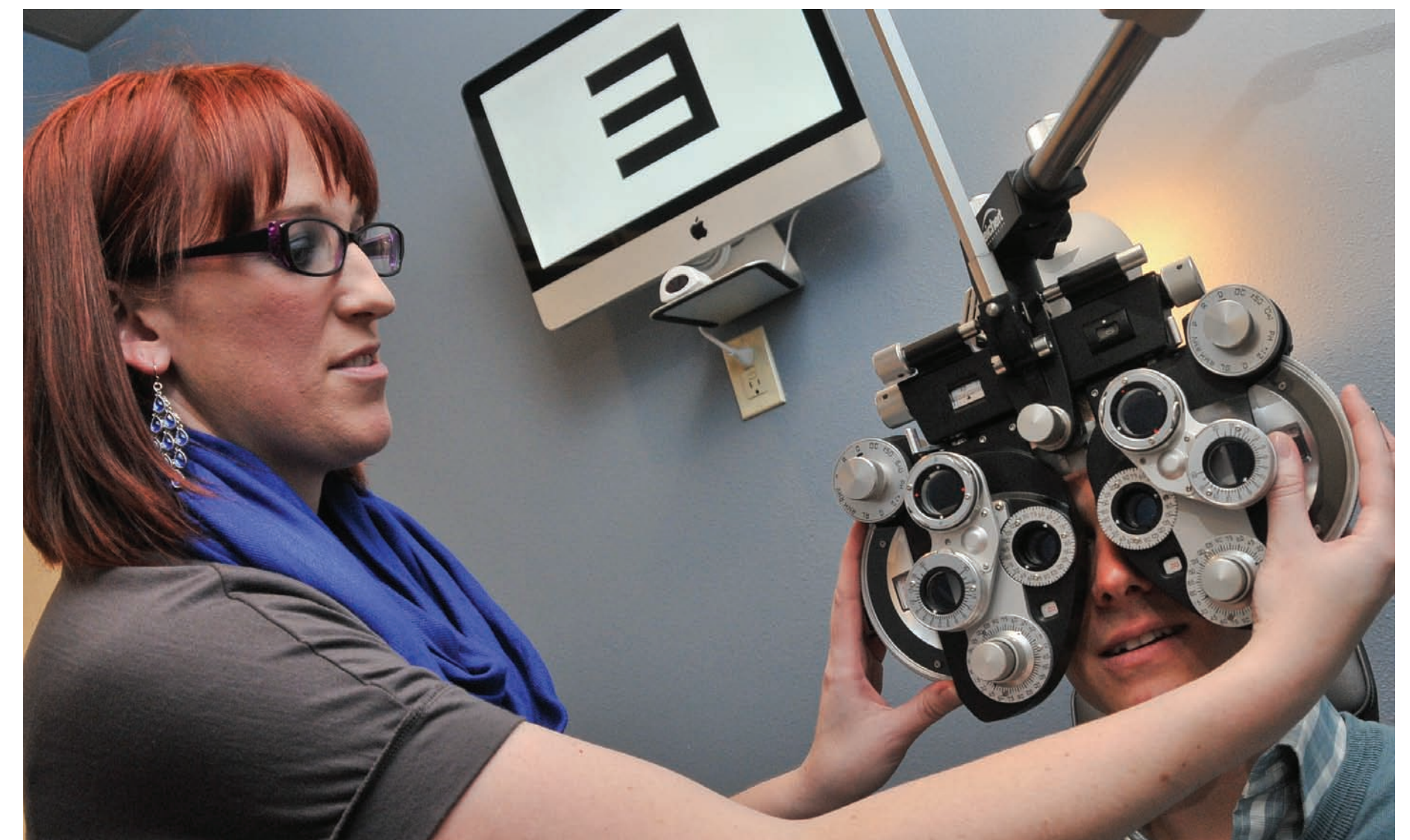
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- \$1** Polar® Fruit Cup • Variety of flavors • 8 oz.
- 168** Peter Rabbit™ Organic Fruit • Variety of flavors • 4-4.4 oz.
- 398** Jif® Creamy Peanut Butter • 28 oz.
- 498** Wonderful® Pistachios • 10 oz.
- ROLLBACK \$6** Was 6.58 Dole® Fruit Cups 12-Pack • Variety of flavors • 48 oz.
- 698** each GoGo Squeez® Applesauce on the Go 12-Pack • Variety of flavors • 38.4 oz.
- ROLLBACK \$6.97** Was 7.97 T.G.I. Friday's® Appetizer Value Pack • 22.3-30 oz.
- 298** each Flat Out® Light or Multi-Grain Wraps • 6 ct.; 11.2 oz.
- 698** per lb. Sara Lee® Lower Sodium Lunch Meat
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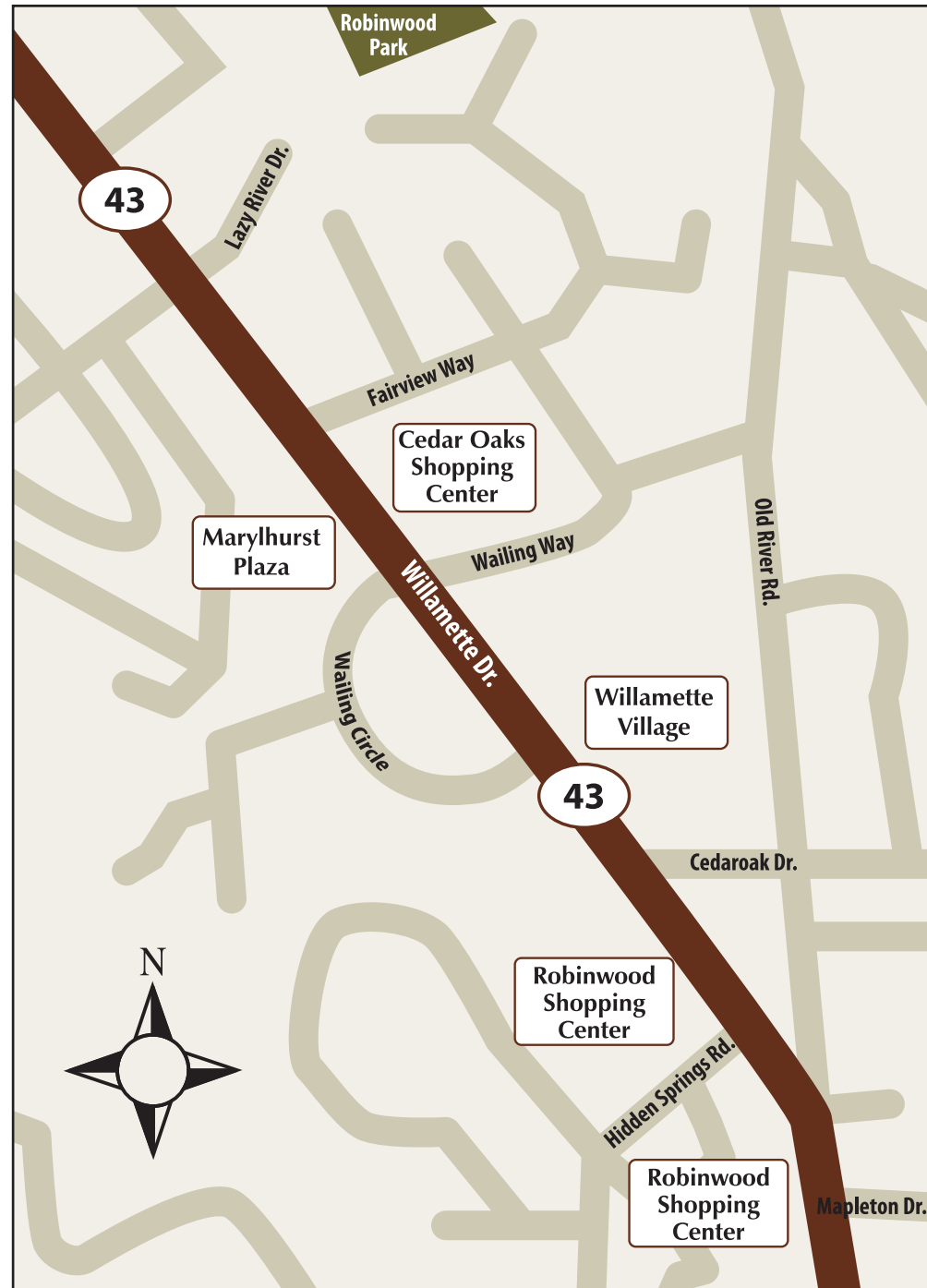
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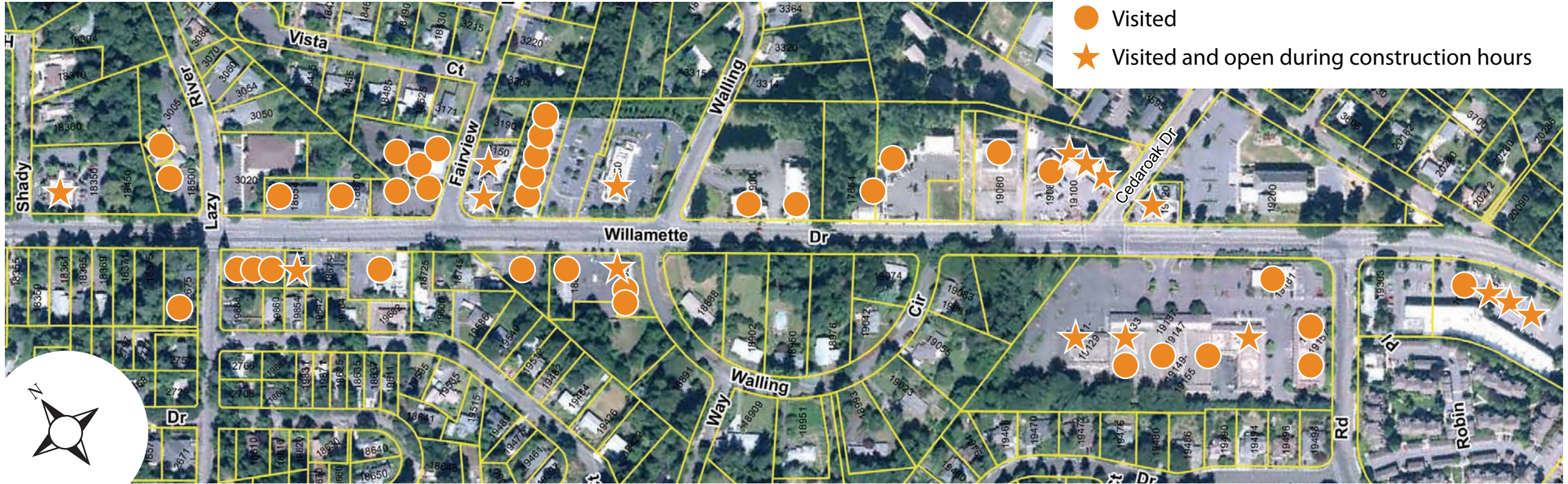
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# Robinwood Businesses on Highway 43



- Visited
- ★ Visited and open during construction hours

Burgerville	Mon - Sun	6:00 a.m. - 11:00 p.m.	United Studios of Self Defense	Mon - Fri	11:00 a.m. - 9:00 p.m.	Round Table Pizza	Sun - Thurs	11:00 a.m. - 10:00 p.m.
Philadelphias Steaks & Hoagies	Mon - Fri	9:00 a.m. - 10:00 p.m.	Body Heart Soul Massage	Mon - Thurs	9:00 a.m. - 8:30 p.m.		Fri - Sat	11:00 a.m. - 11:00 p.m.
	Sat	9:00 a.m. - 11:00 p.m.	McDonalds	Mon - Sat	5:00 a.m. - 11:00 p.m.	BaskinRobbins		11:00 a.m. - 10:00 p.m.
	Sun	9:00 a.m. - 8:00 p.m.		Sun	6:00 a.m. - 11:00 p.m.	Premier Martial Arts	Mon - Thurs	9:00 a.m. - 9:15 p.m.
Thai Orchid Restaurant	Mon - Sun	11:30 a.m. - 9:30 p.m.	Ying Bun Restaurant		11:00 a.m. - 9:30 p.m.		Fri	9:00 a.m. - 7:00 p.m.
Bugattis Ristorante of West Linn	Sun - Thurs	5:00 p.m. - 9:00 p.m.	Senor Taco	Mon - Sun	10:00 a.m. - 9:00 p.m.		Sat	9:00 a.m. - 1:00 p.m.
	Fri-Sat	5:00 p.m. - 10:00 p.m.	7Eleven	Mon - Sun	12:00 a.m. - 11:45 p.m.	Subway Sandwiches	Mon - Sun	7:00 a.m. - 10:00 p.m.
			West Linn Chevron	Mon -Fri	5:00 a.m. - 11:00 p.m.	The UPS Store	Mon	8:30 a.m. - 8:30 p.m.
				Sat	6:00 a.m. - 11:00 p.m.			
				Sun	6:00 a.m. - 10:00 p.m.			



October 16, 2012

Mr. Lance Calvert  
Public Works Director  
City of West Linn  
22500 Salamo Road  
West Linn, Oregon 97068

Re: Lake Oswego – Tigard Water Partnership Project

Dear Mr. Calvert:

As requested, Murray, Smith & Associates, Inc. (MSA) has prepared this letter report to summarize the significance of the Lake Oswego-Tigard Water Partnership (LOTWP) project to the City of West Linn (City) in the context of the City's Water System Master Plan (WSMP) and Capital Improvement Program (CIP), to document a meeting with representatives of the LOTWP and to summarize the assessment of additional information provided by the LOTWP at the request of the City's Utility Advisory Board (UAB).

### **Summary of Findings**

- LOTWP's proposed expansion meets the City's needs for a reliable backup supply system with adequate year-round capacity
- The amended intertie agreement adopted by the cities of Lake Oswego and Tigard commits to providing backup water at the City of West Linn's average day demand of 4 million gallons per day (mgd) through 2041
- LOTWP's proposal to provide this upgraded backup supply at no cost to the City saves \$2.2 million over the intertie enhancement cost assumed in the WSMP
- The City's next best alternative to meeting backup supply reliability needs is to construct a new finished water transmission main at a cost of \$11.6 M, not included in the WSMP CIP budget, and the reliability of this alternative is substantially less than that offered by the full redundancy of LOTWP's new intake, pipeline, and water treatment plant (WTP)
- LOTWP can provide the City with access to significant storage and other water supply sources, including the City of Portland's, as further reliability enhancements
- LOTWP's proposed upgrade allows construction of the Bolton Reservoir on the preferred existing site, and allows downsizing from 8 MG to 4 MG



## Background

The City adopted the current WSMP in November 2008 (Resolution No. 08-44). The CIP for the water system included in the Master Plan report includes approximately \$31 million (2008 dollars) in system capital improvement and capital maintenance projects.

One of the primary focus areas in the WSMP is the identification of appropriate distribution system water storage volumes for emergency conditions, specifically considering water supply reliability and redundancy. The WSMP documented the following key findings:

- *Bolton Reservoir replacement is a high priority improvement* – The existing Bolton Reservoir structure is approximately 100 years old and observations summarized in the City's current and past (1982, 1987, 1999 and 2004) WSMP documents indicate the reservoir has reached the end of its useful life. In addition, the reservoir's hypalon cover, installed in 1989, has also reached the end of its useful life and will require replacement if full reservoir replacement does not occur soon.
- *Recommended storage volume* – The recommended storage volume of the Bolton Reservoir replacement is directly related to the vulnerability of City's supply source and the assessment of available backup supply.
- *Water supply vulnerability* – The City's sole source of water supply, from the South Fork Water Board (SFWB) WTP located in Oregon City, is vulnerable to disruption at critical single points of failure at multiple locations. As documented in the WSMP, the single greatest risk of supply disruption is at the City's 24-inch diameter transmission main crossing of the Willamette River which is suspended from the I-205 bridge. Several other elements of the SFWB supply system also lack redundancy, including the Division Street Pump Station and the segment of the transmission main extending from the pump station to the Willamette River crossing.
- *Availability of backup supply from Lake Oswego* – The City currently has an emergency intertie with the City of Lake Oswego that allows the City to boost water from Lake Oswego's finished water transmission main into the City's distribution system in the event of an emergency which disrupts the City's SFWB supply. However, during the summer season when water demands are high, Lake Oswego lacks available water supply capacity in order to meet the needs of its customers and provide adequate temporary water supply to the City during an emergency. In addition, the Lake Oswego water supply and the City's SFWB supply are both vulnerable to supply disruptions associated with the common Clackamas River water source.
- *Recommended strategy and storage volume* – The WSMP identified a major vulnerability in the City's water supply and presented three alternatives for establishing the recommended emergency storage volume required for the City's water system, in the context of meeting water supply needs during maximum day demand (MDD) conditions:
  1. Construct a parallel river crossing: This alternative focused on constructing improvements to address the most vulnerable portion of the City's water supply system, the I-205 bridge crossing of the Willamette River. Construction of a parallel Willamette River crossing would provide redundant transmission across

the river, reducing the risk of a supply disruption due to the loss of this transmission main. This alternative was not recommended because of the high capital cost and because it does not directly address other vulnerabilities, including the remaining segments of the transmission main system on both sides of the Willamette River.

2. Construct additional distribution system storage: This alternative focused on constructing additional distribution system storage, in the form of an 8 million gallon reservoir to replace the existing Bolton Reservoir, to provide for water supply in a supply disruption emergency. This alternative was also not recommended because of the high capital cost, and this alternative provides only limited benefit as distribution system storage only has a limited capacity to serve customers without additional supply to the system. The proposed Bolton Reservoir would contribute approximately one day of emergency supply.
3. Secure reliable peak season emergency supply: This alternative recognized the potential benefit of coordinating with the City's neighbor – the City of Lake Oswego – and other municipal water providers to utilize existing infrastructure and emergency connections to gain access to alternate supply sources. This alternative involved development of agreements and potential construction of new intertie facilities to secure emergency supply capacity from the Portland Bull Run source. This alternative was selected as the preferred approach as it presented the City with an opportunity to secure access to adequate and reliable backup water supply.

## **Meeting Summary**

At the direction of the City, representatives from MSA (Brian Ginter) met with members of the LOTWP project team (Joel Komarek, City of Lake Oswego; Dennis Koellermeier, City of Tigard; Jon Holland, Brown & Caldwell) and City staff (Jimmy Whynot) on August 16, 2012, to assist the LOTWP with interpretation of the WSMP's analysis, findings and recommendations. Through this discussion, the LOTWP team refined their narrative of project benefits to support the pending land use application(s) for the proposed LOTWP project elements within the City of West Linn.

MSA was directed by City staff to prepare a summary of the meeting and an independent assessment of the significance of the LOTWP's proposed project to the City's selected water supply redundancy and storage capacity strategy for presentation and discussion with the City's UAB.

## **Significance of LOTWP Projects to the City's Master Plan Recommendations**

As described earlier in this report, one of the primary recommendations of the City's adopted WSMP is the development of intergovernmental agreements (IGAs) and facilities necessary to secure access to a redundant source of supply. The recommended capacity of the proposed Bolton Reservoir replacement project is linked to the successful development of a reliable backup supply.

The LOTWP project is a key element of establishing reliable emergency supply for the City. The City has worked with the cities of Lake Oswego and Tigard to develop the required IGAs and to better understand the potential for development of a backup water supply source. Through this process, the LOTWP has confirmed a couple of key conditions:

1. In order for the City of Lake Oswego to reliably provide emergency water supply to the City during the summer season, expansion of the Lake Oswego Water Treatment Plant and other associated facilities, including upsizing the Raw Water Pump Station and Raw Water Transmission Main, as proposed by the LOTWP project are required.
2. The LOTWP has determined that intertie facilities with the Washington County Supply Line are not beneficial, and as such, will not be pursued. This decision is based on water quality concerns associated with blending chlorinated and chloraminated water, and the low likelihood that additional peak season capacity will be available in this transmission main based on the current allocation of the pipeline capacity. *The capital cost, approximately \$2,200,000 (2008 dollars), associated with development of emergency supply included in the WSMP CIP, was for this proposed intertie and associated facilities.*
3. Lake Oswego has inadequate available supply capacity today to provide the City with reliable emergency water supply during construction of the Bolton Reservoir replacement project. During construction, the City will be without a major source of water to maintain service during a short duration supply disruption. It is essential that measures to mitigate this risk during construction be taken. Assuming construction of the Bolton Reservoir replacement project is to begin after the summer of 2014, the LOTWP project will make adequate water supply available for the summer of 2015 as construction continues without the Bolton Reservoir on-line.
4. Conditions of the proposed IGA with the LOTWP and future regional water demand growth may limit the future availability of reliable backup supply during the peak season. Availability is not anticipated to be of concern for approximately 30 years.

If the City is unable to negotiate the necessary agreements with the LOTWP, then the City must reconsider alternatives to address the risk of emergency supply disruptions. In order to quantify the economic value of establishing agreements with the LOTWP, the other two alternatives considered in the WSMP were briefly reconsidered and one alternative was updated to reflect current known conditions.

Based on recent analysis, construction of a larger Bolton Reservoir Replacement is likely infeasible at the current site, and limited alternative sites exist for such a large volume of storage. As previously stated, this alternative also provides a reduced level of reliability as it only provides for one day of emergency supply from storage and does not provide any true measure of supply redundancy. *Further consideration of this alternative is not recommended.*

Construction of a parallel Willamette River crossing would address a major vulnerability, but still leaves several points of potential supply transmission failure. Based on the WSMP and

follow-on investigations of the City's transmission main, construction of parallel piping from the Division Street Pump Station to the beginning of project CIP-65 (replacement of 18-inch diameter transmission main from Broadway Street and Buse Street to Bolton Reservoir) would be required to address the most vulnerable elements of the City's water supply system. *Loss of supply at the SFWB WTP, finished water pipeline, or Division Street Pump Station is not addressed by these improvements.*

The total cost of needed improvements associated with the parallel river crossing option, not recommended in the WSMP, to improve transmission system reliability (if IGAs for emergency supply are not secured) is summarized below.

<b>Project</b>	<b>Estimated Project Cost (2012 Dollars)</b>
Parallel Transmission Main – Division Street Pump Station to Willamette River	\$ 2,140,000
Willamette River Crossing	\$ 9,000,000
Parallel Transmission Main – Willamette River to CIP 65	\$ 440,000
<b>TOTAL</b>	<b>\$ 11,580,000</b>

### **Presentation of Findings to the UAB**

The findings of the assessment described above were presented in preliminary form to the UAB on September 11, 2012. During this presentation, the UAB asked for clarification and additional information requiring follow-up and information from the LOTWP. Two key questions were asked by the UAB:

- What makes the LOTWP water supply system more reliable than West Linn's SFWB supply? Specifically, contrast the river intakes, the new submerged crossing versus West Linn's bridge crossing, and the reliability of the upgraded LOWTP in the event of a major earthquake event.
- What are the LOTWP's emergency water supply plans if an event occurs which impacts all supplies relying on the Clackamas River source, and what does this mean for the City?

The LOTWP provided MSA with detailed documentation to address both questions. This data was reviewed and a summary of the information provided is presented below as a response to the questions posed by the UAB.

### ***LOTWP Project Reliability***

The proposed LOTWP project includes major upgrades and/or construction of new facilities for all elements of the water supply system. As such, these facilities are all being designed to meet or exceed current building code requirements and are being designed to the highest standards with consideration of the need for redundancy and high reliability to supply the LOTWP's needs. A brief description of each element of the supply facility follows.

*River Intake and Pump Station:* The new river intake structure will house three independent fish screens, allowing each screen and pump bay to be isolated in the event that damage to a screen occurs from debris in the river (as happened to the SFWB intake this past winter). In addition, the new intake screens will be protected by an upstream debris deflector, and the screens can be lifted out of the river flow to an elevation above the 500-year flood level. These are all reliability features not included in the SFWB intake design. Furthermore, the new intake structure is being designed to withstand seismic overturning and the simultaneous buoyancy of a 10-year flood event – a conservative standard for dams applied by the Bureau of Reclamation – with an extensive system of 14 rock anchors drilled and grouted into 30 feet of rock.

*Raw Water Pipeline:* The LOTWP's new raw water transmission main will be constructed using cathodically protected, double lap welded ¼-inch thick steel pipe with interior lining and exterior coatings. An independent, third party review of the proposed pipeline material and design (*Lake Oswego Seismic Pipeline Design, Seismic Design Final Memorandum, Degenkolb, August 3, 2012*) verified the pipeline system design addresses the seismic risk associated with a 2,475 year return period event. As previously discussed, the City's water transmission main crossing of the Willamette River is highly vulnerable and has experienced multiple disruptions in service.

*Water Treatment Plant:* The upgraded and expanded LOTWP WTP is being designed to the same standard as the pipeline and intake, with measures in place to protect it from a seismic event with 2,475 year recurrence interval. A system of nearly 1,000 auger-cast piles is being designed to protect the new facility from ground movement and possible liquefaction associated with such a seismic event.

No effort has been made in this report to specifically contrast these design criteria with that of the SFWB WTP. The purpose of this description is to illustrate the specific measures being taken by the LOTWP to assure these facilities remain in service following a major seismic event.

### ***Emergency Water Supply Plans***

As described above, the UAB expressed concern that depending on the LOTWP as an emergency supply for the City may have limited benefit if an emergency condition occurs which impacts all water suppliers relying on the Clackamas River as the source of water. If such an event were to occur, the LOTWP has several emergency provisions in place to continue to provide water to its customers. The first option for both Tigard and Lake Oswego during a short duration supply disruption is the distribution system water storage in each of their respective systems. Tigard has 27 million gallons (MG) of storage and Lake Oswego has 24 MG of storage, plus a proposed addition of 2 MG in the clear well at the new water treatment plant. The combined 53 MG of storage between the two systems is adequate to supply customers through four average day's demand levels.

The City of Tigard also has a system of two aquifer storage & recovery (ASR) wells with a recovery capacity of approximately 5.5 million gallons per day (mgd) for 60 days or longer.

Mr. Lance Calvert  
October 16, 2012  
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In addition, the City of Tigard will maintain its connection with the City of Portland. This connection has approximately 8 mgd of capacity.

This additional storage volume, ASR capacity and connection to the City of Portland will achieve the recommended approach to addressing supply reliability needs outlined in the City's WSMP.

## Summary

This letter report summarizes the significance of the LOTWP project to the City in the context of the City's WSMP and CIP, documents the meeting with representatives of the LOTWP and summarizes the assessment of additional information provided by the LOTWP at the request of the City's UAB. This memorandum presents a synopsis of relevant data for City stakeholders as they review the current status of water system supply and storage strategies.

We appreciate the opportunity to be of service to the City. We would be pleased to further review the report and its findings with you and other City staff, the UAB, City Council or other interested parties.

Sincerely,

MURRAY, SMITH & ASSOCIATES, INC.



Brian Ginter, P.E.  
Associate

BMG:mlm

cc: Mr. Jimmy Whynot, City of West Linn  
Mr. Jon Holland, Brown & Caldwell  
Mr. Joel Komarek, City of Lake Oswego  
Mr. Dennis Koellermeier, City of Tigard