City of Lacey
Request for Qualifications

2019 Well Review and Analysis

SUMMARY
The City of Lacey is seeking a qualified consultant to provide hydrogeological services for rehabilitation of a municipal potable water well.

Statements of Qualifications (SOQs) will be evaluated based on the firm’s experience with projects of this type in similar environments, and the quality and breadth of the approach proposed to complete the work. Interested firms should submit a project approach and identify those individuals, along with their expertise, that will be assigned to the project. Examples of relevant work are encouraged, and should showcase the quality, breadth, and approach used in prior projects.

Statements of Qualifications, prepared according to the following detailed instructions, must be received via email at jjwilson@ci.lacey.wa.us no later than 5:00 p.m. Pacific Standard Time, Friday, November 30, 2018.

The City of Lacey assumes no obligations of any kind for expenses incurred by any respondent to this solicitation.

It is the City of Lacey’s policy to assure nondiscrimination in any contract entered into pursuant to this advertisement. Firms will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award as provided by Title VI of the Civil Rights Act of 1964.

For additional information, contact:

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City of Lacey Public Works
Water Resources Division
420 College Street SE
Lacey, WA  98503
Phone: (360) 456-7791
Fax: (360) 412-3186
E-mail: jjwilson@ci.lacey.wa.us
GENERAL INFORMATION

The City of Lacey has 20 active groundwater wells to provide potable water to its customers. The Well Review and Analysis program will consist of City staff researching the water system’s well conditions and history to propose a rehabilitation program schedule.

Each rehabilitation project may include: investigation, testing, rehabilitation, pump and motor work, disinfection, and report on the work and testing analysis. Since each well is unique in regards to development, construction, aquifer, and water quality, the proposed work plan may differ from well to well. The objective of the rehabilitation (depending on the well) is to:

- Remove biofouling and/or incrustation material, and thereby reduce the potential for sloughing and transport of such material into the water distribution system.
- Stabilize the aquifer formation adjacent to the well screen to reduce sand production.
- Increase well efficiency, specific capacity, and/or well yield.
- Provide an opportunity for the City or City representative to inspect, repair, and/or replace the well pump and motor.

Source 6, located at 2400 Judd St SE, has been identified as the next priority well to rehabilitate during the 2018/2019 winter. This well is unique in that it is screened in two different aquifers that have different water quality characteristics. The Source 6 well was brought online in 1993 and has been rehabilitated numerous times: using a shockblast method in 2001, mechanical methods in 2002, and a hydropulse (sonic) method in 2010. Each time the rehabilitations only partially restored the well capacity, and the well yield continues to decline. The City has had some success with using the proprietary CO2 injection method with two of its wells and is considering its use for Source 6. As a result, the City is seeking a hydrogeologist that has proven success with innovative approaches rehabilitating municipal wells.

SCOPE OF EFFORT AND TIMING

Task 1: Investigation and Work Plan

- Review all pertinent City provided data.
- Conduct on-site tailgate meeting with City staff, then conduct well yield and pump curve tests with existing production pump and valve. City staff will operate City equipment during the testing and provide SCADA readings.
- Conduct scoping meeting with City to recommend and develop scope and schedule of rehabilitation work based on investigation.

Deliverables:

- Well yield and pump curve (1 electronic copy)
- Work Plan, Schedule, and Cost of Services (1 electronic copy)

Task 2:
Below is a list of items which may be included in the work plan. Hydrogeologist will hire companies to provide all labor, equipment, and materials to perform the selected items. All equipment and materials are to be in compliance with NSF 60 and NSF 61 and cleaned before use in the potable water wells.
**Pulling out the Production Pump**

- Before commencing with rehabilitation work, provide a water discharge plan. Due to site constraints, water may not always be disposed of onto the ground. If performing chemical rehabilitation, include plan for disposing of chemicals and flushing well.
- Remove the production pump and place on-site as directed by City staff for the duration of the rehabilitation work.
- Verify the elevation of the pump intake.
- After pulling the pump, photograph the serial number(s) of the pump and/or motor. Also photograph the pump column, pump, and/or motor to document their current condition.
- Once the production pump is removed. City or City representative may disassemble the pump and take wear measurements and photos to document pump condition. City or City representative will inspect, rebuild, and/or replace pump and motor, as required.
- In the work schedule, provide a line item for purchase of long lead items, such as a pump or motor.

*Deliverables:*
- *Discharge plan (1 electronic copy)*
- *DVD of Photographs (1 electronic copy)*

**Video Inspection**

Before and after rehabilitation:
- Perform downhole video inspection of entire length of well bore.

*Deliverables:*
- *DVD and well log report of inspection (1 electronic copy)*

**Rehabilitation**

For rehabilitation of Source 6, the hydrogeologist will evaluate the use of CO2 injection, performed alone, in sequence, or in combination with other rehabilitation methods. Recommendations will be presented for the City’s consideration and include potential benefits and risks of the CO2 injection in comparison to other rehabilitation methods.

Other rehabilitation methods may include:

**Mechanical Rehabilitation**
- Perform one or more of the following mechanical rehabilitation methods per the work plan: brushing, swabbing, air or water scouring, surging, and jetting.
- Bail or air-lift accumulated sediment from tailpipe.

**Chemical Rehabilitation**
- Provide a recovery or neutralization plan to perform once the chemical rehabilitation is complete.
- Use one or more of the following chemical rehabilitation methods per the work plan: surfactants, dispersants, acid, chlorine, and other anti-bacterial chemical.
Other Rehabilitation
- Other rehabilitation includes specialized and proprietary methods, such as sonic waves, and explosive charges.
- If recommending other rehabilitation methods, demonstrate the effectiveness of the method for City’s consideration. Also present successful projects performed by your company using the method, with references.

Deliverables:
- Recovery or neutralization plan for chemical rehabilitation (1 electronic copy)
- Sample projects and references for other rehabilitation (1 electronic copy)

Well Yield and Analysis
After each phase of rehabilitation:
- Perform constant and/or step drawdown tests with consultant provided equipment.
- Monitor observation wells during the drawdown tests with consultant provided equipment, when identified.
- Make recommendations to proceed with the work plan or with a modification to the scope, based on observations and analysis.

Deliverables:
- Test results and analysis (1 electronic copy)
- Observation well data during pump test (1 electronic copy), when identified

Water Quality Testing
City will provide the most recent testing results for the well to be rehabilitated. Provide a water testing plan identifying:
- Any additional testing required prior to rehabilitation in order to establish a baseline for comparison.
- Testing during well rehabilitation to monitor progress.
- Testing after rehabilitation is complete.
- Laboratory where samples will be tested.
All laboratories, testing procedures, and equipment are to be in compliance with the Washington State Department of Health regulations for drinking water. Testing may include the following laboratory and field tests based on the City’s experience and the hydrogeologist’s recommendation.

Laboratory Tests
- Test for one or more of the following: iron, manganese, calcium, hardness, sulfate, alkalinity, total dissolved solids, total suspended and settleable solids, magnesium, chlorides, silica, and nitrate.
- Test for one or more of the following bacteria: coliform, iron, manganese, sulfate-reducing, and HPC (R2A media).
Field Tests

- Test for one or more of the following at the well head: dissolved oxygen, pH, temperature, specific conductance, turbidity, oxidation-reduction potential, and sand production.

**Deliverables:**

- Water Testing Plan (*1 electronic copy*)
- Test results and analysis (*1 electronic copy*)

**Disinfection and Reassembly of Well**

- Disinfect well, pump, and all well assembly parts with chlorine per AWWA C654.
- Reassemble the well and flush until no detectable chlorine residual. Dispose of water per the approved discharge plan.
- Perform a bacteriological test. Reconnect the pump to the water system once the bacteriological test indicates no presence of coliform.
- Conduct well yield and pump curve tests with existing production pump and valve. City staff will operate City equipment during the testing and provide SCADA readings.

**Deliverables:**

- Bacteriological test result (*1 electronic copy*)
- Well yield and pump curve (*1 electronic copy*)

**Report**

- Prepare and submit a draft report describing the procedures, methods, and analysis of results. Report will also include recommendations for future well operations and maintenance.
- Address and incorporate City comments into the final report.

**Deliverables:**

- Draft Report (*1 Word/Excel copy, 1 .pdf copy*)
- Final Report (*1 Word/Excel copy, 1 .pdf copy*)

**Project Timing:**

- Signed Contract – End of January 2019
- Investigation of Source 6 – February 2019
- Negotiate Work Plan and Costs for Source 6 – Beginning of March 2019
- Rehabilitation of Source 6 – March through April 2019
- Report – April through June 2019
SOQ FORMAT:

Consultants are asked to express their interest in this project by offering a SOQ which demonstrates their ability and capacity to provide the services described.

1. **Number of Copies and Due Date** -- Interested consultants should submit one electronic PDF file format of their SOQ so that they are **received no later than 5:00 p.m. Pacific Standard Time, Friday, November 30, 2018**, at jjwilson@ci.lacey.wa.us. SOQs received after the deadline will not be reviewed.

2. **Format** -- Each SOQ will be limited to a total of ten (10) pages, consisting of nine (9) pages and a cover letter. A printed side constitutes one page. Printed means any printing of any kind except for the phrase “this page intentionally left blank.” Pages must be letter size (8.5” x 11”). Margins will be at least 1” top, bottom, left and right. Body type must be 11 point or larger at standard spacing.

3. **Cover Letter** -- A cover letter should establish the firm’s interest in this project and may not exceed one page. The letter must be signed by an individual capable of committing the resources of the proposing firm.

SOQ CONTENT:

**Company Experience** –
- Provide a description of your company’s experiences in performing similar work, addressing the elements listed under “Scope of Effort and Timing”.
- Provide company’s experience with using CO2 injection for rehabilitation of wells.
- Identify every type of rehabilitation method in which your company has had proven success in the past six (6) years.
- Provide company’s experience with rehabilitation of municipal potable water wells in the past six (6) years. Include well information such as yield, depth, and size.
- Prime consultant must specialize in hydrogeological consulting services.

**Key Personnel/Past Performance** –
- Identify and describe the relevant experience and qualifications of the pertinent individuals who would serve as key personnel for this project.
- Identify and describe hydrogeologist qualifications and well rehabilitation experience for potable water and related past projects performed successfully.
- Identify and describe drilling company’s qualifications and well rehabilitation experience for potable water and related past projects performed successfully.
- Identify availability of key personnel to work on this project.
- Identify other staff members and/or subcontractors that will contribute to the project, and their relevant experience.

**Approach and Schedule** –
- Describe your company’s approach to the rehabilitation of Source 6.
• Include a proposed work schedule for rehabilitation of Source 6 including the timing of various key tasks.

Understanding of Project Components –
• Identify objectives/tasks that you feel are key to the success of the project; this may include items not already identified in this Request for Qualifications. References for protocols and methods are encouraged.

Quality Control –
• Describe the standards and methods used by the company to assure useful quality deliverables of this nature to the client.
• Describe how your firm will address concerns or deficiencies in quality control and deliverables and give a specific example.

References –
• Provide descriptions and references for five comparable projects that your company has previously performed. Include contact names, company/agency and telephone numbers for each.
• Identify key personnel listed on this project who has worked on the reference project.

SELECTION PROCESS
Several Public Works staff members will review all SOQs. Each staff member on the evaluation panel will rate the criteria on a scale from 1 to 5 (Poor, Below Average, Average, Above Average, and Excellent), and scores will be added to help determine the most qualified consultants.
SOQs will be rated based on the following criteria:
• Company Experience – 30%
• Key Personnel/Past Performance – 25%
• Approach and Schedule – 20%
• Understanding of Project Components – 20%
• QA/QC Procedures – 5%
  ▪ Points may be deducted for SOQs that do not follow “SOQ FORMAT”.

Staff members may choose a short list of qualified consultants who will be invited to make a presentation to the evaluation panel. Presentations, if needed, will be arranged in December 2018. Based on the SOQs and/or interviews/presentations, the selection panel will choose the company which, in its opinion, best meets the requirements set forth in this Request for Qualifications and negotiate a consultant agreement.

INTENDED SELECTION SCHEDULE
SOQs due 5:00 p.m., Friday, November 30, 2018
Interviews (if needed) December 2018
Negotiations with Finalist December 2018
Signed Contract End of January 2019
SOURCE 6 LOCATION:
### SOURCE 6 INFORMATION:

The following table summarizes the most recent compliance sampling of Source 6.

<table>
<thead>
<tr>
<th>Date</th>
<th>Test</th>
<th>Measurement</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/11/2018</td>
<td>Alkalinity</td>
<td>81</td>
<td>mg/L CaCO3</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Antimony</td>
<td>&lt; 0.003</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Arsenic</td>
<td>&lt; 0.001</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Barium</td>
<td>&lt; 0.1</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Beryllium</td>
<td>&lt; 0.0003</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Cadmium</td>
<td>&lt; 0.001</td>
<td>mg/L</td>
</tr>
<tr>
<td>4/11/2018</td>
<td>Calcium</td>
<td>49</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Chloride</td>
<td>5</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Chromium</td>
<td>&lt; 0.007</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Color</td>
<td>&lt; 5</td>
<td>color unit</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Conductivity</td>
<td>181</td>
<td>umhos/cm</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Copper</td>
<td>&lt; 0.02</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Cyanide</td>
<td>&lt; 0.01</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Fluoride</td>
<td>&lt; 0.2</td>
<td>mg/L</td>
</tr>
<tr>
<td>6/29/2016</td>
<td>Gross alpha</td>
<td>ND</td>
<td>pCi/l</td>
</tr>
<tr>
<td>10/23/2017</td>
<td>Hardness</td>
<td>79</td>
<td>mg/L</td>
</tr>
<tr>
<td>4/11/2018</td>
<td>HPC</td>
<td>13</td>
<td>col/mL</td>
</tr>
<tr>
<td>1/29/2018</td>
<td>Iron</td>
<td>&lt; 0.05</td>
<td>mg/L</td>
</tr>
<tr>
<td>7/27/2017</td>
<td>Lead</td>
<td>&lt; 0.001</td>
<td>mg/L</td>
</tr>
<tr>
<td>1/29/2018</td>
<td>Manganese</td>
<td>&lt; 0.01</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Mercury</td>
<td>&lt; 0.0002</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Nickel</td>
<td>&lt; 0.005</td>
<td>mg/L</td>
</tr>
<tr>
<td>4/11/2018</td>
<td>Nitrate-N</td>
<td>1.4</td>
<td>mg/L</td>
</tr>
<tr>
<td>6/29/2016</td>
<td>Radium 228</td>
<td>ND</td>
<td>pCi/l</td>
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<tr>
<td>5/10/2017</td>
<td>Selenium</td>
<td>&lt; 0.002</td>
<td>mg/L</td>
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<tr>
<td>5/10/2017</td>
<td>Silver</td>
<td>&lt; 0.01</td>
<td>mg/L</td>
</tr>
<tr>
<td>9/7/2016</td>
<td>SOC/herb 515.1</td>
<td>ND</td>
<td>ug/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Sodium</td>
<td>8</td>
<td>mg/L</td>
</tr>
<tr>
<td>4/11/2018</td>
<td>Sulfate</td>
<td>13</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Thallium</td>
<td>&lt; 0.001</td>
<td>mg/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Turbidity</td>
<td>0.1</td>
<td>NTU</td>
</tr>
<tr>
<td>9/7/2016</td>
<td>VOCs 524.2</td>
<td>ND</td>
<td>ug/L</td>
</tr>
<tr>
<td>5/10/2017</td>
<td>Zinc</td>
<td>&lt; 0.2</td>
<td>mg/L</td>
</tr>
</tbody>
</table>

Average pH for 2017/2018 is 6.82

The following 6 pages are from Appendix F of the City of Lacey Water System Comprehensive Plan (February 2013).
Well S06  
(Judd Hill)

**Facility Information**

<table>
<thead>
<tr>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source #</td>
<td>S06</td>
</tr>
<tr>
<td>Address</td>
<td>2400 Judd St. SE</td>
</tr>
<tr>
<td>Year On-Line</td>
<td>1993</td>
</tr>
<tr>
<td>Pressure Zone</td>
<td>337</td>
</tr>
<tr>
<td>Floor Elevation</td>
<td>235.51</td>
</tr>
<tr>
<td>Housing</td>
<td>CMU</td>
</tr>
<tr>
<td>Pump Type</td>
<td>Submersible</td>
</tr>
<tr>
<td>Pump Model</td>
<td>Peerless 8LB - 3 Stage</td>
</tr>
<tr>
<td>Pump Shaft Diameter (in)</td>
<td>N/A</td>
</tr>
<tr>
<td>Column Diameter/Length</td>
<td>6&quot; column, 168'</td>
</tr>
<tr>
<td>Pump Serial #</td>
<td>N/A</td>
</tr>
<tr>
<td>Pump Depth (ft)</td>
<td>168</td>
</tr>
<tr>
<td>Pump Capacity (gpm)</td>
<td>600</td>
</tr>
<tr>
<td>Motor Model</td>
<td>Hitachi</td>
</tr>
<tr>
<td>Motor Serial #</td>
<td>N/A</td>
</tr>
<tr>
<td>Motor Speed (rpm)</td>
<td>3470</td>
</tr>
<tr>
<td>Horsepower</td>
<td>75</td>
</tr>
<tr>
<td>Casing Diameter (in)</td>
<td>16</td>
</tr>
<tr>
<td>Well Depth (ft)</td>
<td>385</td>
</tr>
<tr>
<td>Casing Depth (ft)</td>
<td>190</td>
</tr>
<tr>
<td>Screen</td>
<td>10-inch: 40-slot (190-200, 223-238 ft), 60-slot (325-340, 352-367, 375-380 ft)</td>
</tr>
<tr>
<td>Screen Capacity (gpm)</td>
<td>1850</td>
</tr>
<tr>
<td>Aquifer</td>
<td>Qpg - TQu</td>
</tr>
<tr>
<td>Control Valves</td>
<td>4&quot; 61G-21AB 8&quot; 92G-02BD 2-1/2&quot; 50G-01BD 8&quot; 136EG-03ABCS</td>
</tr>
<tr>
<td>PSV Setting</td>
<td>100 psi @ 530gpm</td>
</tr>
<tr>
<td>PRV Setting (psi)</td>
<td>60</td>
</tr>
<tr>
<td>Flow to Waste Setting</td>
<td>123 psi @ 220gpm</td>
</tr>
<tr>
<td>Flow to Waste Duration (sec)</td>
<td>120</td>
</tr>
<tr>
<td>Well Capacity (gpm)</td>
<td>550</td>
</tr>
<tr>
<td>Chlorine Dose (mg/L)</td>
<td>N/A</td>
</tr>
<tr>
<td>Reliable Capacity (gpm)</td>
<td>400</td>
</tr>
<tr>
<td>Notes</td>
<td>Declining specific capacity, frequent low aquifer alarms.</td>
</tr>
</tbody>
</table>
**WATER WELL REPORT**

**STATE OF WASHINGTON**

**OWNER:** Name: City of Lacey  
Address:  

**LOCATION OF WELL:**  
County: Thurston  
Location: NW SW Sec. 21 T. 18 N. R. 1 W.  

**STREET ADDRESS OF WELL (or nearest address):**  
Corner of Judd St. and 23rd Ave SE  

**PROPOSED USE:**  
- Domestic  
- Irrigation  
- Industrial  
- Municipal [X]  

**TYPE OF WORK:**  
- Owner's number of well (if more than one): [X]  
- Method: Dug  
- Deepened  
- Reclassified  
- Rotary [X]  
- Other [X]  

**DIMENSIONS:**  
- Diameter of well: 16 inches  
- Drilled depth: 403 feet  
- Depth of completed well: 195 feet  

**CONSTRUCTION DETAILS:**  
- Casing installed: 16 ft.  
- Welded [X]  
- Liner installed: Diam. ft.  
- Threaded [X]  
- Perforations: Yes [X]  
- Type of perforator used:  
  - Perforations from:  
  - In. ft. to:  
  - In. ft.  
- Screens: Yes [X]  
- Manufacturer's Name: Johnson  
- Type 304  
- Diameter from:  
  - Diam. 60 ft. to:  
  - Diam. 223 ft. to:  
- Gravel packed: Yes [X]  
- Size of gravel:  
- Gravel placed from:  
- Ft. to:  
- Surface seal: Yes [X]  
- To what depth? 20 ft.  
- Material used in seal:  
- Did any strata contain unusable water? Yes [X]  
- Type of water:  
- Depth of strata:  
- Method of sealing strata off:  

**PUMP:**  
- Manufacturer's Name: [H.P.]  

**WATER LEVELS:**  
- Static level: 9.5 ft. below top of well  
- Date:  
- Artesian pressure: psig per square inch  
- Date:  
- Artesian water is controlled by:  
- Date:  

**WELL TESTS:**  
- Drawdown is amount of water level is lowered below static level  
- Was a pump test made? Yes [X]  
- Yield: 630 gal. min. with 57 ft. drawdown after 24 hrs.  
- Recovery date (time taken to zero when pump turned off) (water level measured from well to top level): 
  - Date:  
  - Water Level:  
  - Time:  
  - Water Level:  
  - Time:  
  - Water Level:  

**WELL CONSTRUCTOR CERTIFICATION:**  
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to the best knowledge and belief.  

**NAME:** Holt Drilling Inc  
**Address:** 10621 Todd Rd E  
**License No.:** 1099  
**Registration No.:**  
**Contractor's License No.:** 1260  
**Date of Completion:** 4-2  
**Signed by:** [Signature]  
**License No.:** 1099  
**Date:** 10-1  

**USE ADDITIONAL SHEETS IF NECESSARY**
Geologic Log

Depth in Feet

Ground Surface Elevation in Feet 234.6

0

Brown, silty SAND (TOPSOIL).

10

Gray to brown, gravelly SAND.

20

Cobbles.

30

50

Gray to brown, fine to medium SAND.

60

Gray to brown, very gravelly SAND.

70

Slightly gravelly, fine to medium SAND.

80

Brown, slightly silty to silty, medium to fine SAND.

90

As above, saturated.

100

Brown, very gravelly, fine to medium SAND.

110

Brown, very sandy GRAVEL with cobbles.

120

Gravel content decreases.
Very gravelly SAND with cobbles.

140

Brown, gravelly SAND with interbedded SILT.

150

Well Design
Top Casing Elevation in Feet 236.07
Casing Stickup in Feet 1.5

Sample Lab

20-inch ø Bentonite GROUT Surface Seal

16-inch ø steel casing

Locking cap

J-2111 August 1988
HART-CROWSER & associates, inc.
Sheet 1 of 3 Figure A-2
Boring Log and Construction Data for Judd Hill Well 6C

Geologic Log

Ground Surface Elevation in Feet 234.6

150
Brown, gravelly SAND with interbedded SILT.

160
Brown, slightly gravelly SAND.

170
Gray to brown, medium to fine SAND with SILT laminae from 167 to 170 feet.

180
Gray to brown, gravelly SAND.

Gravel content decreases.
Trace SILT.

190
Gray to brown, very gravelly SAND.

200
Gravel content decreases.
Fine to medium SAND.

210
Gray to brown, gravelly, fine to medium SAND.

220
Gravel content increases.
Very gravelly SAND.

230
Brown, medium to fine SAND.

240

250

260

270
Gravel content increases slightly.
Gravelly SAND.
Wood/peat fragments.

280
Gray, very silty SAND to sandy SILT.

290
Brown to gray, wet SAND.
Iron stained sand nodules.
Slightly silty.
Slightly gravelly.

300

Well Design
Top Casing Elevation in Feet 236.07
Casing Stickup in Feet 1.5

16-inch @ steel casing
10-foot, 40 slot
10-inch @ pipe size
stainless steel
Johnson well screen

10-inch @ steel pipe
10-foot, 40 slot
10-inch @ pipe size
stainless steel
Johnson well screen

10-inch @ steel pipe
10-inch @ steel pipe

Northwest Filter
4-10 sand

J-2111 August 1988
HART-CROWSER & associates, inc.
Sheet 2 of 3 Figure A-2
# Boring Log and Construction Data for Judd Hill Well 6C

## Geologic Log

<table>
<thead>
<tr>
<th>Depth in Feet</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>Ground Surface Elevation in Feet 224.6</td>
</tr>
<tr>
<td>310</td>
<td>Brown to gray, wet SAND.</td>
</tr>
<tr>
<td>320</td>
<td>Trace wood fragments.</td>
</tr>
<tr>
<td>330</td>
<td>Gray, slightly gravelly SAND.</td>
</tr>
<tr>
<td>340</td>
<td>Gray, silty, medium SAND.</td>
</tr>
<tr>
<td>350</td>
<td>Gray to brown, gravelly SAND.</td>
</tr>
<tr>
<td>360</td>
<td>Trace SILT.</td>
</tr>
<tr>
<td>370</td>
<td>Gravel content increases. Trace SILT.</td>
</tr>
<tr>
<td>380</td>
<td>Interbedded SILT laminae from 343 to 350 feet.</td>
</tr>
<tr>
<td>390</td>
<td>Few cobbles. Trace SILT. Trace SILT. Gray to brown, very sandy GRAVEL. Trace SILT. Brown, SAND with trace gravel. Brown, silty to slightly silty, gravelly SAND.</td>
</tr>
<tr>
<td>400</td>
<td>Bottom of Boring at 403 Feet. Completed 8/8/89</td>
</tr>
</tbody>
</table>

## Well Design

- Top Casing Elevation in Feet 236.07
- Casing Stickup in Feet 1.5

### Diagram Details:
- 10-inch ø steel pipe
- 15 feet,60 slot 10-inch ø pipe size, stainless steel Johnson well screen
- 10-inch ø steel pipe
- 5 feet,60 slot 10-inch ø pipe size, stainless steel Johnson well screen
- 10-inch ø steel pipe
- Bottom of screen assembly at 317.5
- Northwest Filter 4-10 sand

### Notes:
1. Soil description for samples collected between 0 and 128 feet and in a few cases, at other intervals, are based on samples obtained by Holt Drilling. Depths of changes in soil types represent our interpretation of the driller's log. At other depths soil descriptions were interpreted by our office field personnel from soil samples.
2. Water Level 2 is for data indicated and may vary with time of year.
3. B.T. indicates Ball Test.
4. GS indicates a laboratory mechanical grain size analysis was performed on sample.