Goliath Gold Project Fish Addendum

Goliath Gold Project
Treasury Metals Inc.

Prepared for:

Treasury Metals Inc.

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GOLIATH GOLD PROJECT FISH ADDENDUM

F1 Introduction

In April of 2018, Treasury Metals submitted a revised version of the Environmental Impact Statement (EIS) for the proposed Goliath Gold Project (the Project) to the Canadian Environmental Assessment Agency (the Agency) for consideration under the Canadian Environmental Assessment Act (CEAA), 2012. The Agency reviewed the submission and informed Treasury Metals that the requirements of the EIS Guidelines for the Project were met and that the Agency would issue a series of information requests to Treasury Metals regarding the technical review of the EIS and supporting appendices (referred to herein as the Round 2 information requests). The Round 2 information requests were issued to Treasury Metals from July 6th, 2018 to July 27th, 2018 and included questions from the Agency, other Federal and Provincial reviewers, Indigenous communities and interested stakeholders.

Upon review of the Round 2 information requests, it was clear that there was an emphasis from the reviewers on potential changes to water, fish and fish habitat, and the follow-up program presented in the revised EIS (April 2018). To effectively capture any changes to these aspects of the Project and to provide a consolidated, fulsome response to the Round 2 information requests, the following four (4) addendums have been prepared to accompany the Round 2 information request responses:

- Goliath Gold Project Fish Addendum (this document);
- Goliath Gold Project Water Addendum;
- Goliath Gold Project Follow-up Program Addendum; and
- Goliath Gold Project Preliminary Environmental Monitoring Program.

F1.1 Valued Components for Fish and Fish Habitat

As detailed in Section 6.1.3.13 of the revised EIS (April 2018), the effects of the Project to fish and fish habitat considered the following four (4) valued components (VCs):

- Stream-resident fish populations;
- Migratory fish populations;
- Lake-resident fish populations; and
- Fish species-at-risk.

There were no changes to the fish and fish habitat VCs suggested by the Round 2 information requests.

As detailed in Section 6.14 of the revised EIS (April 2018), the effects of the Project were restricted to the stream-resident fish populations, with the potential for some effects to migratory fish populations. There were no predicted effects to the lake-resident fish populations or fish species-at-risk as a result of the Project. This has not changed as a result of the Round 2 information request process. To simplify the information presented in this addendum, the description of effects has focused on stream-resident fish populations and migratory fish populations.

F1.2 Scope of the Assessment of Effects to Fish and Fish Habitat

As described in Section 6.1.3.13 of the revised EIS (April 2018), the evaluation of effects of the Project on fish habitat included consideration of the following indicators:

- Direct loss or alteration of habitat;
- Changes in flows;
- Changes in water quality; and
- Blasting.

The evaluation of effects to fish and fish habitat associated with the above indicators is set out in Section F2 of this addendum.

In addition to the above effects, the evaluation of the direct loss or alteration of habitat also considered the potential for mortality of the fish present in those waterbodies that would be lost as a result of the Project. The evaluation of effects of the Project on fish mortality is set out in Section F3 of this addendum.

F1.3 Round 2 Information Requests Related to Fish and Fish Habitat

A listing of the individual Round 2 information request components regarding effects to fish and fish habitat is provided in Table F1-1, along with a summary of the specific information request, the potential effect to fish or fish habitat it refers to, and whether the request had resulted in an update to the information presented in the revised EIS (April 2018).

F2 Loss or Alteration of to Fish Habitat

As described in Section F1.2 of this addendum, the revised EIS (April 2018) evaluated the effects of the Project on fish habitat using the following four (4) indicators:

- Direct loss or alteration of habitat;
- Changes in flows;
- Changes in water quality; and
- Blasting.

Each of these indicators are discussed in turn, below, with the total habitat loss summarized in Section F2.5.

F2.1 Direct Loss of Habitat

The direct loss of habitat is defined for the purposes of the revised EIS (April 2018) as fish habitat that will be overprinted by the Project. There have been no changes to the locations of Project components as a result of the Round 2 information requests; therefore, the direct loss of fish habitat presented in this addendum has not changed from what was presented in the revised EIS (April 2018). The same reaches of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2 will be overprinted, and thus lost as fish habitat, as a result of the Project..

Table F1-1: Listing of Round 2 Information Requests Related to Fish and Fish Habitat

TMI Identifier	Agency Identifier	Components	Summary of Information Request	Changes to Fish Habitat			Changes to Fish Mortality	Changes to Effects Assessment on Fish and Fish Habitat Presented in the revised EIS (April 2018)
				Loss of Habitat	Change in Flows or Water Levels	Change in Water Quality	Blasting	
TMI_876-RG(2)-01	RG(2)-01	Parts A and B	Provide the relevant information for determining the affected watercourses and waterbodies that will be subject to Section 35 of the *Fisheries Act*, or Schedule 2 of the MDMER.	■	■	■	■	Further detail provided on the fish habitat offsetting plan and likely offsetting areas
TMI_882-AE(2)-06	AE(2)-06	Parts A B, C, D, E, F and G	Identify fish-bearing waterbodies within 500 meters of the blasting activities. Update the noise and vibration assessment to include these locations and compare against DFO Guidelines for blasting.	—	—	—	■	Further detail provided on the assessment of effects from blasting on fish and fish habitat
TMI_884-SW(2)-01	SW(2)-01	Part D, E and F	Superseded	—	—	—	—	—
TMI_885-SW(2)-02	SW(2)-02	at the point closest to the pit	Superseded	—	—	—	—	—
TMI_887-SW(2)-04	SW(2)-04	Parts D, E and F	Provide modelled predicted final effluent concentrations, clarify whether the process effluent was used to estimate seepage water quality, and provide the modelled predicted influent water quality of the open pit from the TSF in post-closure. Describe the potential effects to fish and fish habitat for modelled water quality parameters that may exceed applicable water quality criteria	—	—	■	—	No Update Required
TMI_888-SW(2)-05	SW(2)-05	Parts C, D and E	If tailings will be exposed to the atmosphere, describe the changes in water quality from ARD, dust and metal leaching. How would this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_889-SW(2)-06	SW(2)-06	Parts D, E and F	Assess the potential for methylmercury production in Blackwater Creek wetlands from elevated levels of sulphate in the open pit and in seepage from the TSF and/or WRSA during all phases. How might this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_891-SW(2)-08	SW(2)-08	Parts D, E and F	If the pit were to become meromictic, what would the water quality be in the surrounding watercourses? How this might affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_892-FFH(2)-01	FFH(2)-01	Parts A and B	Provide an estimate of the loss of fish habitat for each fish bearing wetland that will be affected by the Project and updated the accounting for the fish habitat loss.	■	■	—	—	Wetlands to the southeast of the Project that are within the drawdown Zone of Influence and are underlain by granular material have been included in the fish habitat loss accounting
TMI_893-FFH(2)-02	FFH(2)-02	Parts A, B and C	Provide an accounting of the fish habitat impacted by the Project and explain how it was calculated. Provided an estimate of the amount of the fish habitat for each offsetting option. Distinguish what would be considered under Section 35 of the *Fisheries Act* or Schedule 2 of the MDMER.	■	■	—	—	Wetlands to the southeast of the Project that are within the drawdown Zone of Influence and are underlain by granular material have been included in the fish habitat loss accounting
TMI_894-FFH(2)-03	FFH(2)-03	Parts E, F and G	What is the water quality of the Blackwater Creek Tributary 2 diversion channel considering the proximity to the TSF? How this might affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_895-FFH(2)-04	FFH(2)-04	Parts A, B , C, D and E	How could changes in water temperature due to a lack of well-developed riparian vegetation affected fish and fish habitat on Blackwater Creek Tributary 2 diversion channel?	—	—	■	—	Addition of temperature monitoring as part of the Follow-up program for the Blackwater Creek Tributary 2 diversion channel
TMI_896-FFH(2)-05	FFH(2)-05	Parts D and E	Predict the loss of fish habitat as a result of changes in flows / water levels.	—	■	—	—	Further defined the changes in flow and specified which changes in flow would be offset.

Table F1-1: Listing of Round 2 Information Requests Related to Fish and Fish Habitat (continued)

TMI Identifier	Agency Identifier	Components	Summary of Information Request	Changes to Fish Habitat			Changes to Fish Mortality	Changes to Effects Assessment on Fish and Fish Habitat Presented in the revised EIS (April 2018)
				Loss of Habitat	Change in Flows or Water Levels	Change in Water Quality	Blasting	
TMI_897-MW(2)-01	MW(2)-01	Parts D, E and F	Describe the change in water quality due to exposed tailings during the implementation of the TSF cover. How might this affect fish or fish habitat	—	—	■		No Update Required
TMI_898-MW(2)-02	MW(2)-02	Parts F, G and H	Provide a multi-year water cover model for the TSF using appropriate climate data. What conditions will cause the wet cover to fail? How might this affect water quality in surrounding watercourses and fish and fish habitat?	—	—	■		No Update Required
TMI_899-MW(2)-03	MW(2)-03	Parts E, F and G	Provide details of the dry cover and possible causes that may cause the dry cover to fail. How might this affect fish and fish habitat?	—	—	■		No Update Required
TMI_900-MW(2)-04	MW(2)-04	Parts E, F and G	Provide details on the efficiency of the TSF liner and whether clay will be used in addition to the HDPE liner. How might this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_901-MW(2)-05	MW(2)-05	Parts D, E and F	Reassess the seepage rates from the TSF based on conservative assumptions and include progressive degradation of the TSF liner, base of the TSF, and wet or dry cover for the TSF. How might this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_902-MW(2)-06	MW(2)-06	Parts D, E and F	Update the geochemical characterization of mine rock and tailings and determine if this will affect the assessment of fish and fish habitat.	—	—	■	—	No Update Required
TMI_907-MW(2)-11	MW(2)-11	Parts D, E and F	Describe the water quality in the runoff and seepage collection ditches in post-closure. How might this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_908-GW(2)-01	GW(2)-01	Parts E, F and G	Provide a range and travel times of seepage to the surrounding watercourses and determine the capture efficiency of the seepage collection system. How might this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_909-GW(2)-02	GW(2)-02	Parts F, G and H	Reassess the rate of ARD generation and infiltration rates from the WRSA and how this might affect fish or fish habitat.	—	—	■	—	No Update Required
TMI_912-GW(2)-05	GW(2)-05	Parts C, D and E	Describe the purpose of the finger drain and whether it has the potential to increase seepage from the TSF. If there is an increase in seepage, how might this affect fish and fish habitat?	—	—	■	—	No Update Required
TMI_936-AA(2)-02	AA(2)-02	Part A	Revise the assessment of effects of failure of the TSF on fish and fish habitat due to the release of cyanide.	—	—	■	—	No Update Required
TMI_947-MW(2)-12	MW(2)-12	Parts E, F and G	Assess the potential for ARD from the LGO stockpile and how this might affect the fish and fish habitat assessment	—	—	■	—	No Update Required
TMI_948-SW(2)-01B	SW(2)-01B	Parts F, G and H	Incorporate the surface water quality sampling result from 2010/2011 into the baseline surface water quality assessment and provided an assessment on seasonal variation in the baseline water quality data.	—	—	■	—	No Update Required
TMI_949-SW(2)-02B	SW(2)-02B	Parts E, F and G	Provide details on the hydrocarbon and ammonia concentrations predicted to remain in the effluent.	—	—	■	—	No Update Required
TMI_950-FFH(2)-06	FFH(2)-06	Parts B and C	Describe the effects to fish and fish habitat from increases in flows on Blackwater Creek.	—	■		—	No Update Required

Table F1-1: Listing of Round 2 Information Requests Related to Fish and Fish Habitat (continued)

TMI Identifier	Agency Identifier	Components	Summary of Information Request	Changes to Fish Habitat			Changes to Fish Mortality	Changes to Effects Assessment on Fish and Fish Habitat Presented in the revised EIS (April 2018)
				Loss of Habitat	Change in Flows or Water Levels	Change in Water Quality	Blasting	
TMI_951-GW(2)-01B	GW(2)-01B	Parts E, F and G	Update the groundwater model based on the concerns raised, provide a range in seepage volumes from the TSF and WRSA, and determine the capture efficiency of the seepage collection system. How might this affect fish and fish habitat?	—	—	■	—	No Update Required

While the direct loss of habitat has not been altered from what was presented in the revised EIS (April 2018), there were a number of questions raised as part of the Round 2 information request process that have resulted in enclosed information that presents the calculation of direct habitat loss in greater detail than was presented in the revised EIS (April 2018). This additional detail allows for the distinction between overprinted habitat that is subject to Section 35 under the *Fisheries Act* or Schedule 2 of the Metal and Diamond Mine Effluent Regulations under the *Fisheries Act*. Additionally, the habitat affected is presented as total area affected (based on the area of ponds or the length of the river reach times the width of the watercourse [average measured bankfull width]), rather than the lengths affected as was the case in the revised EIS (April 2018). The presentation of the lost habitat measured as area (m^2) allows for the direct comparison of identified losses in fish habitat to the proposed offsetting and compensation measures, discussed in Section F5.3 of this addendum.

The predicted direct loss (overprinting) of fish habitat as a result of the Project has not changed from what was presented in the revised EIS (April 2018), and is summarized in Table F2.1-1. As noted above, the direct loss of fish habitat in Table 2.1-1 has been provided as the area of fish habitat that will be overprinted by the Project. The table also includes a description of the method used to calculate the fish habitat losses.

F2.2 Change in Flows/Water Levels

As part of the revised EIS (April 2018), changes in surface water flows were evaluated (Section 6.9 of the revised EIS [April 2018]), and then used in the assessment of the effects of the Project on fish and fish habitat (Section 6.9 of the revised EIS [April 2018]) to determine whether the predicted changes in flows were likely to result in effects to fish and fish habitat. There were no changes to the surface water flow predictions presented in the revised EIS (April 2018) as a result of the Round 2 information request process. As part of the Round 2 information request process, there were a number of questions raised that have resulted in the enclosed information that presents the calculation of changes in flows as a result of the Project in greater detail than was presented in the revised EIS (April 2018). Table F2.2-1 provides the description of the changes in flows for all phases of the Project, including the changes for the smaller reaches of the watercourses not included specifically in the revised EIS (April 2018). As was clearly stated in Section 6.9.4.2 and 6.9.4.4 of the revised EIS (April 2018), the Project is expected to have a negligible effect on the inflows to both Thunder Lake and Wabigoon Lake and would have no measurable effects on the water levels in either Wabigoon Lake or Thunder Lake. There would be no changes to the predicted changes in water levels in both Wabigoon Lake and Thunder Lake as a result of the Round 2 information requests.

Table F2.1-1: Direct Loss of Fish Habitat

Waterbody	Reach Identifier	Description of Reach	Specific Reach / Wetland Location	Approach for Calculating Habitat Loss	Area of Fish Habitat Loss (m^2)
Blackwater Creek Tributary 1	BW-T1-R2	Reach of Tributary 1 upstream from the berm that surrounds the operations area	WLD4b(Pond1) located partially within proposed open pit.	LIO and aerial/satellite imagery	13,244
			WLD4b (Pond2) located entirely within proposed open pit.	LIO and aerial/satellite imagery	3,097
			WLD4a(Pond) located immediately upstream of berm surrounding the operation area.	LIO and aerial/satellite imagery	22,084
			Reach connecting WLD4b(Pond1) to WLD4b(Pond2)	Length: 78.5 m Channel Width: 1.1 m	86
			Reach connecting WLD4b(Pond2) to WLD4a(Pond).	Length: 177.2 m Channel Width: 1.1 m	195
Blackwater Creek Tributary 2	BW-T2-R2	Section of Tributary 2 within the berm that surrounds the operation area	Reach from berm at downstream end to WLD2(Pond) located within operation area.	Length: 197.3 m Channel Width: 1.2 m	237
			WLD2(Pond) located within operations area.	LIO and aerial/satellite imagery	1,445
			Blackwater Creek Tributary 2 as well as T2-A and T2-B R1 upstream of WLD2(Pond) and within berm that surrounds operation area.	Length: 2,133.0 m Channel Width: 1.2 m	2,560
				Total Direct Loss of Habitat Area (m^2)	**42,948**

As shown in Table F2.2-1, the Project is anticipated to result in both increases and decreases in flows within the surrounding watercourses. The predicted changes in flows vary depending on both the watercourse and Project phase. Of the 19 reaches listed in Table F2.2-1, two (2) reaches are over printed by the Project (BW-T1-R2 and BW-T2-R2), and therefore no changes in flows are calculated. These reaches are discussed in Section F2.1 of this addendum. Of the remaining seventeen (17) reaches in Table F2.2-1, there are seven (7) reaches identified above where the projected changes in flows are expected to meaningfully affect the fish habitat present and are thus considered as lost fish habitat. These reaches are summarized in Table F2.2-2, along with the habitat loss they represent. Specifically, the following six (6) reaches of tributary watercourses have been identified as lost fish habitat as a result of changes to the predicted flows:

- **Blackwater Creek Tributary 1 (BW-T1-R1)**: The reach of Blackwater Creek Tributary 1 from Blackwater Creek upstream to the berm that surrounds the operations area (BW-T1-R1) is anticipated to have flow reduction of 95%, as a result of the upstream catchment areas enclosure within the perimeter ditch and berm that surrounds the operations area. This will result in the loss of 777 m^2 of fish habitat, as shown in Table F2.2-2.
- **Blackwater Creek Tributary 2 (BW-T2-R1)**: The reach of Blackwater Creek Tributary 2 between Blackwater Creek and the berm that surrounds the operation area (BW-T2-R1) is anticipated to have a loss in flow of reduction of 85%, as a result of the upstream catchment areas enclosed within the perimeter ditch and berm that surrounds the operations area. This will result in the loss of 856 m^2 of fish habitat, as shown in Table F2.2-2.
- **Blackwater Creek Tributary 2 (BW-T2-R3a):** There is also a stretch of Blackwater Creek Tributary 2, upstream of the berm surrounding the operations area to the confluence with the diversion channel (BW-T2-R3a) that will experience a 100% loss of flow and result in a further 140 m^2 of lost fish habitat (see Table F2.2-2).
- **Blackwater Creek Unnamed Tributary (BW-U1)**: An Unnamed Tributary of Blackwater Creek, just upstream from the effluent discharge location for the Project (BW-U1) is anticipated to have a 65% flow reduction as a result of the upstream catchment areas enclosed within the perimeter ditch and berm that surrounds the operations area. This will result in the loss of 327 m^2 of fish habitat.
- **Blackwater Creek Tributary 4 (BW-T4-R1)**: Blackwater Creek Tributary 4 downstream of the WLD5(Pond) inclusive of the area that is underlain by a granular surficial deposit and may be affected by the groundwater drawdown for the Project. This flow loss has been conservatively assessed to be 100% as a result of the dewatering process. This will result in the loss of 793 m^2 of fish habitat, as shown in Table 2.2.-2.
- **Pond on Blackwater Creek Tributary 4 (WLD5 Pond)**: There is a pond at the headwaters of Blackwater Creek Tributary 4 within WLD5 that is underlain by a granular deposit and may be affected by the groundwater drawdown ZOI. This flow loss has been conservatively assessed to be 100% as a result of the dewatering process. This will result in the loss of 5,864 m^2 of fish habitat, as shown in Table 2.2-2.
- **Hoffstrom's Bay Tributary**: All sections of Hoffstrom's Bay Tributary upstream of Thunder Lake are anticipated to experience a permanent reduction in flow of 7.8% as a result of the upstream catchment areas enclosed during site preparation and construction within the perimeter ditch and berm that surrounds the operations area. It is anticipated that all sections of Hoffstrom's Bay Tributary will experience flow reductions during the operations and closure phases due to the reduced groundwater discharge resulting from the drawdown of the water table caused by the dewatering of the open pit and underground mine. The total flow reductions during operations and closure are

estimated to be 14.4%. Dewatering will cease at the end of operations, but it is anticipated that the groundwater table will not fully recover to near pre-development limits until the open pit is filled.

There are six (6) of the reaches listed in Table F2.2-1 where the changes in flows predicted to occur as a result of the Project are lower than 10%. As the changes in flows in these reaches are less than the threshold identified by DFO (2013) as having a low probability of "detectable impacts to ecosystems", these changes are not expected to result in any loss of fish habitat. These reaches include the following:

- **Blackwater Creek**: The reach of Blackwater Creek, upstream of the constructed watercourse to convey flows from the upstream sections of Blackwater Creek Tributary 2 (BW-R5) is anticipated to have flow reduction of 9.5% during the operations and closure phases. This reduction is a result of reduced groundwater discharge to Blackwater Creek resulting from the drawdown of the water table caused by the dewatering of the open pit and underground mine. Dewatering will cease at the end of operations, but it is anticipated that the groundwater table will not fully recover to near pre-development limits until the open pit is filled.
- **Blackwater Creek Tributary 2**: The reaches of Blackwater Creek Tributary 2 that are upstream from the constructed watercourse to convey flows from the upstream sections of Blackwater Creek Tributary 2 is anticipated to experience flow reductions of 9.5% during the operations and closure phases due to the reduced groundwater discharge to Blackwater Creek resulting from the drawdown of the water table caused by the dewatering of the open pit and underground mine. Dewatering will cease at the end of operations, but it is anticipated that the groundwater table will not fully recover to near pre-development limits until the open pit is filled.
- **Little Creek**: Little Creek upstream of Thunder Lake is anticipated to experience a permanent reduction in flow of 8.7% as a result of the upstream catchment areas enclosed within the perimeter ditch and berm that surrounds the operations area.
- **Thunder Lake Tributary 2**: The portion of Thunder Lake Tributary 2 from Thunder Lake upstream to the confluence with Thunder Lake Tributary 3 is anticipated to experience a reduction of flow of 1.7% during operations and a reduction of 1.2% during closure. The reductions are a combination of periodic taking of fresh water from the upstream ponds within the former MNRF tree nursery during operations, and reduced groundwater discharge resulting from the drawdown of the water table caused by the dewatering of the open pit and underground mine. Dewatering will cease at the end of operations, but it is anticipated that the groundwater table will not fully recover to near pre-development limits until the open pit is filled.
- **Thunder Lake Tributary 2**: The portion of Thunder Lake Tributary 2 upstream from the confluence with Thunder Lake Tributary 3 is anticipated to experience a reduction of flow of 0.6% during operations. The reductions resulting from the periodic taking of fresh water from pond within the former MNRF tree nursery.

  Thunder Lake Tributary 3: The portion of Thunder Lake Tributary 3 upstream from the confluence with Thunder Lake Tributary 2 is anticipated to experience a reduction of flow of 0.8% during operations and a reduction of 0.6% during closure. The reductions are a combination of periodic taking of fresh water from the ponds within the former MNRF tree nursery during operations, and reduced groundwater discharge resulting from the drawdown of the water table caused by the dewatering of the open pit and underground mine. Dewatering will cease at the end of operations, but it is anticipated that the groundwater table will not fully recover to near pre-development limits until the open pit is filled.

Table F2.2-1: Predicted Changes in Surface Water Flows by Reach and Project Phase

Waterbody	Reach Identifier	Description of Reach	Reach Length (m) (1)	Site Preparation and Construction		Operations		Closure		Post-closure Phase	
				Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)
Blackwater Creek (main stem)	BW-R1	Blackwater Creek between Wabigoon Lake and Tributary 1	3,810	(a)–Loss of the Tributary 1 and Tributary 2 catchment areas enclosed within berm around the operations area.	-24.2%	(a)–Loss of the Tributary 1 and Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown. (c)–Discharge of treated effluent from Project.	-3.9%	(a)–Loss of the Tributary 1 and Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	-31.4%	(a)–Loss of the Tributary 1 and Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown. (c)–Overflow from pit lake.	+5.7%
	BW-R2	Blackwater Creek between Tributary 1 and the diffuser	184	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area.	-12.9%	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown. (c)–Discharge of treated effluent from Project.	-2.5%	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	-21.2%	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown. (c)–Gain from pit lake overflow	-12.9%
	BW-R3	Blackwater Creek between the diffuser and Tributary 2	507	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area.	-12.9%	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	-21.6%	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	-21.2%	(a)–Loss of the Tributary 2 catchment areas enclosed within berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	-12.9%
	BW-R4	Blackwater Creek between Tributary 2 and the constructed watercourse that conveys the upstream catchment area of Tributary 2 to Blackwater Creek	1,897	(a)–Gain of the Tributary 2 catchment areas upstream of the berm around the operations area.	+27.3%	(a)–Gain of the Tributary 2 catchment areas upstream of the berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	+15.2%	(a)–Gain of the Tributary 2 catchment areas upstream of the berm around the operations area. (b)-Decrease in groundwater discharge due to dewatering drawdown.	+15.2%	(a)–Gain of the Tributary 2 catchment areas upstream of the berm around the operations area. (b)–Decrease in groundwater discharge due to dewatering drawdown.	+27.3%
	BW-R5	Blackwater Creek upstream from the constructed watercourse that conveys the upstream catchment area of Tributary 2 to Blackwater Creek	1,800	None	+0.0%	(a)-Decrease in groundwater discharge due to dewatering drawdown.	-9.5%	(a)-Decrease in groundwater discharge due to dewatering drawdown.	-9.5%	None	+0.0%
Blackwater Creek Tributary 1	BW-T1-R1	Reach of Tributary 1 from Blackwater Creek upstream to the berm that surrounds the operations area	707	(a)–Loss of the Tributary 1 catchment enclosed within berm around the operations area.	-95.0%	(a)–Loss of the Tributary 1 catchment enclosed within berm around the operations area.	-95.0%	(a)–Loss of the Tributary 1 catchment enclosed within berm around the operations area.	-95.0%	(a)–Gain from the overflow of water from pit lake through the engineered spillway.	+124.0%
	BW-T1-R2	Reach of Tributary 1 upstream from the berm that surrounds the operations area	590	Overprinted by mine	N/A	Overprinted by mine	N/A	Overprinted by mine	N/A	(a)–Overprinted by the pit lake.	N/A

Table F2.2-1: Predicted Changes in Surface Water Flows by Reach and Project Phase (continued)

Waterbody	Reach Identifier	Description of Reach	Reach Length (m) (1)	Site Preparation and Construction		Operations		Closure		Post-closure Phase	
				Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)
Unnamed Tributary to Blackwater Creek	BW-U1	Upstream from the confluence with Blackwater Creek	273	(a)–Loss of catchment enclosed within berm around the operations area.	-65.0%	(a)–Loss of catchment enclosed within berm around the operations area.	-65.0%	(a)–Loss of catchment enclosed within berm around the operations area.	-65.0%	(a)–Loss of catchment enclosed within berm around the operations area.	-65.0%
Blackwater Creek Tributary 2	BW-T2-R1	Reach of Tributary 2 between Blackwater Creek and the berm that surrounds the operation area	713	(a)–Loss of the Tributary 2 catchment enclosed within berm around the operations area. (b)–Diversion of the Tributary 2 catchment upstream of TSF.	-85.5%	(a)–Loss of the Tributary 2 catchment enclosed within berm around the operations area. (b)–Diversion of the Tributary 2 catchment upstream of TSF.	-85.5%	(a)–Loss of the Tributary 2 catchment enclosed within berm around the operations area. (b)–Diversion of the Tributary 2 catchment upstream of TSF.	-85.5%	(a)–Loss of the Tributary 2 catchment enclosed within berm around the operations area. (b)–Diversion of the Tributary 2 catchment upstream of TSF.	-85.5%
	BW-T2-R2	Section of Tributary 2 within the berm that surrounds the operation area	3,010	Overprinted by MWP and TSF Overprinted by berm around operations area and impoundment dams.	N/A	Overprinted by MWP and TSF Overprinted by berm around operations area and impoundment dams.	N/A	Overprinted by MWP and TSF Overprinted by berm around operations area and impoundment dams.	N/A	Overprinted by MWP and TSF Overprinted by berm around operations area and impoundment dams.	N/A
	BW-T2-R3	Sections of Tributary 2 upstream from the confluence with the diversion channel	2,686	None	NA	(a)-Decrease in groundwater discharge due to dewatering drawdown.	-9.5%	(a)-Decrease in groundwater discharge due to dewatering drawdown.	-9.5%	None	+0.0%
	BW-T2-R3a	Sections of Tributary 2 upstream of the berm surrounding the operations area to the confluence with the diversion channel	117	Isolated from the upstream catchment areas by diversion channel	-100.0%	Isolated from the upstream catchment areas by diversion channel	-100.0%	Isolated from the upstream catchment areas by diversion channel	-100.0%	Isolated from the upstream catchment areas by diversion channel	-100.0%
Blackwater Creek Tributary 4	WLD5(Pond)	Section of WLD5 that is underlain by a granular material.	Pond	None	N/A	Decrease in groundwater discharge due to dewatering drawdown	-100.0%	Decrease in groundwater discharge due to dewatering drawdown	-100.0%	None	+0.0%
	BW-T4-R1	Section of Tributary 4 that is underlain by a granular material.	660	None	N/A	Decrease in groundwater discharge due to dewatering drawdown	-100.0%	Decrease in groundwater discharge due to dewatering drawdown	-100.0%	None	+0.0%
Little Creek	LC-R1	Includes all of the watercourse upstream of Thunder Lake	1,900	(a) Decrease of the Little Creek catchment enclosed within berm around the operations area.	-8.7%	(a) Decrease of the Little Creek catchment enclosed within berm around the operations area.	-8.7%	(a) Decrease of the Little Creek catchment enclosed within berm around the operations area.	-8.7%	(a) Decrease of the Little Creek catchment enclosed within berm around the operations area.	-8.7%
Hoffstrom's Bay Tributary	HBT-R1	Includes all of the watercourse upstream of Thunder Lake	2,580	(a) Decrease of the Hoffstrom's Bay Tributary enclosed within berm around the operations area.	-7.8%	(a) Decrease of the Hoffstrom's Bay Tributary enclosed within berm around the operations area. (b) Decrease in groundwater discharge due to dewatering drawdown	-14.4%	(a) Decrease of the Hoffstrom's Bay Tributary enclosed within berm around the operations area. (b) Decrease in groundwater discharge due to dewatering drawdown	-14.4%	(a) Decrease of the Hoffstrom's Bay Tributary enclosed within berm around the operations area.	-7.8%
	TL2-R1	Thunder Lake Tributary 2 from Thunder Lake to the confluence with Thunder Lake Tributary 3	1,290	None	+0.0%	(a)–Periodic withdrawals from irrigation ponds at former MNRF tree nursery.	-1.7%	(a)-Effects of decrease in groundwater discharge to Thunder Lake Tributaries 2	-1.2%	None	+0.0%

Table F2.2-1: Predicted Changes in Surface Water Flows by Reach and Project Phase (continued)

Waterbody	Reach Identifier	Description of Reach	Reach Length (m) (1)	Site Preparation and Construction		Operations		Closure		Post-closure Phase	
				Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)	Change or Alteration	Change in Flow (%)
Thunder Lake Tributary 2						(b)-Effects of decrease in groundwater discharge to Thunder Lake Tributaries 2 and 3 due to dewatering drawdown.		and 3 due to dewatering drawdown.			
	TL2-R2	Thunder Lake Tributary 2 from the confluence with Thunder Lake Tributary 3 upstream to the irrigation pond to the north of former MNRF tree nursery	1,500	None	+0.0%	(a)–Periodic withdrawals from irrigation ponds at former MNRF tree nursery.	-0.6%	None	+0.0%	None	+0.0%
Thunder Lake Tributary 3	TL3-R1	Thunder Lake Tributary 3 upstream of the confluence with Thunder Lake Tributary 2 to the Tree Nursery Ponds	1,570	None	+0.0%	(a)–Periodic withdrawals from irrigation ponds at former MNRF tree nursery. (b)-Effects of decrease in groundwater discharge to Thunder Lake Tributary 3 due to dewatering drawdown.	-0.8%	(a)-Effects of decrease in groundwater discharge to Thunder Lake Tributary 3 due to dewatering drawdown.	-0.6%	None	+0.0%

Table F2.2-2: Loss of Fish Habitat Associated with Changes in Surface Water Flows

Waterbody	Reach Identifier	Description of Reach	Specific Reach / Wetland Location	Approach for Calculating Habitat Loss	Area of Fish Habitat Loss (m^2)
Blackwater Creek Tributary 1	BW-T1-R1	Reach of Tributary 1 from Blackwater Creek upstream to the berm that surrounds the operations area	Same as General Reach Location.	Length: 706.6 m Channel Width: 1.1 m	777
Blackwater Creek Tributary 2	BW-T2-R1	Reach of Tributary 2 from Blackwater Creek upstream to the berm that surrounds the operations area	Same as General Reach Location.	Length: 713.3 m Channel Width: 1.2 m	856
	BW-T2-R3a	Sections of Tributary 2 upstream of the berm surrounding the operations area to the confluence with the diversion channel	Same as General Reach Location.	Length: 116.7 m Channel Width: 1.2 m	140
Unnamed Tributary to Blackwater Creek	BW-U1	Upstream from the confluence with Blackwater Creek	Same as General Reach Location.	Length: 272.8 m Channel Width: 1.2 m	327
Blackwater Creek Tributary 4	WLD5(Pond)	Pond within WLD5 that is underlain by a granular material.	Same as General Reach Location.	Pond Area: 5,864 m^2	5,864
	BW-T4-R1	Section of Tributary 4 that is underlain by a granular material	Same as General Reach Location.	Length: 660.8 m^2 Channel Width: 1.2 m	793
Hoffstrom's Bay Tributary	HBT-R1	Includes all of the watercourse upstream of Thunder Lake	Same as General Reach Location.	Length: 2,580 m^2 Channel Width: 1.2 m	3,096
				Total Direct Loss of Habitat Area (m^2)	**11,853**

The four (4) remaining sections from Table F2.2-1 correspond to sections of the main stem of Blackwater Creek where changes in flows ranged from decreased in flow of 31% up to an increase in flow of 27%, depending on the reach and Project phase. The amount of fish habitat in Blackwater Creek watercourse is largely determined by beaver activity, as the area of habitat provided by beaver ponds is much larger than the area of stream habitat between those ponds. Consequently, the area of habitat is not directly correlated with flow. The area of beaver ponds varies over time when existing beaver dams are abandoned and new beaver dams are constructed. In this context, the changes in flow arising from the Project in these four (4) reaches are not expected to have any ecologically meaningful effect on the ability of the streams to support stream-resident small-bodied fish, and are not expected to affect large-bodied fish downstream. Therefore, no additional losses of habitat are associated with the changes in flows in these four (4) reaches.

As described in Section 5.8.4 of the revised EIS (April 2018), "a portion of Keplyn's Bay was separated from Wabigoon Lake by the construction of the railway", and that "flow from Blackwater Creek is conveyed under the railway by at least two corrugated steel pipes." During the post-closure, increases in flow for the portion of Blackwater Creek near this culvert were predicted. Table F2.2-3 summarizes the existing and post-closure flows at modelling node BW2 (near the mouth of Blackwater Creek, immediately upstream of the portion of Keplyn's Bay where the culverts under the railway are situated). The following changes in flows were predicted for the month of May, when fish passage through the culvert is likely to be of greatest importance from a fisheries perspective:

- an increase of 4.9% during average conditions (from 0.349 to 0.366 m^3/s);
- an increase of 7.7% for dry conditions (from 0.098 to 0.105 m^3/s); and
- and increase of 7.5% for wet conditions (from 0.599 to 0.644 m^3/s).

Table F2.2-3: Loss of Fish Habitat Associated with Changes in Surface Water Flows

Scenario	Parameter	Change in Flow in May
Average Year	Existing Flow (m^3/s)	0.349
	Post-closure Flow (m^3/s)	0.366
	Post-closure Change (m^3/s)	+0.0172
	Post-closure Change (%)	+4.9%
Dry Year	Existing Flow (m^3/s)	0.098
	Post-closure Flow (m^3/s)	0.105
	Post-closure Change (m^3/s)	+0.0075
	Post-closure Change (%)	+7.7%
Wet year	Existing Flow (m^3/s)	0.599
	Post-closure Flow (m^3/s)	0.644
	Post-closure Change (m^3/s)	+0.0447
	Post-closure Change (%)	+7.5%

The increases in predicted post-closure flows during the average (0.366 m^3/s) and dry (0.105m^3/s) conditions are considerably lower than the existing flows experienced during wet (0.644 m^3/s) conditions. Therefore, the culverts should not present a barrier to upstream fish migration during average and dry conditions as fish are already experiencing flows in this range. For the 1 in 20 wet year conditions, post-closure flows at the mouth of Blackwater Creek were predicted to be 7.5% higher than the current conditions. While this nominal increase in flows should not present conditions that would prevent fish passage, Treasury Metals has indicated that a full assessment of the capacities of culverts downstream of the Project would be completed as part of the detailed engineering. In the event that detailed engineering identifies situations where the capacities of the downstream culverts need to be increased (including for ensuring fish passage) Treasury Metals would work with the appropriate Agencies to modify the designs for the downstream culverts, as required.

F2.3 Change in Water Quality

As part of the Round 2 information request process, a number of questions and concerns were raised by the reviewers regarding the changes in water quality as a result of the Project, and the potential for those changes to affect fish and fish habitat. To address these questions and concerns in a consolidated manner, Treasury Metals has prepared the Goliath Gold Project Water Addendum to accompany the Round 2 information request responses. This addendum provides updated water quality models as requested in the Round 2 information request process and quantifies the predicted changes to surface water quality model predictions that reflect all of the changes required to respond to the Round 2 information requests and provides an update to the surface water quality expected as a result of the Project. To summarize the findings of the Goliath Gold Project Water Addendum, as it applies to fish and fish habitat, the Project will result in minor changes to the surface water quality predictions presented in the revised EIS (April 2018). The updated surface water quality modelling continues to indicate that surface water quality will largely be unchanged as a result of the Project, with resulting water quality being the same as, or slightly improved from the existing conditions. In those situations where the water quality is predicted to be higher than existing conditions, the resulting water quality remains below the Provincial Water Quality Objectives (PWQO) for the protection of aquatic life. Therefore, there are no predicted effects to fish habitat from changes to water quality as a result of the Project.

F2.4 Blasting

As discussed in Section 6.14 of the revised EIS (April 2018), blasting activities are expected at the open pit and associated underground mine. Under baseline conditions, the only fish-bearing waterbody within 500 m of the open pit, the setback distance identified by DFO (Wright and Hopky 1998) to ensure the protection of fisheries, is Blackwater Creek Tributary 1 (BW-T1-R1), as shown in Figure F2.4-1. This section of Blackwater Creek was determined to be fish habitat that would be lost as a result of changes in flows (see Section F5.2 and Table F2.2-2); therefore, it is predicted that there would be no fish present at these locations once the operations area is established and BW-T1-R1 is isolated by the construction of perimeter berm and collection ditching.

The other relevant areas where the effects of blasting on fish could be of concern are illustrated within Figure F2.4-1. Using the protocols set out in (Wright and Hopky 1998), the estimated vibration (peak particle velocity) and blasting overpressure presented in Table F2.4-1 have been calculated. The results show that the estimated blasting pressure in water, assuming a 100 kg charge weight, are below the 100 kPa limit for water overpressure set out in (Wright and Hopky 1998). In addition, the peak particle velocities, assuming a 100 kg charge weight, are below the 13 mm/s limit suggested in Wright and Hopky

(1998) at the closest points within Thunder Lake and Blackwater Creek to the open pit. Therefore, it is predicted that no fish, or spawning areas would be affected by blasting activities.

F2.5 Summary of the Effects on Fish Habitat

As described above, the effects of the Project on habitat have been characterized as the following:

- Direct loss or alteration of habitat;
- Changes in flows;
- Changes in water quality; and
- Blasting.

As described in Section F2.1, direct loss of habitat was identified on two (2) reaches of the local tributary watercourses, namely: the portion of Blackwater Creek Tributary 1 upstream from the perimeter berm and collection ditch around the operations area; and the portion of Blackwater Creek Tributary 2 within the perimeter berm and collection ditch around the operations area. Losses of habitat as a result of changes in flow due to the Project was also identified on four (4) reaches of the local tributary watercourses, namely: the portion of Blackwater Creek Tributary 1 downstream of the perimeter berm and collection ditch around the operations area; the unnamed tributary to Blackwater Creek immediately upstream of the proposed discharge location; the portion of Blackwater Creek Tributary 2 downstream of the perimeter berm and collection ditch around the operations area; the portion of Blackwater Creek upstream from the perimeter berm and collection ditch around the operations area to the diversion channel. There were no losses of habitat identified as a result of changes in water quality or effects related to blasting.

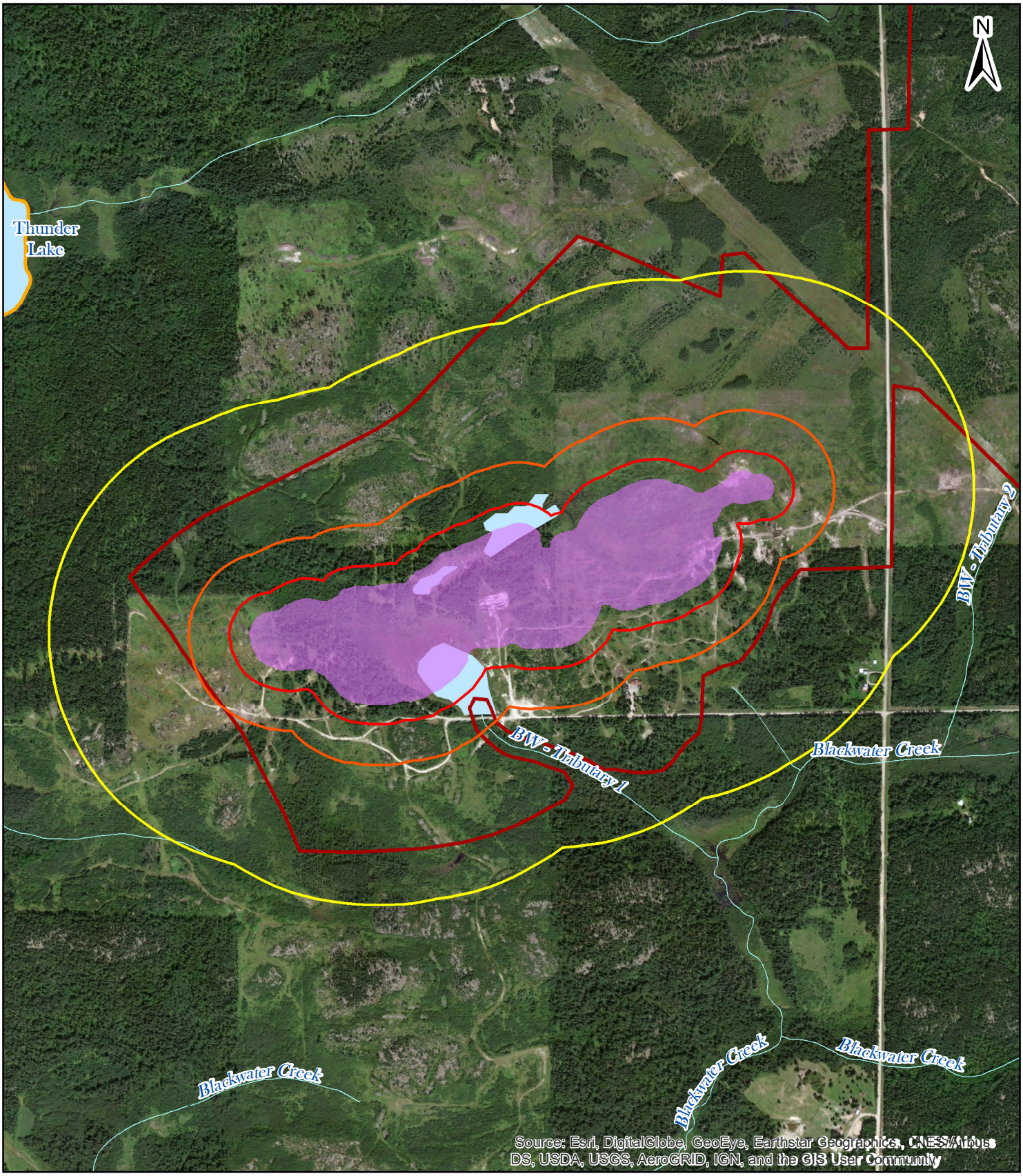


Figure F2.4-1: Distance from Blasting Activities

Legend

- Operations Area
- Local Study Area
- Waterbody
- Watercourses
- Open Pit
- 50 m
- 150 m
- 500 m

SCALE: 1:13,014

Projection: NAD 1983 UTM Zone 15N

Date created: 2018-08-16

RESOURCES GROUP

0 0.0750.15 0.3 0.45 0.6 Km

Table F2.4-1: Predicted Effects of Blasting on Fish Habitat

Waterbody	Description	Distance to Pit Perimeter (m)	Estimated Upper Bound [1] PPV (mm/s)	Estimated from DFO Method [3] PPV (mm/s)	Estimated Blasting Overpressure in Water [4] (kPa)	Estimated Blasting Overpressure in Air [5] (dBL Peak)
Thunder Lake	at the point closest to the pit	938	3.3	0.7	0.9	124
Blackwater Creek	at the point closest to the pit	519	8.2	1.8	2.4	128
Blackwater Creek Tributary 1 at the edge of the operations area	outside of the operations area at the point closest to the pit	There would be no habitat in this reach of Blackwater Creek Tributary 1. This habitat was considered to be lost due to changes in flow (see Table F2.2-2)				

Notes: *Values based on assumed 100 kg charge weight per delay unless otherwise noted*

[1] *PPV estimated from ISEE Blasting Handbook Table 26.3 upper bound equation for coal mines*
[2] Maximum charge weight per delay to meet 13 mm/s DFO limit for spawning fish habitat
[3] PPV estimated from DFO document (Appendix II); appears to be based on ISEE Blasting Handbook general curve fit
[4] Peak water overpressure estimated from DFO document (Appendix II) equations, using PPV from DFO methodology (see Note [3]). When upper bound PPV values are used to derive the water overpressure, some locations may see higher predicted values. For example, Blackwater Creek Tributary 1 (BW – Trib 1) would need to have the charge weight limited to 85 kg to achieve the 100 kPa limit when based on the upper bound values (see Note [1])
[5] Unweighted decibels referenced to 20 microPascals based on metal mines equation from Table 26.7 of ISEE Blasting Handbook

A summary of these losses is provided in Table F2.5-1. These losses of habitat would only affect stream-resident fish, as no migratory fish were identified in these reaches.

F3 Changes to Fish

As stated in the revised EIS (April 2018), the only affect predicted to fish was the mortality of fish in those portions of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2 that will be overprinted by the Project. As described in Section 6.14 the revised EIS (April 2018), in preparation for mining the open pit and construction the TSF and minewater pond, sections of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2 will need to be isolated and drained prior to construction. It is anticipated that the majority of stream-resident fish inhabiting these sections of tributary will move downstream as the water levels are reduced. Relocation of the fish that remain within the isolated portions of these drained tributaries will be undertaken, but given the habitat conditions (soft substrates, dense riparian vegetation) and the difficulty that they will pose to fish capture, mortality of fish will occur after these sections are isolated. A conservative estimate of 50% of the stream-resident fish within these sections of the tributaries have been predicted to be lost as a result of the Project.

There were no predicted effects to migratory fish, lake-resident fish populations or fish species-at-risk as a result of the Project. The findings presented in the revised EIS (April 2018) have not changed as a result of the Round 2 information request process.

F4 Mitigation

F4.1 Mitigation and Avoidance Measures

As part of the Round 2 information request process, a number of questions and concerns were raised by the reviewers regarding mitigation measures to minimize effects to fish and fish habitat. Specifically, comments related to fish and fish habitat mitigation measures asking if additional mitigation measures were required to reflect changes to the fish and fish habitat effects assessment. An example of this type of question is TMI_889-SW(2)-06 Part E, which asks Treasury Metals to "Describe mitigation measures to prevent adverse effects to fish and fish habitat, if necessary" based on the responses to Parts A through D.

Table F4.1-1 provides the mitigation measures as they were presented in the revised EIS (April 2018). None of the mitigation measures presented in the revised EIS (April 2018) have been changed as they all are predicted to effectively avoid or mitigate the predicted effects of the Project on fish and fish habitat.

In revising the effects assessment for fish and fish habitat to reflect the Round 2 information request, no additional mitigation measures are proposed. The avoidance and mitigation measures outlined in Table F4.1.1 are considered sufficient to minimize or negate any predicted effects identified in Sections 2 and 3.

Table F2.5-1: Summary of Fish Habitat Losses

Waterbody	Reach Identifier	Description of Reach	Specific Reach / Wetland Location	Habitat Loss (m^2)				Overall Fish Habitat Loss (m^2)
				Direct Loss	Change in Flows / Water Levels	Change in Quality	Blasting	
Blackwater Creek Tributary 1	BW-T1-R2	Reach of Tributary 1 upstream from the berm that surrounds the operations area	Upstream-most wetland (T1-BP A) located partially within proposed open pit.	13,244	—	—	—	13,244
			Mid-reach wetland (T1-BP B) located entirely within proposed open pit.	3,097	—	—	—	3,097
			Downstream-most wetland (T1-BP C) located immediately upstream of berm surrounding the operation area.	22,084	—	—	—	22,084
			Reach connecting upstream-most wetland to mid-reach wetland and	86	—	—	—	86
			Reach connecting mid-reach wetland to downstream-most wetland.	195	—	—	—	195
	BW-T1-R1	Reach of Tributary 1 from Blackwater Creek upstream to the berm that surrounds the operations area	Same as General Reach Location.	—	777	—	— [1]	777
Blackwater Creek Tributary 2	BW-T2-R2	Section of Tributary 2 within the berm that surrounds the operation area	Reach from berm at downstream end to wetland located within operation area.	237	—	—	—	237
			Wetland (T2-BP A) located within operations area.	1,445	—	—	—	1,445
			Blackwater Creek Tributary 2 as well as T2-A and T2-B R1 upstream of wetland and within berm that surrounds operation area.	2,560	—	—	—	2,560
	BW-T2-R1	Reach of Tributary 2 from Blackwater Creek upstream to the berm that surrounds the operations area	Same as General Reach Location.	—	856	—	—	856
	BW-T2-R3a	Sections of Tributary 2 upstream of the berm surrounding the operations area to the confluence with the diversion channel	Same as General Reach Location.	—	140	—	—	140
Unnamed Tributary to Blackwater Creek	BW-U1	Upstream from the confluence with Blackwater Creek	Same as General Reach Location.	—	327	—	—	327
Blackwater Creek Tributary 4	WLD5(Pond)	Pond within WLD5 that is underlain by a granular material.	Same as General Reach Location.	—	5,864	—	—	5,864
	BW-T4-R1	Section of Tributary 4 that is underlain by a granular material	Same as General Reach Location.	—	793	—	—	793
Hoffstrom's Bay Tributary	HBT-R1	Includes all of the watercourse upstream of Thunder Lake	Same as General Reach Location.	—	3,096	—	—	3,096
			Total Loss of Habitat (m^2) [2]	**42,948**	**11,853**	**0**	**0**	**54,801**

Notes:

(1) The portion of Blackwater Creek Tributary 1, upstream from Blackwater Creek to the perimeter berm and ditch around the operations area was identified as being lost as a result of changes to flows.

(2) The numbers for total habitat losses may not equal the total provided in Section F4 due to rounding.

F4.2 Fish Habitat Offset

In the context of the CEAA, 2012, the fisheries offsetting would be considered mitigation that would fully offset and mitigate the adverse effects of the Project on fish habitat. A draft fish offsetting and compensation plan was included as Appendix II to the revised EIS (April 2018) and will serve as a starting point for discussions with Environment and Climate Change Canada (ECCC) and Fisheries and Oceans Canada (DFO). The details of the Fish Compensation Plan will be finalized following the EA process through discussion with ECCC and DFO.

To satisfy the concerns raised by the Agency through the Round 2 information request process, Treasury Metals has refined the effects predictions and quantified the areas of fish habitat that would require offsetting as a result of the Project. Through this further refinement, it has been determined that 54,801 m^2 of fish habitat will be lost due to effects from the Project, 50,559 m^2 of which will be subject to Section 35 of the Fisheries Act and the remaining 4,242 m^2 of which will be subject to Schedule 2 of the Metal and Diamond Mine Effluent Regulations. Table F4.2-1 provides the effects, the areas, and the authorization required for each reach of watercourse that will be lost due to the Project. For the purposes of the EA process, Treasury Metals has provided the preliminary location of the offsetting habitat (Figure F4.2-1). The preliminary offsetting habitat consists of two (2) ponds on either side of Blackwater Creek consisting of 60,000 m^2 and the Blackwater Creek Tributary 2 diversion channel consisting of 3,047 m^2 for a total area of 63,047 m^2 (Table F4.2-2). As a result, the preliminary plan for fish habitat offset and compensation is calculated to compensate fish habitat lost as a result of the Project at a ratio of 1.15 m^2 of habitat offset to every 1 m^2 of habitat removed. It is important to note that this preliminary habitat offset design was developed for the purposes of the EA and is subject to refinement following discussions with ECCC and DFO.

F5 Residual Effects

As stated in the Section 6.14.6 of the revised EIS (April 2018) and in Section F4 above, the proposed fish habitat compensation and offsetting would represent mitigation in the context of the CEAA, 2012, that would offset and mitigate the predicted adverse effects of the Project on fish habitat. Therefore, following offsetting, the only predicted residual adverse effects that remain would be the potential for mortality of stream-resident fish during the site preparation and construction phase. Specifically, there would be a percentage of the stream-resident fish within those waterbodies overprinted by the Project (portions of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2) that would remain within the watercourses to be overprinted, and that could not be effectively salvaged. Table F5-1 summarizes the predicted residual adverse effects of the Project on fish and fish habitat, taking into consideration the mitigation and avoidance measures presented in Section F4.1, and the offsetting and compensation presented in Section F4.2.

No changes have been made to the residual effects presented in the revised EIS (April 2018) as a result of the Round 2 information request process. Refinements that were made to the predicted effects on fish habitat are all captured under the fish habitat offset plan and are fully mitigated.

Table F4.1-1: Mitigation Measures for Fish and Fish Habitat

Mitigation Identifier	Mitigation Measure	Effects Mitigation Measures are Applicable to				
		Fish Habitat				Fish
		Direct Loss of Habitat	Change in Flows or Water Levels	Change in Water Quality	Blasting	Mortality
Mit_008	Progressively construct a perimeter ditch and seepage collection system around the operations area to capture and direct all runoff from the site to the water management system.	—	—	■	—	—
Mit_024	The pit lake will be monitored as it is filling to determine whether batch treatment will be required to ensure the water meets PWQO, or background concentrations if background levels exceed the PWQO, prior to the discharge from the pit lake to a tributary of Blackwater Creek.	—	—	■	—	—
Mit_050	Optimize the layout of the Project to minimize the footprint, and to the extent possible, minimizing the catchment areas diverted from Little Creek and Hoffstrom's Bay Tributary.	■	—	—	—	■
Mit_053	During operations, excess water not required in the process will be treated to concentrations that meet Provincial Water Quality Objectives (PWQO) or Canadian Water Quality Guidelines (CWQG) for the protection of aquatic life, or background if background levels exceed the PWQO, prior to discharging to Blackwater Creek. In the case of mercury, effluent will be treated to meet the background concentrations in Blackwater Creek.	—	—	■	—	—
Mit_057	The refined water balance for the Project looks to optimize the use of water collected within the operations area for use in the processing of ore. This limits the effects on surface water quantities by minimizing water taking and providing flexibility regarding the volumes discharged from the Project.	—	■	—	—	—
Mit_058	Treated effluent will be discharged to Blackwater Creek through an engineered structure designed to minimize erosion risks.	—	—	■	—	—
Mit_060	Once the pit has filled during the post-closure phase, excess water will be allowed to passively discharge through a spillway into the former channel of Blackwater Creek Tributary 1.	—	—	■	—	—

Table F4.1-1: Mitigation Measures for Fish and Fish Habitat (continued)

Mitigation Identifier	Mitigation Measure	Effects Mitigation Measures are Applicable to				
		Fish Habitat				Fish
		Direct Loss of Habitat	Change in Flows or Water Levels	Change in Water Quality	Blasting	Mortality
Mit_077	Prior to overburden removal, any beaver dams within the Project footprint will be removed and the impoundments will be allowed to draw down. This will reduce the number of fish that will remain in isolated sections of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2.	—	—	—	—	■
Mit_078	Activities and the construction of Project components that will impact or overprint watercourses (i.e., the perimeter ditch, the effluent diffuser, water intakes) will occur during the fisheries timing window when in-stream work is permitted.	—	—	—	—	■
Mit_079	To the extent practicable, fish in the sections of Blackwater Creek Tributary 1 that will be isolated by the construction of the perimeter ditch and overprinted by the removal of overburden from the open pit will be captured and relocated to the same tributaries downstream from the operations area, or to the main branch of Blackwater Creek.	—	—	—	—	■
Mit_080	To the extent practicable, fish in the sections of Blackwater Creek Tributary 2 that will be isolated by the construction of the perimeter ditch and overprinted by the construction of the TSF will be captured and relocated to the same tributaries downstream from the operations area, or to the main branch of Blackwater Creek.	—	—	—	—	■
Mit_081	The fresh water needs for the Project will be met by withdrawals from the irrigation ponds on Thunder Lake Tributary 2 and Thunder Lake Tributary 3. The withdrawals will not exceed 5% of the flows in either of the two creeks. Pump intakes will be fitted with fish screens to prevent entrainment.	—	■	—	—	—
Mit_082	As the Project advances, detailed engineering will be completed to ensure that all downstream culverts on Blackwater Creek can support any predicted increases in flows. This would include ensuring that the downstream culverts will continue to provide adequate fish passage.	—	■	—	—	—

Table F4.1-1: Mitigation Measures for Fish and Fish Habitat (continued)

Mitigation Identifier	Mitigation Measure	Effects Mitigation Measures are Applicable to				
		Fish Habitat				Fish
		Direct Loss of Habitat	Change in Flows or Water Levels	Change in Water Quality	Blasting	Mortality
Mit_083	Provide offsetting of fisheries habitat losses as part of the authorization required under the Fisheries Act.	■	■	■	■	—
Mit_124	Once the pit lake is fully flooded, it is expected that the monitoring of the water quality in the pit lake will continue for a period of time to determine whether additional batch treatment may be required to ensure the water released from the pit lake meets effluent release limits.	—	—	■	—	—

Table F4.2-1: Authorization under Section 35 of the Fisheries Act and through a Schedule 2 Amendment under the Metal Mining Effluent Regulations

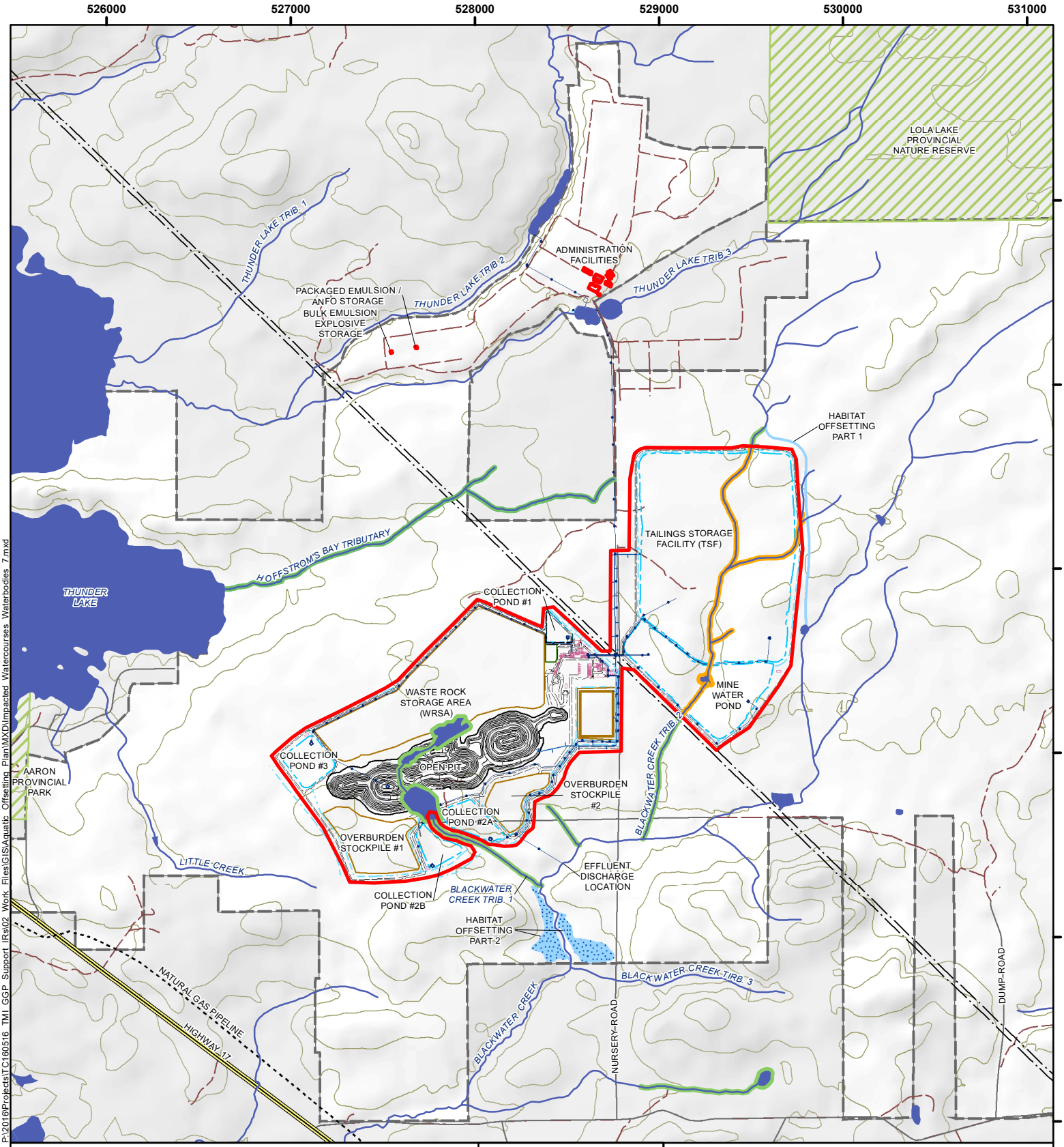
Reach	General Reach / Wetland Location	Specific Reach / Wetland Location	Habitat Alteration	Authorization Required	Area of Fish Habitat Loss (m^2)
Blackwater Creek Tributary 1 Reach 1	Reach of Tributary 1 from Blackwater Creek upstream to the berm that surrounds the operations area	Same as General Reach Location.	Flow temporarily reduced or eliminated.	Section 35	777
Blackwater Creek Tributary 1 Reach 2	Upstream end of Blackwater Creek Tributary 1 downstream to berm that surrounds the operations area.	Upstream-most wetland located partially within proposed open pit.	Overprinted by open pit.	Section 35	13,244
		Mid-reach wetland located entirely within proposed open pit.	Overprinted by open pit.	Section 35	3,097
		Downstream-most wetland located immediately upstream of berm surrounding the operation area.	Overprinted by open pit.	Section 35	22,084
		Reach connecting upstream-most wetland to mid-reach wetland and	Overprinted by open pit.	Section 35	86
		Reach connecting mid-reach wetland to downstream-most wetland.	Overprinted by open pit.	Section 35	195
Blackwater Creek Unnamed Tributary Reach 1	The Unnamed Tributary of Blackwater Creek from the headwaters to the confluence	Same as General Reach Location	Flow temporarily reduced or eliminated	Section 35	327

Reach	General Reach / Wetland Location	Specific Reach / Wetland Location	Habitat Alteration	Authorization Required	Area of Fish Habitat Loss (m^2)
	with Blackwater Creek main channel				
Blackwater Creek Tributary 2 Reach 1	Downstream end of Blackwater Creek Tributary 2 upstream to the berm that surrounds the operation area.	Same as General Reach Location.	Flow temporarily reduced or eliminated.	Section 35	856
Blackwater Creek Tributary 2 Reach 2	Blackwater Creek Tributary 2 reach contained within the berm that surrounds the operation area.	Reach from berm at downstream end to wetland located within operation area.	Overprinted by Tailings Storage Facility.	Schedule 2	237
		Wetland located within operations area.	Overprinted by Tailings Storage Facility.	Schedule 2	1,445
		Blackwater Creek Tributary 2 as well as T2-A and T2-B R1 upstream of wetland and within berm that surrounds operation area.	Overprinted by Tailings Storage Facility.	Schedule 2	2,560
Blackwater Creek Tributary 2 Reach 3	Blackwater Creek Tributary 2 reach upstream of the berm that surrounds the operation area.	Reach from berm surrounding operations area upstream to proposed diversion channel.	Flow temporarily reduced or eliminated.	Section 35	140
Blackwater Creek Tributary 4	The open water portion of the wetland within the Zone of Influence (ZOI) that is underlain by a granular deposit	Same as General Wetland Location	Dewatering of the open pit could temporarily drain the open water within the creek (conservatively	Section 35	5,864

Reach	General Reach / Wetland Location	Specific Reach / Wetland Location	Habitat Alteration	Authorization Required	Area of Fish Habitat Loss (m^2)
	southeast of the Project, along with Tributary 4 downstream of the pond.		assumed 100% loss of the watercourse)		
		Blackwater Creek Tributary 4 downstream of the wetland	Dewatering of the open pit could temporarily drain the open water within the pond (conservatively assumed 100% loss of the pond)	Section 35	793
Hoffstrom's Bay Tributary	Includes all of the watercourse upstream of Thunder Lake	Same as General Reach Location.	Flow temporarily reduced or eliminated	Section 35	3,096
Total Area (m^2) Considered for Authorization under Section 35 of the *Fisheries Act*					**50,559**
Total Area (m^2) Considered for Schedule 2 amendment under the *MDMER*					**4,242**

Table F4.2-2: Estimate of Proposed Fish Habitat Offsetting/Compensation

Offsetting/Compensation Measure	Area of Fish Habitat Provided by Offsetting Measure (m^2)	Basis for Area Calculated for Offsetting / Compensation Measure
Diversion of Blackwater Creek Tributary 2, upstream of the operations area	3,047	Blackwater Creek Tributary 2 must be realigned to convey non-contact water around the proposed Project site. The most direct route to convey this water was provided as a drawing in the Fish Habitat Offsetting document. The length of this diversion would be 1,219 m straight downvalley. The proposed width of the bankfull channel which would be considered as the offsetting measure is 2.5 m, which when multiplied by the length gives an offsetting area of 3,047.5 m^2.
Creation of New Pond(s) for Fish Habitat	60,0000	This offsetting measure would involve the excavation of two new ponds to provide fish habitat. The ponds will be located adjacent to Blackwater Creek immediately downstream of the confluence with Blackwater Creek Tributary 1. The ponds will be located within Treasury Metal's current property boundary of claims and dispositions. The ponds will be connected to an existing creek via a short outlet channel and the water level within the creek it is connected to will set the water elevation for the pond. The new ponds will be excavated such that a total of 6.0 ha of area will be wetted based on this water elevation.



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LEGEND

- Hydro Line
- Natural Gas Pipeline
- Highway
- Local Street
- Resource / Recreation Trail
- Provinical Park / Nature Reserve
- Watercourse / Waterbody
- Contours (10 m interval)
- Property Boundary of Claims and Dispositions
- Area Beyond Property Boundary

Site Infrastructure

- Operations Area
- Access Haul Roads
- Pipeline
- Ditching
- Emergency Spillway
- Processing Plant and Ancillary Facilities
- Security Fence
- Stockpile

Fisheries Impacts

- Schedule 2
- Section 35

Habitat Offsetting Options

- Part 1: Blackwater Creek Tributary 2 Diversion (0.3 ha)
- Part 2: Potential New Pond / Basin Along Blackwater Creek (6 ha)

0 250 500 1,000 1,500 2,000 Metres

NOTES:
- Watercourses represent pre-development conditions based on LIO database, as modified by KBM.

Datum: NAD83
Projection: UTM Zone 15N

N W E S

TREASURY wood. METALS Inc.

GOLIATH GOLD PROJECT

Fisheries Impacts Compensation and Offsetting Locations

PROJECT N°: TC160516 | **Figure F4.2-1**

SCALE: 1:28,000 | DATE: November 2018

Table F5-1: Residual Adverse Effects for Fish and Fish Habitat

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
Stream-resident fish population	Direct loss or alteration of habitat	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	50% (2)	none	none	none
	Changes in flows or water levels	Net habitat loss (m^2)	0	0	0	0
	Changes in water quality	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0
	Blasting	Fish mortality proportion (%)	0	0	0	0
Migratory fish populations	Direct loss or alteration of habitat	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0
	Changes in flows or water levels	Net habitat loss (m^2)	0	0	0	0
	Changes in water quality	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0
	Blasting	Fish mortality proportion (%)	0	0	0	0
Lake-resident fish populations	Direct loss or alteration of habitat	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0
	Changes water levels	Net habitat loss (m^2)	0	0	0	0
	Changes in water quality	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0
	Blasting	Fish mortality proportion (%)	0	0	0	0
Fish species-at-risk	Direct loss or alteration of habitat	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0
	Changes in flows or water levels	Net habitat loss (m^2)	0	0	0	0
	Changes in water quality	Net habitat loss (m^2)	0	0	0	0
		Fish mortality proportion (%)	0	0	0	0

Valued Components (VCs)	Indicators	Measures	Site Preparation and Construction	Operations	Closure	Post-closure
	Blasting	Fish mortality proportion (%)	0	0	0	0

Notes:

(1) It was predicted that there would be a 50% mortality for those stream-resident fish that remained in the portions of Blackwater Creek Tributary 1 and Blackwater Creek Tributary 2 overprinted as a result of the Project.

F6 Fish and Fish Habitat Follow-up Program

As part of the Round 2 information requests, there were a number of questions and concerns from the reviewers regarding the Fish and Fish Habitat Follow-up Program. Specifically, the information requests asked that Treasury Metals update the Fish and Fish Habitat Follow-up Program to reflect any changes to the effects assessment on fish and fish habitat. The following monitoring component was added to the Follow-up Program to address the Round 2 information request TMI_895-FFH(2)-04 regarding the potential for increased water temperature in the Blackwater Creek Tributary 2 diversion channel due to the lack of riparian vegetation providing shade to the channel:

- Water temperature will be monitored with temperature loggers that include out of water detection (onset HOBO TidbiT MX Temperature 400' or similar) from June 1 through September 30 each year, with temperature logged at half-hour intervals.

For the complete Fish and Fish Habitat Follow-up Program, please refer to The Goliath Gold Project Follow-up Program Addendum.

F7 References

Fisheries and Oceans Canada (DFO). 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries In Canada. Canadian Science Advisory Secretariat Science Advisory Report 2013/017.

Wright, D.G., and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Can. Tech. Rep. Fish. Aquat. Sci. 2107: iv + 34p.