GEODESIGN INC
AN NV5 COMPANY

Memorandum

To:	Christina Robertson-Gardiner, AICP Josh Wheeler, P.E. John Lewis, P.E.	From:	Erick J. Staley, C.E.G.
Company:	City of Oregon City	Date:	January 6, 2020
Address:	625 Center Street Oregon City, OR 97045		

cc:	Jamison Luther, RJL Holdings, LLC (via email only) Robert Luther, RJL Holdings, LLC (via email only) David Poulson, P.E., PACE Engineering, Inc. (via email only) Brian Lee, P.E., PACE Engineering, Inc. (via email only) Kelly Hossaini, P.C., Miller Nash Graham & Dunn LLP (via email only)

GDI Project:	RJLHold-1-01
RE:	Lower Campus Slope Stability and Dewatering System Forest Edge Apartments Oregon City, Oregon

On behalf of RJL Holdings, LLC (RJL), this memorandum presents a summary of the landsliding affecting the Lower Campus at the Forest Edge Apartments, discusses the stabilization project completed at the adjacent Berryhill Apartments, and discusses the methods and benefits of stabilizing the Lower Campus. RJL requests that this memorandum be placed into the record for the upcoming proceedings for the proposed Lower Campus redevelopment project.

Both the Forest Edge Apartments and the eastern two buildings of the Berryhill Apartments are located within an ancient landslide complex. A significant portion of the ancient landslide reactivated in 2006 during a very wet winter, threatening the two buildings at Berryhill and most of the improvements at the Forest Edge Lower Campus. The Lower Campus is located on the active landslide mass, which consists of a relatively slow-moving, deep-seated landslide block. The two Berryhill buildings are located at the top of the active headscarp on a narrow remnant of the ancient landslide. Since 2006 the active landslide has experienced continued displacement in response to heavy rainfall events or sustained rainfall during the wet season.

An engineered retaining wall was constructed at the top of the active headscarp at the Berryhill Apartments in 2016 and 2017 to stabilize the ancient remnant underlying the Berryhill buildings. The Berryhill project was designed by a qualified geotechnical engineering consultant and underwent careful review by the City of Oregon City's (City) geotechnical engineer prior to permitting and eventual construction of the slope mitigation.

RJL has pursued a similar process to stabilize their portion of the reactivated ancient landslide. They engaged a qualified geotechnical engineering consultant (GeoDesign, Inc.) since the spring of 2017 to study the landslide and develop mitigation strategies. GeoDesign has conducted several phases of site exploration and installed three new inclinometers and a variety of groundwater monitoring instruments to understand the relationship between groundwater levels and landsliding.

Based on the collected data and engineering analyses since the spring of 2017, it is GeoDesign's recommendation that the landsliding affecting the Lower Campus be mitigated by dewatering the landslide mass. An effective dewatering system would maintain reduced water levels throughout the year and protect the site from rapid rises in groundwater resulting from precipitation cycles.

A dewatering system consisting of 14 vertical wells was installed at the Lower Campus in the spring of 2018. The system has dropped groundwater levels below those measured during pre-dewatering summer months, when groundwater is at its seasonally lowest elevation and landsliding would not be expected. Inclinometer data indicate the dewatering system has had the desired effect in arresting landslide displacement. In addition, the degree of dewatering observed at the site provides some freeboard in groundwater levels for the system to respond to heavy precipitation events.

The Lower Campus landslide was evaluated by other geotechnical professionals since active landsliding initiated in 2006 and prior to GeoDesign's work. Previous consultants used similar equipment to what GeoDesign has used to characterize the landslide hazard. These consultants also concluded that the best method to address the landsliding was by dewatering the landslide. Also, the City's geotechnical engineer (Tim Pfeiffer of Foundation Engineering, Inc.) reviewed GeoDesign's technical reports throughout the initial permitting process. Based on his comments in meetings, the geotechnical reviewer also concurs with our opinion that a dewatering system represents a feasible option for the site.

Landslide dewatering is often achieved using horizontal drains that gently slope below the landslide and cause groundwater to drain out of it by gravity. This method requires free and clear access to the toe of the landslide so the drains can be installed below the slide and avoid being sheared by possible movement. Due to the geometry and size of the landslide and the location of the environmentally sensitive Newell Creek canyon at the bottom of the landslide, horizontal drains are not a feasible option for the Lower Campus slide. Instead, GeoDesign recommended using a vertical well system installed within the landslide mass. This allows the system to be readily accessed and maintained from the Lower Campus area.

While the necessity of supplying power to an active, vertical dewatering system makes them less common than using horizontal drains, many landslides are mitigated using powered, active systems like the one at Forest Edge. GeoDesign has experience using these systems, including stabilization of a 50-acre landslide using a 16-well dewatering system on another site. The wells require monitoring and maintenance to ensure they are properly functioning and have stabilized this massive landslide for close to 20 years.

In addition to the on-site benefits, we anticipate that stabilizing the Lower Campus landslide block will benefit adjacent areas that have historically been affected by active landsliding, including a fill failure at the Forest Edge Upper Campus and the Berryhill Apartments. The Lower Campus is situated such that its stability promotes the stability of uphill, adjacent areas.

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