

Understanding:

The City of Longview and the Beacon Hill Water and Sewer District (BHWSO) (jointly referred to as City), developed a new water drinking water supply between 2011 and 2013, changing the source water from the Cowlitz River surface water supply to the Mint Farm Groundwater Source. In January 2013, construction was completed of the new groundwater source, and the change of source was initiated. Chemistry changes and directional flow changes from the new source caused spotting/scale and taste, odor, and color (T&O/Color) issues resulted in a significant number of complaints from the customers.

In September 2014, the City retained CH2M to assist with a community outreach and water supply evaluation process/study. This work was recently completed, and the City decided, based on community recommendation, to proceed with an evaluation to determine potential water quality and water supply yield by using a horizontal collector well(s) along the banks of the Cowlitz River with the intent to replace the Mint Farm water supply. At present the City desires to investigate three possible well sites generally identified as:

- North Lexington
- South Lexington
- Fisher's Lane Water Treatment Plant

The goal of this feasibility study is to assess the ability of a future collector well(s) to provide the desired potable water source. This feasibility assessment will provide information to determine the appropriate location and available quantity of the future collector well(s) necessary to meet the water supply needs. This work will entail field drilling of exploratory test wells, field and laboratory water quality assessments, and engineering analysis for potential well locations along the Cowlitz River at points ranging from Longview to Lexington.

The field and engineering analysis is divided into three separate activities, with the scope of work for each ensuing activity based on the previous activity. The work tasks have been designed to incrementally develop site-specific data necessary to evaluate the feasibility of developing a water supply along the Cowlitz River, with higher costs incurred for the later tasks to provide greater certainty that quality and yield can be met. The scope of work includes exploratory drilling to assess the sites, followed by one detailed large aquifer test at the preferred site, with the option to include a detailed aquifer test at a second site as requested and approved by the City. Underground investigations are each unique and a multitude of variables exist that can impact project direction. This scope of work is presented with optional tasks to allow further investigations should the field and laboratory test results differ from the anticipated results. In this fashion, the City is able to maintain cost control as the project proceeds and information is received.

Based on the water quality results, the work also includes determining an appropriate water treatment process (without having the data to confirm/deny riverbank filtration is an option) and

the ability to utilize either the Fishers Lane Water Treatment Plant, or the Mint Farm Water Treatment Plant to provide treatment for potable water to the City.

To adequately obtain the community's ideas and thoughts on the future of drinking water for the City and BHWSD, it is proposed to continue the public outreach and involvement activities in tandem with the technical and field evaluation process. This includes reconvening members of the Citizens Advisory Committee (CAC) to review the test results and make recommendations regarding continued investigation of the Cowlitz River horizontal collector option. The work also includes other outreach activities to inform and obtain input from the community at-large regarding the study results.

This scope of work is provided in six distinct tasks as outlined below; Tasks 1, 2 and 3 were included in the original Water Supply Review scope of work:

- **Task 4** – Exploratory Test Drilling – Three Potential Sites
- **Task 5** – Aquifer Testing – One Site
- **Task 6** – Engineering Analysis and Preliminary Design
- **Task 7** - Community Outreach and Involvement
- **Task 8** - Project Management
- **Task 9** – Optional Aquifer Testing – Second Site

Details of these six tasks are described below. Note that Task 9 is an Optional Task, to be conducted only upon City written authorization to proceed.

Task 4: Exploratory Test Drilling – Three Potential Sites

The primary objective of this Task is to locate a potential site for a collector well supply by evaluating the horizontal and vertical variability of the aquifer through initial field testing. Task 4 results will be used to support Task 5 aquifer testing to refine the location for a collector well(s).

Task 4A – Document Review, Access, Permitting and Water Rights

Collect and review existing studies and documentation to develop the drilling program.

Literature Review:

To commence the work, a literature study will be conducted to review the existing information and hydrogeological data to identify existing information that can be utilized in the study. This will include the following:

- Logs and drilling reports for existing supply and monitoring wells
- Pumping test data
- Geotechnical and engineering data
- Published maps and geologic reports
- Reports and data on file with state or local agencies
- Aerial photography and images
- Other information that pertains to the areas of interest.

Property Access/Permission:

Of the three potential sites for exploratory drilling, one of them is owned by the City. The other sites will require right of access to allow for the drilling programs defined in Tasks 4, 5 and 9. The City will lead the negotiations to obtain the right to access the properties. CH2M will support the City with details of drilling activities to provide to the property owners with the impacts on the property for the disturbance.

Permitting:

Permitting will be required for drilling wells as required by the Department of Ecology in the form of drilling start cards. CH2M will prepare the start cards for the project. Permitting may be necessary for well water discharge to the river, or drilling in/near the dike along the Cowlitz River. Any permitting associated with the drilling, other than the start cards, will be led by the City and supported by CH2M with materials describing the work to be performed.

Water Rights

The City will lead the negotiations/discussion with the Department of Ecology to determine process and constraints associated with water rights adjustments that would be necessary to develop a collector well along the Cowlitz River.

Task 4B – Exploratory Well Drilling and Quantity Testing

Following the work completed on Task 4A, the project will move to drilling, sampling, and testing exploratory borings/observation wells at three sites along the Cowlitz River, as approved by the City.

Drilling/Well Completion:

Exploratory drilling at three locations is proposed to identify the most promising locations for further aquifer testing. The drilling will be directed by a hydrogeologist experienced in collector well evaluations who will make necessary decisions as to boring depth and hydraulic interval testing. The test borings will be 6-inch diameter and drilled using rotasonic drilling methods. Lithologic samples will be obtained every five (5) feet and at each change in formation materials from the ground surface to the completion depth.

Borings will be advanced to approximately 60 feet below grade. Sieve analyses will be performed on selected lithologic samples collected from the test borings to determine optimum well screen design for the Task 5 aquifer test well, and to help evaluate hydraulic conductivity. Upon completion of the task, all samples not selected for sieve analysis will be delivered to the City for retention.

Hydraulic interval testing will be conducted at each exploratory boring. It is anticipated that one test will be conducted at each boring (in some cases, more than one zone may be designated for testing). The testing will be conducted to estimate the hydraulic conductivity of the selected intervals. The interval(s) to be tested will be selected by the hydrogeologist on the basis of the drilling and sampling results. Upon reaching the total completion depth of each test boring, a PVC screen will be installed and the casing will be pulled back to reveal the screen in the selected interval. The well screen should be greater than 10-feet long so that when the casing is pulled back, up to 10-feet of well screen can be exposed to the aquifer.

Well Development:

Development of the test interval will be accomplished by pumping, bailing and/or air lifting until the water produced is visibly clear and contains little or no sediment. Development time shall be approximately two (2) hours. Response of the well to development pumping will be noted so that pumping rates for the hydraulic interval testing can be estimated.

Test Pumping:

The test boring will be equipped with a temporary pump capable of pumping a maximum of 100 gallons per minute (gpm). Suitable equipment such as an in-line flow meter or free-discharge orifice will be used to accurately determine the pumping rate. The selected interval will be pumped for a minimum of two (2) hours. The pumping period will be divided into four (4) steps of at least thirty (30) minutes duration. During each step, the pumping will be maintained at a constant rate. The pumping rate will be varied between steps so the steps are run at approximately 25%, 50%, 75% and 90% of the maximum achievable pumping rate. The pumping rate should be adjusted and stabilized as quickly as possible between steps.

Depths to water will be measured to the nearest 0.01 foot in the test boring prior to and during the pumping period. The elapsed time of pumping to the nearest minute and the pumping rate

associated with each water level measurement will be recorded. During each step of the pumping period, water level measurements in the test boring will be made on the following schedule:

- Every 1 minute for 0 to 6 minutes from the start of the step;
- Every 2 minutes for 6 to 12 minutes from the start of the step;
- Every 5 minutes starting at 15 minutes from the start of the step.

At the end of the test pumping period, water levels in the test boring will be monitored for a minimum of 30 minutes of recovery on the same schedule specified for the pumping period.

Well Abandonment:

Following completion of the interval sampling, and after decisions of where additional aquifer testing may be performed, the test borings will be abandoned in accordance with state regulations if not converted to temporary 2-inch ID PVC Observation wells for support of Task 5 activities.

Water Quality Sampling and Analysis:

During the test pumping, water quality samples will be monitored in the field for pH, conductivity, iron, hardness and temperature. During the pumping test, water samples for screening water quality will be collected by CH2M near the end of the test. Samples will be collected for laboratory analysis of general water quality parameters, otherwise known as Primary/Secondary Inorganic Chemicals and National Secondary Drinking Water Chemicals, and the following specific parameters of interest:

- Dissolved Oxygen
- Oxygen Reduction Potential
- Dissolved Silica
- Hydrogen Sulfide
- Hardness

The City will pay direct, the costs of the laboratory analysis.

Task 5: Detailed Aquifer Testing

Should results of the exploratory test drilling program (Task 4) at one or more sites prove favorable, Task 5 - Aquifer Testing at one preferred site will be conducted to further evaluate aquifer properties for potential development of a collector well(s).

After completing the exploratory wells testing, analysis and report, combined with CAC and City review, one location will be selected for the following detailed aquifer testing:

- Installation of up to 3 additional observation wells
- Installation/development of a temporary test pumping well
- Installation of test pumping equipment and discharge line
- Installation of a river staff gage
- Running a 4-hour multiple-rate step drawdown test
- Conducting a 72-hour constant-rate test

Task 5 of the investigation includes the following:

Installation of Additional Observation Wells:

Additional observation wells will be located in a pattern as needed to compute aquifer parameters and the permeability of the riverbed (conductance) as a part of the aquifer testing program. It is anticipated that three (3) additional observation wells will be required at the test sites. Lithologic samples will be obtained every five (5) feet and at each change in formation materials from the ground surface to the well completion depth. Sieve or gradation analyses will be performed on up to five lithologic samples collected from each of the observation well borings of the unconsolidated aquifer material in order to better characterize the nature of the aquifer materials.

Following completion of drilling and sampling, each boring will be converted to a 2-inch ID PVC piezometer equipped with a slotted screen placed in the lower portion of the formation, starting about 10 feet below the top of the aquifer interval. Following installation, the well will be developed to assure openness to the aquifer. Drill depths will be based upon conditions encountered. For estimating purposes, drill depths are estimated at 60 feet.

Test Pumping Well Installation:

During the installation of the observation wells, a 10 to 12-inch diameter temporary pump test well will be drilled. The well will be equipped with 30 to 40 feet of continuous-slot wire-wound well screen. The screen slot size selected will be dependent upon grain size distribution of the exploratory well and the adjacent observation wells. Following installation, the well will be thoroughly developed using surging and air lift techniques and equipped with a pump capable of producing a minimum of 500 gpm for the long term test.

Following installation of the wells and a staff gauge in the Cowlitz River to measure river stage, the necessary piping and controls will be installed at the test pumping well. Discharge from the pump will be measured using a circular free-discharge pipe orifice weir with water conveyed to the river or a suitable distance away from the well, with the necessary controls to minimize erosion and recharge of the aquifer during the test.

Aquifer Testing:

Aquifer testing will consist of an initial 4-hour multiple-rate step test and then a 3-day (72-hour) constant-rate pumping test complete with groundwater and river level monitoring for each site. The length of the test may be extended if steady state or equilibrium conditions are not achieved within 72 hours of constant-rate pumping. The pumping rate of the test well will be selected to maximize the pumping rate without dewatering the test production well during the testing period.

Testing will be supervised by a hydrogeologist experienced with conducting aquifer testing. During testing, water levels in the wells will be monitored continuously using a computer assisted data acquisition unit which utilizes pressure transducers (e.g. In-Situ 3000). The water level in the Cowlitz River will also be monitored during the test. Water levels will be measured and monitored to the nearest 0.01 foot. Elevation control and location of all wells, borings, and measuring points would be surveyed for location maps and potentiometric surface mapping. Testing will be conducted as follows:

- A background water level monitoring period (approximately 1 day).
- An four-hour multiple rate step drawdown test
- A recovery/background period (at least 16 hours)
- A 72-hour constant rate pumping test.
- A 2-day recovery period.

Following the pumping tests, the piezometers and the test pumping well may be left in place and secured, either by welding a steel plate on top of the casing or by using a locking well cap to prevent unauthorized access, so the wells can be used during subsequent construction or long term monitoring as necessary. Piezometers and wells no longer needed for monitoring or that are in locations that will be disturbed during future construction activities will be abandoned. The wells will be abandoned according to the appropriate regulations.

Water Quality Sampling and Analysis:

A series of water samples will be collected from the test well to evaluate changes in the water chemistry. A set of water samples will be collected from the test well at selected intervals to evaluate preliminary water quality. During the pumping period, temperature of the pumped discharge and the Cowlitz River will be periodically measured using a hand-held thermometer. Near the end of the 72-hour pump test, CH2M will collect water samples for laboratory analysis of the City's Tier 1, Tier 2 and 3 analyte testing list, and the National Secondary Contaminant list with addition of:

- Dissolved Oxygen
- Oxygen Reduction Potential
- Dissolved Silica
- Hydrogen Sulfide
- Paraquat
- Methyl Mercury

. The City will pay direct the cost of the analysis performed by the laboratory.

Task 6: Engineering Analysis and Conceptual Design

Engineering analysis includes both well/aquifer testing analysis and reporting, and conceptual design for a collector well source. Three reports will be prepared. The first report will provide results of the exploratory well drilling work and recommendations for the selection of sites of the Aquifer Testing (Task 5). The second report will provide the results of the Aquifer Testing, with information as to the yield and quality of water and a recommendation regarding collector well site(s). The third report will be a conceptual design of a collector water supply, including site development, conveyance, and treatment.

Task 6A Well Testing Data Analysis and Reporting

Data collected from Tasks 4 and 5 will be evaluated and included in a report on aquifer properties, aquifer yield, and preliminary well design. Estimates will be prepared for anticipated collector well yields considering both average conditions and low, winter conditions that may be expected. These yield computations typically consider anticipated river/ground water levels and water temperatures, among other criteria.

Report 1 – Exploratory Well Report

A first report will be prepared indicating the results of the exploratory well drilling, water quality analysis, and recommendations of the sites for proceeding with the aquifer testing program. All pertinent field and water quality data collected during the project will be organized and appended to the report. This report will be provided to City Staff as a draft report, then incorporating comments, and preparing the final report for submission to the Customer Advisory Committee, Beacon Hill Water and Sewer District, and the City Council.

Report 2 – Aquifer Testing Report

The second report will provide the results of the aquifer pump testing and water quality testing, and will include additional recommendations on location and number of collector wells. This report will be provided to City Staff as a draft report, then incorporating comments, and preparing the final report for submission to the Customer Advisory Committee, Beacon Hill Water and Sewer District, and the City Council.

This report will include recommendations concerning well spacing and preferred locations necessary to future water supply demands, and a preliminary collector well design including caisson depths, number of laterals, orientation, screen diameters, screen slot openings and screen placement and lengths.

Task 6B – Engineering Conceptual Design

Conceptual Design will provide the next level of planning description and cost estimating for a collector water supply source located near the Cowlitz River. This effort will include conceptual design level development of the raw water supply, pumping systems, conveyance and treatment. The deliverable for this report will be a written description of the facilities, site diagram(s) of the supply and conveyance facilities, and the ability to utilize the existing treatment facilities. Updated cost estimates will also be provided.

Task 7 – Community Outreach and Involvement

In the City’s desire of ensuring public transparency, information dissemination, and obtaining input from the community during the feasibility evaluation of moving to a new water source, it is important to continue with the community outreach and involvement program.

To maintain the continuity of communications and transparency during the feasibility study, the following activities will be conducted:

Task 7A: Facilitate the Customer Advisory Committee (CAC)

Reconvene the CAC and facilitate two meetings.

We will reach out to the existing CAC members to identify their interest in continued participation in two meetings during this next phase of the feasibility study. These meetings will be intended as informational check-in points for the committee to attend, ask questions, and provide input. These meetings will be open to the public and will provide the opportunity for a public comment period.

Meetings will likely be held in January and April 2016, pending the field testing and laboratory analysis.

- **Meeting 1 –**
 - Provide a project update on the exploratory test drilling and water quality testing at the testing locations.
 - Present two preferred locations for further testing, and reasons why
 - Next steps and City Council presentation.
- **Meeting 2 –**
 - Present findings of the Aquifer Test and water quality test results for the preferred collector well location and capacity.
 - Next steps, including public open house and City Council presentation.

Meetings will be documented and meeting minutes will be shared publicly via the project website.

Task 7B: Public Communications and Outreach

Public access to water supply information and study findings are central to addressing the community conversation and concerns, and for building a problem-solving context for the study. Online communication is the spine of the public communications component for this project. It allows open and complete access to even the most detailed project information. In addition, we will hold a public open house following the second public meeting of the CAC.

- **Web presence** – CH2M will continue to maintain and update the content of the existing project website. The website will be transferred to the City at the end of the study process.
- **Fact sheets and FAQ’s** – Create and distribute one hard copy project informational piece for posting to the website, countertop distribution, and use at the public open house and at CAC meetings.

- **Stakeholder E-mail list** – CH2M will continue to maintain the project stakeholder e-mail list and send up to 2 project notifications. CH2M will deliver the contact list to the City following the commencement of the study.
- **Public open house** – A face-to-face open house will be held prior to a City and Beacon Hill Water and Sewer District decision on the feasibility study results, to provide an opportunity for the public to receive information on the study and provide input. CH2M will develop and create the open house materials. The City will provide the venue for the event.

Task 8: Project Management

General Project Management

Project management will be ongoing throughout the duration of the project (assumed to be 7 months) as we work closely with the City to ensure the study meets the desired schedule, budget, and technical requirements. We will manage all components of the study, taking a proactive role in keeping the study on schedule.

We will prepare a Microsoft Project schedule and keep it updated as the study proceeds to keep the City abreast of the timeline. The project manager will also coordinate the team members and with the City representative throughout the study.

Monthly invoices will be provided, tracking the expenditures against the budget. The monthly updated schedule will be updated and provided with the invoice and baseline schedule.

Overall project management of the Consultant team members will be the responsibility of CH2M which includes coordinating and communicating with the team members to ensure the project team is meeting scope, schedule, and budget.

Task 9: Optional Alternative Task

Aquifer Testing and Reporting – Second Site

The base scope of work (Tasks 4 through 8) includes a single detailed aquifer test. As with any subsurface investigation, variables and unknowns exist which may prompt an additional detailed aquifer test at a second location. With the testing of the second site included as an optional task, the City can control the exploratory costs, only approving additional testing as warranted and desired.

This task includes conducting a second detailed aquifer test (as defined in Task 5) at a second location, and would include analysis and reporting as defined in the second report under Task 6.

This work would be conducted after the first aquifer test was completed, and analysis indicated further field work is recommended to analyze a second site.

This work would only be conducted as approved by written authorization of the City.

Should this optional task be conducted, the schedule for completion would incur a delay.

Project Schedule

A schedule is presented on the following page for identifying the study elements and completion. Major milestones identified in the schedule include:

- Oct 14, 2015 – Notice to Proceed
- Nov 02, 2015 – Begin drilling exploratory test wells
- Dec 22, 2015 – Publish Exploratory Well Report
- Jan 5, 2016 – CAC Meeting 1
- Jan 28, 2016 – City Council Update
- Feb 11, 2016 – Begin detailed aquifer testing
- Apr 20, 2016 – Publish Aquifer Test Report
- Apr 27, 2016 – CAC Meeting 2
- May 04, 2016 – Open House
- May 19, 2016 – Joint Council / BHWSD Workshop
- June 9, 2016 – City Council Decision