Peace Project Water Use Plan

Williston Reservoir Trial Tributaries

Implementation Year 5

Reference: GMSWORKS-19

Ole Creek 2016 Engineering Inspection Report

Study Period: 2016

KERR WOOD LEIDAL

May 14, 2018
Site Inspection Report

PROJECT: WILLISTON TRIAL TRIBUTARIES POST-CONSTRUCTION MONITORING

CLIENT: BC Hydro

TO: Shelley Wennas, PMP

SITE NAME: Ole Creek

REPORT DATE: May 14, 2018

FILE NO.: BC Hydro Contract 00093683 & KWL File: 0478.189

PREPARED BY: Stefan Joyce, P.Eng ON SITE

DATE: May 4 & 5, 2016 WEATHER

May 4: Cloudy with sunny breaks, some light rain
May 5: Sunny and windy

TAILGATE MEETING NOTES Reviewed hazards, risks, game plan for day and check-in schedule. Confirmed safety gear and equipment. {Used in this form in lieu of KWL “Appendix B04-Tailgate Meeting”}

KWL STAFF

Stefan Joyce [Original hardcopy signed]

Tom Claxton [Original hardcopy signed]

Peter Collins [Original hardcopy signed]

EMERGENCY CONTACT

Nearest Hospital: Mackenzie District Hospital
45 Centennial Dr., Mackenzie BC

Emergency Phone No.

Hospital (non-emergency): 250 997-3263

Police (non-emergency): 250 997-3288

Wildfire Management 1800 663-5555

Client Project Manager Shelley Wennas 604 528-7791

On-site First aid Attendant Peter Collins

Planned Daily Activities

Survey and inspection (May 4, 2016)

Training of the environmental monitoring contractor for future annual inspections (May 4, 2016)

Survey and inspection (May 5, 2016)

Additional Identified Hazards

No additional hazards that weren’t identified in the project safety plan.

Additional Identified Hazard Mitigation

Not applicable.

Site Hazard Assessment and Safety Plan reviewed? YES NO N/A

1.0 SURVEY SUMMARY

- All the berms were above the reservoir level (not submerged) and the creek flow was high, but safe to wade in most locations, so a complete survey of the berm and channel in the vicinity of the work area was conducted.
- The 2016 survey extents are presented in the enclosed drawings.
- Berm profiles and sections are presented in the survey drawings showing the 2014 pre-construction, 2014 post-construction, and the 2016 follow up surveys.
- The 2016 survey drawings used the record drawings as base and have retained the 2014 drawing numbering of 1000-C1800061 for plan and profile of Ole Creek. A new 2016 cross section drawing was added as drawing number 1000-C1800066 to follow the numbering from the 2014 drawing set. Digital survey data was also provided for BC Hydro’s records.
2.0 GENERAL SITE OBSERVATIONS:

- The reservoir level at the time of the work was surveyed at 664.6 m (May 5)
- The works are performing well and the creek is still maintaining a single thread channel as designed.
- There appears to be some settlement / erosion on the right bank (looking downstream) berm crest.
- The debris catchers have sustained some damage, but are largely performing well and have prevented log debris from blocking the creek mouth.
- Upstream of the works there is gravel deposition and a logjam that is threatening the long-term effectiveness of the constructed works downstream within the reservoir.
PHOTO 4 (Panoramic): Ole Creek looking downstream along Berm ‘A’ just upstream of Berm ‘C’

PHOTO 5 (Panoramic): Ole Creek looking downstream from below Berm ‘A’
### 3.0 BERM GEOMETRY, EROSION AND AGGRADATION, CHANNEL OBSERVATIONS

List of berms (in order from reservoir to upland):

#### 3.1 Berm ‘D’: Low gravel berm (right bank)
- The berm is generally in good condition; however, there has been some settlement/displacement and erosion of the finer fraction of material from the berm crest based on visual observations and the survey (see Profile on DWG 1000-C1800061-R2, and Sections 0+360 and 0+380 on 1000-C1800066-R0).
- The top of berm is slightly uneven in some locations with some large cobble proud of crest.
- The erosion, settlement and displacement of some material could be caused by large woody debris movement, wave action, ice movement, and creek flow over the berm as the reservoir level rises.
- The berm is still functioning well and serving the purpose of maintaining a single thread channel.
- Berm ‘D’ and the lower portion of Berm ‘C’ have been altered more than the other berms since construction, which is likely due to it being at a lower elevation than the other berms, and thus subject to more erosive action.

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**PHOTO 6 (Panoramic):** Looking upstream at Berm ‘D’ from right bank

**PHOTO 7 (Panoramic):** Looking upstream along Berm ‘D’ from downstream end of berm
PHOTO 8: Berm ‘D’ looking from left bank

PHOTO 9: Berm ‘D’ looking downstream

PHOTO 10: Looking upstream at Berm ‘D’ from downstream end of berm. Note erosion of fine fraction of the berm crest.

PHOTO 11: Looking downstream at Berm ‘D’
3.2 Berm ‘B’: Low gravel berm (left bank)

- Berm ‘B’ has retained its shape and shows no significant signs of erosion or settlement based on visual observations and the survey (see Profile on DWG 1000-C1800061-R2, and Sections 0+280 through 0+300 on 1000-C1800066-R0).
- There is some unevenness to the berm crest with some large cobble proud of crest. This has likely occurred due to floating log movement, wave action, and reservoir ice movement.
- The LWD embedded in the berm is intact and does not appear to have shifted.

PHOTO 12 (Panoramic): Berm ‘B’ looking downstream on left side of photo and Berm ‘D’ at right side

PHOTO 13 (Panoramic): Berm ‘B’ looking upstream at lower end (in centre of photo)

PHOTO 14 (Panoramic): Looking at Berm ‘B’ from Berm ‘D’
PHOTO 15: Looking downstream along Berm ‘B’

PHOTO 16: Buried LWD in Berm ‘B’

PHOTO 17: Looking downstream along Berm ‘B’

PHOTO 18: Downstream end of Berm ‘B’
3.3 Berm ‘C’: Low gravel berm with wood debris catcher and buried wood debris elements (right bank)

- Berm ‘C’ is generally in good condition; however, there has been some settlement/displacement and erosion of the finer fraction of material from the berm crest based on visual observations and the survey, particularly in the lower section of the berm (see Profile on DWG 1000-C1800061-R2, and Sections 0+200 through 0+320 on 1000-C1800066-R0).
- The berm is still functioning well and serving the purpose of maintaining a single thread channel.
- The top of berm is slightly uneven in some locations with some large cobble proud of crest.
- The erosion, settlement and displacement of some material could be caused by large woody debris movement, wave action, ice movement, and creek flow over the berm as the reservoir level rises.
- The lower portion of Berm ‘C’ and Berm ‘D’ have been altered more than the other berms since construction, which is likely due to it being at a lower elevation than the other berms, and thus subject to more erosive action.
- The buried / embedded large woody debris (LWD) is intact and does not appear to have shifted.
- The wood debris catcher has been effective in capturing log debris limiting deposition of log debris at the creek mouth (see Photos 28 & 29).
- The woody debris catcher has sustained some impact damage resulting in two broken upright logs.
- There is also frictional damage on the wood debris catchers (tan coloured where rubbed, see Photo 30).

PHOTO 19 (Panoramic): Looking downstream along the lower section of Berm ‘C’ at LWD location

PHOTO 20 (Panoramic): Looking downstream along Berm ‘C’ from just downstream of woody debris catcher
PHOTO 21 (Panoramic): Looking upstream at Berm ‘C’ and woody debris catcher

PHOTO 22 (Panoramic): Looking upstream along Berm ‘C’ and woody debris catcher (on left in photo)
PHOTO 23 (Panoramic): Looking downstream at Berm ‘C’ and woody debris catcher

PHOTO 24 (Panoramic): Looking upstream at Berm ‘C’ and woody debris catcher

PHOTO 25: Captured woody debris & broken logs

PHOTO 26: Damage to woody debris catcher
PHOTO 27: Looking upstream at lower Berm ‘C’ from downstream end of berm. Note uneven top of berm, some large cobble proud of crest.

PHOTO 28: Looking downstream at Berm ‘C’. Armour layer of cobble in good condition.

PHOTO 29: Looking upstream at Berm ‘C’ from downstream end of berm.

PHOTO 30: LWD Looking downstream
3.4 Berm ‘A’: Low gravel berm with wood debris catcher (left bank)

- Berm ‘A’ has retained its shape and shows no significant signs of erosion or settlement based on visual observations and the survey (see Profile on DWG 1000-C1800061-R2, and Sections 0+160 through 0+220 on 1000-C1800066-R0).
- Some erosion is visible around the base of the upright logs of the woody debris catcher, where additional backfill had been placed. Erosion did not occur on the berm crest.
- The woody debris catcher has largely been effective and has captured much log debris and has prevented blockage of the creek mouth (see Photos 33, 34 & 39). Some of the upright logs in the woody debris catcher have sustained impact damage. Three upright logs have broken and a few have shifted by log impact, many show rubbing and impact damage near the base of the logs (see example Photos 40 & 41).
- There is some log debris that has managed to float between the left (berm ‘A’) and right bank (Berm ‘C’) woody debris catchers, but this is limited and could be manually removed if it becomes an issue (see Woody Debris Observations section below).
- There has been some vegetation growth on the berm crest, however the willow stakes did not take following installation (noted in previous monitoring).
- The ECM is mostly intact but is deteriorating (as expected).
- The buried / embedded LWD is intact and does not appear to have shifted.

PHOTO 31 (Panoramic): Berm ‘A’ and left bank woody debris catcher

PHOTO 32 (Panoramic): Berm ‘A’ and left bank woody debris catcher (note bend is exaggerated)
PHOTO 33 (Panoramic): Downstream end of Berm ‘A’ (note flotsam) and woody debris catcher

PHOTO 34 (Panoramic): Woody debris catcher with captured wood visible behind the upright logs. Some wood debris not captured is visible to the right (note bend is exaggerated in panoramic).

PHOTO 35 (Panoramic): Berm A and left bank woody debris catcher looking from left bank. Note some shifted and broken upright logs.
PHOTO 36: Downstream end of Berm ‘A’ looking downstream

PHOTO 37: Flotsam at downstream end of Berm ‘A’ looking downstream

PHOTO 38: Upstream end of Berm ‘A’

PHOTO 39: Logs caught by woody debris catcher

Photo 40: Broken upright log of the woody debris catcher

Photo 41: Damage to base of woody debris catcher upright logs
### 4.0 WOOD DEBRIS OBSERVATIONS

- There is a small logjam that has formed just upstream of Berm ‘C’ and along Berm ‘A’. It is in the vicinity of where some log debris was able to pass between the woody debris catchers, so it is likely a combination of log debris transported by the creek and logs floated from the reservoir.
- The environmental monitoring contractor noted that the logjam is not presently a barrier to fish passage, but could become one if it accumulates material. This logjam should be monitored and could be removed if it becomes a barrier to fish passage.
- The log debris that has managed to float between the debris catchers and has come to rest on the berm crest could be removed, but at present it is limited and not a problem. The environmental monitoring contractor commented that the wood often floats in and out during the season. The accumulation of wood should be monitored.
- If the opening at the creek between the left and right bank wood debris catcher were narrower, then there may have been less material floated upstream along the creek, however if it were narrower, it could have encouraged a logjam at the debris catcher opening around the creek.
PHOTO 45 (Panoramic): Looking upstream at logjam from right bank

PHOTO 46 (Panoramic): Looking at channel upstream of logjam from right bank, Berm ‘A’ at right
5.0 UPSTREAM CHANNEL OBSERVATIONS

- As noted in the construction completion report\(^1\), there is a gravel bar and logjam upstream of the constructed works that could result in an avulsion along a historical dry channel (see Figure 1 enclosed).
- Gravel/cobble deposited during a large event perhaps about 5 years ago (The environmental monitoring contractor commented that 2011 flow was high in this area). This has changed the course of the creek and it is now undermining tree roots, which will cause trees to fall over and potentially create log jams. The channel has become less defined and more unstable since the 2014 observation. Selective removal of trees at risk of falling across channel could be considered and monitoring is recommended during the annual inspections.
- As noted in 2014 during construction, there is a log jam located just downstream of gravel/cobble deposition that could encourage an avulsion around the creek works constructed in 2014, rendering them ineffective. The log jam accumulated additional debris since 2014. The logjam is located at Long. 124°31'48.53"W & Lat. 56°27'15.54"N (GPS Waypoint). It is recommended that the logjam be monitored and potentially removed where it spans stream.

PHOTO 50 (Panoramic): Logjam at centre and potential avulsion path (to the left) looking downstream.

PHOTO 51 (Panoramic): Former creek channel blocked by gravel, looking upstream.

PHOTO 52 (Panoramic): Upstream end of gravel bar on left and altered creek path to right looking downstream. Trees at right could fall and create additional logjams.
PHOTO 53 (Panoramic): Upstream end of gravel bar on left looking upstream

PHOTO 54: Looking downstream at logjam

PHOTO 55: Primary log in logjam recommended for monitoring and potential removal
6.0 RECOMMENDATIONS

- The settlement/displacement on Berm 'D', should be monitored during the annual monitoring work. It is possible that the settlement / erosion could have been greatest in the first season, and may lessen with time. If the berm height becomes less than 0.8 m above the creek, then repairs should be considered.

- The logjam in the creek channel between Berm 'A' & Berm 'C', should be monitored. If it accumulates more material and becomes a barrier to fish passage, then it should be removed.

- The log debris that floated between the woody debris catchers and has come to rest on the berm crest should be monitored during annual inspections. If it continues to accumulate, then it should be removed.

- The logjam located at Long. 124°31'48.53"W & Lat. 56°27'15.54"N (GPS Waypoint) should be monitored and potentially removed. It could be removed in the late summer or winter when creek flows are much less.

- The creek channel upstream of the logjam proposed for removal should be monitored for additional logjams created by trees falling due to the change creek alignment.

- Continue to monitor the works annually. This inspection form could be used as a template.

- Schedule the 2019 survey and inspection to be conducted prior to increased spring melt (high creek flow), and during the lowest annual reservoir levels (following icemelt) to enable survey of the creek bed and inspection of the lowest elevation berm works.

- As the annual monitoring does not include a survey component, the monitoring should include GPS waypoints of key observations or issues. Photographs should be referenced to key berm features (eg downstream end of Berm 'B' locking upstream) and could be geo-referenced with waypoints.

Closing

If you have any questions regarding this Inspection report, please contact the undersigned at 604-294-2088.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by: Stefan Joyce, P.Eng
Hydrotechnical Engineer

Reviewed by: Dave Murray, P.Eng, ASCE, CPESC
Water Resources Engineer

Encl.: Figure 1
Survey Drawings
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Revision History

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Survey Drawings
Figure 1

Location of the Logjam, Gravel Bar, and Potential Avulsion Path

Reference: Orthophoto from BC Hydro.

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