SPECIFICATIONS
for
INSTALLATION AND TESTING OF GROUNDWATER INJECTION WELL

for

Oregon State University – Cascades
Bend, Oregon

Prepared by:
Integral Group
The Wallace Group

PROJECT NO: 151906.000

ISSUE DATE: March 16th, 2020

1. GENERAL

1.1 Scope of Work

Oregon State University (OSU) is installing the first phase of an open loop geo-exchange (GHX) systems on its Cascades campus in Bend, Oregon.

The scope of work under this contract will include the following:

1. Installation of a groundwater injection well and associated testing.
2. Purchase and Installation of a new submersible pump inside the existing groundwater production well.
3. Purchase and installation of new pit-less adapter for existing groundwater production well.
4. Re-developing of the existing groundwater production well.

Additional scopes could include the following at Owner's discretion:

1. Temporary power for pump testing.
2. Installation of temporary piping interconnecting the production and injection wells.

1.2 Contractor Qualifications and Responsibilities

1. Notwithstanding the General Conditions, within this scope and Specifications, the term Contractor refers to a qualified and experienced well drilling contractor, and any additional required subcontractors. The Contractor can retain other adequately qualified and experienced subcontractors for the portions of the scope for which the selected subcontractors are better qualified. However, the Contractor shall carry full responsibility for completing the entire scope under this Contract.

2. Evidence of Contractor's qualification shall include licensing or registration by the authority having jurisdiction, where local law requires well drilling contractors licensing or registration. In the State of Oregon, The Contractor shall have a valid "Water Supply Well Constructor's License" issued by the State of Oregon, a copy of which shall be submitted with the bid. Additional Contractor's qualifications are also beneficial and shall be demonstrated by submitting copies of their additional relevant certification(s) through third party industry certification or accrediting organizations, which may include IGSHPA, NGWA, CGC, or other relevant licensing bodies or agencies.

3. The contractor including all subcontractors shall also demonstrate relevant experience, skills and competency by providing a list of references for their previously completed projects of comparable scope and complexity.

4. The Contractor shall be responsible for all permits required to complete the scope under this Contract and for following all applicable local, state and federal codes and regulations. Where any discrepancy exists between local codes and regulations and this specification, the more stringent of the two documents shall prevail.

5. The Contractor shall provide all necessary materials, equipment, labor, supervision, and perform all work and fulfill all requirements under this scope as set forth in accordance with these Specifications

6. The contractor shall be familiar with the latest version of the ANSI/ CSA/ IGHSPA C448 Series 16 Standard; design and installation of ground source heat pump systems for commercial and residential buildings (a bi-national standard by Canada and the US) and assure that all work carried out under this scope will be done in accordance with the guidelines outlined in this standard.

7. The Contractor shall take all necessary precautions to protect the site from any damage resulting from the drilling operation including a pre-investigation site survey to check for underground services prior to commencing the work under this scope.

8. The Contractor shall provide water and all temporary power and fuel to site for drilling operations.

9. The Contractor shall remove all cutting, slurry, and groundwater from site.

2. INJECTION WELL INSTALLATION

1. As specified herein, furnish, install, test and place in satisfactory operation one 14" diameter, 500 ft deep groundwater injection well capable of effectively absorbing 825 to 1,000 gpm of groundwater flow under continuous operation. The well shall be completed with 304 stainless steel casing extending into the bedrock, 304 stainless steel injection screen extending from the bottom of the well casing to the bottom of the well and 304 stainless steel pitless adapter unit installed at the top of the casing. The well shall be fitted with 6" diameter HDPE vertical injection pipe extending down from the pitless adapter down to at least 20 ft below the lowest GW static water level.

2. The injection well location shall be as shown on the drawing in Appendix A.

3. No particular type of drilling method for the injection well is specified. However, the selected drilling method must be capable of effectively drilling the well in the anticipated regional geology and drilling conditions to complete the drilling in a timely, efficient, and cost-effective manner.

4. Well casing extending into the underlying bedrock is required to stabilize and seal the upper portion of the drill hole where unconsolidated soils are encountered. The well casing shall be sealed through upper unconsolidated strata as per all applicable regulations.

5. The Contractor shall install the injection well-surface seal in accordance with Oregon Water Resources Department regulations

6. The Contractor shall use drilling fluids that minimize mud-cake buildup on the borehole wall to avoid plugging up groundwater bearing fracture zones. Drilling fluids could use mud thinners or dispersants to minimize mud intrusion into fractures.

7. The Contractor shall be responsible for drill cuttings and groundwater control and management on the site, and for removal of the cutting's material and groundwater from the project site and disposing of it elsewhere in an environmentally safe manner.

8. Any groundwater used or generated in the drilling operation will be disposed in a manner which safeguards equipment and other assets and protects the health and safety of all workers and passers-by. At the pre-construction meeting the Contractor shall provide a sediment control plan detailing all measures as it fits within the overall site's sediment control plan.

9. The Contractor shall make all necessary provisions to prevent water from flowing outside of the work zone

10. Groundwater used or generated in the drilling operation should be collected by means of a vac-truck or dispersed back to ground if the site permits

3. MODIFICATIONS TO THE EXISTING GW PRODUCTION WELL

1. The existing production test well shall be modified as part of this scope into a permanent GW production well. The modifications will include the following:

2. Pitless adapter installation
    1. A 10" stainless steel pitless adapter shall be installed in the existing ground water production well. Supply and install the pitless adapter as per section 7 – Pitless Adapter Specification and section 11 Equipment schedule.
    2. The well casing cap to be welded on top of the pitless adapter shall extend to at least 12" above the ground surface as per OWRD requirements

3. The Contractor shall install the injection well-surface seal in accordance with Oregon Water Resources Department regulations

3. New submersible pump installation
    1. The new submersible pump shall be installed in the existing ground water production well. Supply and install the new submersible pump as per section 8 - Pump Specification and section 11 Equipment schedule.
4. Redevelopment of the existing production well
    1. The existing production well has been stagnant since early December 2019. It was originally installed with 12" low-carbon steel casing which was recently (March 2020) removed and replaced with a smaller diameter 10" stainless steel well casing. The well shall be redeveloped to ensure all iron oxide and other sediments are purged and only clean groundwater water is available for the injection well test.

       The well redevelopment shall consist of pumping the GW at the continuous design flow of 825 gpm for a minimum of 2hrs. The GW shall be safely discharged to the designated location on site. The driller should plan that the discharge location may be up to 1200 ft away and they should plan on covering the cost of that conveyance.

4. PROVISION OF TEMPORARY POWER

1. Permanent power may or may not be available for the pump startup, testing etc. The Contractor shall provide separate pricing to provide temporary power to the submersible pump for the pump startup and commissioning, production well redevelopment and injection well test in the event onsite power is not available.
2. Upon completion of the injection well test scope the Contractor is to ensure submersible pump power connection is terminated in the pitless adapter junction box and ready for final connection.

5. PROVISION OF TEMPORARY GROUNDWATER PIPEWORK BETWEEN PRODUCTION & INJECTION WELL

1. The permanent conveyance line between the production and injection well may not be installed and available for the production well and injection well testing. The Contractor shall provide separate pricing to provide new 8" diameter temporary pipework interconnecting the GW production and injection wells for the injection well test and shall be constructed and coordinated with site reclamation progress in the event the permanent line is not yet installed. Refer to Appendix A for indicative temporary pipework route. The temporary piping with all fittings and accessories shall be from non-ferrous materials (i.e. HDPE).
2. The piping shall be purged with clean groundwater from the production well prior to the start of the injection well test to ensure no foreign materials get carried into the injection well during the test.

6. GW INJECTION WELL TEST

1. Drilling Contractor shall log and provide the following information to The Wallace Group to compile an injection-well test report. Owner and Integral Group shall be copied on all submissions.

    1. The Contractor shall provide all materials necessary to conduct a step-rate GW injection test on the injection well with the water source from the aforementioned production well.
    2. Once groundwater levels in both production and injection wells have stabilized, after all equipment installations and before the step-rate-GW injection test, starting static groundwater levels will be recorded in the production and injection wells.
    3. The step-rate GW injection test shall be run for a minimum of three-rates steps, each step maintained and monitored for a minimum of 60 minutes or until a steady-state-groundwater level is monitored and recorded, to a maximum of 825 to 1,000 gpm.
    4. Pumping and injection flow rates, water levels inside the production and injection wells, along with time shall be recorded
    5. The submersible pump in the production well shall be controlled manually to achieve the required step flows for each required step duration
    6. Once the maximum GW injection rate has been reached, a steady-state-groundwater level maintained and monitored for at least 60 minutes, the GW injection test can be stopped, and the groundwater levels monitored and recorded until they have recovered to pre GW injection test levels.

7. PITLESS ADAPTER SPECIFICATION

1. Supply and install pitless adapters at the top of the existing 10" production well and the new 14" injection well 304 stainless steel casings. Both pitless adapters shall be constructed from 304 stainless steel. The use of any low-carbon steel/ ferrous components as part of the pitless adapter assembly will not be acceptable. Refer to the Equipment schedule in section 11.

2. The contractor shall submit shop drawings for the pitless adapters including the manufacturer and model of the pitless unit to be installed with detailed specifications and drawings of the units to be installed.

3. The pitless adapter is to be provided with the following:
    1. Stainless steel inserts used at critical "O" ring seal and spool seat surfaces
    2. Water tight, heavy duty stainless steel cap
    3. Stainless steel screened well vent
    4. Neoprene cap gasket
    5. Upper casing barrel to extend the well head at least 12" above ground supplied by factory or installer.
    6. Weld-on discharge; 6" flanged connection to be provided.
    7. Two (2), oblong shaped, 3" ID x 1.25" ID stainless steel access channels for pump controls wiring and ground water level monitoring.
    8. An airline (PE pipe with diameter that will fit through the pitless adapter access channel) extending to at least 20ft below the SWL to deploy transducers for water level monitoring
    9. Weld-on connection 304 stainless steel well casing with cap with pressure fitted port, electrical junction box and all required accessories to make a complete and operational well meeting all regulatory requirements
4. Follow all recommendations in pitless adapter manufacturer's installation instructions.

5. Pitless adapter is to be installed with the 6" dia flanged horizontal discharge pipe connection 5 ft below grade to ensure the horizontal piping is installed below frost line. The well casing cap to be welded on top of the pitless adapter shall extend to at least 12" above the ground surface as per OWRD requirements. The horizontal connection shall be sealed with a blank flange until the permanent horizontal piping gets connected (by others) to the pitless adapter.

8. SUBMERSIBLE WELL PUMP SPECIFICATION

1. Supply and install submersible vertical turbine well pump and accessories capable of delivering a minimum of 825 gpm at 556 ft of head in the existing GW production well. The pump shall be constructed from 304 stainless steel. The use of any low-carbon steel/ ferrous components as part of the pump assembly will not be acceptable. The pump diameter shall fit inside the existing 10" diameter well casing while pumping the target design flow. Refer to Equipment schedule in section 11.

2. The contractor shall submit shop drawings for the submersible pump including the manufacturer and model of the pump to be installed with detailed specifications and shop drawings including certified pump curves showing pump performance characteristics with pump and system operating points plotted. Include pump curves at 10% speed increment between 100% and 50 % pumps speed (60Hz – 30Hz) and NPSH curves when applicable. Show pump weights, motor and pump operating or efficiencies and electrical power characteristics.

3. The pump motors shall be high efficiency and/or inverter only and shall be suitable for variable speed operation and compatible with variable frequency drives.

4. Check and align pump prior to start-up or commissioning.

5. Follow all recommendations in manufacturer's installation instructions.

6. Install to depth indicated and obtain approval of installation from Integral Group.

7. Use start-up services of pump, motor and VFD manufacturers.

8. The variable speed of the submersible pump motor shall NOT be lowered below the minimum motor speed recommended by pump motor & VFD manufacturers in order to protect the motor from overheating and to comply with the motor manufacturer's warranty requirements. At all times, the controls must be set to ensure that well pumps cannot be operated at speeds below which flow ceases.

9. During testing, each pump shall be operated at each allowable/feasible frequency above 30 Hz, in increments of 1 Hz, for a period of no less than 3 minutes at each frequency.

10. During the injection well test the pump shall be manually controlled as described in section 6.

9. DRILLER'S LOGS, RECORDS AND REPORTS

1. Drilling Contractor shall log and provide the following information to The Wallace Group to compile an injection-well report. Owner and Integral Group shall be copied on all submissions.

    1. The subsurface stratigraphy including:
        1. Each formation type encountered during well drilling (drill log)
        2. Each formation depth (in feet)
        3. Depth of any significant cracks, fissures or caverns encountered
    2. The aquifer type and conditions (confined, unconfined, flowing, etc) including:
        1. All water bearing zones and if encountered:
        2. Zone depths
        3. Estimated injection rate
    3. The drilling method used, including:
        1. Type of drilling equipment used (i.e. mud-rotary, air-rotary, air-ha mmer, etc.), and rig model number
        2. Drilling penetration speed
        3. Bag quantity of drill mud used if applicable
        4. Total time to drill the injection well excluding shut-downs to obtain water or mechanical breakdowns.
        5. Collect soil/rock samples to create a Borehole Log.
        6. Identify features that may affect the performance or layout of ground loop, ease of drilling and depth of groundwork.
    4. A completed, signed report shall be supplied immediately at the conclusion of the drilling process.
    5. Provide a conclusion and recommendation based on findings.

10. SUMMARY OF DELIVERABLES

1. Driller's log and TWG report as outlined in section 9 complete with recommendations regarding optimal GW injection well design (overall depth, GW injection zone(s) depth, GW injection screen design, etc.) to return the targeted GW rate of 825 to 1,000 gpm into the aquifer.

2. GW step-injection rate test report as outlined in Section 6 complete with conclusions and recommendations on realistically achievable sustained injection rates.

3. The Owner and Integral Group shall be copied on all submissions.

11. EQUIPMENT SCHEDULE

1. The contractor shall supply and install a submersible pump that meets the requirements listed in the equipment schedule below, in addition to the requirements listed in section 8.

SUBMERSIBLE PUMP SCHEDULE	
TAG	P-1
SERVICE	GROUND WATER DISTRIBUTION
LOCATION	OSU PRODUCTION WELL
PUMP TYPE	SUBMERSIBLE WELL PUMP
MANUFACTURER	FRANKLIN
MODEL NUMBER	825SSI150F1060686
NUMBER OF STAGES	6
OPERATING RANGE (GPM)	410-825
HEAD (FT. HD)	556
MOTOR POWER (HP)	150
MOTR RPM	3450
VOLTAGE/FREQUENCY/PHASE	575/60/3
DISCHARGE NPT SIZE (INCHES)	6
PUMP BOWL DIAMETER (INCHES)	8.19
MOTOR SIZE (INCHES)	8
WELL CASING INSIDE DIAMETER (INCHES)	10
NOTES	- ALL PUMP COMPONENTS TO BE MADE OF STAINLESS STEEL 304 OR EQUIVALENT - ALL MOTOR COMPONENTS TO BE MADE OF STAINLESS STEEL 316 OR EQUIVALENT - C/W INTEGRATED CHECK VALVE

2. The contractor shall supply and install pitless adapters that meet the requirements listed in the equipment schedule below, in addition to the requirements listed in section 7.

PITLESS ADAPTER FOR GW PRODUCTION AND INJECTION WELLS		
TAG	PS-1	PS-2
SERVICE	GW PRODUCTION WELL OSU	GW INJECTION WELL OSU
LOCATION	OSU PRODUCTION WELL	OSU INJECTION WELL
MANUFACTRER	MAASS MODEL MB PITLESS UNIT IN 304 STAINLESS STEEL	MAASS MODEL MB PITLESS UNIT IN 304 STAINLESS STEEL
WELL CASING (IN)	10ø	14ø
PUMP COLUMN DISCHARGE/ INJECTION PIPE (IN)	6”	6”
ACCESSORIES	PROVIDE THE FOLLOWING ACCESSORIES: - SEALED WIRE CONNECTIONS - AIRLINE TEST BLOCKS - TORQUE ARRESTOR AND LIFT-OUT BAIL AND HOLD DOWN RING - 6” FLANGED HORIZONTAL CONNECTION C/W BLANK FLANGE	PROVIDE THE FOLLOWING ACCESSORIES: - SEALED WIRE CONNECTIONS - AIRLINE TEST BLOCKS - TORQUE ARRESTOR AND LIFT-OUT BAIL AND HOLD DOWN RING - 6” FLANGED HORIZONTAL CONNECTION C/W BLANK FLANGE
NOTES	- STAINLESS STEEL INSERTS USED AT "O" RING SEALS AND SPOOL SEAT SURFACES - ALL WETTED PARTS MADE OF STAINLESS STEEL - CASING TO BE STAINLESS STEEL 304	- STAINLESS STEEL INSERTS USED AT "O" RING SEALS AND SPOOL SEAT SURFACES - ALL WETTED PARTS MADE OF STAINLESS STEEL - CASING TO BE STAINLESS STEEL 304

END

APPENDIX 'A' –

Proposed GW Injection Well Location

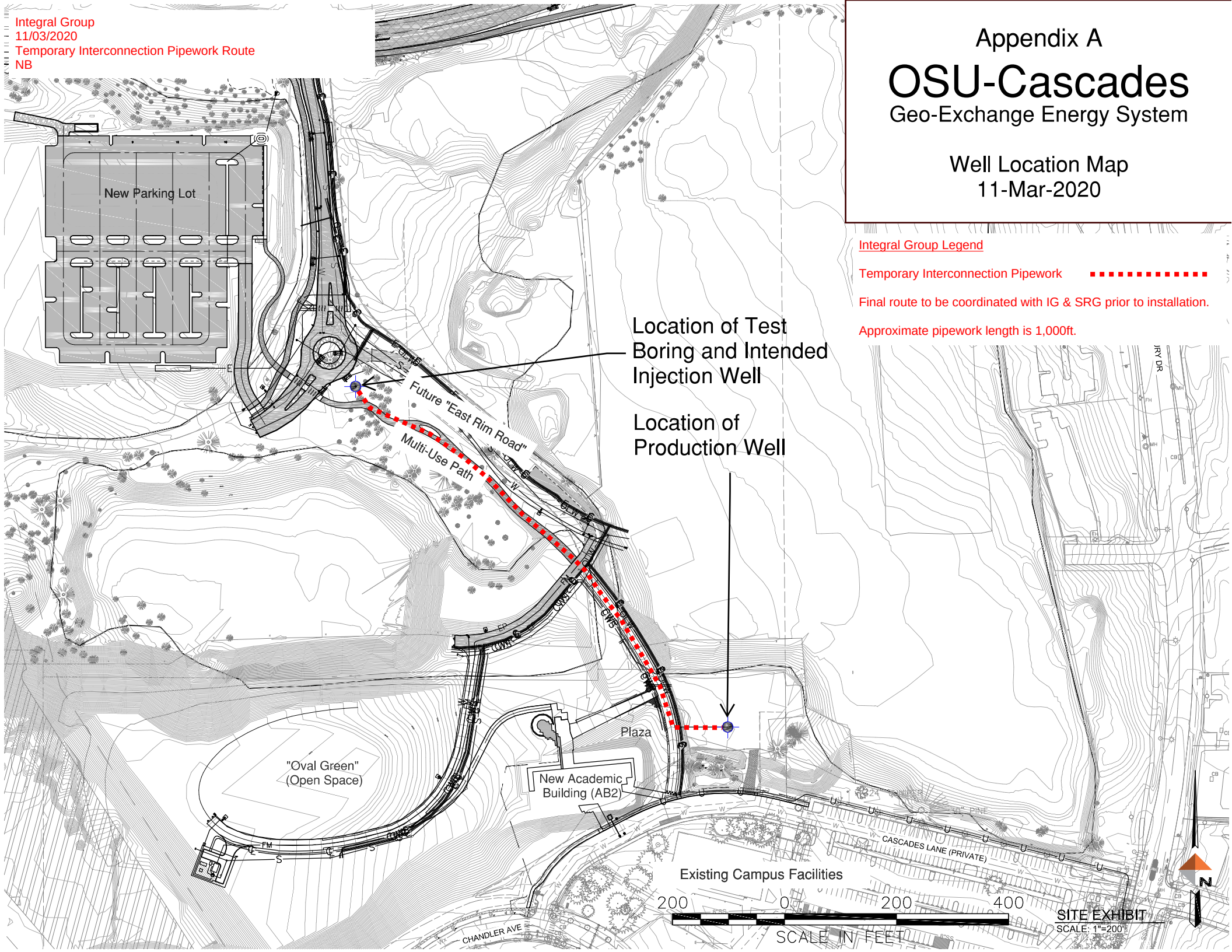
Integral Group
11/03/2020
Temporary Interconnection Pipework Route
NB

Appendix A

OSU-Cascades

Geo-Exchange Energy System

Well Location Map
11-Mar-2020



Integral Group Legend

Temporary Interconnection Pipework

Final route to be coordinated with IG & SRG prior to installation.

Approximate pipework length is 1,000ft.