

Peace Project Water Use Plan

Williston Reservoir Trial Tributaries

Implementation Year 5

Reference: GMSWORKS-19

6 Mile 2016 Engineering Inspection Report

Study Period: 2016

KERR WOOD LEIDAL



Site Inspection Report

PROJECT:	2016 WILLISTON TRIAL TRIBUTARIES POST-CONSTRUCTION MONITORING						
CLIENT:	BC Hydro						
TO:	Shelley Wennas, PMP						
SITE NAME:	6 Mile Creek						
REPORT DATE:	May 14, 2018						
FILE NO.:	BC Hydro Contract 00093683 & KWL File: 0478.189						
PREPARED BY:	Stefan Joyce, P.I	Eng ON SITE	•	May 2: 11am OFF SITE May 2: 6pm May 3: 8:30am May 3: 4pm			
INSPECTION DATE:	May 2 & 3, 2016	WEATHER		May 2: Warm, sunny & windy May 3: Mild, overcast with some sunny breaks			
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 S	EMERGENCY CONTACT					
Stefan Joyce {Or		{Original hardco	Original hardcopy signed}		Nearest Hospital: - Mackenzie District Hospital		
Tom Claxton		{Original hardcopy signed}		45 Centennial Dr., Mackenzie BC			
Peter Collins {O		{Original hardco	(Original hardcopy signed)		Emergency Phone No.		
	Planned Dail	Emergency Services	911				
Survey and inspection	on (May 2, 2016)	Hospital (non-emergency):	250-997-3263				
Survey and inspection	on (May 3, 2016)	Police (non-emergency):	250-997-3288				
Training of the environment of t		Wildfire Management	1-800-663-5555				
				Client Project Manager	Shelley Wenaas 604 528-7791		
		On-site First aid Attendant	Peter Collins				
Additional Identifie		Additional Identi	dditional Identified Hazard Mitigation				
High creek flow was made it unsafe to cre			Survey of the creek thalweg and opposite bank was not conducted for safety reasons. In-stream survey work was				

1.0 SURVEY SUMMARY

survey.

- As noted above, the flow in Six Mile Creek was too high to safely survey or allow crossing without a boat.
- Survey within the creek was only possible along the berm toe and in sheltered locations.
- The 2016 survey extents are presented in the enclosed drawings.

Site Hazard Assessment and Safety Plan reviewed?

- 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-C1800063 and 1000-C1800064 for plan and profile of Six Mile Creek. Two new 2016 cross section drawings were added as drawing numbers 1000-C1800067 and 1000-C1800068 to follow the numbering from the 2014 drawing set. Digital survey data was also provided for BC Hydro's records.

limited to berm toe and calm areas.

YES

NO

N/A



2.0 GENERAL SITE OBSERVATIONS:

- The works are also performing well and the creek is still maintaining a single thread.
- Only the lowest berm was completely submerged so an inspection of the majority of the works was conducted. The water level of the reservoir was surveyed at 664.1 m (May 2, 2016).
- The upstream most berm (Berm 'J') has effectively prevented an avulsion around the lower works.
- No significant damage to the works was observed and the berm geometry largely been preserved.
- The coir of the soil wraps is holding up well and no bulk bags (white material) have become exposed.
- The erosion control matting (ECM) is deteriorating (as expected) and will not float as a mat any longer where it had previously become buoyant and caused a concern as a potential trapping hazard to fish. The ECM no longer poses a hazard for fish.
- The large woody debris (LWD) has remained stable reinforcing the berm toe, and appears to be creating habitat complexity along the creek, as intended.
- As noted in the site hazards and mitigation section above, the creek flow was too high to safely survey or cross the channel by wading. Survey was only possible along the berm toe and in sheltered locations.
- Please refer to the enclosed survey drawings and the construction completion report¹.



PHOTO 1 (Panoramic): Single Thread Channel Looking Downstream from Berm 'B'



PHOTO 2 (Panoramic): Single Thread Channel Looking Downstream from Downstream End Of Berm 'C'

¹ KWL, February 2015, Construction Completion Report: GMSWORKS #19 Williston Reservoir Trial Tributaries – BC Hydro Report No. N3700.



PHOTO 3 (Panoramic): Channel Along Sharp Bend Along Berm 'J' (Note Panoramic Exaggerates Bend)



PHOTO 4: Deteriorating ECM (above) & Coir Soil Wraps in Good Condition (below)



PHOTO 5: Ice Damage to ECM.

3.0 BERM GEOMETRY, EROSION AND AGGRADATION, CHANNEL OBSERVATIONS

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

3.1 Berm 'A': LWD and buried bulk bag (left bank)

- Berm 'A' was fully submerged, KWL was unable to perform an inspection.
- This berm is considered to be less critical than the upper berms relative to the overall function of the works.



PHOTO 6: Looking Downstream at Berm 'A' (fully submerged) and Berm 'G' (mostly submerged)



3.2 Berm 'G': Non-vegetated geogrid soil wrap (left bank):

- Only small section of the berm crest was above water, so a full inspection was not possible, however some
 observations were made and a survey was conducted.
- The berm crest appears to be generally in good condition and there is no significant berm settlement or erosion to the berm crest and profile based on the survey (see Profile on DWG 1000-C1800064-R2, and Sections 0+800 through 0+820 on 1000-C1800068-R0). There appears erosion or settlement on the side slope as noted on Section 0+800, however this could not be visually confirmed as it was submerged.
- The large woody debris (LWD) was not visible for inspection.
- The ECM is deteriorating, particularly where it had become buoyant.



PHOTO 7 (Panoramic): Looking Upstream at Berm 'G'



PHOTO 8 (Panoramic): Looking Downstream at Berm 'G'



PHOTO 9: Survey of Toe of Berm 'G' on Creek Side



PHOTO 10: Berm 'G' Looking Upstream



3.3 Berm 'F': Non-vegetated geogrid soil wrap (left bank)

- Much of the downstream end of the berm was submerged at the time of the site visit.
- The berm appears to be in good condition. No significant settlement or erosion was observed in the field or noted in the survey (see Profile on DWG 1000-C1800064-R2, and Sections 0+660 through 0+760 on DWG 1000-C1800068-R0). Some erosion is noted around the LWD at berm toe on section 0+740, but this could not be visually confirmed as it was submerged during inspection.
- The LWD is in good condition and has not displaced. There are some eroded pools and gravel deposition at the toe around the LWD (visible in Photo 16 below, and indicated on section 0+740), which was desired for habitat.
- The creek channel closer to the thalweg (lowest point) appears to have scoured down to some degree since the berm was constructed, likely due to the greater concentration of flow, however it was not safe to survey the channel to confirm.
- The ECM is deteriorating and has been rolled up along the crest in locations, most likely due to becoming buoyant and the creek overtopping of the berm crest as the reservoir level rises.
- There was a fine layer of sand/silt covering berm.
- Exposed coir material used in the soil wraps is in good condition and functioning well.
- Erosion appears to have occurred downstream of the berm where the ground is 'natural' (see Photo 12)



PHOTO 11 (Panoramic): Looking Upstream from Berm 'G' to Berm 'F'



PHOTO 12: Downstream End of Berm 'F' Looking Upstream. Possible Erosion Downstream of Berm in 'Natural' Area (Note Water Flowing from Left to Right Side of Photo).



PHOTO 13: Berm 'F' Looking Upstream (Note Damaged/Decomposing ECM)



PHOTO 14: Berm 'F' Looking Upstream (Note Damaged/Decomposing ECM). Water on Right Side of Photo is Backwater rom Reservoir, Not a Side Channel.



PHOTO 15: Upstream End of Berm 'F' Looking Upstream



PHOTO 16: LWD and Toe Erosion and Deposition Creating Habitat Features in Channel



PHOTO 17: LWD, Deposition and Channel Scour/Deepening



PHOTO 18: Deposited Log Along LWD and Deteriorating ECM



PHOTO 19: Coir Soil Wrap Layers in Good Condition. Note Upper Layer is ECM.



3.4 Berm 'D': LWD and buried bulk bag (left bank)

- The berm in good condition. No significant settlement or erosion was observed in the field or noted in the survey (see Profile on DWG 1000-C1800063-R2, and Sections 0+620 and 0+640 on DWG 1000-C1800068-R0)
- The LWD is in good condition and is not displaced.
- The ECM is deteriorating. There are also some areas where ice damage to the ECM is evident.
- The ECM is still covered with gravel/cobble where it was placed on the crest to stop it from floating.
- The creek eroded pools and deposited gravel material around LWD.
- This berm does not have coir soil wraps as erosion protection on its face as a variety of methods were utilized in this trial. There is no erosion on the berm face at this time, however if it were to occur, then additional longitudinal LWD or coir soil wraps could be installed.



PHOTO 20 (Panoramic): Looking Downstream at Berm 'D'



PHOTO 21 (Panoramic): Looking Upstream from Upstream End of Berm 'D'



PHOTO 22: Looking Upstream at Berm 'D'



PHOTO 23: LWD at Berm 'D'.



PHOTO 24: Material Used to Cover ECM When it Became Buoyant Still in Place.



PHOTO 25: Deposition and Erosion Near LWD

3.5 Berm 'B': Non-vegetated geogrid soil wrap (left bank)

- Berm in good condition. No significant settlement or erosion observed in the field or noted in the survey (see Profile on DWG 1000-C1800063-R2, and Sections 0+540 and 0+560 on DWG 1000-C1800067-R0)
- LWD is in good condition and is not displaced.
- There appears to be some deposition at the toe, which is confirmed on Section 0+540. There also appears to erosion in the channel thalweg, but this was not able to be confirmed by survey due to high flow.
- The coir material in the soil wraps is in good condition.
- ECM is deteriorating where exposed (not covered with sand/cobble to prevent floating).
- Overland flow blockage / roughness (buried LWD) is not disturbed and in good condition.



PHOTO 26 (Panoramic): Looking Downstream at Berm 'B'



PHOTO 27 (Panoramic): Looking Upstream at Berm 'B'



PHOTO 28: Coir Soil Wraps in Good Condition



PHOTO 29: There Appears to be Some Deposition at the Berm Toe (and Channel Erosion in Thalweg)

3.6 Berm 'C': Vegetated geogrid soil wrap (left bank)

- Berm 'C' is in good condition with no significant settlement or erosion observed in the field or noted in the survey (see Profile on DWG 1000-C1800063-R2, and Sections 0+380 and 0+460 on DWG 1000-C1800067-R0)
- The LWD is in good condition and has not displaced.
- Most of the willows (2014 live brush and stakes) do not appear to have survived however there are a few areas
 where the willow has taken (see Photo 38). It was also early in the season, so it is likely that additional growth will
 take hold above the reservoir this summer.
- The upstream half of the berm had good grass growth from 2015 on the crest (see Photo 40 & 41).
- · The ECM, where exposed, is deteriorating.
- The rock spur at the downstream end is still intact (see Photo 34).
- Flotsam deposited on berm crest provides evidence of the high reservoir level and or wave action in 2015 to an elevation of approximately 670 m (see Photos 40 & 41 and DWG 1000-C1800063-R2). Much of Berm 'C' appears to have been submerged in 2015, which is likely why much of the willow does not appear to have survived.
- The upstream tie-in location for Berm 'C' to the beaver pond is stable and has not changed since construction.



PHOTO 30 (Panoramic): Downstream end of Berm 'C' looking upstream.



PHOTO 31 (Panoramic): Berm 'C' looking upstream from downstream end.



PHOTO 32 (Panoramic): Looking downstream from upstream end of Berm 'C'



PHOTO 33 (Panoramic): Intact beaver/habitat pond upstream of Berm 'C'.



PHOTO 34: Downstream end of Berm 'C' looking downstream



PHOTO 35: Downstream end of Berm 'C' looking upstream



PHOTO 36: Coir soil wraps, willow brush layers along berm and native grasses/reeds at toe



PHOTO 37: UAV Marker (surveyed)



PHOTO 38: Few willow stakes took hold in downstream berm area (lower elevation), however there is some limited new growth. Willow was likely submerged as indicated in photos below.



PHOTO 39: Looking upstream at willow layers (mostly dead) in the lower berm and grasses in the upper berm that had grown (not active growth yet this year given time of site visit).



PHOTO 40: Looking downstream along Berm 'C', note flotsam in foreground.



PHOTO 41: Looking upstream at upstream end of Berm 'C', note flotsam deposition from reservoir in 2015 indicating that the berm was likely mostly submerged in 2015. Note 2015 grass growth.

3.7 Berm 'J': Vegetated geogrid soil wrap (left bank)

- Berm 'J' has effectively protected kept the creek from eroding behind the works. The berm is in good condition. No significant settlement or erosion observed in the field or noted in the survey (see Profile on DWG 1000-C1800063-R2, and Sections 0+300 and 0+320 on DWG 1000-C1800067-R0)
- The LWD is in good condition and has not displaced.
- The creek has eroded away the bank in front of the berm and there is now a ~2m long section of riprap exposed to the water (see Photos 46 & 47).
- Riprap launching toe trench has begun to 'launch' into eroded creek bank as expected and designed protecting the toe of Berm 'J' (see Photo 48).
- Willow shoots were thinly spread out, but were starting to come up all along berm at the time of the site visit (see Photo 52).
- Grass and other vegetation growing on top and on back side of berm.
- The ECM has deteriorated as expected.
- Evidence of moose damage to crest of berm (hoof prints observed, see Photos 53, 54 & 55).



PHOTO 42 (Panoramic): Downstream end of Berm 'J' looking upstream. (Note black geotextile in foreground which is likely silt fence material, not bulk bag material, which is white.)



PHOTO 43 (Panoramic): Berm 'J' looking upstream. Beaver / habitat pond at right of the photo



PHOTO 44 (Panoramic): Looking downstream at Berm 'J'



PHOTO 45 (Panoramic): Upstream end of Berm 'J' looking upstream



PHOTO 46: Eroding Bank and 'launching' riprap toe trench looking upstream



PHOTO 47: Eroding bank and 'launching' riprap toe trench looking downstream



PHOTO 48: Launching riprap toe.



PHOTO 49: Coir soil wraps, willow brush layers, LWD, and riprap toe looking upstream



PHOTO 50: Gravel bar across from Berm 'J'



PHOTO 51: Soil wraps, willow brush layers, LWD and riprap looking downstream



PHOTO 52: Willow starting to take in brush layers



PHOTO 53: Moose tracks in berm crest and ECM.



PHOTO 54: Moose related damage on creek-side slope (mostly to ECM layer)



PHOTO 55: Moose related damage on back-side slope of berm



4.0 WOOD DEBRIS OBSERVATIONS

- There is very little accumulation of woody debris.
- Some isolated pieces and logs observed, such as at Berm 'F' as noted in Photo 18 above.

5.0 UPSTREAM CHANNEL OBSERVATIONS

- The creek has eroded the bank along the toe of Berm 'J' as noted in the section above.
- The channel upstream of the works and gravel bar across from 'Berm J' does not appear to have changed significantly since 2014.

6.0 RECOMMENDATIONS

- Continue to visually monitor the works annually. This inspection form could be used as a template.
- We understand that the monitoring site visits by the the environmental monitoring contractor are scheduled at different stages over the spring, summer and fall. As this inspection occurred prior to the vegetation growth period, we recommend that the biologist observe and record the locations, approximate elevations and success of vegetation growth along the Berm 'C' and Berm 'J'.
- As the ECM has a relatively short lifespan and has deteriorated significantly, the berm surfaces covered by the ECM, may experience some erosion. These areas should be monitored during future annual monitoring. If significant erosion occurs, then BC Hydro could consider protecting those areas.
- Bathymetric survey (boat and sounder) of the creek channel at high reservoir levels could be conducted to cover areas that were unsafe to survey in May 2016. BC Hydro could consider a bathymetric survey at high water, if that would be beneficial for habitat monitoring of the channel.
- The 2016 survey provided sufficient coverage of the majority of the berm features (only Berm 'A' was not surveyed) so additional survey for the berm works is not recommended until the planned 2019 survey.
- 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. The berms should be surveyed at low reservoir levels in 2019 by a topographic survey to enable visual identification of key berm features.
- If the creek is unsafe to survey by wading again in 2019, then we recommend that the creek channel be surveyed at high reservoir level by boat later that year.
- As the annual monitoring does not include a survey component, include GPS waypoints of key observations. Photographs should be referenced to key berm features (eg upstream end of Berm 'B' looking downstream) and could be geo-referenced with waypoints at the key observation locations.

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:

Reviewed by:

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he filed original.

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Encl.: Survey Drawings



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Revision History

Revision #	Date	Status	Revision Description	Author
0	May 14, 2018	Final	Final	PAC/SFJ
А	August 30, 2016	Draft	Draft for Client Review	PAC/SFJ





Survey Drawings







