MEETING SUMMARY

Updated Groundwater Study Report
Black Canyon Hydroelectric Project (P-14110)

June 23, 2015

Time: 1:00 PM to 3:00PM

Location: Snoqualmie City Hall
38624 SE River St.
Snoqualmie, WA 98065

Meeting Agenda:

Provide a summary overview of the Second Year Updated Groundwater Study Report.

Presenters:

Chris Spens, Licensing Manager for Black Canyon Hydro, LLC
Laura Strauss, LG, LHg, Principal, Northwest Land & Water, Inc.

FERC Staff Present:

Kim Nguyen, Project Manager
Tony Rana, Hydrogeologist

Supporting Information:

Previously Filed Second Year Updated Groundwater Study Report
Updated Groundwater Study Report Power Point Slides as a PDF Doc
Isotope Study Power Point Slides as a PDF Doc
Sign-In Sheet as a PDF

Meeting Summary:

The meeting started with an overview of the study objectives as follows:

- Define the Hydraulic Groundwater-Surface Water Interaction (Connectivity) between the North Fork Snoqualmie River and the

Canyon Springs Aquifer.
- Characterize the Geochemical Connectivity of the North Fork Snoqualmie River and Canyon Springs Aquifer.
- Identify the Losing and Gaining Sections of the North Fork Snoqualmie River and Quantify Seepage Loss along the Losing Sections.
- Quantify the Outflow Contribution of Canyon Springs to the North Fork Snoqualmie River.

The study utilized the following methods:

- Review prior geologic investigation records including area bore logs, USGS reports, geologic mapping and stratigraphic analysis.
- Perform field surveys of the river channel and adjacent lands. Analyze satellite/aerial survey photos, video and LIDAR information.
- Establish three new groundwater wells (Piezometers). Monitor water levels and take water samples for analysis.
- Complete geochemical isotope sampling and profiling to determine the potential exchange between water sources.
- Measure river discharge differential to determine loss or gain.
- Perform an evaluation of the Canyon Springs outflow.

Geology Study:

The results of geologic mapping and field surveys were presented in a series of Power Point (PP) slides #4-18. The results indicated that the majority of the Project area is comprised of glacial outwash materials on top of bedrock. In addition, the uppermost section of the bypassed river reach lies perched on top of a glacial till (hardpan) layer that inhibits water exchange between the river and the underlying strata. All but the uppermost section of the bypassed reach lies incised in bedrock. A map of the key findings is provided as slide #18 (Figure 23).

Piezometers:

Three Piezometers were established as shown in slides #19-24. The piezometer borings determined depth to bedrock, type of geologic strata encountered, depth to groundwater and change in groundwater depth over time. The combined drill logs and prior geologic mapping provided for the creation of estimated geologic cross sections through the intake site and through the Canyon Springs Aquifer Recharge Area. The key findings are that bedrock lies approximately 180 feet below the river at the intake site, that a groundwater lens of 39 to 52 feet in thickness lies on top of the bedrock at P2 and that there is a dry layer of outwash material over 100' thick between the river bottom and the top of the groundwater lens thereunder.

Isotope Analysis:

The objective of the isotope analysis was to:

- Use stable isotopes to identify if river is a significant source of water to City spring
- Characterize isotopic signature of groundwater, river water, spring water
- Identify difference or similarities, interpret

The general approach was to:

1. Collect samples
2. Analyze for routine chemistry and stable isotopes that occur in water (D/H; $^{18}O/^{16}O$)
3. Graph with meteoric water line
4. Evaluate/interpret; use in conjunction with hydrogeologic data

An explanation of the basis of the approach was explained and provided in slides #3-4 of the Isotope Power Point Presentation.

Sampling sites are shown in Isotope slide #5. Sampling dates are shown in slide #6. Ground elevation, depth of wells, depth to bedrock and elevation of the adjacent river section are shown in slide #7.

Results of the three isotope sampling events are shown in slides #8-10. The primary conclusion of the isotope sampling method is that the water coming from Canyon Springs and seeps is most like the water found in P2 near the intake, and the source of both is most likely low and intermediate elevation precipitation from the catchment areas shown in Isotope slide #11. There does not appear to be a significant contribution from the river to P2 or the Springs, although there may be some contribution.

Discharge Differential Measurement:

This method essentially compared the measured river discharge at the uppermost stream gage at the intake with another gage located approximately 2500 feet downstream. An acoustic doppler current profiler (ADCP) is used to measure discharge. The method is intended to determine whether a specific reach located between the two gages is either gaining or losing water to the surrounding riverbanks and bottom.

Discharge measurement occurred on three different dates. Results are shown on slides #28-29. The results are concluded as follows:

Overall there was much more scatter of the discharge data at an individual site on a single day than expected. The ADCP manufacturer (TRDI) reports repeated discharge measurements within 2% of the mean as an expected standard with a 1200 kHz Rio Grande. On only one site on one day did the discharges fall within this narrow range of accuracy. The transects are, at best, only a fair location for accurate discharge measurements due to the large and variable bed elements and complex flow patterns.

The direction of the velocity is generally complex across each of the transects. The eddies in the pool show multi directional velocities in both horizontal and vertical directions on each transect.

The method and equipment at the described locations were unable to differentiate a significant discharge difference.

Canyon Springs Outflow Measurement:

- The City withdraws between 0.5 and 1.2 cfs average monthly flow. There are occasional peaking periods that are greater during operational shifts from source to source.
- There are two spring box collectors with overflow pipes, but only one spring box has significant active overflow.
- Pipe overflow averaged about 1.0 to 1.2 cfs during periods of observation, roughly equivalent to the higher demand periods of City water withdrawal.
- In addition to the spring box outflow there are multiple hillside spring outbreaks along the approximately 600 ft long Canyon Springs traverse.
- The hillside springs vary in elevation by approximately 15-20 ft.
- Solely by visual estimation, there appears to be substantially more water flowing from all the hillside springs combined than there is from the overflow pipes during the periods of observation. Perhaps 3-5 times greater.
- The quantity of water exiting the hillside springs combined with the overflow from the pipes and the withdrawal of water by the City suggest a much larger area of aquifer contribution than previously considered.

Slides #32-41 depict conditions and findings at the Canyon Springs field site.

Results and Conclusions:

Based on aerial and ground field survey methods all but the uppermost 3500ft. of the Project bypassed river reach is incised in bedrock. From 3500ft. downstream of the Project Intake to approximately 1000ft. upstream of the Intake a glacial till/hardpan layer was observed on the west bank of the river, occasionally obscured by river bed load, hillslope talus or vegetation. The entire area upstream and east of the Intake site is comprised of glacial outwash materials overlaying bedrock. There are no active surface water courses noted crossing the valley from east to west toward the river south of Hancock Creek in this vicinity.

A groundwater lens 39ft-52ft. thick lies more than 100ft. below the river bed at Piezometer #2. The strata between the groundwater surface and the river bed elevation is dry.

Both surface and subsurface flow near the Intake site must pass through a narrow funnel constriction of bedrock as shown in (Slide 24). Isotope data collected to date strongly suggest that water discharging from Canyon Springs is recharged primarily from local precipitation and is not recharged to a significant degree by the river. However, the results do not definitively exclude any recharge from the river based on isotopic data alone.

At present, based on the available information, the areas shown in Appendix A, Exhibit 4 (Slide 44) are the area's most likely to contribute to groundwater recharge for Canyon Springs.

In Closing:

The City of Snoqualmie maintains a municipal water source at Canyon Springs. The Black Canyon Hydro Project bypassed reach of the NF Snoqualmie River lies adjacent to the aquifer recharge area. The river may provide *some* contribution to aquifer recharge, however that portion of the Project reach at a higher elevation than the springs lies in an incised bedrock canyon and also on a glacial till (hardpan) geologic contact. The river is predominantly isolated from the aquifer recharge area by subsurface geology.

The use of isotope studies indicate that the source of Canyon Springs is likely from local precipitation combined with groundwater originating as precipitation on the east side of the river and upslope thereof. The actual aquifer recharge area is perhaps 3x larger than originally considered. Project facilities will predominantly be located underground in bedrock. The Project is not likely to

have a significant adverse influence on the Canyon Springs water supply quantity, quality or delivery operations.

Question and Answer Period:

Pertinent Groundwater Study questions and answers are summarized here, they are *not* verbatim. A complete video recording is available of the entire meeting including the question and answer period upon request to BCH.

Q, unidentified audience- So that is to say there won't be any effect on the City's water supply?

A, Spens- We do not believe there will be any significant adverse impact on the City's groundwater supply as a result of the Project. One of the benefits of the study is finding that the area of contribution to the groundwater supply appears to be much larger.

Q, unidentified- How is it built? (the Project)

A, Spens- Description provided (same as in study report)

Q, unidentified-Will there be any building at the bottom of the project, at the tailrace?

A, Spens- Description provided (same as study report) all facilities except for access road will be underground. Access will likely be from North Fork Rd, across a previous logging road corridor across private property. Tunnel excavation materials may be trucked out or moved by conveyor system to North Fork Rd and then trucked to the north to existing forest road borrow pits.

Q, Matt Baerwald- Why those two sites for stream gaging (differential measurement)?

A, Spens-Upper site chosen because it represents upper limit of potential project and has been in place for a long period, therefore well calibrated. The downstream gage, the middle gage site, was chosen because that is the beginning of bedrock/hardpan contained channel. If it is going to leak anywhere it should be in this uppermost section.

Q, James Peterson- Where is the risk assessment for all the activity, roads and construction that is going to take place in the aquifer contribution area?

A, Spens- The groundwater study is one of many studies, perhaps 15, carried out to assess the potential environmental impacts of the project. The FERC scopes the studies, reviews the results, conditions the project with preventative requirements, including best management plans etc to ensure there will not be any adverse effects. The project will be heavily conditioned.

Q, Martin Tuip- What about seismic risk? That should be part of the groundwater assessment because that is the major risk.

A, Kim Nguyen- That was not part of the groundwater study.
A, Spens- We did do a preliminary geotechnical study to evaluate rock suitability. There are two other projects in the vicinity that we could look at to see what was required. FERC will ultimately decide what the study requirements will be.

Closing:

Citizens made a few additional inquiries about project construction, methods and techniques and other issues not related to the groundwater study. The meeting Ended at 3:00pm.

Attendees:

See Sign-In Sheet included herein