

Appendix 6.7-C

Conceptual Fish Habitat Offsetting Plan

AJAX PROJECT

**Environmental Assessment Certificate Application / Environmental Impact Statement
for a Comprehensive Study**

**KGHM AJAX MINING INC.
AJAX PROJECT**



CONCEPTUAL FISH HABITAT OFFSETTING PLAN

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KGHM AJAX MINING INC. AJAX PROJECT

CONCEPTUAL FISH HABITAT OFFSETTING PLAN VA101-246/36-1

Rev	Description	Date
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EXECUTIVE SUMMARY

Purpose

The Ajax Project will result in the permanent loss of fish habitat, which is considered *serious harm to fish* as defined by the *Fisheries Act*. In British Columbia, proposed Major Projects are required to obtain an Environmental Assessment Certificate in accordance with the *British Columbia Environmental Assessment Act* (BCEAA). Federally, the Ajax Project will undergo a Comprehensive Study according to the transition provisions under the *Canadian Environmental Assessment Act* 2012 (CEAA 2012) with the Canadian Environmental Assessment Agency (CEA Agency) providing a lead coordination role. An Application for an Environmental Assessment Certificate and Environmental Impact Statement (Application/EIS) must be made by the Project Proponent to the Environmental Assessment Office (EAO) and CEA Agency, and the Application/EIS must comply with all the information requirements set out in the Application Information Requirements (AIR) and EIS Study Guidelines (AIR/EIS Guidelines) formally approved and issued by the EAO and CEA Agency. The AIR/EIS Guidelines for the Ajax Project state: “*If serious harm to fish or fish habitat is unavoidable, the Application/EIS will describe the serious harm and will present a conceptual fish habitat offsetting plan. The guidance material provided by Fisheries and Oceans Canada, and MOE will be used in the development of a Fish Habitat Offsetting Plan*”.

This document presents the Conceptual Fish Habitat Offsetting Plan (the Offsetting Plan) to address the unavoidable *serious harm* to fish via loss of fish habitat as a result of the Ajax Project. The Plan has greatly benefited through consultation with regulatory agencies and Aboriginal groups to offset serious harm and provide a new productive recreational and Aboriginal fishery. This Plan has been drafted to exceed the requirements of Section 35(2) of the *Fisheries Act* and provides Fisheries and Oceans Canada (DFO) with the information necessary to confirm that measures to offset unavoidable residual *serious harm to fish* can be achieved. The offsetting concept presented will be advanced to a detailed Offsetting Plan with accompanying engineering design that will be part of an application for authorization of *serious harm to fish* under the *Fisheries Act*.

Consultation

The Offsetting Plan has relied on consultation with federal and provincial governments, community groups, and with Aboriginal groups. Several fisheries-related meetings have occurred with DFO, the Ministry of Forests, Lands, and Natural Resources Operations (FLNRO), stakeholders, and Aboriginal groups since 2014. The BC EAO Section 11 Order (issued on January 11, 2012) and the Section 13 Order (issued July 23, 2015) for the Ajax Project identified the following Aboriginal Groups with asserted interests that could potentially be affected by the Project:

- Tk'emlúps te Secwépemc (TteS) and Skeetchestn Indian Band (SIB), jointly known as the Stk'emlupsemc te Secwépemc Nation (SSN)
- Lower Nicola Indian Band (LNIB) located in nearby Merritt and a part of the Nlaka'pamux Nation, and
- Ashcroft Indian Band (AIB) located close to the Town of Ashcroft and part of the Nlaka'pamux Nation.

In addition, the CEA Agency directed KGHM Ajax Mining Inc. (KAM) to engage with and collect information from the Whispering Pines/Clinton Indian Band (WP/CIB), part of the Secwépemc Nation.

Potential effects on Jacko Lake and Peterson Creek are a key concern of the SSN. The SSN refer to Jacko Lake as Pipsell and value it for Aboriginal harvesting resources (fish, riparian plants) and as a spiritual place. The SSN believe that trout people, or spirits, exist both within and below Jacko Lake and move through the underground waters between various water bodies (SSN 2015a, 2015b). Through consultation, SSN has identified Jacko Lake as having cultural significance and has stated there is no acceptable mitigation for impacts to Jacko Lake. Avoidance has been the only acceptable alternative provided by the SSN to date. KAM acknowledges the importance of protecting Jacko Lake and has taken significant measures to address concerns of the SSN. In addition to concerns over impacts to Jacko Lake and Peterson Creek, the SSN has stated an interest in improving existing Aboriginal Fisheries. This feedback has helped KAM understand the importance of Jacko Lake and Peterson Creek to the SSN and has taken this into account by limiting the impacts to the waterbody to the extent possible and selecting the preferred offsetting concept that seeks to enhance overall production of Aboriginal and recreational fishing in the Project area.

Existing Conditions

Jacko Lake is considered a recreational and Aboriginal fishery. Provincial records report that no fish were present in the waterbody in 1939. However, anecdotal reports suggest that Jacko Lake was an important rainbow trout fishery before the arrival of Europeans, and that local Aboriginal Groups fished for rainbow trout and kokanee. Peterson Creek within the Project area downstream of Jacko Lake offers marginal rainbow trout spawning and rearing habitat due to the high silt content of the substrate, lack of instream cover and low channel complexity, minimal riparian habitat, and high summer water temperatures and low dissolved oxygen concentration due to low flows. Rainbow trout in Peterson Creek in the proposed Project area therefore do not directly support a recreational fishery or contribute to the productivity of the Jacko Lake rainbow trout population.

Potential Effects and Serious Harm Assessment

A comprehensive assessment of potential effects of the Project on fish and fish habitat was undertaken as required by the AIR/EIS Guidelines for the Ajax Project. The Project has the potential to affect fish and aquatic resources (including habitat) upon which they rely due to the proximity of Project components to Jacko Lake and Peterson Creek. Mitigation measures to avoid, minimize, or control potential adverse effects of the Project on Fish and Fish Habitat were identified, including: design changes; implementation of industry best management practices; and provision of restoration or offsetting. Avoidance of activities that have the potential to incur serious harm to fish has been integral to the design and engineering of the Project, and has been accomplished in two ways. First, the number, duration, and spatial extent of alterations of fish habitat have been reduced, to the extent possible, by working with the design team to relocate or re-engineer mine components or activities that could potentially result in serious harm to fish. Second, measures have been developed to mitigate the spatial extent, duration, and magnitude of any unavoidable effects to fish habitat that may be considered serious harm to fish. Where residual serious harm to fish remains after avoidance and mitigation measures are incorporated, an offsetting concept has been proposed.

The total fish habitat losses identified as unavoidable serious harm to fish total 8.08 ha for the Ajax Project. This includes a net gain of 2.29 ha of instream habitat, a net loss of 1.85 ha of lake habitat, and a net loss of 8.51 ha of riparian habitat.

Conceptual Offsetting Plan

The proposed Offsetting Plan concept is to modify the volume and depth of Inks Lake by draining, excavating, and re-filling the modified basin using fresh water from Kamloops Lake. Inks Lake is located west of Jacko Lake and is unable to support fish without enhancement due to its shallow depth, lack of inflow, and unsuitable water quality. By increasing the depth and volume of Inks Lake and supplying appropriate water, it has the potential to support fish and create an Aboriginal and recreational fishery through the annual stocking of rainbow trout. The potential fish habitat gains that could be accomplished by establishing a fishery on Inks Lake have the potential to greatly exceed the fish habitat offsetting requirements for the Ajax Project.

The net habitat balance resulting from the Offsetting Plan is 2.29 ha of instream habitat, 4.22 ha of lake habitat, and -0.12 ha of riparian habitat. After taking into account proposed offset to loss ratios, the net positive value of 6.39 ha demonstrates that the proposed Conceptual Fish Habitat Offsetting Plan is larger than necessary to offset the amount of serious harm to fish and fish habitat from the Ajax Project. Pending review comments and discussion with agencies, further adjustments to the Conceptual Offsetting Plan will be necessary such that fish habitat offsetting is equivalent to the magnitude of serious harm identified for the Project.

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APPENDICES

Appendix A	Fish and Fish Habitat Site Photos
Appendix B	Peterson Creek Fish Habitat Mapping

ABBREVIATIONS

AIB	Ashcroft Indian Band
AIR	Application Information Requirements
AIR/EIS Guidelines	Application Information Requirements/Environmental Impact Statement Guidelines
Application/EIS	Application /Environmental Impact Statement
BC	British Columbia
BCEAA	BC Environmental Assessment Act
°C	Degrees Celsius
CEAA 2012	Canadian Environmental Assessment Act 2012
CEA Agency	Canadian Environmental Assessment Agency
CRA	Commercial, Recreational, or Aboriginal
CV	Coefficient of Variation
DFO	Fisheries and Oceans Canada
EA	Environmental Assessment
EAO	Environmental Assessment Office
EIS	Environmental Impact Statement
EC	Environment Canada
FFSBC	Freshwater Fisheries Society of BC
FISS	Fisheries Information Summary System
FLNRO	Ministry of Forests, Lands, and Natural Resource Operations
g	grams
ha	hectare
hr	hour
IDF	Inflow Design Flood
KAM	KGHM Ajax Mining Inc.
KGHM	KGHM Polska Miedz S.A.
km	kilometer
km ³	kilometer cubed
KP	Knight Piésold Ltd.
LNIB	Lower Nicola Indian Band
LSA	Local Study Area
m	meter
m ³	meter cubed
m ³ /s	meters cubed per second
MAP	mean annual precipitation
masl	Meters Above Sea Level
MEM	Ministry of Mines
Mm ³	million meters cubed
MOE	Ministry of Environment
MOF	Ministry of Forests
MOTI	Ministry of Transportation and Infrastructure
MRSF	Mine Rock Storage Facilities
na	not applicable

n.d. no date
Offsetting Plan Fish Habitat Offsetting Plan
PCDSPeterson Creek Diversion System
PETPotential Evapotranspiration
PMP Probable Maximum Precipitation
Project.....the Ajax Project
RSA..... Regional Study area
SARA Species at Risk Act
SIB Skeetchestn Indian Band
SSN..... Stk’emlupsemc te Secwépemc Nation
TSF Tailings Storage Facility
TteSTk’emlúps te Secwépemc
VC(s)..... Valued Component(s)
WMP Water Management Plan
WP/CIB Whispering Pines/Clinton Indian Band

1 – INTRODUCTION

1.1 REPORT PURPOSE AND ORGANIZATION

The Ajax Project will result in the permanent loss of fish habitat, which is considered *serious harm to fish* as defined by the *Fisheries Act*. In British Columbia, proposed Major Projects are required to obtain an Environmental Assessment Certificate in accordance with the *British Columbia Environmental Assessment Act* (BCEAA). Federally, the Ajax Project will undergo a Comprehensive Study according to the transition provisions under the *Canadian Environmental Assessment Act* 2012 (CEAA 2012) with the Canadian Environmental Assessment Agency (CEA Agency) providing a lead coordination role. An Application for an Environmental Assessment Certificate and Environmental Impact Statement (EIS) must be made by the Project Proponent to the Environmental Assessment Office (EAO) and CEA Agency, and the Application/EIS must comply with all the information requirements set out in the Application Information Requirements (AIR) and EIS Study Guidelines (AIR/EIS Guidelines) formally approved and issued by the EAO and CEA Agency. The AIR/EIS Guidelines for the Ajax Project state: “*If serious harm to fish or fish habitat is unavoidable, the Application/EIS will describe the serious harm and will present a conceptual fish habitat offsetting plan. The guidance material provided by Fisheries and Oceans Canada, and MOE will be used in the development of a Fish Habitat Offsetting Plan*”.

The purpose of this Conceptual Fish Habitat Offsetting Plan (the Offsetting Plan) document is to demonstrate that the fish habitat offsetting strategy for the Ajax Project will comply with the requirements of Section 35(2) of the *Fisheries Act*. The intent of the Offsetting Plan is to provide Fisheries and Oceans Canada (DFO) with the information necessary to determine if measures to offset unavoidable residual *serious harm to fish* (as defined in the *Fisheries Act*) can be achieved. The Offsetting Plan has the following objectives:

1. Identify, describe, and quantify all potential residual effects of the Project that may result in *serious harm to fish*, which may occur during the construction, operations, closure and post-closure phases.
2. Describe the fish species being affected by the proposed Project activities and the importance of the affected habitat to the fish population and Commercial, Recreational, or Aboriginal (CRA) fisheries.
3. Describe, rationalize, and quantify the proposed concept to offset the loss of fish productive capacity and support available fisheries management objectives and local restoration priorities.
4. Describe the benefits and uncertainty associated with the proposed offsetting concept.
5. Describe potential limitations to constructability for the proposed offsetting concept.
6. Outline a monitoring plan to assess the effectiveness of fish habitat created to offset habitat losses.

The only fish species in the Project site is resident rainbow trout (*Oncorhynchus mykiss*) that were introduced to Jacko Lake in the 1940s and sustained by annual stocking of hatchery raised rainbow trout since the mid-1950s. The unavoidable *serious harm to fish* identified in this report is associated with resident rainbow trout habitat in Jacko Lake and its outlet stream, Peterson Creek.

The organization of the report is based on DFO guidance concerning the Fisheries Protection Policy, fish habitat offsetting, and the content of applications for *Fisheries Act* Authorization (DFO 2013a, 2013b, 2013c). The goal of this report is to describe the concept to offset the permanent loss of fish

habitat and associated productive capacity by carrying out the Project. The concept will serve as the basis for an application for authorization of *serious harm to fish* habitat as required by the *Fisheries Act*. This application will be developed and submitted during the environmental assessment of the Project using preliminary engineering design and other analyses and information as described in this conceptual plan.

1.2 REGULATIONS AND POLICY

1.2.1 Federal Policy and Guidelines

The Federal Fisheries Protection Policy Statement and the Proponents Guide to Offsetting (DFO 2013a, 2013b) provide direction for interpreting the broad powers mandated in the *Fisheries Act*. They outline DFO's objective of maintaining or enhancing ongoing productivity and sustainability of CRA fisheries. DFO is guided by the following principles to meet the goal and objectives of the Fisheries Protection Policy Statement (DFO 2013a):

- Avoid harm: Whenever possible, DFO's preference is to maintain the productivity of Canada's fisheries by avoiding impacts to fish and fish habitat. Proponents are responsible for managing and mitigating impacts resulting from their projects.
- Promote sound decision-making: In making regulatory decisions, DFO will be informed by the best available science, technical information, and traditional knowledge and be guided by the application of precaution and a risk-based approach to decision-making.
- Enable best-placed delivery: Other entities across Canada may be well-placed to achieve and deliver the objectives of the fisheries protection provisions. DFO will seek to collaborate with partners who have the knowledge, capacity, and interest in fisheries conservation and protection when these align with DFO's mandate, priorities, and objectives.
- Employ a standards-based approach: DFO will develop and support the use of standards that provide clarity and certainty to proponents while maintaining the sustainability and ongoing productivity of Canada's fisheries.
- Consider the ecosystem context: The consideration of cumulative effects on the state, resiliency, and natural biodiversity of the ecosystem will guide DFO in achieving the objectives of the Fisheries Protection Policy Statement.

Under these principles, DFO works with proponents and government agencies to ensure that projects are designed to maintain fish habitat while recognizing the potential or existing land use value. In cases where losses of fish habitat cannot be avoided by project development, habitat replacement or enhancement may be accepted as offsetting measures on a case by case basis. Offsetting is interpreted through the Policy as follows:

"An offset measure is one that counterbalances unavoidable *serious harm to fish* resulting from a project with the goal of maintaining or improving the productivity of the Commercial, Recreational, or Aboriginal Fishery. Offset measures should support available fisheries management objectives and local restoration priorities" (DFO 2013a).

Once it has been determined that a *Fisheries Act* Authorization is required in order for a project to proceed, the four factors described in Section 6 of the Act must be considered by the Minister before an Authorization can be issued. These factors are:

1. The contribution of the relevant fish to the ongoing productivity of Commercial, Recreational, or Aboriginal (CRA) Fisheries
2. Fisheries management objectives
3. Whether there are measures and standards to avoid, mitigate, or offset *serious harm to fish* that are part of a Commercial, Recreational, or Aboriginal Fishery, or that support such a fishery, and
4. The public interest.

An offsetting plan is intended to describe measures to offset any residual impacts that will cause serious harm to fish and should also demonstrate that the offsetting measures will maintain or improve the productivity of the impacted fishery.

Other factors to be considered in an offsetting plan include:

- Opportunities to mitigate existing impacts or constraints to fish and fish habitat in the watershed
- Aboriginal Group's traditional access to fish in the area, traditional uses, and ecological knowledge
- Compliance of offsetting plans with recovery planning for species listed under the *Species at Risk Act* (SARA)
- Risk of failure and the time lag until offsetting habitats become fully functional
- Potential for the proposed project to adversely affect the offsetting works in the future
- Intrinsic value of habitat to be enhanced compared with the productive capacity gained through habitat enhancement, and
- Perpetuity of offsetting works.

In addition to the above factors, the following criteria were also considered in the development of this Offsetting Plan:

- Site specificity – to the extent possible the offset measures should be implemented within the sub watersheds that are within the local study area.
- Locally valued fish species – the offset measures selected for implementation should consider the interests of local fisheries use.
- High probability of success with measurable results – the offset measures selected for implementation should be associated with a high likelihood of success to make a meaningful contribution to the local fishery, and should be measurable.

1.2.2 British Columbia Government

The British Columbia (BC) Provincial Government has no direct legal authority over the protection of fish habitat. Given this, the Province defers decisions on the acceptability of *serious harm to fish* and fish habitat and the proposed compensation for these to DFO. However, BC Ministry staff can provide expert advice and recommendations to DFO and proponents as part of the planning process to identify, avoid, mitigate, and offset serious harm to fish. This includes direction on regional or provincial fisheries management objectives that may be used to guide offsetting planning.

The province of BC has set a goal to be recognized for providing the “Best Fisheries Management, Bar None” (MOE 2007). To achieve this goal the Ministry of Environment (MOE) has created the Freshwater Fisheries Program to assist government staff and partners in prioritizing efforts and collaboration to effectively manage freshwater fisheries in BC.

The Freshwater Fisheries Program is developed and delivered through the Environmental Stewardship Division of the MOE and the Freshwater Fisheries Society of BC (FFSBC), a non-profit organization previously part of the MOE. FFSBC annually stocks approximately 1000 lakes and streams and provides conservation fish culture services to support the recovery of endangered fish species. The mission of FFSBC is to build the best freshwater fisheries in North America. MOE (2007) lists the guiding principles of FFSBC as:

- Wild fish populations are an important component of healthy aquatic ecosystems and the foundation of significant social and economic benefits to the Province. These benefits are derived from a variety of recreational opportunities.
- Aboriginal Groups and Stakeholder interests and preferences should be explicitly addressed in fisheries management, restoration, and enhancement plans.
- Angling is recognized as a valued and healthy pursuit.
- The relationship among governments, Aboriginal Groups, Partners, and Stakeholders involved in fisheries management must be clear, collaborative and productive.
- The best available science will be provided to decision makers and the public - decisions will be transparent about the trade-offs being made and the uncertainties that exist.
- Strong shared stewardship of our fisheries resource is dependent on increasing awareness and accountability for fish and fish habitat among all British Columbians.
- Credibility and expertise will be maintained by promoting innovative approaches to recruitment, training, professional development and succession planning.

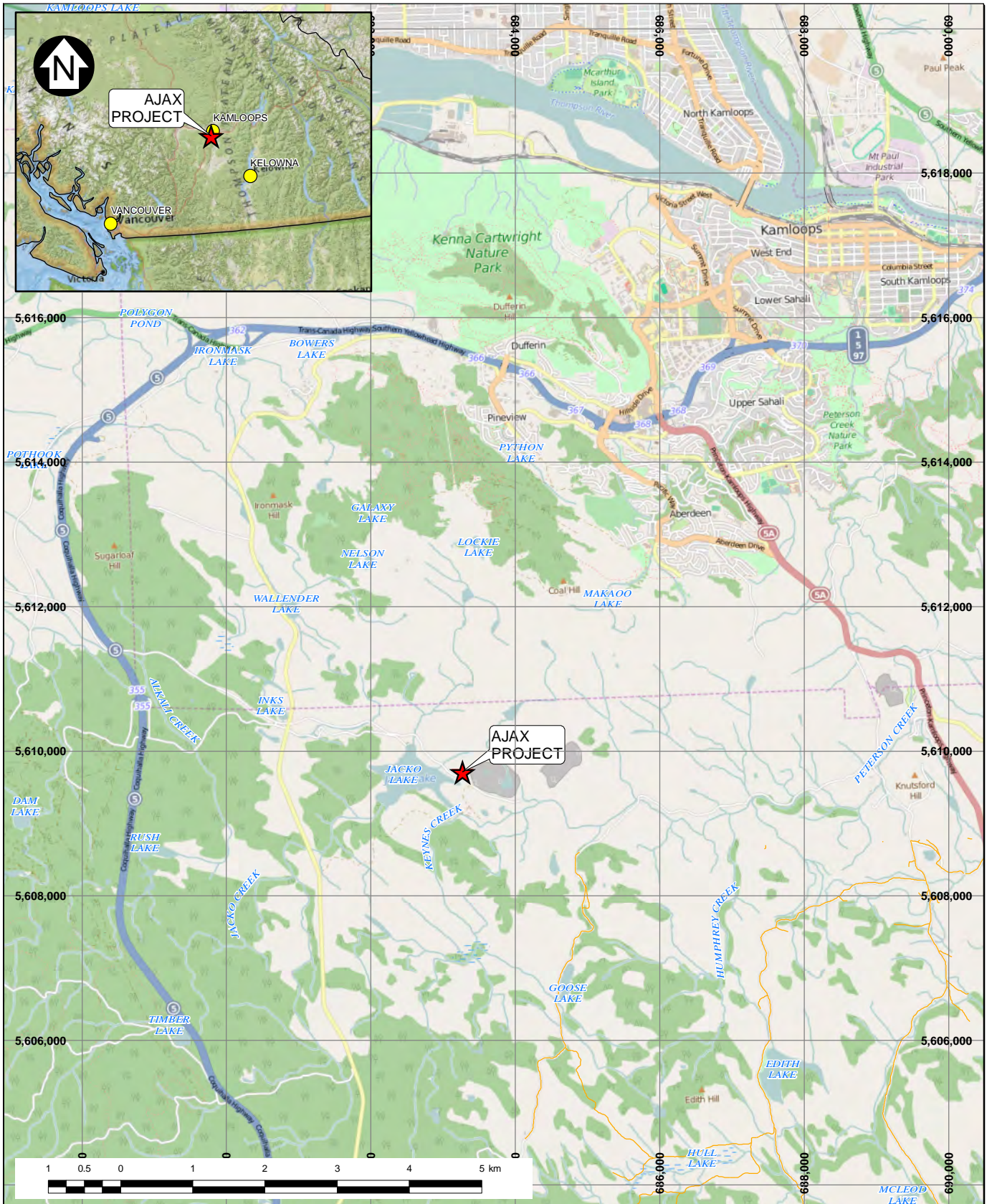
Webb (2007) list priorities for small lakes fisheries management in the Thompson Nicola Region as securing and conserving water, developing a management strategy to address non-indigenous fish introductions, and assessing and simplifying fishing regulations.

1.3 AJAX PROJECT OVERVIEW AND SCHEDULE

The proponent KGHM Ajax Mining Inc. (KAM), proposes to develop the Ajax Project (the Project), an open pit copper-gold mine at the historic Afton Mining Camp, south of the City of Kamloops, BC. The Project is located in the South-Central Interior of British Columbia, southeast of the junction of the Trans-Canada Highway No. 1 and the Coquihalla Highway (No. 5), within the Thompson Nicola Regional District (Figure 1.1). The Ajax property includes two historic pits: the Ajax West Pit, and the Ajax East Pit. Both pits were mined in the 1980s and 1990s.

The British Columbia EAO Section 13 Order for the Project identified the following Aboriginal Groups that could potentially be affected by the Project:

- Tk'emlúps te Secwépemc (TteS) and Skeetchestn Indian Band (SIB), jointly known as the Stk'emlupsemc te Secwépemc Nation (SSN). The SSN represents the TteS and the SIB in all matters within the traditional territory. All matters on Indian Reserve lands are dealt with separately at the individual First Nation level. In 2007, the two groups formed the SSN to manage negotiations, conservation, and resources for the New Afton open pit mine (BC Aboriginal Business and Investment Council, n.d.). However, historically the TteS and the SIB were considered by the Secwepemc to be one (SSN 2015a, 2015b). The SSN aims to strengthen the economic and social conditions for its Nation members and works to capitalize on business opportunities arising from the resource sector. Both groups are members of the Secwépemc Nation.



LEGEND:
 ★ PROJECT LOCATION

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE OPEN STREET MAP.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N..
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:75,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	OG DESIGNED	CAC DRAWN	RCB REVIEWED
0	17AUG15	ISSUED WITH REPORT			

KGHM AJAX MINING INC.

AJAX PROJECT

PROJECT LOCATION

Knight Piésold
CONSULTING

PI/NO. VA101-246/36	REF NO. 1
FIGURE 1.1	
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- Lower Nicola Indian Band (LNIB) located nearby Merritt and a part of the Nlaka'pamux Nation.
- Ashcroft Indian Band (AIB) located close to the Town of Ashcroft and part of the Nlaka'pamux Nation.

The Whispering Pines/Clinton Indian Band (WP/CIB) is an additional Aboriginal Group with interests in the Project area. The CEA Agency directed KAM to engage with and collect information from the WP/CIB. The WP/CIB reserves are located near Clinton on Highway 97 and near Kamloops, BC. The WP/CIB is a member of the Secwépemc Nation (Shuswap Nation Tribal Council 2014).

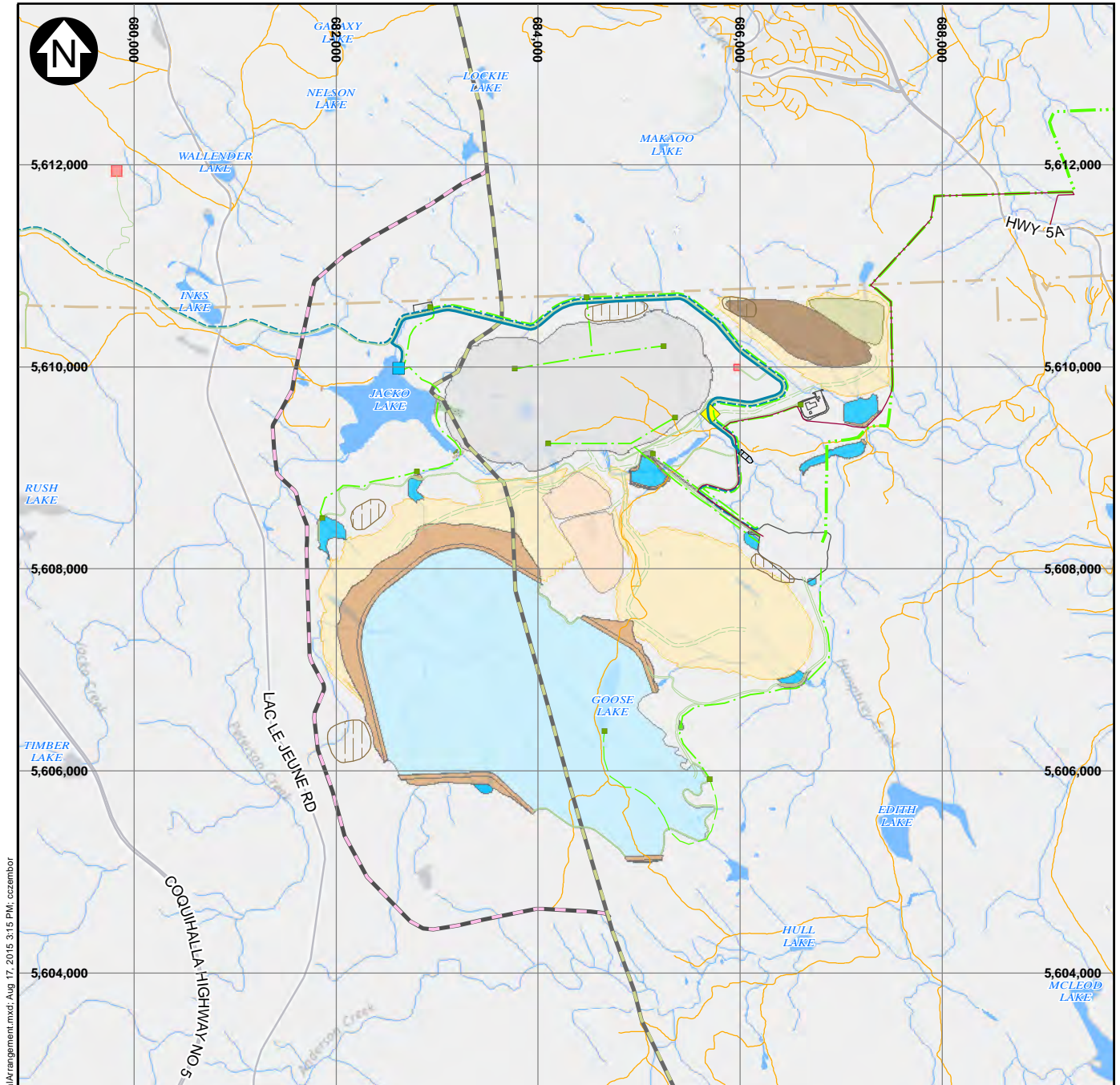
The Project lies within the Secwépemc traditional territory. The Project also lies in the Nlaka'pamux Nation (LNIB and AIB) traditional territory. KAM also continues to engage Metis Nation BC, as directed by the CEA Agency. Key Project facilities include the Tailings Storage Facility (TSF), water management ponds, Peterson Creek diversion, and the Tailings Embankments, which will be constructed using mine rock, and four mine rock storage facilities (MRSFs) (Figure 1.2). The four MRSFs include the:

- South Mine Rock Storage Facility
- East Mine Rock Storage Facility
- West Mine Rock Storage Facility, and
- In-Pit Mine Rock Storage Facility.

Several facilities that will be part of the Operation phase but will not remain after Project closure include the:

- Plant Facilities and Administration Buildings
- Reclamation Stockpiles
- Explosives Facility
- Truck Stop and Fuel Storage
- Power Lines
- Water Lines, and
- Access Roads.

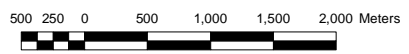
The mine plan for the Project predicts an operation based on a mill throughput of 65,000 tonnes of ore per day from the Ajax Pit with up to a 23-year mine life. The Construction phase of the Project will be 2.5 years and following the 23-year Operation the Decommissioning and Closure phase is expected to take 5 years. The Post Closure phase will be 5+ years and will include ongoing reclamation activities and Post Closure monitoring. Over the mine life, the Project will produce approximately 140 million pounds of copper and 130,000 ounces of gold annually with the concentrate shipped by truck to the Port Metro Vancouver. The Ajax Project phases and timelines are shown in Table 1.1 below.



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LEGEND:

<ul style="list-style-type: none"> ROAD MINOR ROAD RIVER/CREEK LAKE CITY OF KAMLOOPS BOUNDARY <p>PROPOSED JACKO LAKE FACILITIES</p> <ul style="list-style-type: none"> DAM OUTLINE NE ARM LOSS EXISTING SE ARM BERM 	<p>PROPOSED PETERSON CREEK FACILITIES</p> <ul style="list-style-type: none"> DIVERSION INTAKE DIVERSION DIVERSION DISCHARGE <p>PROPOSED MINE SITE FACILITIES</p> <ul style="list-style-type: none"> OVERPASS ELECTRICAL INFRASTRUCTURE POWERLINE - CABLE POWERLINE - 25kV 	<ul style="list-style-type: none"> POWERLINE - 230kV ROAD - MINE SITE ROAD - HAUL NATURAL GAS LINE (APPROX. LOCATION) WATERLINE KINDER MORGAN PIPELINE - CURRENT KINDER MORGAN PIPELINE - REROUTED OPEN PIT TAILINGS STORAGE FACILITY (TSF) 	<ul style="list-style-type: none"> TSF EMBANKMENT WATER MANAGEMENT POND WATER MANAGEMENT DAM/EMBANKMENTS RECLAMATION STOCKPILE TOPSOIL STOCKPILE OVERBURDEN STOCKPILE ORE STOCKPILE MINE ROCK STORAGE FACILITY (MRSF) CRUSHER/CONVEYOR 	<ul style="list-style-type: none"> RECLAIM TANK PAD MINE SITE BUILDINGS EXPLOSIVES FACILITY
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NOTES:

- BASE MAP: ESRI ARCGIS ONLINE MAPPING.
- COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

KGHM AJAX MINING INC.	
AJAX PROJECT	
PROJECT GENERAL ARRANGEMENT PLAN	
	P/A NO. VA101-246/36 REF NO. 1 FIGURE 1.2 REV 0

REV	DATE	DESCRIPTION	OG DESIGNED	CAC DRAWN	RCB REVIEWED
0	17AUG15	ISSUED WITH REPORT			

Table 1.1 Ajax Project Mine Phases and Schedule

Project Phase	Duration Years	Calendar Years	Mine Life Years
Construction	2.5	2017 to 2019	-2 to 1
Operation	23	2020 to 2042	1 to 23
Decommissioning and Closure	5	2043 to 2048	24 to 29
Post Closure	TBD	TBD	TBD

1.4 CONSULTATION

The development of this Offsetting Plan has included consultation with federal and provincial governments, community groups and with Aboriginal Groups. Several fisheries-related meetings have occurred with DFO, the Ministry of Forests, Lands, and Natural Resources Operations (FLNRO), stakeholders, and Aboriginal Groups since 2014 as listed in Table 1.2. These discussions have provided:

- KAM with the opportunity to describe the Project and its potential impacts to fish and fish habitat to regulators
- KAM with information regarding SSN concerns over impacts to Aboriginal fisheries including those in Jacko Lake and Peterson Creek
- Federal and provincial regulators and Aboriginal Groups with the opportunity to articulate their concerns about the Project and their respective fisheries management objectives
- DFO with the opportunity to describe their obligations under the *Fisheries Act* and the “Fisheries Productivity Investment Policy” (DFO 2013b) and their expectations for what is included in the Offsetting Plan, and
- The opportunity to collectively determine how best to achieve fish habitat offsetting through compilation, screening, and finalization of offset options supported by all parties.

Table 1.2 Fish Habitat and Offsetting Consultation Events

Date	Location	Attendees / Request To	Description
May 29, 2014	Kamloops	SSN, KAM	Fish Habitat Loss
Sep 17, 2014	Kamloops	Fish and Game Assoc. Reps, KAM	Fish Habitat Loss Compensation Plan - Special Interest Group Meeting
Oct 6, 2014	Kamloops	SSN	Requested meeting to discuss Fish Habitat and Offsetting without response
Oct 8, 2014	Kamloops	FLNRO, DFO, MOE, KAM	Fish Habitat Effects and Offsetting Meeting
Feb 5, 2015	Kamloops	FLNRO, DFO, KAM, SSN	Fish Baseline and Fish Habitat Offsetting Meeting
Apr 21, 2015	Kamloops	FLNRO, DFO, MOE, KAM, SSN	Fish Habitat Offsetting and Loss of Fishing Experience
May 15, 2015	Kamloops	SSN	Requested meeting to discuss fish habitat offsetting without response
Jul 13, 2015	Kamloops	SSN	Requested meeting to discuss fish habitat offsetting without response

Consultation with the above groups has provided important information which has helped shape the offsetting plan for the Project. The following is a summary of key information received from Aboriginal Groups, Community Groups as well as Federal and Provincial Agencies.

1.4.1 Aboriginal

The BC EAO section 11 Order (issued on January 11, 2012) and the section 13 Order (issued July 23, 2015) for the Ajax Project identified the following Aboriginal Groups with asserted interests that could potentially be affected by the Project:

- Tk'emlúps te Secwépemc (TteS) and Skeetchestn Indian Band (SIB), jointly known as the Stk'emlupsemc te Secwépemc Nation (SSN)
- Lower Nicola Indian Band (LNIB) located in nearby Merritt and a part of the Nlaka'pamux Nation, and
- Ashcroft Indian Band (AIB) located close to the Town of Ashcroft and part of the Nlaka'pamux Nation.

In addition, the CEA Agency directed KAM to engage with and collect information from the WP/CIB, part of the Secwépemc Nation.

The SSN has reiterated concerns with impacts of the Project to Jacko Lake and Peterson Creek. To date, the SSN has not provided preferred ideas for offsetting; the SSN has stated the best option to mitigate serious harm to fish and fish habitat is through the avoidance of impacts.

Potential effects of the Project to Jacko Lake and Peterson Creek are a key concern of the SSN. The SSN refer to Jacko Lake and the surrounding area as Pipsell and value it for Aboriginal harvesting resources (fish, riparian plants) and as a spiritual place. The SSN believe that trout people, or spirits, exist both within and below Jacko Lake and move through the underground waters between various

water bodies. During consultation, SSN has identified Jacko Lake as having cultural significance. The SSN has also expressed concerns that Peterson Creek would be permanently altered regardless of reclamation efforts and that the temporary diversion would create permanent effects on a spring Aboriginal fishery on Peterson Creek. KAM acknowledges the importance of protecting these waterbodies and has taken significant measures to address SSN's concerns.

In 2014, KAM investigated the potential connectivity between Jacko Lake and the proposed Ajax pit to protect the lake from potential adverse effects associated with the Project. This investigation was undertaken in part to address SSN concerns that Jacko Lake may seep into the pit. The investigation required a Notice of Work under the Multi-Year Area Based authorization MX-15-188 granted by the Ministry of Energy and Mines (MEM). The Notice of Work was approved in December 2013. From September 2012 to December 2013, KAM exchanged numerous emails and letters, held 11 meetings to present Jacko Lake investigation options and seek SSN feedback, and also hosted a site tour for SSN elders. As a result of this consultation, KAM developed a deeper understanding of SSN concerns related about Jacko Lake which includes concerns about disturbance to the bottom of Jacko Lake. This led to significant changes to the Jacko Lake investigation program to address SSN concerns, facilitate SSN involvement in program monitoring and support SSN oversight on all reclamation work associated with the investigation program.

In a meeting with KAM on May 29 2014, SSN requested clarification about the potential loss of north-east arm of Jacko Lake. At the meeting KAM stated that the Open Pit will impinge on the northeast arm of the lake and the Kinder Morgan pipeline, which will require relocation by decommissioning a segment of the existing pipeline and constructing a new segment west of Jacko Lake. Currently the pipeline segment is located under the northeast arm of Jacko Lake and will require removal. An embankment consisting of a sheet-pile dyke structure would be installed west of the existing pipeline to enable removal and will remain in place throughout the mine life to provide a barrier and buffer between Jacko Lake and the open pit boundary and storage of the Probable Maximum Precipitation (PMP) within Jacko Lake.

With respect to information sharing, KAM provided SSN with historical documentation relating to Jacko Lake. This information outlines how the lake was raised incrementally over the past century largely for agricultural and irrigation purposes. KAM also made various requests to the SSN to discuss the Project General Arrangement to disclose potential impacts to Jacko Lake, the preliminary habitat assessment for Jacko Lake, potential habitat offsetting requirements, potential habitat offsetting opportunities for Jacko Lake and within the Kamloops area, and to address concerns regarding Jacko Lake fish habitat. However, the SSN were not available to meet or did not respond to invitation. In October 2014, KAM presented to the SSN Joint Resource Council an overview of baseline data and effects assessments for geochemistry, water balance, water quality, as well as pit/lake closure plans, and Jacko Lake/pit connectivity. KAM requested a follow up meeting to discuss the topic in greater detail with KAM consultants. KAM was unsuccessful in securing this meeting with SSN.

KAM shared information on the results of baseline studies, preliminary effects assessments, and proposed offsetting mitigation plans for the fish populations and fish habitat VC. This included two meetings on February 5, 2015 and April 21, 2015. Discussions focused on fish habitat losses and gains, the history of Jacko Lake and its preliminary habitat assessment, and alternative habitat offsetting suggestions. One of the goals of the meeting was to obtain SSN input into suggestions for

habitat offsetting plans in the Kamloops area. From October 2014 to present, KAM continued to try and arrange meetings with the SSN to discuss fish habitat offsetting plans and gain SSN input. These efforts are on-going.

KAM has also undertaken a number of measures to address SSN concerns regarding Jacko Lake and water resources. This includes ensuring that the assessment of potential effects on the surface water quality Valued Component (VC) utilizes sound water quality research, assesses potential effects on water quality, and identifies measures to protect water quality. In addition, KAM implemented measures to address concerns on Jacko Lake such as:

- Maintaining access to Jacko Lake during operations (however, use of Jacko Lake and surrounding land will be restricted during blasting for public safety). Notification of blasts will be provided in advance. KAM has developed blasting protocols to ensure that vibrations comply with guidelines for fish.
- Potential effects on SSN harvesting are assessed and described in an additional VC titled Current Use of Lands and Resources for Traditional Purposes in the Application/EIS.
- The assessment of potential effects on the grasslands surrounding Jacko Lake (known to have provided plant harvesting opportunities for the SSN) and water quantity and water quality VCs are in being evaluated as part of the Application/EIS.

Appendix 15-A in the Application/EIS, Summary of Communication provides a detailed record of all meetings and correspondence with the SSN.

Through consultation, SSN has identified Jacko Lake as having cultural significance and has stated there is no acceptable mitigation for impacts to Jacko Lake. In addition to concerns over impacts to Jacko Lake and Peterson Creek, the SSN has stated an interest in improving existing Aboriginal Fisheries. This feedback has helped KAM understand the importance of Jacko Lake and Peterson Creek to the SSN and has taken this into account by limiting the impacts to the waterbody to the extent possible and selection of an offsetting concept to enhance overall production of Aboriginal and recreational fishing in the Project area

1.4.2 Regulatory

DFO has provided useful guidance to understanding offsetting requirements under the *Fisheries Act* and recent changes to guidance to account for offsetting principles as well as coordination with local fishery managers.

FLNRO has provided useful information and offsetting guidance via communication of concerns about Project impacts of the on fish and fish habitat in Jacko Lake and Peterson Creek. In addition, FLNRO has raised concerns about the impacts of the Ajax Project on recreational angling and the anglers' fishing experience. As mitigation for fishery impacts, FLNRO suggested the creation of fish habitat to support a recreational and Aboriginal Fishery on Inks Lake during meetings in early 2015.

2 – BASELINE AQUATIC ENVIRONMENT

2.1 REGIONAL AND LOCAL STUDY AREAS

The Regional Study Area (RSA) for Fish and Fish Habitat was selected based on the potential for direct and indirect interaction or cumulative effects to occur. It is defined as the Peterson Creek watershed to the confluence with the South Thompson River, as well as a buffer along the water pipeline from Kamloops Lake. The Local Study Area (LSA) is the area in which the most potential Project interactions and physical, visual, and auditory effects are expected to occur. The LSA for the purpose of the Fish and Fish Habitat Effects Assessment is defined as the Project site and surrounding area within which there is a reasonable potential for immediate direct and indirect effects on fish, fish habitat, and aquatic resources. The RSA and LSA boundaries are shown on Figure 2.1. Site photos from the study area are shown in Appendix A.

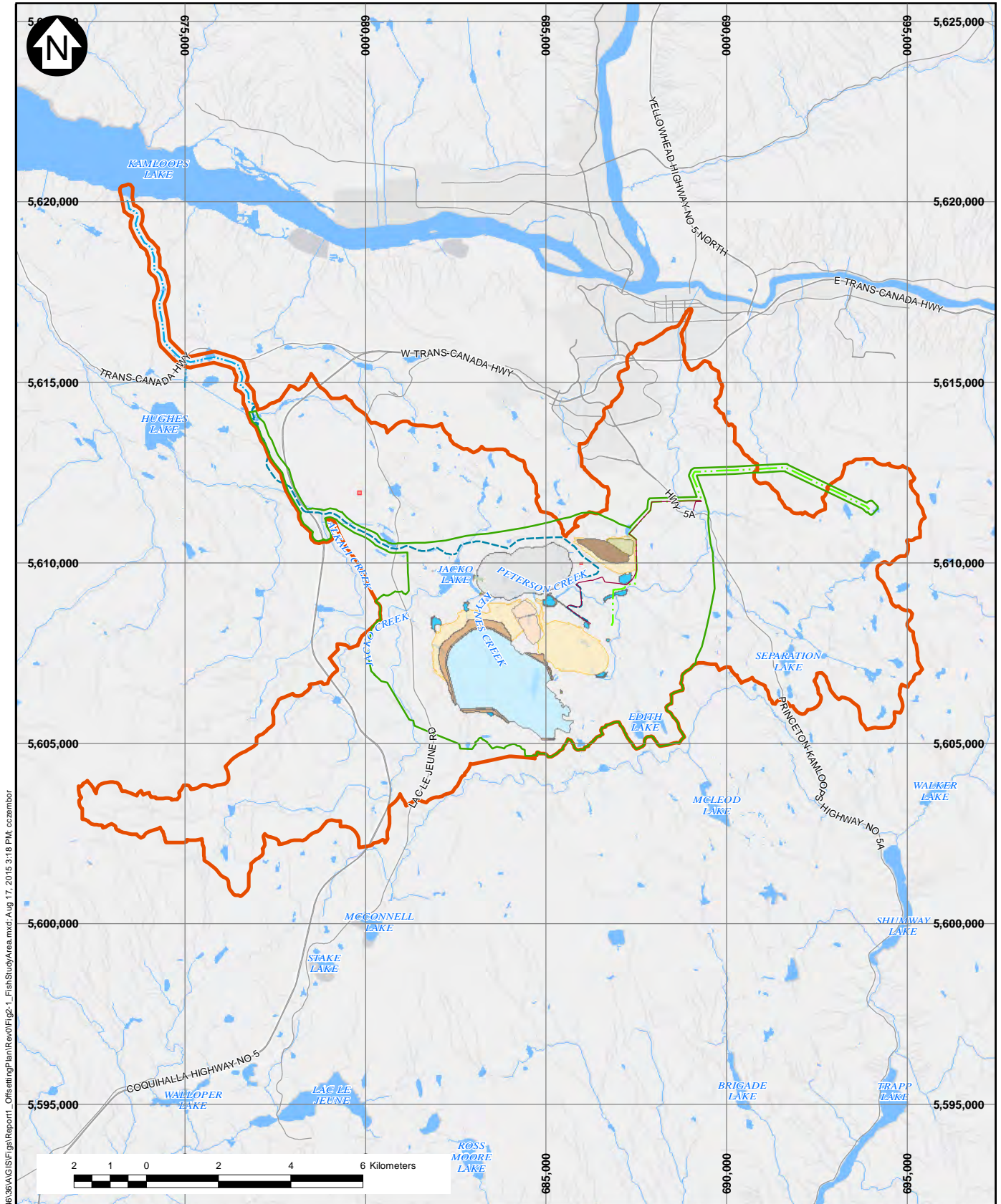
2.2 PETERSON CREEK

Peterson Creek (watershed code: 128-009700) has a mainstem length of approximately 33 km and a watershed area of approximately 82 km² (Summit 2006). Peterson Creek flows from a small, unnamed lake and wetland at elevation 1449 m, and runs north for a short distance into Connolly Lake before turning in an easterly direction. After crossing under Highway 5 the creek flows north and then east to flow under Lac Le Jeune Road approximately 800 m downstream of the confluence with Jacko Creek. From Jacko Lake the Peterson Creek continues east before flowing north as it nears the confluence with Davidson Brook. Peterson Creek flows into the South Thompson River approximately 1.2 km upstream from the North Thompson River confluence. The lower reaches run through Peterson Creek Park and an urbanized portion of the city of Kamloops, BC (Figure 2.2).

The average gradient of Peterson Creek is approximately 3.2% and Bridal Veil Falls forms a fish barrier approximately 2.4 km upstream of the confluence with the South Thompson River. The major tributaries of Peterson Creek include Davidson Brook, Humphrey Creek, Keynes Creek, and Jacko Creek. Edith Lake is located within the headwaters of Humphrey Creek. Rainbow trout (*Oncorhynchus mykiss*) is the only fish species present in Peterson Creek in the Project area; coho salmon fry (*O. kisutch*) have been observed in Peterson Creek near the confluence with the South Thompson River. Peterson Creek has been heavily altered by anthropogenic influences. The creek has been used as a source of drinking water, irrigation, and as a drainage channel since European settlers colonized the Kamloops area. The majority of the creek within the city of Kamloops is now buried in culverts and channelled in concrete waterways from Columbia Street to the Thompson River (City of Kamloops 2007).

The section of Peterson Creek downstream of Jacko Lake often runs dry in summer and fall and has been heavily impacted through channelization for irrigation and ranching activities. As a result this section of the creek offers low quality fish habitat when flowing and no habitat when dry. The section of Peterson Creek below Jacko Lake flows between the historic Afton Mining Camp and Ajax mine site for approximately 2.3 km, with the existing Ajax east and west pits to the north and a reclaimed waste rock storage facility to the south. Peterson Creek flows under Highway 5A through an approximately 1.5 m diameter culvert. Upstream of Highway 5A, the creek is low gradient and shows extensive disturbance from cattle. The 1,000 m long sub-reach immediately below Jacko Lake that runs through the historic Afton Mining Camp and Ajax mine site was lined with impervious till during the fall of 1990 to reduce water seepage and improve irrigation flows in the channel (Price 1991).

Stream flows in Peterson Creek downstream of Jacko Lake are subjected to natural variations through an annual increase during spring freshet, followed by a gradual reduction in stream discharge in the summer months that are augmented by the opening of a manual control gate located at the outlet of Jacko Lake. During some years (e.g., 2011) somewhat rapid increases in stream discharge are observed when freshet inflows supersede the maximum elevation of the Jacko Lake flow control structure and water is forced to spill over the spillway crest. Peak flows are currently regulated due to the active management of water levels in Jacko Lake. The lake is drawn down in July and August to meet downstream water licence requirements. Lake levels also drop during this period due to evaporative losses from the water surface in combination with negligible to no surface runoff from upper Peterson Creek. Flows in Peterson Creek during early April through early September (2008, 2009, 2011) averaged $0.046 \text{ m}^3/\text{sec}$ and ranged from a low of near zero in early spring and late summer months to a high of approximately $0.56 \text{ m}^3/\text{sec}$ observed during late May 2011 as shown on Figure 2.3 (KP 2012a).



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LEGEND:

- ROAD
- RIVER / CREEK
- LAKE
- STUDY AREA**
- LOCAL
- REGIONAL

PROPOSED FACILITIES

- POWERLINE - 230kV
- NATURAL GAS LINE (APPROX. LOCATION)
- WATERLINE EXISTING
- WATERLINE

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

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FISH AND FISH HABITAT STUDY AREA



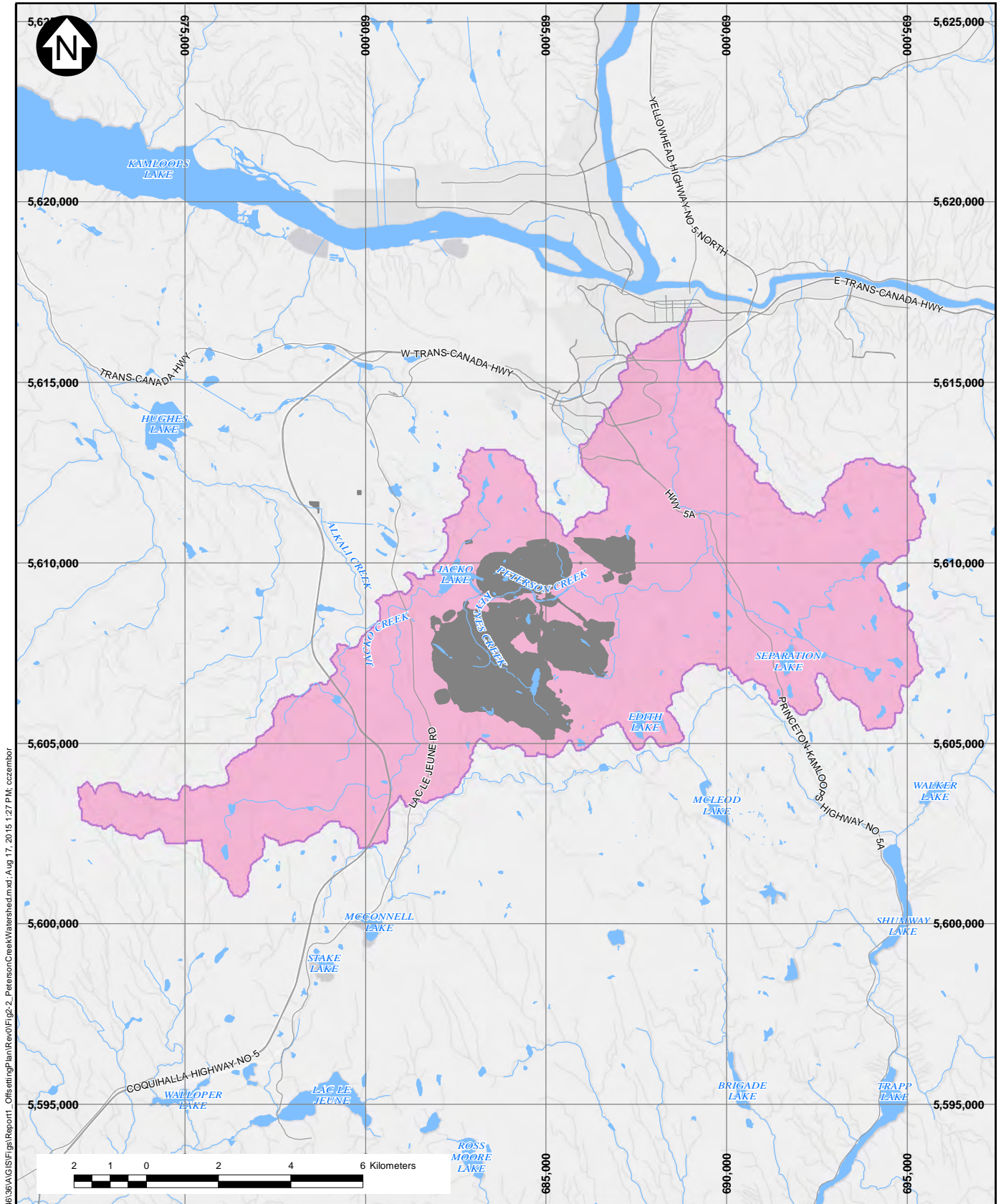
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FIGURE 2.1

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LEGEND:

- ROAD
- RIVER/CREEK
- LAKE
- PETERSON CREEK WATERSHED
- PROPOSED MINE SITE FACILITIES

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE MAPPING.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

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PETERSON CREEK WATERSHED

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CONSULTING

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FIGURE 2.2

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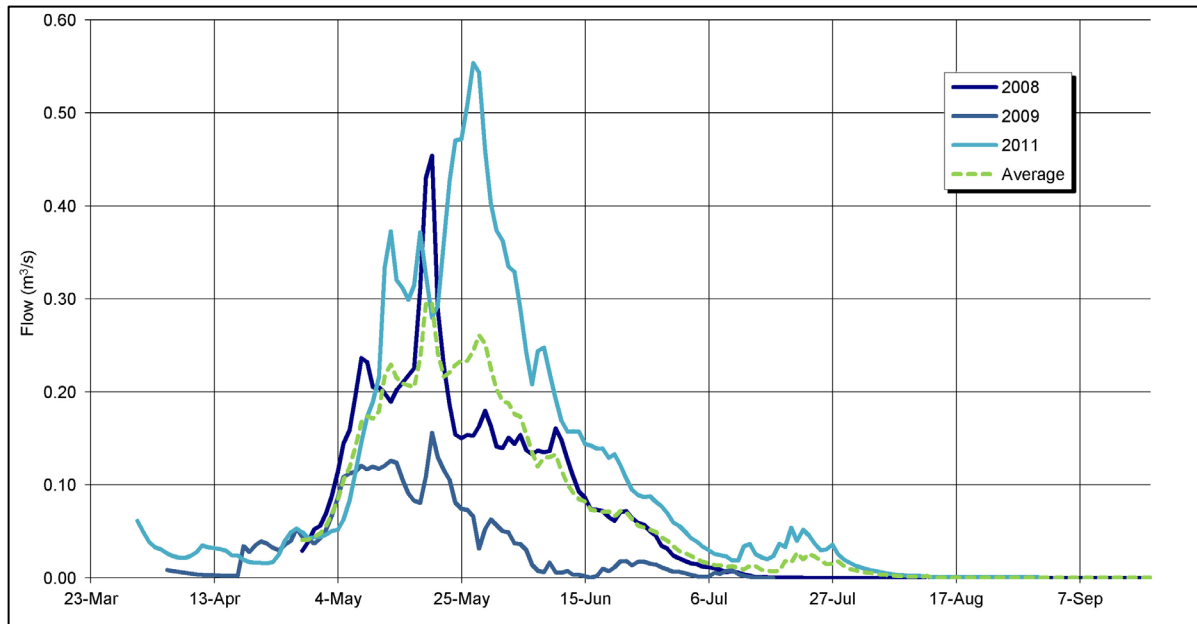


Figure 2.3 Peterson Creek Daily Flow Record (2008, 2009, 2011)

Water temperatures in sections of Peterson Creek downstream of Jacko Lake are presented in the baseline fisheries reports (KP 2013, KP 2015a). Daily averaged stream water temperatures ranged from 20 to 25°C at two water quality sampling locations within 3 km downstream of Jacko Lake during June through late August (2008-2011). Adult rainbow trout are generally a cool-water species, with a lethal temperature limit near 27°C. Rainbow trout can survive temperature extremes by seeking out refuge areas with groundwater upwelling or heavy cover, however, the summer water temperatures observed in Peterson Creek generally exceed the optimal temperature (10-14° C) outlined for rainbow trout egg incubation and juvenile growth (Ford et al. 1995, McPhail 2007).

Raleigh et al. (1984) demonstrate that there is a strong relationship between the annual flow regime of the waterways and the quality of rainbow trout habitat within them. The most critical flow period is typically during base flow (lowest flows of late summer to winter). A base flow 50% of the average annual daily flow is considered excellent for maintaining quality trout habitat, a base flow of 25% to 50% is considered fair, and a base flow of < 25% is considered poor. Base flows in Peterson Creek downstream of Jacko Lake are generally less than 25% of annual daily flow and therefore could be designated as poor quality rainbow trout habitat.

Previous to 1990, it was estimated that approximately 50% of water released from the Jacko Lake outlet into Peterson Creek was not available for irrigation due to seepage and evapotranspiration that was occurring in the creek channel between the storage dam and the first irrigation gate located several kilometers downstream (Price 1991). To help mitigate these water losses, a 1,000 m portion of Peterson Creek that runs through the historic Afton Mining Camp and Ajax mine site was lined with impervious till during the fall of 1990 (Price 1991). During the construction of the revised intake and dam spillway the outlet of Jacko Lake was screened by a vertical slot grate with 2 cm spacing to exclude stocked adult rainbow trout from dispersing into the lower portion of Peterson Creek. Since the addition of the outlet screen the only route for adult rainbow trout to enter Peterson Creek occurs

during spring freshet when Jacko Lake elevations temporarily overtop the spillway crest and fish are able to enter the creek through the spillway channel.

Since the initiation of the baseline sampling program in 2007 the fish observed during repeated sampling events in the portion of the Peterson Creek downstream of Jacko Lake have been a collection of small bodied rainbow trout (35-190 mm fork length) within Peterson Creek Park approximately 13.7 km downstream of Jacko Lake (upstream of Bridal Veil Falls), and several adult rainbow trout in spawning dress (250-300 mm) immediately downstream of the lake outlet when the spillway was actively spilling water (i.e., late May 2011, 2014) (KP 2013, KP 2015a). The fish observed in Peterson Creek Park may represent a feral population of rainbow trout, while the adult fish observed near the Jacko Lake outlet during years with higher water returns are likely fish that found temporary passage through the unscreened lake spillway during freshet flows. The potential for rainbow trout stocked in Jacko Lake to carry out life processes important for the maintenance of a viable population in the upper portion of Peterson Creek immediately downstream of the mine site is unlikely, and no feral juvenile fish (i.e., aged 0+) have been observed in this area during repeated fisheries investigations (KP 2013, KP 2015a).

Peterson Creek within the Project area downstream of Jacko Lake offers marginal rainbow trout spawning and rearing habitat due to the high silt content of the substrate, lack of instream cover and low channel complexity, minimal riparian habitat, and high summer water temperatures and low dissolved oxygen concentration due to low flows. Rainbow trout in Peterson Creek in the proposed Project area therefore do not support a recreational fishery or contribute to the productivity of the Jacko Lake rainbow trout population.

2.3 JACKO LAKE

Water licences for water extraction from Jacko Lake and Peterson Creek date back to 1877 when the watershed was used primarily by ranchers for irrigation of hay fields. Peterson Creek and Jacko Lake flows are regulated for irrigation and conservation. There are 36 current water licences on Peterson Creek (including Jacko Lake); seven of the licences have no identified purpose or quantity (iMapBC 2015). The total volume by identified purpose is:

- Domestic 15.911 m³/day
- Irrigation 1,133,657 m³/year
- Stock watering 6.819 m³/day
- Storage - non-power 493,515 m³/year, and
- Conservation - stored water 432,335 m³/year.

Several water abstraction licences are currently used in Peterson Creek and according to Price (1991), during years with high water returns most of the licensed water use requirements can be met; however in dry years, when returns are reduced, the quantity of water can be much less than required. For example, in 1989 and 1990 there was no water available for irrigation from Jacko Lake because of an unusually low snow pack in the Peterson Creek watershed.

The current perimeter of Jacko Lake is 5,600 m at its full pool, with a water surface elevation of 892 masl. A bathymetric and fisheries resource survey of Jacko Lake conducted by the British Columbia Fish and Game Branch during 1950 (FGB 1954) shows a small lake with a perimeter of 3,700 m, surface area of 40 ha, and volume of approximately 3,600,000 m³ (Figure 2.4). To improve water storage, the lake was raised during the 1970s and updated mapping from 1978 shows an

expanded lake, with the creation of the northeast and southeast arms and expansion of the two westerly arms (Figure 2.5). According to the 1978 survey, the expanded lake had an enlarged perimeter of 4,925 m, surface area of 46.7 ha, and a volume of approximately 4,000,000 m³ with a spillway crest elevation of 891.1 masl (MOE 1980).

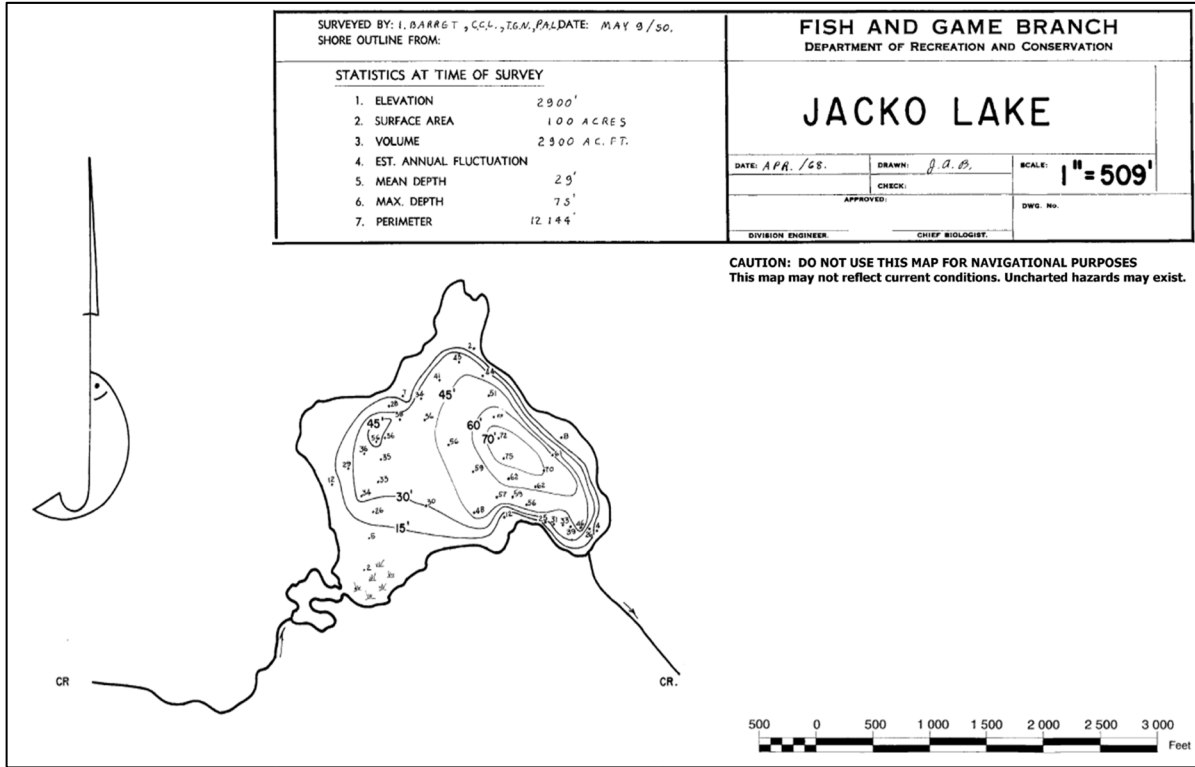


Figure 2.4 1950 Bathymetric Map of Jacko Lake

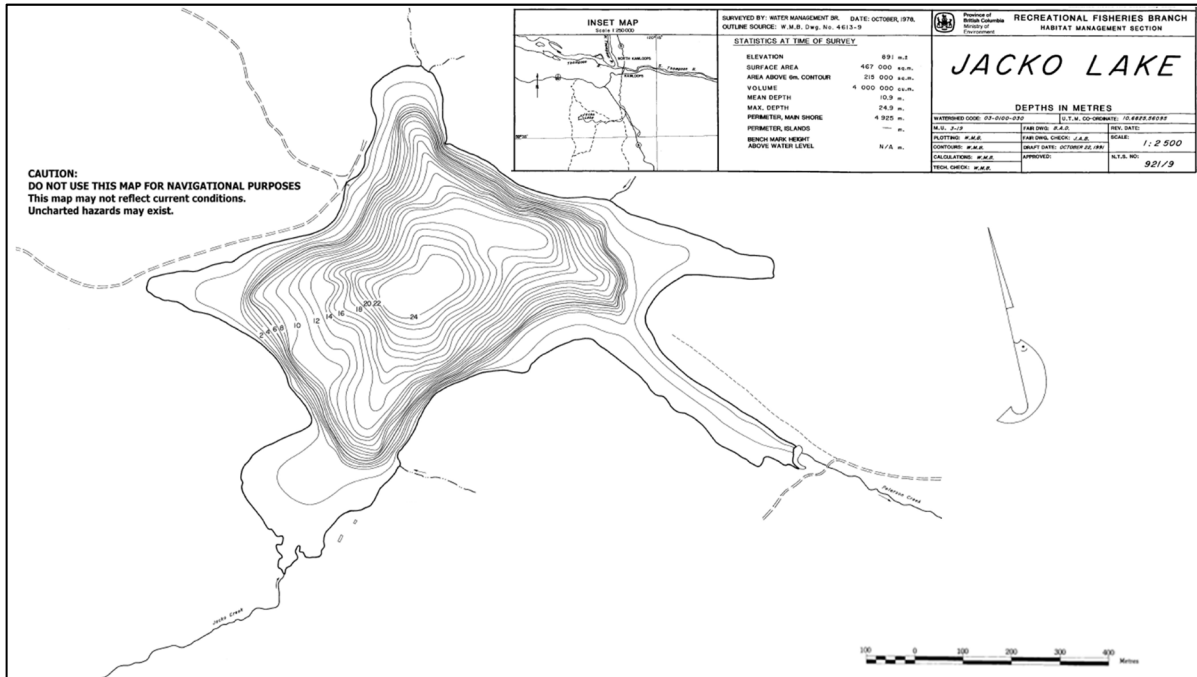
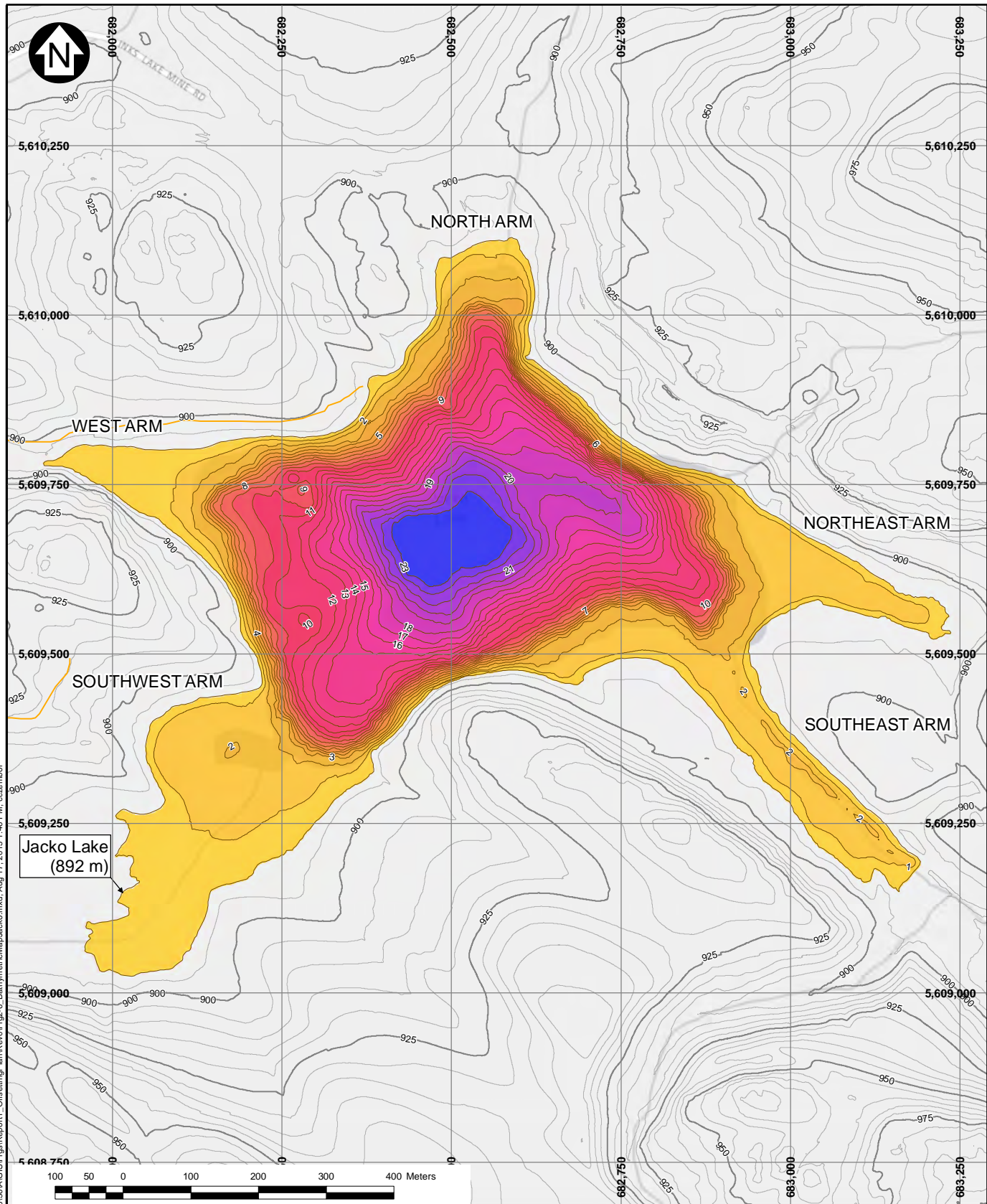


Figure 2.5 1978 Bathymetric Map of Jacko Lake

As mitigation to the development of their mine site adjacent to Jacko Lake in the early 1990s, Afton Operating Corporation raised the height of the Jacko Lake outlet dam in the fall of 1990 by approximately 1 m to 892 masl and allocated the increase in water storage licence to the MOE to improve fisheries conservation (Price 1991). The current maximum water elevations of Jacko Lake (892 masl), reflect this most recent water storage increase and estimates of the lakeshore perimeter are currently 5,600 m with a surface area of approximately 48.2 ha. The extraction of water from Jacko Lake is controlled by downstream water users and during periods of low water returns, it is known that water allocated to the MOE fish conservation licence is utilized for irrigation and FLNRO is currently developing a water release schedule for Jacko Lake that protects this conservation storage (FLNRO 2012).

The most recent bathymetric survey of Jacko Lake was conducted for the Ajax Project by Frontier Geosciences in 2014 (see Figure 2.6). From the survey the estimated surface area of Jacko Lake at 892 masl is 48.27 ha while the lake volume is 3,946,915 m³. The estimated baseline littoral area from 0-3 m depth is 21.64 ha or about 45% of the total lake area, while the littoral volume is 260,000 m³ or 6.6% of the total lake volume.

Jacko Lake is considered to support a recreational and Aboriginal fishery. Provincial fishery records (Fisheries Information Summary System (FISS)) indicate that no fish were present in Jacko Lake in 1939 but multiple cohorts of rainbow trout (1+ to 3+ aged fish) were captured during targeted sampling by the Provincial Fishery Agency in 1949 and 1950 (FGB 1954).



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LEGEND:

- UNPAVED ROAD
- BATHYMETRIC DEPTHS (1 m)
- CONTOUR (25 m)
- CONTOUR (5 m)

NOTES:

1. BASE MAP: KGHM LIDAR CONTOURS.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

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BATHYMETRIC CONTOUR MAP OF JACKO LAKE 2014

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FIGURE 2.6

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It is likely that these fish were stocked from local sources and an unverified account in the literature suggests rainbow trout were introduced into the lake in the 1940s; however, provincial fish stocking records only extend from 1954. Since 1954, the Provincial authorities have stocked hatchery raised rainbow trout into Jacko Lake annually (except during 1991) with an assortment of fry, fingerling and yearlings for recreational angling purposes. Various local hatchery strains of fish have been released over the years; however, since 2002 triploid (reproductively sterile) and some diploid (reproductively viable) fish have been liberated with the aim of improving angling opportunities (Go Fish BC 2012). The SSN has stated that the lake supported an aboriginal fishery prior to stocking suggesting fish were present pre-stocking; however verified records of fish presence in Jacko Lake prior to 1939 are unsubstantiated.

The benefits of stocking sterile fish into lakes frequented by anglers include: increased fish size due to the fact that energetic resources usually diverted into reproductive development can go to somatic (body) growth, and; the inability to reproduce or mate with other hatchery or wild individuals. Sterility of triploid fish is different depending on the sex of the fish. Female triploids are hormonally and functionally sterile (i.e., no ovary development or behavioural changes). Male triploids are infertile but still produce hormones that cause changes associated with maturation including deterioration of flesh quality, early mortality and the development of testes and other secondary sex characteristics. In addition, they demonstrate “false” spawning behaviour, including migration and interactions with other fish on the spawning beds but an inability to reproduce (FFSBC 2004).

Fish sampling was conducted in Jacko Lake using minnow traps, winged fyke nets, and gillnets as part of the Project baseline fisheries surveys. During August 2010 fish sampling efforts, a multi-panel floating gill net was set within the northeast arm and a single panel sinking gill net was set between the northeast and southeast arms of Jacko Lake. The floating and sinking gillnets were monitored and soaked for 1 hour and 1.5 hours, respectively, to minimize fish mortality. A total of 30 rainbow trout were captured in the floating gill net ranging in fork length from 80 mm to 505 mm, and one rainbow trout (126 mm length) was captured in the sinking gill net.

Length frequency analysis of rainbow trout captured in Jacko Lake during all sampling efforts show two discrete length-at-age modalities. The first size grouping was made up of fish ranging in length from 80 mm to 140 mm (1+ and 2+) which was comprised of less than 20% of the fish sampled. The second size grouping was made up of larger fish ranging in length from 275 mm to 505 mm, aged between 4+ to 9+ and constituted 80% of the rainbow trout sampled within Jacko Lake. In all of the larger fish examined for age validation through scale annuli counts, the first two to three annuli were made up of tightly grouped narrow circuli (indicating slower hatchery growth), with the outer annuli being wider with more circuli (indicating faster lake growth), and stronger winter checks (Stamford 2011).

2.4 KEYNES CREEK AND GOOSE LAKE

Provincial mapping shows an unnamed, second order creek, locally known as Keynes Creek, flowing into Peterson Creek at the downstream end of the Jacko Lake spillway. An unnamed second order creek (watershed code 128-009700-48900-54900) is mapped as flowing from the southeast into Keynes Creek approximately 2.3 km from the mouth. Goose Lake is mapped as the headwater lake of a tributary to Keynes Creek. The mainstem length is recorded as 3.1 km and the gradient is

reported as 1.2% in the provincial database (iMap BC 2015). No direct channel connection or alluvial material is present in lower Keynes Creek where it is reportedly confluent with Peterson Creek.

Goose Lake is a small (approximately 6.14 ha), shallow lake with a north-south orientation within an unnamed tributary watershed of Keynes Creek. The lake has a perimeter of 1.4 km and sits at an elevation of 969 masl. The unnamed tributary is a non-classified drainage as it does not have a continuous channel bed or definable, visibly continuous banks. On June 3, 2014 the depth of Goose Lake was visually estimated as 1 m; an extensive algal mat was present over much of the lake. The lake shore and banks are gently sloping, and the lake substrate is comprised of fine silts and organics. Riparian vegetation is composed of grasses and sedges. Goose Lake has very high total dissolved solids (ranging between 3,165 mg/l and 4,550 mg/l) and is therefore classified as moderately saline (KP 2013).

Neither Keynes Creek nor Goose Lake is considered a CRA fishery. There are no provincial records of fish in either Keynes Creek or Goose Lake. In addition, no fish were captured or observed in Keynes Creek or Goose Lake during the Fish and Aquatics baseline data collection program. Bi-weekly water samples and in situ readings have been collected from Goose Lake by KAM since April 2014. Several of the measured parameters are outside the recommended guidelines for aquatic life, including dissolved oxygen, pH, chloride, sulphate, ammonia, and dissolved arsenic. No evidence of a historic or current Secwépemc fishery on Goose Lake was found by AMEC (2012) during traditional use studies completed for the proposed Project. There is no surface connection between Goose Lake and any fish-bearing watercourse.

2.5 ALKALI CREEK

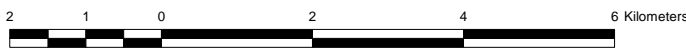
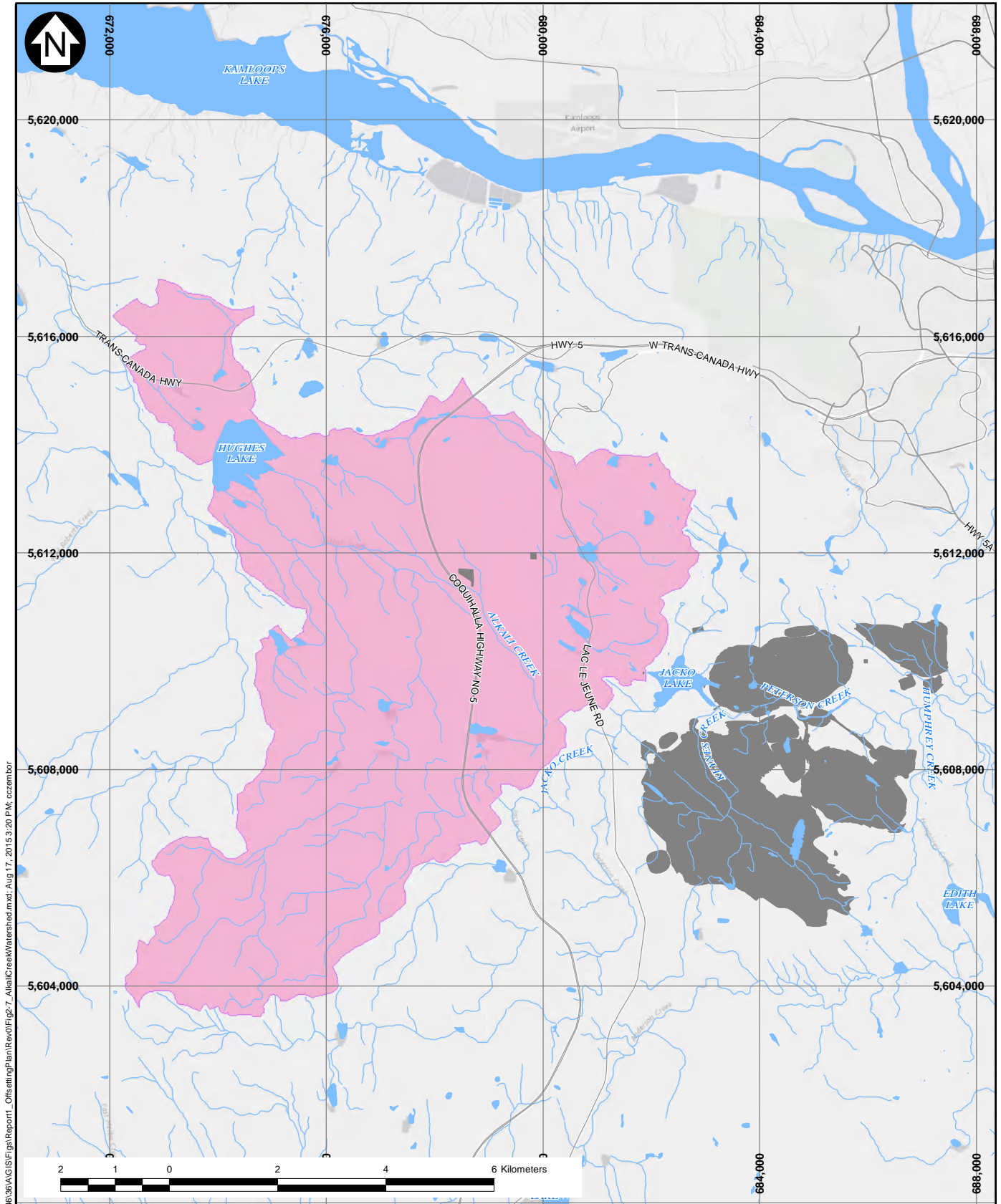
Alkali Creek (watershed code 120-862000-40700) has a watershed area of 4,703 ha and flows from the east to its confluence with Cherry Creek about 10.1 km upstream from where Cherry Creek discharges to Kamloops Lake (Figure 2.7). Rainbow trout are recorded throughout the Cherry Creek watershed in the provincial database; brook trout are also recorded in Dairy Lake, within the Beaton Creek watershed (tributary to Cherry Creek), and there is one observation of a bull trout in a tributary to Chuwhels Lake in 1995. A diversion structure located in the lower 500 m of Cherry Creek prevents upstream passage of fish from Kamloops Lake. Many of the former Afton Mine components are within the Alkali Creek watershed, including the historic tailings storage facility (the former Hughes Lake) and Pothook Lake. There are no records of fish from the Alkali Creek watershed.

The water line from Kamloops Lake for the Ajax Project will cross the outlet creek from Rush Lake, an unnamed tributary of Alkali Creek (watershed code 120-862000-40700-61400) east of Highway 5, near the former mine haul road from the former Ajax Mine to the former Afton Mine. No evidence of a natural creek was found at this location; however, a rip-rapped ditch runs parallel to and then under the former Afton Mine Haul Road through a 1.85 m diameter culvert near Highway 5. An additional culvert runs under the former Afton Mine Haul Road from a ditch along the east side of Highway 5. The culverts converge on the north side of the Afton Mine Haul Road, reporting to an approximately 60 m long ditch that ends in a 1.85 m diameter culvert under Highway 5.

2.6 INKS LAKE

Inks Lake (watershed code 120-862000-40700-61400-2240) is a non-fish bearing lake situated immediately northwest of the intersection of Lac Le Jeune Road and Inks Lake Road. The catchment

area that directs surface runoff to Inks Lake is shown on Figure 2.8. The lake is comprised of two basins: the south basin, approximately 7.0 ha in size, is joined by an approximately 40 m long channel to a smaller 1.5 ha north basin. During drier periods there is no surface flow connecting the two basins. Immediately northwest of the Inks Lake north basin, there is a small 0.3 ha unnamed kidney-shaped pond. No surface channel is visible between this pond and Inks Lake. A bathymetric survey of Inks Lake was conducted for the Ajax Project by Allnorth Consulting Ltd. in May 2015. The maximum depths recorded were less than 4 m for the south basin, 1 m for the north basin, and 1 m for the west pond. The estimated total volume of the three basins from the survey data is 85,000 m³.



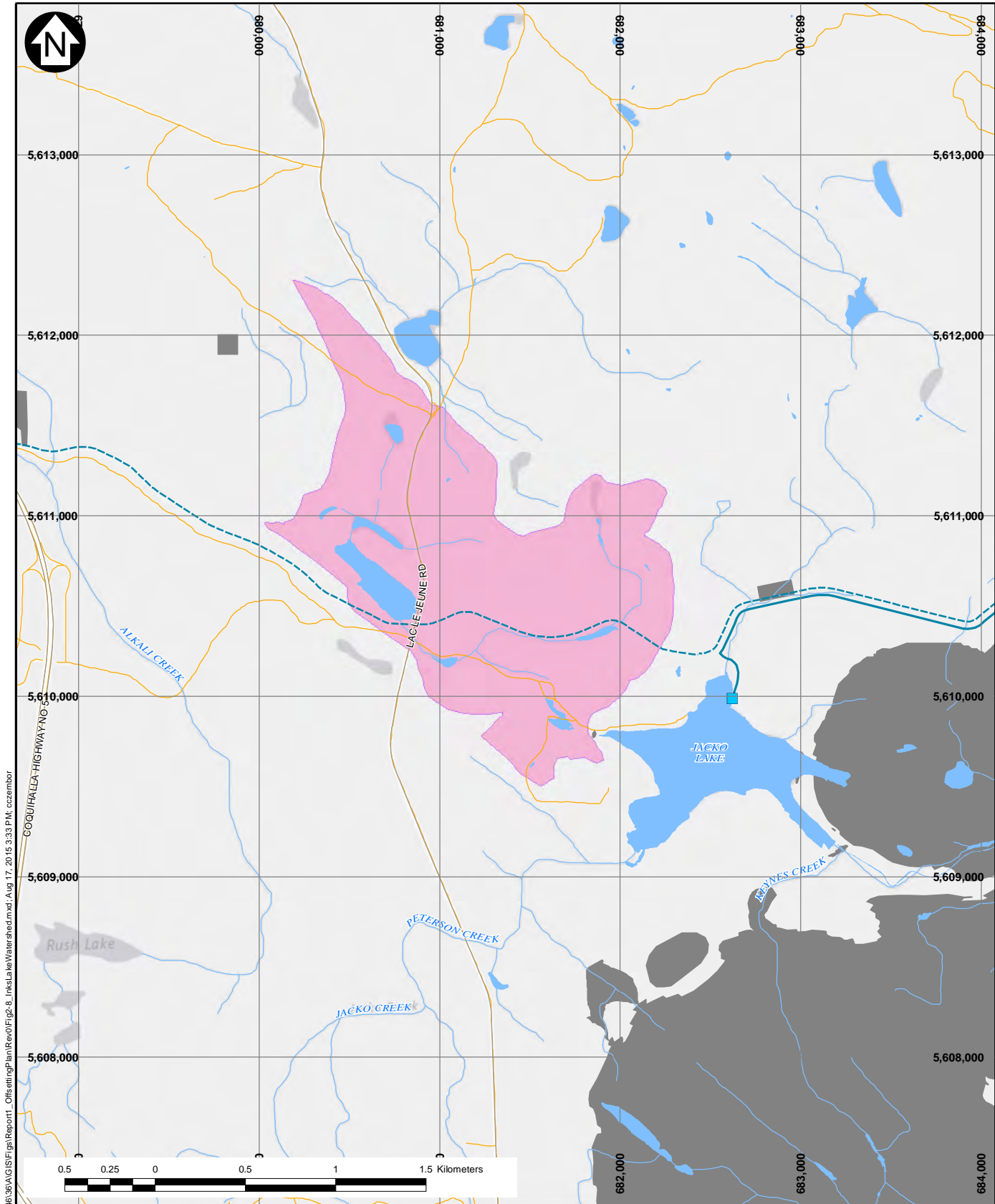
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LEGEND:		NOTES:	
	ROAD	1.	BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
	RIVER/CREEK	2.	COORDINATE GRID IS IN METRES.
	LAKE		COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
	ALKALI CREEK WATERSHED		
	PROPOSED MINE SITE FACILITIES		

KGHM AJAX MINING INC.	
AJAX PROJECT	
ALKALI CREEK WATERSHED	

REV	DATE	DESCRIPTION	OG DESIGNED	CAC DRAWN	RCB REVIEWED
0	17AUG15	ISSUED WITH REPORT			

<i>Knight Piesold</i> CONSULTING	P/ANO. VA101-246/36	REF NO. 1
	FIGURE 2.7	
		REV 0



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LEGEND:

- ROAD
- UNPAVED ROAD
- RIVER/CREEK
- LAKE
- INKS LAKE WATERSHED
- DIVERSION INTAKE
- DIVERSION
- WATERLINE
- PROPOSED MINE SITE FACILITIES

NOTES:

1. BASE MAP: ESRI ARCGIS ONLINE IMAGERY.
2. COORDINATE GRID IS IN METRES.
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

KGHM AJAX MINING INC.

AJAX PROJECT

INKS LAKE WATERSHED

Knight Piésold
CONSULTING

P.I.A.NO.
VA101-246/36

REF NO.
1

FIGURE 2.8

REV
0

REV	DATE	DESCRIPTION	OG DESIGNED	CAC DRAWN	RCB REVIEWED
0	17AUG15	ISSUED WITH REPORT			

There is no surface connection between Inks Lake and Alkali Creek. Surface flow between Jacko Lake and Inks Lake is theoretically possible during flood events, if lake levels were elevated above the height of land between the Peterson Creek and Alkali Creek drainages and would flow through a series of culverts between the northwest arm of Jacko Lake and Lac Le Jeune Road. However, there is no existing stream connection between Jacko Lake and Inks Lake.

KP (2012b) conducted an initial assessment of Inks Lake to determine its fish-bearing status. Water quality samples and in-situ parameters were collected to assist in the physical characterization of Inks Lake. The deepest spot in the south basin was estimated to be 5 m. Sediment samples collected from the shore of Inks Lake during August 2010 indicate elevated concentrations of several metals. Bed material is almost exclusively silt, with some clay and sand being present. No fish presence was detected in Inks Lake over the course of two years of sampling using a variety of gear types. Water quality in Inks Lake is not considered suitable for the survival or reproduction of rainbow trout, because the majority of the conductivity measurements taken within Inks Lake were beyond the range of tolerances which typically supports a fish community (i.e., < 3,000 to 3,500 $\mu\text{S}/\text{cm}$). Surface water temperature measurements in Inks Lake ranged from a minimum of -0.14°C in March 2012 to a maximum of 25.2°C in August 2012.

2.7 KAMLOOPS LAKE

The City of Kamloops is located on Kamloops Lake, a riverine lake, situated downstream of the confluence of the North Thompson and South Thompson rivers. A raw water pump station intake is proposed on Kamloops Lake to provide freshwater to the Project site via pipeline for potable and process water. The approximate location of the pump station in relation to downtown Kamloops is shown on Figure 2.1.

Kamloops Lake has a surface area of 5,584 ha, a maximum depth of 150.9 m, and a mean depth of 74.1 m (FISS 2015). Kamloops Lake has been described as a widening and deepening of the Thompson River with a lake volume of 3.7 km^3 (Wijtkamp 2011). The residence time of Kamloops Lake has been estimated as eight weeks (Macdonald et al. 1999, Wijtkamp 2011). Nordin and Holmes (1992) describe Kamloops Lake as a long, narrow, steep-sided lake physically dominated by inflow from the Thompson River. Due to the short residence time, seasonally high turbidity, and low available nutrient input, Kamloops Lake has relatively low biological productivity (Nordin and Holmes 1992). The low levels of phosphorous in Kamloops Lake make it oligotrophic, which limits biological production (Thompson Nicola Regional District 2013).

The intake is proposed at the vicinity of the existing pump station used by the New Afton Mine, located approximately 10 km west of Kamloops. Urban Systems Ltd. (2008) describes the area where the New Afton intake is situated as a steep rip-rap embankment and an un-vegetated mixed boulder and cobble shoreline; no aquatic macrophytes were noted. Substrate below the low water level is composed of very fine, mobile sediments (Urban Systems Ltd. 2008). Due to the large size of substrates along the shoreline, Urban Systems (2008) noted that this area provides poor quality spawning habitat for most species of fish, and that it is unlikely for salmon to spawn in the area.

Provincial records indicate that four species of salmon (chinook, coho, sockeye, pink), one species of trout (rainbow or steelhead), and two char (Dolly Varden, bull trout) are found within Kamloops Lake (FISS 2015). Largescale sucker, longnose sucker, mountain whitefish, northern pikeminnow, peamouth chub, burbot, prickly sculpin, redbreasted shiner, and lamprey are also present (FISS 2014).

Beniston and Lister (1985) reported that coho, chinook, and sockeye salmon; rainbow trout; and mountain whitefish utilize Kamloops Lake for rearing.

Beniston and Lister (1985) found that juvenile chinook were the main salmonid species rearing along the shoreline of Kamloops Lake in June, although only two yearling chinook were captured, leading the authors to conclude that smolts from the North Thompson River migrate seaward during late March to early May. Similarly, Beniston and Lister (1985) captured only two yearling sockeye in August (compared to 26 in June), suggesting that juveniles move to steeper off-shore rearing areas in late summer. There are no known salmon spawning areas in Kamloops Lake; spawning primarily occurs in Shuswap Lake and North Thompson River tributaries. The non-anadromous species found in the lake either require gravel substrate for spawning, or streams (Urban Systems Ltd. 2008).

2.8 LOCAL STUDY AREA CONTRIBUTION TO FISHING

Jacko Lake is considered a recreational and Aboriginal fishery. Provincial records report that no fish were present in the waterbody in 1939 (FISS 2015). However, anecdotal reports suggest that Jacko Lake was an important rainbow trout fishery before the arrival of Europeans, and that local Aboriginal Groups fished for rainbow trout and kokanee (AMEC 2015).

Provincial stocking records date from 1954 (when 74,000 rainbow trout were stocked); in the last two decades numbers have ranged from 6500 to 16,000 rainbow trout per year (FFSBC 2015). Since 2010, both Pennask (diploid) and Fraser Valley (triploid) strains have been released into Jacko Lake, from fingerling to fall catchable life stages (FFSBC 2015). Between 2010 and 2014 a total of 55,500 rainbow trout were released (FFSBC 2015). In April 2015 6500 all-female Pennask strain yearlings and 3500 triploid Fraser Valley fingerlings were released.

Rainbow trout are typically released in the spring (between April and June) as yearlings and fingerlings. An additional release of fall catchable rainbow trout occurred in September 2010. Release data for the period 2010 through 2014 indicates fingerling stocks are a triploid Fraser Valley strain with an average weight of 6.58 grams; yearlings are diploid Pennask strain with average weight of 10.15 grams. The “fall catchable” life stage release was a triploid Fraser Valley strain with an average weight of 68.21 grams (FFSBC 2015).

Peterson Creek within the Project area downstream of Jacko Lake offers marginal rainbow trout spawning and rearing habitat due to the high silt content of the substrate, lack of instream cover and low channel complexity, minimal riparian habitat, and high summer water temperatures and low dissolved oxygen concentration due to low flows. Rainbow trout in Peterson Creek in the proposed Project area therefore do not support a recreational fishery or contribute to the productivity of the Jacko Lake rainbow trout population.

3 – EFFECTS ASSESSMENT SUMMARY

The following content in Section 3.0 of this report is summarized from the Application/EIS effects assessment section on fish and fish habitat that is Section 6.7 of the Application/EIS (KP 2015b). This information is provided as context for the serious harm assessment in Section 4.0.

3.1 FISH HABITAT IMPACTS

3.1.1 Introduction

Fish and Fish Habitat was selected as a VC for consideration in the environmental effects assessment for the Ajax Project based on early consultation with government agencies, members of the public and stakeholder groups, and Aboriginal Groups (KGHM 2015). The Project has the potential to affect fisheries and aquatic resources (including habitat) upon which they rely due to the proximity of Project components to Jacko Lake and Peterson Creek, and the location of the water intake pipe on Kamloops Lake. The potential effects of the Project identified and assessed in the Application include:

- Loss of habitat in Peterson Creek related to the Open Pit and the mine rock storage facilities
- Impact of mining dust and vibrations on fish in Jacko Lake
- Loss of habitat and altered fish distribution and abundance in Peterson Creek downstream of the Project area resulting from reduced flow
- Loss of habitat in northeast arm of Jacko Lake related to Open Pit development
- Loss of habitat in Kamloops Lake as a result of water intake upgrades
- Loss of habitat in Jacko Lake as a result of seepage or drainage of lake water into the adjacent Open Pit
- Water temperature variation, and
- Direct mortality or sub-lethal effects to fish as a result of altered water quality (e.g., changes in metal concentrations, temperature, dissolved oxygen concentration) or blasting activities resulting during Project construction, operation and decommissioning.

Based on an assessment of the preliminary Project design and the Project Activity list, the likely mechanisms or pathways through which interactions between the Project and Fish and Fish Habitat VC were identified. Direct habitat loss will occur in areas where the Project will encroach into any riparian area or wetted area of a stream or lake. Direct mortality as a result of Project activities could also result from increased fishing pressure from the influx of mine staff or contractors, rapid increases in pressure as a result of blasting in the Open Pit or installation of a sheet pile dam for construction of the northeast dyke, crushing as a result of instream works in fish-bearing waters, entrainment or impingement on intake screens on Jacko Lake or Kamloops Lake, or stranding in dewatered areas of Jacko Lake or Peterson Creek resulting from flow alterations. Potential sub-lethal effects on the fish populations in Jacko Lake and Peterson Creek were assessed by considering potential changes in water chemistry, sediment quality, primary productivity, and behavioural changes related to noise and light.

3.1.2 Water Management Summary

This section is provided for context of impacts to fish and fish habitat as a result of the Project's water management infrastructure.

Management of Jacko Lake is required because the Open Pit will impinge on the northeast arm of the lake and the Kinder Morgan pipeline, which will require relocation to the west. Four (4) engineered dams, each less than 5 m high with crest lengths ranging from 30 m to 175 m, are required within Jacko Lake to manage flood levels, maintain setback from the Open Pit and for removal of the Kinder Morgan pipeline, which runs beneath the northeast arm of the lake. Therefore, the water management plan (WMP) for Jacko Lake and Peterson Creek (Lower) includes:

- Construction of four new dams on Jacko Lake
- Removal of the existing dam and low-level outlet on Jacko Lake
- Construction of the Peterson Creek Diversion System (PCDS), which will allow for inflows into Jacko Lake to be pumped around the mine site and re-introduced to Peterson Creek (Lower)
- Temporary abandonment of the Peterson Creek (Lower) channel between the outlet of Jacko Lake and the eastern extent of the Open Pit for Operation (this channel will be re-established during Closure and Decommissioning)
- Construction of a new pond, the Central Pond, within Peterson Creek (Lower) adjacent to the Open Pit, and
- Construction of a new pond, the Peterson Creek Downstream Pond (PCDP), within Peterson Creek (Lower) downstream of the confluence with Humphrey Creek.

The following key objectives will be addressed by these facilities during Operation:

- Upgrade existing Jacko Lake facilities and provide design flood storage
- Divert inflows to Jacko Lake around the Open Pit with downstream discharge into Peterson Creek (Lower), and
- Supply water to downstream water licence holders.

The design and operational features of these structures are described in more detail below and in the Ajax Water Management and Hydrometric Monitoring Plan (Appendix 6.4-D of the Application/EIS). The following sections provide a summary of potential impacts to fish habitat as a result of the Project. This summary is followed by a serious harm to fish assessment that provides results of impacts considered serious harm that require offsetting measures.

3.1.3 Peterson Creek

The Open Pit will extend into Peterson Creek near the outlet of Jacko Lake. Flows from Jacko Lake will be diverted north around the Open Pit via the PCDS and returned to the natural channel upstream of the Peterson Creek Downstream Pond. The diversion will result in the direct loss of approximately 3.57 ha of instream fish habitat and 5.32 ha of riparian habitat in Peterson Creek. Indirect habitat loss could occur in areas downstream of Project components in Peterson Creek and Kamloops Lake as a result of flow alterations.

3.1.4 Jacko Lake

Currently flow from Jacko Lake is managed through a spillway on the southeast arm of the lake. To mitigate risk of flooding to the Project, manage downstream flows and meet environmental and water license requirements, full containment of the Inflow Design Flood (IDF) within Jacko Lake will be provided via dam construction and installation of a pumping system to divert flow to the Peterson Creek Downstream Pond. The pond will be managed to regulate flows for downstream water license requirements. To retain the IDF, four (4) small dams are required on the east and west side of Jacko

Lake. These structures will be required early in the Construction phase of the Project, during Operation and will remain in place Post Closure. Upon closure, Peterson Creek will be re-established.

Engineered dams will be constructed to a crest elevation of 894.5 m on the western, northeastern, and southeastern arms of Jacko Lake. Four dams will be constructed: the West Dam (JLD1), the Northeast Dam (JLD2), the Southeast Saddle Dam (JLD3), and the Southeast Dam (JLD4). West Dam is located on a catchment divide between the Jacko Lake and Inks Lake watersheds and has a maximum height of 2.5 m. Northeast Dam and the southeastern dams (JLD3 and JLD4) are located on the east side of Jacko Lake closest to the Open Pit and range up to 5 m in height. The dams will be constructed from engineered fill sourced from local borrow and will incorporate drainage features to control seepage through the dams. All dams will be constructed to a crest elevation of 894.5 masl, with minimum crest widths of 5 m and design slopes of 3H:1V (upstream and downstream).

During the spring freshet, the normal water level of Jacko Lake will be maintained at an elevation of 892.0 masl using the PCDS. The purpose of the dams is to manage storm water that causes the lake to rise above the normal water level of 892.0 masl during large rainfall/runoff events. The spillway invert elevation for the existing Jacko Lake outlet dam is at elevation 892.0 masl.

The Open Pit will extend into the tip of the northeast arm of Jacko Lake. The existing Kinder Morgan pipeline that transects this arm of the lake will need to be removed prior to Open Pit development; therefore, a dyke will be installed to allow work to be conducted in isolation of flow. The dyke will remain in place during Project Operation to allow access to ore along the west edge of the Open Pit. Direct habitat loss in Jacko Lake will be approximately 2.84 ha (2.04 ha of lake habitat and 0.80 ha of riparian habitat).

3.1.5 Goose Lake and Keynes Creek

The TSF and the MRSFs will result in the loss of Goose Lake as well as portions of Keynes Creek and tributaries to Keynes Creek. There are no provincial records of fish in Goose Lake, and no indication that it has been used as an Aboriginal fishery. No fish were captured or observed using electrofishing or baited minnow traps in 2014. Goose Lake does not contribute to the productivity of the Jacko Lake or Peterson Creek rainbow trout populations. Due to the lack of surface connectivity to any fish bearing water, they do not provide a supply of food and fish do not depend on them directly or indirectly to carry out their life processes. Therefore, it is concluded that neither Goose Lake nor Keynes Creek is considered fish habitat under the definition provided by the *Fisheries Act*.

3.1.6 Kamloops Lake Intake and Pipeline

The Project's water supply system will consist of an upgraded intake and pumping station at Kamloops Lake, the existing New Afton water pipeline between Kamloops Lake and the New Afton Mine, approximately 16 km of new pipeline from a booster station at New Afton to the Ajax processing plant and two new booster stations along the new pipeline. An intake system and existing steel pipeline is currently operated by New Gold Inc. to supply water to the New Afton Mine located approximately 10 km northwest of the Project. The pipeline was oversized at the time of construction to allow for future expansion. In addition to the intake currently in operation for the New Afton Mine there exists water intake infrastructure immediately south of the New Afton intake previously

operated by Teck for the historic Afton Mine. This infrastructure includes a wet well and pump house that is not currently in use and will be upgraded for the Project.

Upgrades to the existing intake and pump house will be required to provide water to the Project including modifications and replacement of the existing pumps, piping and electrical systems. Upgrade of existing infrastructure will not result in increased disturbance associated with the existing intake. No permanent direct habitat loss is associated with the Kamloops Lake Water Intake, as the disturbance will be limited to the period of construction. The pipeline intake will be screened to mitigate fish entrainment.

3.2 MITIGATION

Mitigation measures to avoid, minimize, and/or control potential adverse effects of the Project on Fish and Fish Habitat can include: design changes, implementation of Best Achievable Control Technology or management practices, and providing restoration or offsetting. Mitigation and management plans outline a range of measures to reduce Project effects on VCs. Many of the mitigation and management measures work along the interaction pathway between the Project and the VC. In addition to the Fisheries and Aquatic Life Monitoring Plan, the following management and monitoring plans that are presented in Chapter 11 of the Application/EIS will also contain measures that will protect fish and fish habitat during the normal course of Construction and Operation:

- Surface Water Quality Management and Monitoring Plan
- Groundwater Quality Management and Monitoring Plan
- Erosion and Sediment Control Plan
- Acid Rock Drainage Management Plan
- Air Quality Management Plan
- Water Management and Hydrometric Monitoring Plan
- Explosives Management Plan
- Soil Salvage and Handling Plan
- Dark Sky Management and Monitoring Plan, and
- Noise Management Plan.

3.3 RESIDUAL EFFECTS

The residual effects that are anticipated to remain after the implementation of mitigation measures are:

- Direct habitat loss for rainbow trout in Peterson Creek and Jacko Lake within the Project footprint
- Indirect habitat loss in Peterson Creek downstream of the Project area associated with flow reductions
- Fish mortality in Jacko Lake associated with changes in pressure from installation of the sheet pile dam for development of the Open Pit, and
- Sub lethal effects on fish populations in Peterson Creek downstream of the Project area from changes in water temperature and primary productivity associated with reduced flows.

The residual effect related to direct habitat loss is characterized as not significant after consideration of this proposed offsetting plan. The residual effects related to direct habitat loss have been classified as a “*serious harm to fish*” as defined in the *Fisheries Act* which is described in the assessment that follows. Other residual effects such as indirect habitat loss due to reduced stream

flow, fish mortality, and sub-lethal effects on fish in Peterson Creek have been characterized as not significant and are not considered to result in serious harm to fish.

4 – SERIOUS HARM ASSESSMENT

4.1 APPROACH

Section 35 of the *Fisheries Act* prohibits *serious harm to fish*; as defined in the *Act* as “the death of fish or any permanent alteration to, or destruction of, fish habitat”. The purpose of this section is to present an assessment of the unavoidable serious harm to fish and fish habitat that was identified in the Ajax Project effects assessment and summarized in Section 3.0 of this report.

DFO (2013a, 2013b) provides proponents with the following policy guidance concerning serious harm to fish. Proponents are responsible for avoiding and mitigating *serious harm to fish* that are part of or support CRA fisheries.

DFO (2013b) interprets serious harm to fish as:

- The **death of fish**
- A **permanent alteration** to fish habitat of a spatial scale, duration, or intensity that limits or diminishes the ability of fish to use such habitats as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes, or
- The **destruction of fish habitat** of a spatial scale, duration, or intensity that fish can no longer rely upon such habitats for use as spawning grounds, or as nursery, rearing, or food supply areas, or as a migration corridor, or any other area in order to carry out one or more of their life processes.

Subsection 35(1) of the *Fisheries Act* prohibits serious harm to fish or fish habitat. Projects that are likely to reduce the ability of the fish habitat to directly or indirectly support the life processes of fish or result in the death of fish are in contravention of the *Act*. When proponents are unable to completely avoid or mitigate *serious harm to fish*, their projects will normally require authorization under Subsection 35(2) of the *Fisheries Act* in order for the project to proceed without contravening Subsection 35(1) of the *Act*. Impact avoidance and minimizing impacts through mitigation strategies that are “practical and technically and economically feasible should be fundamental for Project design” from the perspective of DFO.

Bradford et al. (2015) provide advice on possible tools and approaches to inform regulatory decisions related to serious harm to fish. This advice considers the magnitude and likelihood of potential impacts to fish and fish habitat that may result from development projects (works/undertakings/activities), particularly the influence of spatial and temporal scale, and the magnitude of potential impact to fisheries productivity. They conclude that a decision-support framework should be informed by the following:

- The nature of the impact of the project on fish and fish habitat. Impact is assessed by temporal and spatial scales and intensity (including mortality).
- The type of fish habitat or species that will be exposed to the project’s residual impacts. Some form of classification scheme utilizing habitats and potential species could be used to reflect regional priorities.

In consideration of this guidance, the following parameters were evaluated as part of the serious harm assessment:

- The temporal scale of the impact (duration, permanent, reversible, or transient)

- The spatial scale of the impact based on the change in habitat quantity (destruction)
- The spatial scale of the impact based on the change in habitat quality (alteration)
- The productivity of the affected fish habitat, and
- The intensity or the magnitude of the residual effect to fish habitat that occurs within the temporal and spatial bounds (including mortality).

Bradford et al. (2015) acknowledge that methods to quantify lost productivity may be coarse but that any attempt to quantify impacts is an improvement over qualitative or judgement-based approaches. The primary metric used to measure the change in habitat quantity is the surface area of the affected fish habitat. This is a standard approach used to quantify fish habitat losses and gains for proposed development projects in Canada. Further discussion and feedback from DFO may be required to confirm appropriate quantitative metrics to support the assessment of serious harm for the Ajax Project.

The following section presents the serious harm assessment for the fish and fish habitat areas affected by the Ajax Project. An overview map of the affected areas is shown on Figure 4.1.

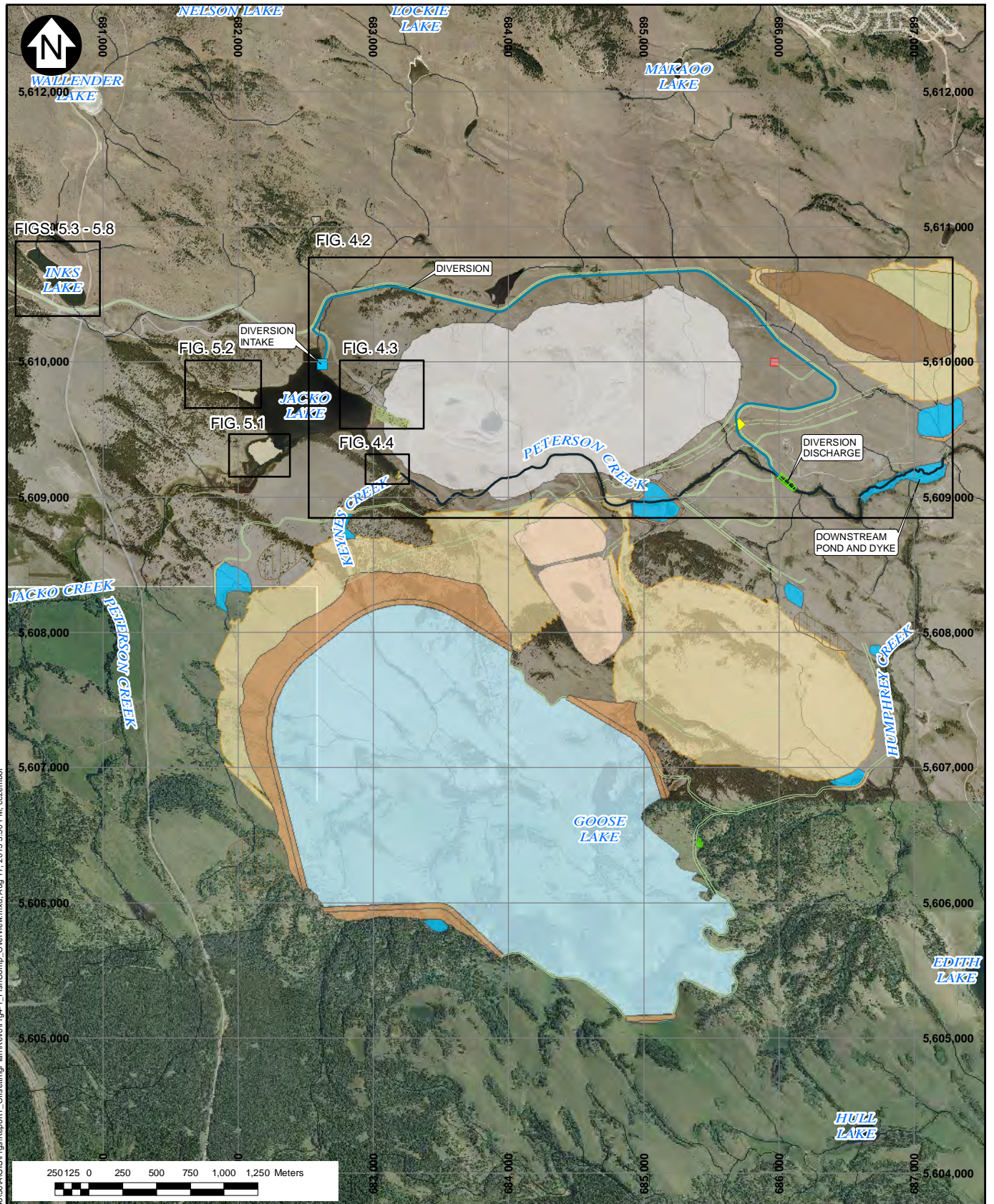
4.2 PETERSON CREEK

4.2.1 Peterson Creek Diversion Section and Downstream Pond

The development of the Ajax Project Open Pit will require dewatering a 3.6 km section of Peterson Creek below the outlet of Jacko Lake (Figure 4.2). Peterson Creek flows will be intercepted at the outlet of Jacko Lake by a new water retaining dam. Inflows to Jacko Lake will be pumped through a diversion pipeline from the north arm and returned via a discharge system to Peterson Creek about 3.6 km downstream from Jacko Lake. This mitigation is necessary to maintain flows in Peterson Creek below the pipeline discharge point. The dewatering of a 3.6 km section of Peterson Creek was identified as an unavoidable impact of mining the Open Pit. Further rationale for the unavoidability of the impact is provided in the Application/EIS Alternatives Assessment (ERM 2015).

Surplus water from Jacko Lake will be diverted to a constructed pond on Peterson Creek, which will be operated similar to the Jacko Lake spillway and low-level outlet to regulate supply to downstream users. The PCDP will remain after mine closure and water releases will be managed to provide the needs of downstream users in accordance with existing operational rules. The PCDP will provide water storage on Peterson Creek downstream of the pipeline diversion discharge.

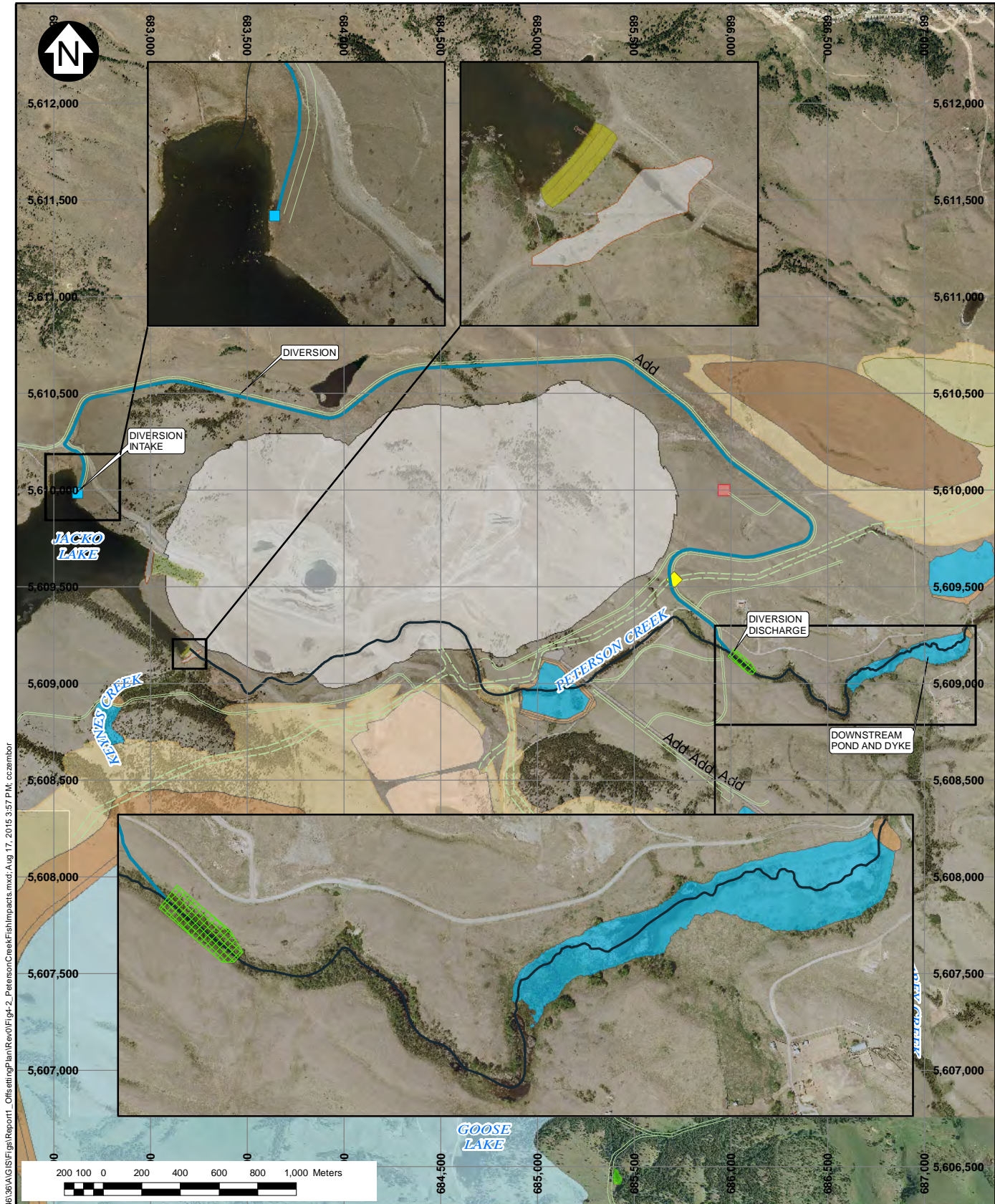
The PCDP comprises a dam and a lined water storage pond. The dam will be located approximately 350 m downstream of the confluence with Humphrey Creek, near an existing access road crossing. Design of the pond provides for water storage up to the normal water level of 865.5 m, which equates to a storage capacity of 68,000 m³. The dam will be a broad-crested weir structure with an overflow spillway that passes excess pond inflows downstream into Peterson Creek. The sill of the weir and the spillway is designed to pass an IDF flow of 153 m³/s, based on the 24-hour PMP. Flood routing indicates that the maximum water level during the IDF is 867.4 m. A low level decant system will be installed to provide flow control for the British Columbia Water Steward.



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LEGEND:		PROPOSED PETERSON CREEK FACILITIES		PROPOSED JACKO LAKE FACILITIES		NOTES:	
<ul style="list-style-type: none"> RIVER/CREEK LAKE EXISTING SE ARM BERM 		<ul style="list-style-type: none"> DIVERSION INTAKE DIVERSION DIVERSION DISCHARGE DOWNSTREAM POND DYKE DOWNSTREAM POND 		<ul style="list-style-type: none"> DAM OUTLINE NE ARM LOSS DREDGING AREA 		<ol style="list-style-type: none"> 1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY. 2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N. 	
0	17AUG15	ISSUED WITH REPORT		OG	CAC	RCB	
REV	DATE	DESCRIPTION		DESIGNED	DRAWN	REVIEWED	

KGHM AJAX MINING INC.	
AJAX PROJECT	
FISH HABITAT IMPACTS OVERVIEW MAP	
	P.I.NO. VA101-246/36 REF NO. 1 FIGURE 4.1 REV 0



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LEGEND:

— RIVER/CREEK	PROPOSED PETERSON CREEK FACILITIES	PROPOSED JACKO LAKE FACILITIES
■ LAKE	■ DIVERSION INTAKE	■ DAM OUTLINE
■ EXISTING SE ARM BERM	■ DIVERSION	■ NE ARM LOSS
	■ DIVERSION DISCHARGE	■ DREDGING AREA
	■ DOWNSTREAM POND DYKE	
	■ DOWNSTREAM POND	

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

KGHM AJAX MINING INC.
 AJAX PROJECT
PETERSON CREEK FISH HABITAT IMPACTS

Knight Piésold CONSULTING	P.I.NO. VA101-246/36	REF NO. 1
FIGURE 4.2		REV 0

REV	DATE	ISSUED WITH REPORT	DESCRIPTION	OG DESIGNED	CAC DRAWN	RCB REVIEWED
0	17AUG15	ISSUED WITH REPORT				

The pond will extend approximately 700 m upstream of the dam, and has a maximum width of about 150 m. Surface area of the pond is approximately 6.14 ha at the normal water level of 865.5 m. The pond basin will be fully lined with a low permeability barrier to minimize seepage losses into the underlying foundation. The broad-crested weir will be 70 m wide and up to 5.6 m high at the abutments. Weir crest elevation at the abutments will be 868.3 m, with a sill elevation of 865.5 m and width of 38 m (equal to the normal water level of the pond).

The spillway will be an armoured trapezoidal channel with 3H:1V side slopes and a base width of 38 m. The chute will be tied into the existing Peterson Creek channel, with appropriate energy dissipation and erosion/scour protection works to be determined during the detailed design phase. An access road immediately downstream of the spillway chute will also be moved or redesigned to pass appropriate flood flows (Norwest 2015). The dam is located about 5.1 km downstream from the outlet of Jacko Lake and will be a permanent structure.

Flow releases from the PCDP will be operated similarly to Jacko Lake. During the spring freshet, it is expected that pond levels will be at the spillway invert elevation of 865.5 m with no need for active management of the structure. During the summer, when Jacko Lake water levels fall below elevation 892.0 m, water will be pumped out of the lake to meet downstream water license requirements. Flows pumped out of Jacko Lake during this period will either discharge through the PCDP spillway or the low-level outlet will need to be operated to regulate supply to downstream users.

The temporal scale of the impact will be initiated during early construction and last through the 23 year mine life. During the closure phase of the Project the channel of Peterson Creek below the outlet of Jacko Lake will be restored and the diversion pipeline will be decommissioned. The temporal scale of the impact will be approximately 30 years. Based on DFO criteria, the impact to Peterson Creek in the 3.6 km diversion section and footprint of the Downstream Pond dam is classified as destruction of fish habitat.

The spatial scale of the impact on Peterson Creek was estimated by mapping the stream channel and functional riparian zone and quantifying the project affected areas using high resolution imagery and Geographic Information System. The 0.75 km section of Peterson Creek below the pipeline discharge and above the Downstream Pond was not included as part of the affected area. The 0.85 km section of Peterson Creek that will become the Downstream Pond was included as part of the affected area. The detailed maps from this analysis are presented in Appendix B. Wetlands were designated separately from fish habitat and incorporated to the wetland offsetting plan (Keystone 2015).

The affected area of Peterson Creek runs through the historic Afton Mining Camp and Ajax mine site and has been heavily influenced by historic mining and rangeland activities. The stream characteristics comprise a low gradient, channelized straight glide with abundant fine substrate, little channel complexity, and little to no riparian canopy. The fish habitat in this section of creek is rated as poor due to previous industrial activities, beaver activity, cattle grazing, human disturbance, and water abstraction. The affected area consists of 3.85 ha of low gradient stream channel and pond habitat, and 7.71 ha of riparian vegetation, and includes the 3.6 km diversion section and footprint of the PCDP and water retaining dam.

The productivity of the fish habitat that will be lost is considered marginal due to poor quality. The primary function of this section of Peterson Creek as fish habitat is seasonal rearing habitat for rainbow trout that pass over the Jacko Lake spillway during spring freshet. Rainbow trout spawning activity has been observed in Peterson Creek just below the outlet of Jacko Lake in June although it is considered unlikely that this activity contributes to natural recruitment. The spawning sites are typically dewatered by the end of June as water levels in Jacko Lake fall below the dam spillway elevation. Many or all of the spawning fish observed may be sterile rainbow trout triploids. No other suitable spawning sites occur in the 3.6 km diversion section below Jacko Lake or in the footprint of the Peterson Creek Downstream Pond. Rainbow trout fry have not been collected in the Peterson Creek reach downstream of Jacko Lake, and emergent fry would not be able to swim upstream into Jacko Lake due to gradient and either low flow or absence of flow over the spillway following fry emergence. Therefore it is concluded that there is no recruitment of rainbow trout from Peterson Creek into Jacko Lake.

High summer water temperatures combined with low flows severely limit the productivity of this habitat for rearing, and it is unlikely that the diversion section could support overwintering due to low flows and ice formation. FLNRO has identified that this section of Peterson Creek may be a conduit for rainbow trout to move from Jacko Lake to the lower reaches of Peterson Creek. It is possible that trout that enter the section do so seasonally during freshet over the dam spillway without the ability to move back to Jacko Lake. Fish that do not migrate to lower Peterson Creek in summer experience high mortality due to decreasing flows, high water temperature, and entrainment. Once constructed, The Downstream Pond dam will prevent the upstream movement of rainbow trout into the downstream pond or reaches upstream including Jacko Lake. The riparian vegetation adjacent to Peterson Creek is typically grasses and sedges, with some willow and alder. A canopy is largely absent as the channel flows through rangeland. Pockets of water birch are present in confined valley sections of the creek below Goose Lake Road.

The intensity of the impact is high since the affected habitat will be rendered unsuitable for fish once flows are cut off from the outlet of Jacko Lake at the onset of construction. Fish are present seasonally in this section of Peterson Creek so salvage may be necessary, depending on construction timing, to remove fish from the diversion section once it is dewatered to mitigate direct mortality.

4.2.2 Blasting

The use of explosives will be required to develop the Open Pit and is described in detail in Section 3.5 of the Application/EIS. The closest blasting in the Open Pit to the edge of Jacko Lake will be 50 m (BAI 2014). Mitigation is proposed to minimize the potential lethal effects of blasting vibration and overpressure on rainbow trout in Jacko Lake and no significant residual effects are anticipated (KP 2015b). However, monitoring of blasting overpressure and effects to fish is proposed to confirm this prediction and efficacy of mitigation measures.

4.2.3 Lower Peterson Creek

Flow impacts to lower Peterson Creek will be mitigated through the PCDS, which will pump water from Jacko Lake to the PCDP located approximately 3.6 km below the existing outlet of Jacko Lake. It is expected that the PCDS will mostly be required during the spring freshet in order to maintain the normal water level of 892 masl in Jacko Lake and during the summer to maintain existing

downstream water licenses. Flows currently discharge from the lake through a spillway with an invert elevation of 892 masl. This normal water level will be maintained to the extent possible during Construction and Operation by pumping water around the north side of the Open Pit. The pumping system is currently designed to handle 288 m³/hr at 112 m of head. During the summer, at water levels below elevation 892 masl, water will be pumped out at the direction of the province-appointed water bailiff to meet the requirements of downstream water licenses. Operational rules governing the release of this licensed water are summarized in the Ajax Project Water Management and Hydrometric Monitoring Plan (Appendix 6.4-D of the Application/EIS).

The Project footprint will reduce the catchment area that reports to Jacko Lake and Peterson Creek. The impact of reduced flows in lower Peterson Creek was assessed in the Project effects assessment and determined to be not significant to fish considering the annual flow variability and magnitude of flow reductions under baseline conditions. The indirect loss of habitat in Peterson Creek on the productivity of the rainbow trout population downstream of the Project area is minor for the Construction and Operation phases and negligible Post Closure. The average Mean Annual Discharge is estimated to be reduced by 13% during the Construction phase, 18% during the Operation phase, and 6% during at Post Closure once surface flow is restored to Peterson Creek immediately downstream of the Jacko Lake dam. No impacts on the recreational or Aboriginal fishery are anticipated from this reduction of flow and therefore, no serious harm to fish is anticipated to occur in lower Peterson Creek as the result of flow reductions from the Ajax Project.

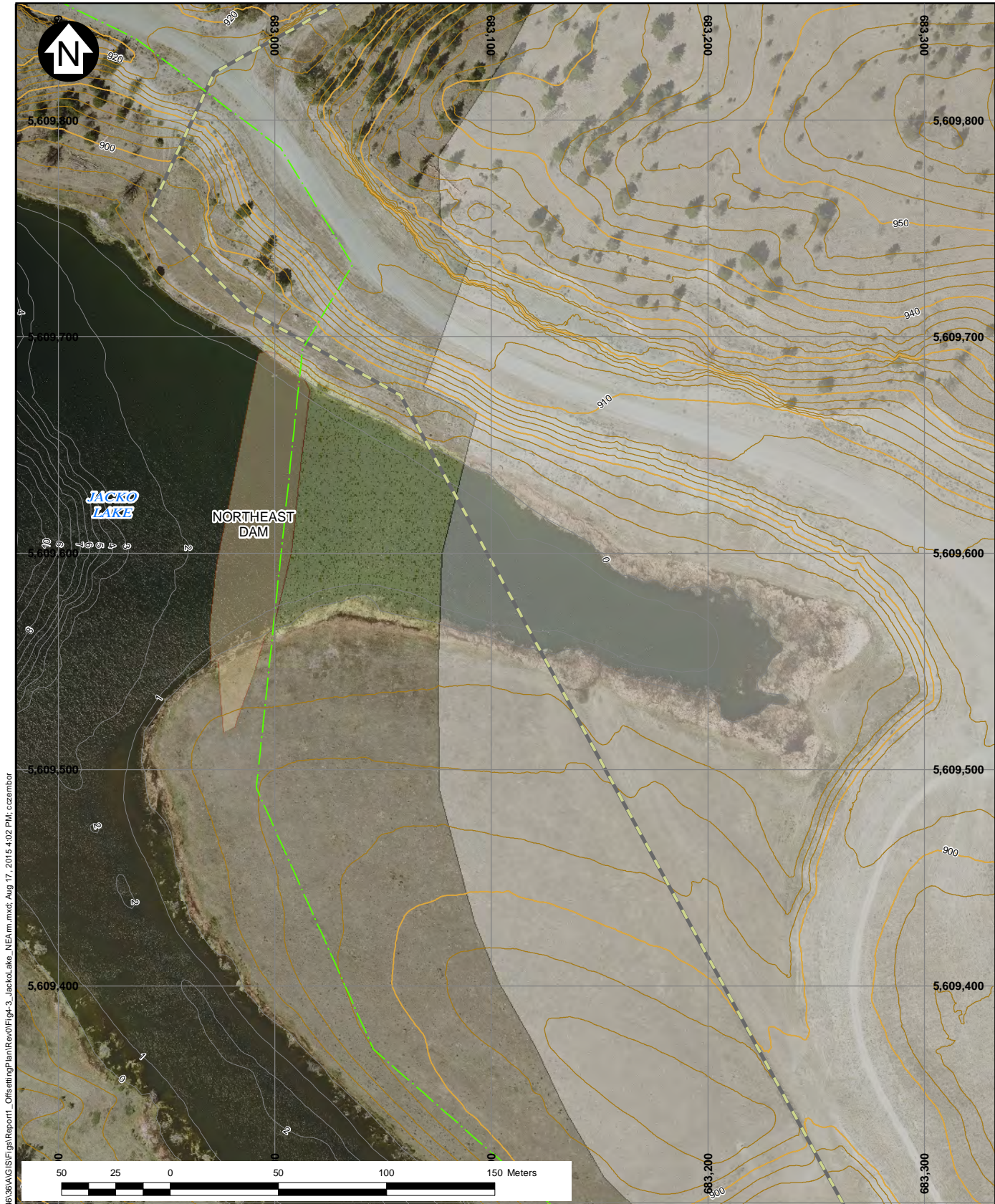
4.2.4 Peterson Creek Upstream of Jacko Lake

Flow impacts to upper Peterson Creek above Jacko Lake are assessed in the Project effects assessment. The mine footprint will reduce the catchment area that reports to the fish-bearing section of Peterson Creek above Jacko Lake but the magnitude of this impact was determined to be minimal and not significant to fish considering the annual flow variability and magnitude of flow reductions under baseline conditions. Peterson Creek at the inlet to Jacko Lake is normally dry throughout most of the summer following freshet and over the winter months. No serious harm to fish is anticipated to occur in Peterson Creek above the inlet to Jacko Lake as the result of flow reductions from the Ajax Project.

4.3 JACKO LAKE

4.3.1 Northeast Arm

The Open Pit will extend into the tip of the northeast arm of Jacko Lake as shown on Figure 4.3. The existing Kinder Morgan pipeline that transects this arm of the lake will need to be removed prior to Open Pit development; therefore, a dyke will be installed to allow work to be conducted in isolation of flow. The dyke will remain in place during Project Operation to enable development of the west pit wall. A 5 m high water retention earthfill dam with a crest length of 200 m and crest elevation of 894.5 masl is proposed at the mouth of the northeast arm. The slope of the upstream dam face (towards Jacko Lake) is designed to be 3:1 and its base will be at elevation 889.7 masl, which is 2.3 m below the 892 masl level of Jacko Lake (Norwest 2015).



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LEGEND:

- CONTOUR (10 m)
- CONTOUR (2 m)
- BATHYMETRIC DEPTHS (1 m)
- LAKE
- POWERLINE - 25 kV
- KINDER MORGAN PIPELINE - CURRENT
- DAM OUTLINE
- NE ARM LOSS
- OPEN PIT

PROPOSED FACILITIES

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

KGHM AJAX MINING INC.

AJAX PROJECT

JACKO LAKE NORTHEAST ARM FISH HABITAT IMPACTS

Knight Piésold
CONSULTING

P/A NO.
VA101-246/36

REF NO.
1

FIGURE 4.3

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The dewatering of the northeast arm is an unavoidable impact of the Project because a significant portion of the mineral reserves of the Project are located below or in close proximity to the manmade northeast arm of Jacko Lake. The proposed dam also requires a setback between the slope of the dam and the ultimate pit limit for dam stability. Further rationale for the unavoidability of the impact is provided in the Application/EIS Alternatives Assessment (ERM 2015).

The northeast arm of Jacko Lake is a man-made, shallow embayment with a surface area of approximately 2.0 ha and depths ranging from 0-2 m. The arm consists exclusively of littoral habitat comprised of open water and aquatic vegetation along the lake margins and a narrow strip of upland shrub riparian vegetation. The lake bottom consists of a layer of fine sediments over glacial till. The northeast arm represents 4.2% of the total Jacko Lake area and 9.4% of the total littoral area shallower than 3 m depth (Table 4.1). The estimated volume of the northeast arm is 18,401 m³ or 0.5% of the total volume of Jacko Lake. The shoreline perimeter of the northeast arm is 655 m which is equivalent to 11.7% of the total 5,600 m shoreline perimeter of Jacko Lake at 892 masl.

Table 4.1 Jacko Lake and Northeast Arm Dimensions

Item	Jacko Lake	Northeast Arm	% of Total
Surface Elevation (masl)	892	892	100.0%
Surface Area (ha)	48.2	2.0	4.2%
Volume (m ³)	3,946,915	18,400	0.5%
Littoral Area (ha)	21.6	2.0	9.4%
Littoral Volume (m ³)	260,000	18,400	7.1%
Shoreline Perimeter	5,600	655	11.7%

The primary function of the northeast arm as fish habitat is food production to support fish growth and rearing habitat for stocked rainbow trout in Jacko Lake. There is no spawning habitat due to lack of suitable substrate of lotic habitat, nor is there overwintering habitat as it is too shallow to avoid freezing in winter.

The water retaining dam will be a permanent structure; therefore, the temporal scale of the impact is permanent and will be initiated during the early stages of construction. Based on DFO criteria the impact to the northeast arm of Jacko Lake is classified as destruction of fish habitat.

The spatial scale of the impact to the northeast arm is illustrated on Figure 4.3. The fish habitat losses associated with the dam footprint and dewatered northeast arm are 2.04 ha of littoral habitat and 0.80 ha of riparian vegetation. The subsurface dam interface with Jacko Lake will have a slope of 3:1 and provide similar rearing conditions to the moderately sloped shoreline to the northwest once aquatic vegetation has become re-established.

The productivity of the affected fish habitat in the northeast arm for summer fish food production and rearing can be conservatively estimated relative to the total littoral habitat area in Jacko Lake. The northeast arm accounts for 9.4% of the total littoral area in Jacko Lake. Therefore it has been assumed that the contribution of the northeast arm is 9.4% of the total food production from littoral areas in Jacko Lake. This is an over-simplistic comparison since food production is driven by other factors outside the littoral area and is not necessarily limiting to fish if the lake is below carrying capacity. The northeast arm is 0.5% of the total volume of Jacko Lake, 4.2% of the total lake area,

7.1% of the littoral volume, and 11.7% of the shoreline perimeter. The conclusion from these comparisons is that the northeast arm likely contributes 5% to 10% to fish food production in Jacko Lake.

The short term intensity of the impact is high since the affected habitat will be removed from Jacko Lake at the onset of construction. Fish salvage may be necessary to remove fish from the northeast arm once it is isolated and partially dewatered to mitigate direct mortality. The longer term intensity of the impact depends on whether or not the removal of the northeast arm has a measurable impact on fish growth as a result of changes in rearing habitat and food supply. The fish population in Jacko Lake is driven by anthropogenic factors such as annual stocking and fishing mortality, which in combination with food supply and physical habitat parameters determine the annual biomass of the fish population. The equilibrium between the number of fish and fish habitat is highly dependent on annual stocking and fishing pressure, and is confounded by extreme events or annual variations in physical factors such as water supply and water quality. The concern raised by FLNRO is that this balance could be upset by removal of the northeast arm resulting in smaller fish or less of them due to reduced food supply.

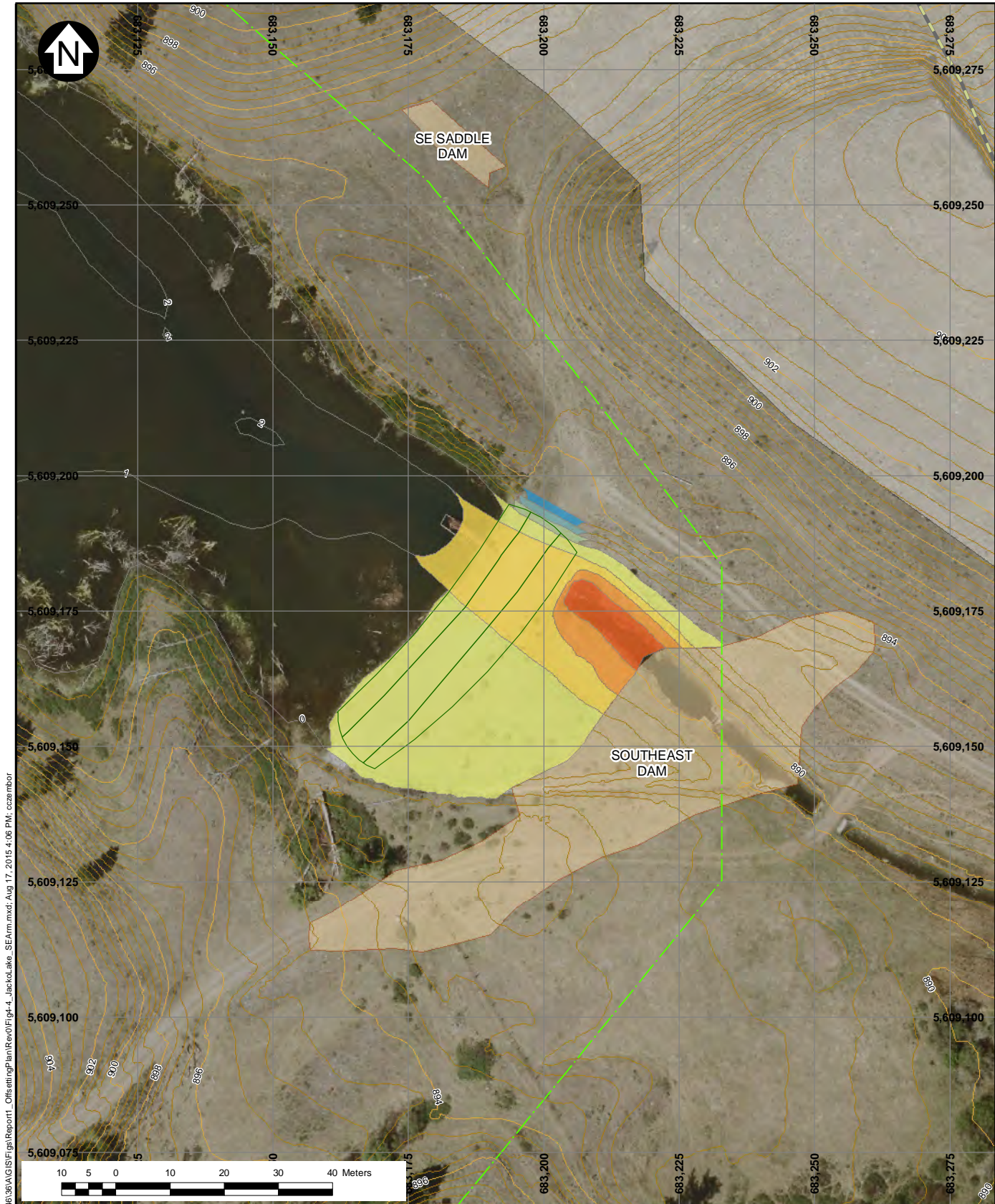
4.3.2 Southeast Arm

The southeast arm of Jacko Lake is a shallow 2.7 ha embayment that ends in an existing water retention earthfill dam and spillway outlet to Peterson Creek. Depths in the southeast arm range from 0-2 m. The water management plan requires replacement of the existing dam on the southeast arm of Jacko Lake to manage the probable maximum flood event. In addition the dam will enable the diversion of Peterson Creek north of the proposed Open Pit as part of the PCDS. The southeast dam is a 5 m high water retention earthfill dam with a crest length of 120 m and crest elevation of 894.5 masl. The slope of the dam face towards Jacko Lake is 3:1 and its base will be at elevation 889.5 masl about 1.5 m below the 892 masl level of Jacko Lake (Norwest 2015).

The water management plan also requires a smaller 0.7 m high saddle dam with a crest length of 30 m on the east side of the southeast arm of Jacko Lake (Norwest 2015). The base elevation of the southeast saddle dam is 893.8 masl and above the full pool water elevation in Jacko Lake of 892.0 masl. The saddle dam is not considered a fish habitat loss due to its small footprint and since the affected vegetation is grassland which offers minimal riparian habitat value.

The temporal scale of the impact is permanent and will be initiated during the early stages of construction. The water retaining dam is a permanent structure that is designed for perpetuity. The new southeast dam will require infilling of a section of Peterson Creek.

The spatial scale of the impact to the southeast arm is shown on Figure 4.4. The replacement dam will be located downstream of the existing dam and therefore will increase the lake area of the southeast arm by 0.2 ha resulting in a modest fish habitat gain for Jacko Lake. The new dam will infill 0.1 ha of Peterson Creek, which is accounted for in the assessment of Peterson Creek presented above.



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LEGEND:

- CONTOUR (2 m)
- CONTOUR (0.5 m)
- BATHYMETRIC DEPTHS (1 m)
- EXISTING SE ARM BERM
- POWERLINE - 25 KV
- KINDER MORGAN PIPELINE - CURRENT
- DAM OUTLINE
- OPEN PIT
- DREDGING AREA (DEPTH TO ELEVATION IN MASL)
- 893.5

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

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JACKO LAKE SOUTHEAST ARM FISH HABITAT IMPACTS							
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: small;">P/ANO. VA101-246/36</td> <td style="font-size: small;">REF NO. 1</td> </tr> <tr> <td colspan="2" style="text-align: center;">FIGURE 4.4</td> </tr> <tr> <td style="font-size: x-small;">REV</td> <td style="font-size: x-small;">0</td> </tr> </table>	P/ANO. VA101-246/36	REF NO. 1	FIGURE 4.4		REV	0
P/ANO. VA101-246/36	REF NO. 1						
FIGURE 4.4							
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The productivity of the affected fish habitat in Peterson Creek is considered marginal due to poor habitat quality, while the unit productivity of the new littoral habitat created in the southeast arm should be similar to other littoral areas of Jacko Lake.

The short term intensity of the impact is high since the affected habitat will be removed from Peterson Creek at the onset of construction. Fish salvage will be necessary to remove fish from Peterson Creek once it is isolated and partially dewatered to mitigate direct fish mortality. Removal of the existing dam will occur in isolation from Jacko Lake and the new lake area will be flooded once construction is completed.

4.4 GOOSE LAKE AND KEYNES CREEK

Goose Lake and Keynes Creek will be infilled as part of the construction of the TSF. These aquatic areas are fishless and do not support a CRA fishery. The effects of flow reductions to downstream areas on Peterson Creek were assessed as part of the project effects assessment. No serious harm to fish will occur as a result of infilling Goose Lake and Keynes Creek for the Ajax Project.

4.5 KAMLOOPS LAKE

Kamloops Lake is an important migration corridor for salmonids and supports a CRA fishery. The proposed pump station and the intake pipe on the south shore of Kamloops Lake will be in the vicinity of the existing New Afton Intake Structure. Preliminary designs indicate that the intake pipe will be installed in the lake by excavating along the foreshore to the water level and dredging a trench below the water level to ensure that the pipe is buried a sufficient depth to prevent freezing (Urban Systems Ltd. 2015). The trench will be backfilled with excavated and imported material prior to restoration of the foreshore area. The intake will be screened to prevent fish entrainment. No permanent direct habitat loss or direct fish mortality is associated with the Kamloops Lake Water Intake, as the direct disturbance will be limited to the period of construction. No serious harm to fish will occur from the construction and operation of the Kamloops Lake Water Intake.

4.6 FISH HABITAT LOSSES AND GAINS

The quantitative results from the serious harm assessment are summarized in Table 4.2. Fish habitat losses in Peterson Creek below Jacko Lake include an estimated 3.85 ha of instream channel and pond habitat and 7.71 ha of riparian vegetation. Fish habitat gains associated with the PCDP total 6.14 ha. The overall net change of fish habitat in Peterson Creek is a habitat gain of 2.29 ha of instream channel and pond habitat and habitat loss of 7.71 ha of riparian vegetation.

Fish habitat losses in the northeast arm of Jacko Lake total 2.04 ha of littoral habitat and 0.80 ha of riparian vegetation. The littoral habitat gains in the southeast arm total 0.18 ha. The overall net loss of fish habitat in Jacko Lake is 1.85 ha of littoral habitat and 0.80 ha of riparian vegetation. From a lake surface area perspective the post-project surface area affected is 3.9% of the total lake area and 8.7% of the littoral area (Table 4.3). The post-project affected volume is 6.5% of the total lake volume.

The total habitat losses identified as unavoidable serious harm to fish total 8.08 ha for the Ajax Project. This includes a net gain of 2.29 ha of instream habitat, a net loss of 1.85 ha of lake habitat, and a net loss of 8.51 ha of riparian habitat.

TABLE 4.2

**KGHM AJAX MINING INC.
AJAX PROJECT**

**CONCEPTUAL FISH HABITAT OFFSETTING PLAN
FISH HABITAT LOSSES AND GAINS**

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Waterbody	Location	Fish Habitat Type	Fish Habitat Area Losses (ha)			Fish Habitat Area Gains (ha)			Net Habitat Area (ha)			Overall Total
			Instream	Lake	Riparian	Instream	Lake	Riparian	Instream	Lake	Riparian	
Peterson Creek	3.6 km Dewatered Section	Instream channel and pond	-3.57						-3.57	0.00	0.00	Overall Total
Peterson Creek	3.6 km Dewatered Section	Riparian zone			-5.32				0.00	0.00	-5.32	
Peterson Creek	Downstream Pond	Instream channel and pond	-0.28			6.14			5.86	0.00	0.00	
Peterson Creek	Downstream Pond	Riparian zone			-2.39				0.00	0.00	-2.39	
Subtotals:			-3.85	0.00	-7.71	6.14	0.00	0.00	2.29	0.00	-7.71	
Jacko Lake	Northeast Arm	Littoral lake habitat		-2.04					0.00	-2.04	0.00	
Jacko Lake	Northeast Arm	Riparian zone			-0.80				0.00	0.00	-0.80	
Jacko Lake	Southeast Arm	Littoral lake habitat					0.18		0.00	0.18	0.00	
Subtotals:			0.00	-2.04	-0.80	0.00	0.18	0.00	0.00	-1.85	-0.80	
Totals (ha)			-3.85	-2.04	-8.51	6.14	0.18	0.00	2.29	-1.85	-8.51	

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TABLE 4.3

**KGHM AJAX MINING INC.
AJAX PROJECT**

**CONCEPTUAL FISH HABITAT OFFSETTING PLAN
JACKO LAKE BASELINE AND POST-PROJECT AFFECTED SURFACE AREAS AND VOLUMES**

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Waterbody	Baseline Surface Area (ha)	Mine Affected Surface Area (ha)	Change (ha)	Difference (%)	Baseline Volume (m³)	Mine Volume (m³)¹	Change (ha)	Difference (%)
Jacko Lake	48.27	46.39	-1.88	-3.9%	3,946,915	3,946,915	0	0.0%
Jacko Lake Littoral	21.64	19.76	-1.88	-8.7%	260,000	243,200	-16,800	-6.5%
Northeast Arm	2.04	0.00	-2.04	-100.0%	18,400	0	-18,400	-100.0%
Southeast Arm (new)	0.00	0.16	0.16	na	0	1,600	1,600	na

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NOTES:

1. THE MINE AFFECTED VOLUME OF JACKO LAKE IS ASSUMED TO BE EQUAL TO THE BASELINE VOLUME AS WATER IN AFFECTED AREA WILL BE DISPLACED.
2. NA = NOT APPLICABLE

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5 – CONCEPTUAL OFFSETTING PLAN

5.1 APPROACH

Avoidance of activities that have the potential to incur *serious harm to fish* has been integral to the design and engineering of the Project, and has been accomplished in two ways. First, the number, duration, and spatial extent of alterations of fish habitat have been reduced, to the extent possible, by working with the design engineers to relocate or re-engineer mine components or activities that could potentially result in *serious harm to fish*. Second, measures have been developed to mitigate the spatial extent, duration, and magnitude of any unavoidable effects to fish habitat that may be considered *serious harm to fish*.

For any residual impacts to fish habitat resulting from the proposed Project, the approach to identify appropriate fish habitat offsets has been guided by the following:

- DFO's Fisheries Productivity Investment Policy guidance
- Provincial fisheries management objectives
- Technical feasibility
- Stability and permanence
- Biological relevance, and
- Cost-effectiveness of options to meet offsetting guiding principles.

The Project would result in the permanent loss of fish habitat and its associated productive capacity. Proven techniques in similar geographic settings for similar fish species provide the greatest likelihood of offsetting lost productive capacity for the long term, are least likely to fail structurally, and require the least amount of maintenance. Low-risk options that are biologically relevant were prioritized during the development of this Offsetting Plan.

The technical feasibility of the proposed offsetting options were assessed in consideration of the unique site conditions present, including topography, geomorphology, hydrology, site accessibility, and the type of physical works proposed. To satisfy DFO's Fisheries Protection Policy guidance, the technical feasibility, biological relevance, and effectiveness of the offsetting works will be determined during long-term monitoring.

The assumption in most cases is that a 1:1 gain-to-loss ratio is necessary to satisfy DFO's Fisheries Productivity Investment Policy guidance. Offsetting ratios less than 1:1 were also used to calculate offsetting areas in consideration of the productivity, importance, and quality of lost and gained habitats. Fish habitat offsetting ratios greater than those applied may be required if the offsetting plan includes options that utilize techniques with long lag-times before they become fully functional. KAM intends to construct the agreed-upon offsetting works as quickly as possible to reduce lag-time effects. Equivalency of the proposed offsets is also considered relative to the productivity, importance, and quality of net fish habitat losses identified in the serious harm assessment.

5.2 OFFSETTING CONCEPTS CONSIDERED

An initial list of potential offsetting options for the Ajax Project was developed for the Project and is summarized in Table 5.1.

TABLE 5.1

**KGHM AJAX MINING INC.
AJAX PROJECT**

**CONCEPTUAL FISH HABITAT OFFSETTING PLAN
LIST OF POTENTIAL OFFSETTING OPTIONS**

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Rank	Offsetting Option	Source	Type of Offset	Size of offsets (S,M, L)	Option Location	Description
1	Increase Elevation of Jacko Lake by raising impoundment structures	Previous on-site habitat compensation	Increase in Littoral Habitat Area	Large	On-site	Previous compensation allowed for increases to the lake elevation. Significant increase in littoral habitat and volume within Lake
2	Jacko Lake Habitat improvements (increase depth SW Arm/Inlet area)	Angler Group meeting	Increase in Habitat Area / Improvement	Moderate	On-site	Desire to increase depth in this arm of the lake increase usable littoral area and improved angling access
3	Development of spawning channel in SE Arm of Jacko Lake	KGHM water management	Potential Spawning Habitat	Moderate	On-site	Provide spawning opportunities for spawning during spring flows where non currently exist
4	Development of downstream pond habitat at the end of the Peterson Creek Diversion	KGHM water management	Development of new water retention pond with aquatic habitat	Moderate	On-site	Development of pond habitat at end of Peterson Creek diversion with control structure – size and feasibility of the pond is currently in review.
5	Upper Peterson Creek Spawning improvements (Jacko Lake inlet)	EA Baseline Work / Previous works by MOE	Potential Spawning Habitat	Small	On-site	Provide opportunities for inlet spawning during spring flows
6	Middle Peterson Creek overwintering improvements (U/S Bridal Veil Falls)	EA Baseline Work	Overwintering Habitat Improvements	Small	On-site	Provide better overwintering habitat for rainbow trout (increase survivals)
7	Lower Peterson Creek overwintering improvements (D/S highway)	EA Baseline Work	Overwintering Habitat Improvements	Small	On-site	Provide better overwintering habitat for rainbow trout (increase survivals)
8	Development of Fish habitat in Inks Lake	KGHM water management	Development of new fish habitat in non-fish bearing waters	Large	Off-site (Cherry Creek Watershed)	Provide flow from Jacko Lake into Inks Lake and develop a stocked fish population with habitat improvements
9	Lower Peterson Creek naturalization	EA Baseline Work	Concrete channel could be naturalized; potential for salmon habitat	Small	On-site	Improvements to urbanized stream – Coho rearing
10	Demonstration pond at local Park in Kamloops	EA Baseline Work	Community Improvement	Small	On-site	Public Relations
11	Thompson River Tributaries (Deadman, Bonaparte Rivers)	EA Baseline Work	Habitat development and Watershed Restoration	Moderate	Off-site	Watershed Restoration
12	Research and other ongoing projects	DFO offsetting guide	Complementary measures	Small	Off-site / On-site	Complementary measures are investments in data collection and scientific research related to maintaining or enhancing the productivity of commercial, recreational or Aboriginal fisheries. In areas where there are limited opportunities for measures to offset fisheries productivity losses and where there is limited understanding or data on fisheries populations, complementary measures may be considered in addition to other offsetting measures. Complementary measures may comprise up to 10% of the required amount of offsetting; the remaining 90% of the offset amount must consist of habitat enhancement, restoration or creation offsetting measures
13	Riparian Improvements in the North or South Thompson	EA Baseline Work	Direct riparian offsets	Moderate	Off-site	Planting of riparian habitat in portions of the watersheds where bank stability / watershed improvements are required.
14	Local Lake overwintering improvements	Provincial Fisheries (Roche, Edith, other lake with winterkill potential)	Aeration or habitat improvement (e.g. diversion)	Moderate	Off-site	Numerous lakes in region with known winterkill potential (e.g. Roche, Edith, Red)
15	Watershed restoration / Improvements within SSN Territory	Local Forest Practices	Watershed Restoration,	Moderate / Large	Off-site	Obtain guidance regarding opportunities within SSN Territory
16	Stocking of barren or unproductive lakes	Angler Group meeting	Improve angling opportunities	Moderate / Large	Off-site	Obtain guidance regarding opportunities from Provincial regulators and local management plans

M:\1\01\00246\36\A\Report\1-Report\Rev 0\Tables\Table 5.1 Offsetting Options.xlsx\Ranking

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Potential options were evaluated by consideration of multiple criteria including:

- Support of Aboriginal groups
- Support of regulatory agencies
- Adherence to DFO's principles for offsetting
- Location within the Peterson Creek watershed and close to the Project site
- Self-sustaining
- Technically feasible and economically viable, and
- Provide similar "in-kind" habitat as an offset.

The option to raise the normal water level of Jacko Lake was initially selected for further evaluation after it was deemed to potentially meet the greatest number of evaluation criteria relative to other options. Another factor that favored evaluation of the option included the fact that the lake had been raised multiple times in the past. The last time the lake level was raised was in 1990 by Afton Operating Corp. as mitigation for development of the Ajax East and Ajax West pits. The concept involved increasing the area of Jacko Lake by raising the normal lake level by 2 m to an elevation of 894 masl. Raising the water level in Jacko Lake would increase the inundated surface area and littoral habitat to offset the loss of the northeast arm of Jacko Lake and 3.6 km section of Peterson Creek.

This offsetting concept was introduced to agencies and Aboriginal groups at meetings on February 5, 2015 and a number of concerns were raised. Most important were concerns voiced by the SSN regarding any further changes to Jacko Lake. DFO mentioned that the concept alone may not provide the required offsetting habitat and that additional options may be required. The concept was more closely evaluated in consideration of comments received from the SSN after presentation of the concept as the preferred option. KAM has been attentive to Aboriginal concerns and community values associated with Jacko Lake and have selected a pit design that strikes a balance between preserving the lake and maximizing the in-situ resource. Consideration of Aboriginal concerns to limit any additional impacts to Jacko Lake was instrumental in the decision to advance an alternative to raising Jacko Lake.

In addition to the recognition of Aboriginal concerns of further impacts to Jacko Lake, a geotechnical evaluation of raising the dam and proximity of the required structure revealed technical concerns with the option. Raising the water level in Jacko Lake by two meters requires a larger dam for which the increased dam height and proximity of water behind the dam would violate the minimum setback distance between the overburden that would underlie the dam and the west pit wall. In particular, the overburden between the proposed dam and the open pit would be inundated within the required setback. Results from the preliminary stability analysis indicates that the minimum setback distance between the west pit crest and the proposed southeast dam is 40 m and the minimum overall overburden pit slope angle of 2.5H:1V. These setback requirements are designed to mitigate potential shallow slope and deep seated slope failures of the overburden that could result in dam failure. Reducing the extent of the pit to increase the distance between the west pit wall and the northeast dam was not advanced because it would result in a significant reduction in mineable ore reserves and was considered economically unviable for the Project. Relocation of the dam on the northeast dam farther west into Jacko Lake would require a significantly longer and higher dam as the foundation area within Jacko Lake becomes substantially deeper. The increased footprint of the

larger dam would extend further into Jacko Lake and result in a greater loss of fish habitat via the loss of more area in the northeast arm and a large portion of the southeast arm.

Therefore the concept to raise Jacko Lake was deemed unfavorable based on comments received during consultation with Aboriginal groups and agencies as well as geotechnical concerns with the proposed required configuration to raise the lake. KAM understands the importance of Jacko Lake to the SSN and therefore this option that would involve greater impact to Jacko Lake was not advanced.

5.3 INKS LAKE OFFSETTING PLAN

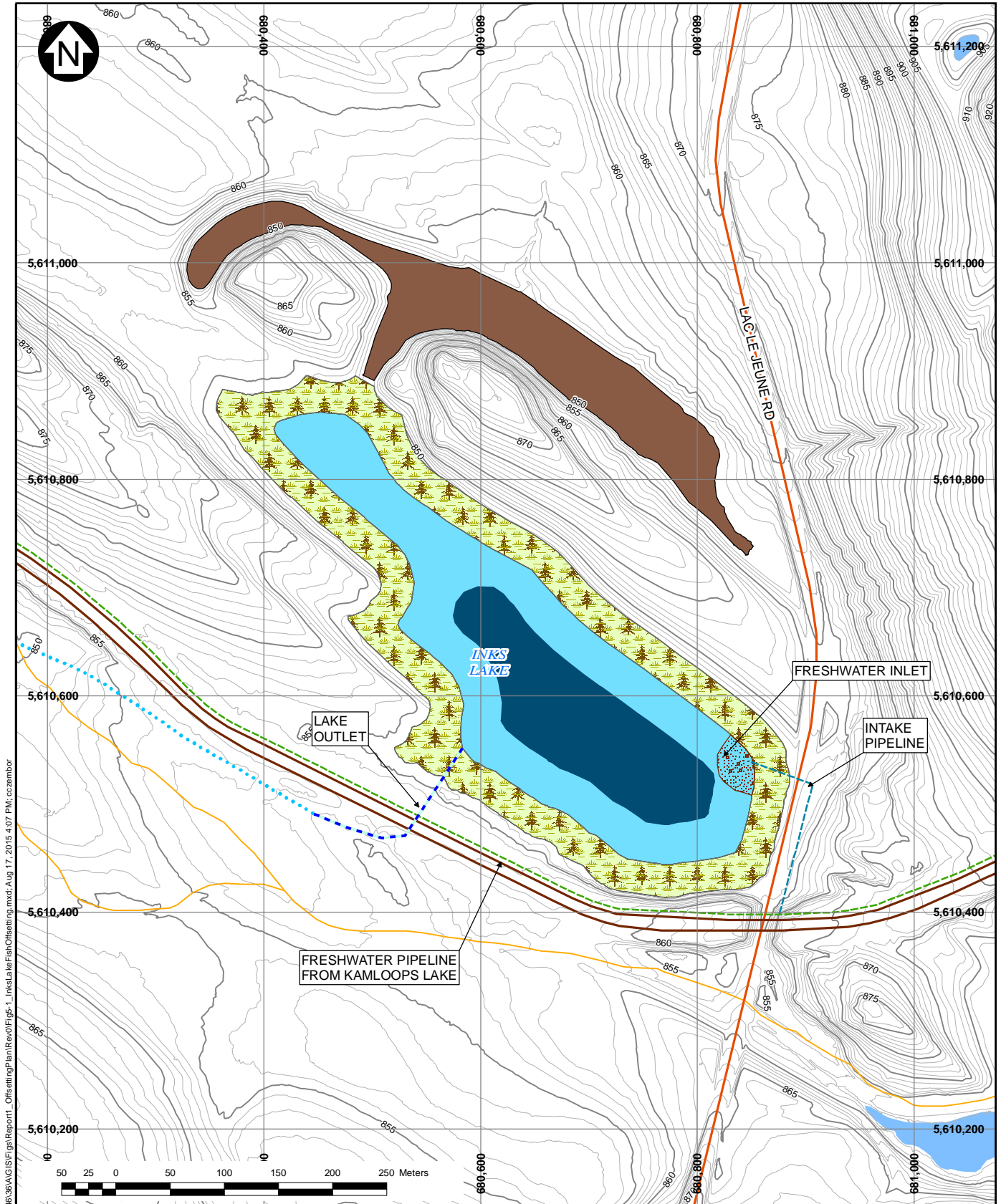
5.3.1 Introduction

The recommendation to assess Inks Lake as a potential option to offset the impacts of the Ajax Project on fish habitat was provided by FLNRO at an Ajax Project meeting on April 21, 2015. The suggested concept is to modify the size and depth of Inks Lake by constructing a water retaining dam, excavation, or a combination of the two and filling the basin using water supplied by the proposed Ajax freshwater pipeline and pumping station in Kamloops Lake. Inks Lake is unable to support fish without enhancement due to its shallow depth, lack of inflow, and unsuitable water quality. By increasing the depth and volume of Inks Lake it has the potential to support fish and create a fishery through the annual stocking of rainbow trout. The potential fish habitat gains that could be accomplished by establishing a fishery on Inks Lake have the potential to greatly exceed the fish habitat offsetting requirements for the Ajax Project.

5.3.2 Description of Offsets

The Inks Lake offsetting concept is shown on Figure 5.1. The design consists of the south basin of Inks Lake filled to a water surface elevation of 852 masl and within 1.3 m freeboard of Lac Le Jeune Road. The lake surface area at 852 masl is 6.07 ha. Existing lake sediments will be removed and underlying overburden materials in the south basin will be excavated to a maximum depth of 12 m. The lake bottom will be excavated to achieve a 10-12 m depth over 30% of the lake area. The preliminary excavation volume is estimated to be 180,000 m³ at 3:1 side slopes. Steeper side slopes and reduced excavation volumes are possible depending on the subsurface materials and if bedrock is encountered. The estimated lake volume at 852 masl following excavation is 450,000 m³. A spillway channel with an invert elevation of 852 masl will be constructed at the southwest end of the lake.

The Offsetting Plan will rehabilitate the existing Inks Lake south basin to create a deeper freshwater lake which is suitable for fish habitat. The existing lake water will be drained and the lake bottom excavated to increase the volume and maximum depth of the lake. Fresh water will be pumped using a spur from the proposed freshwater pipeline to provide process water for the Project from Kamloops Lake to fill Inks Lake. Once the lake has been refilled, the lake shoreline will be planted with native vegetation to establish a functional 30 m wide riparian zone. The lake will be stocked on an annual basis with rainbow trout from a local hatchery as in Jacko Lake as no suitable stream exists in the area to allow for fish spawning and natural recruitment. The conceptual design values for Inks Lake baseline and Offsetting Plan are compared in Table 5.2 below. Depth area capacity curves are shown on Figure 5.2.



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LEGEND:		NOTES:	
GENERAL		1. BASE MAP: 1 METRE LIDAR. 2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.	
— CONTOUR (1 m)	--- INTAKE PIPELINE	■ INKS LAKE (0 - 10 m)	
— CONTOUR (5 m)	--- LAKE OUTLET	■ INKS LAKE (10 - 12 m)	
— ROAD - PAVED	--- PIPELINE	■ RIPARIAN ZONE	
— ROAD - UNPAVED	... ALKALI CREEK TRIBUTARY	■ EXCAVATION DISPOSAL AREA	
— ROAD - HAUL	■ INLET		
■ LAKE			

KGHM AJAX MINING INC.	
AJAX PROJECT	
INKS LAKE FISH HABITAT OFFSETTING PLAN	
	P/ANO. VA101-246/36 REF NO. 1 FIGURE 5.1 REV 0

Table 5.2 Conceptual Design Values

Item	Inks Lake Baseline	Inks Lake Offsetting Plan
Surface Area (ha)	8.74	6.07
Shoreline Perimeter (m)	2,340	1,325
Spillway Elevation (masl)	na	852
Volume (m ³)	85,000	450,000
Maximum Depth (m)	4	12

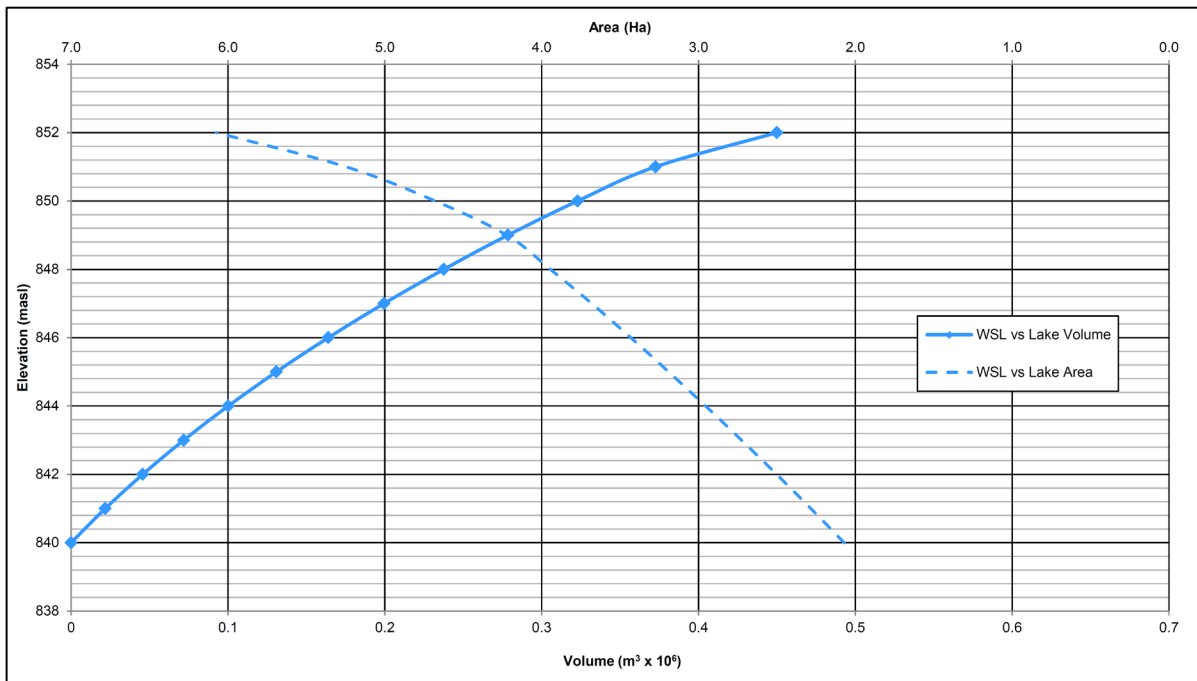


Figure 5.2 Inks Lake Depth Area Capacity Curves

5.3.3 Geology

This section on geology is included to assess the potential subsurface conditions in Inks Lake considering the conceptual plan to excavate and deepen the lake basin. The current assumption is that the subsurface geology has low permeability and/or the water table would allow for a lake after excavation. In the event that seepage to ground is an issue the lake bottom could be lined with a low permeability liner.

The elevation of the surrounding area varies between approximately 860 masl and 850 masl. The area comprises a series of rounded hills with predominantly gentle slope angles and characterized by landforms reflecting the area’s history of glaciation. The bedrock was deeply sculpted and gouged by ice sheets that generally flowed across the Project from the northwest to the southeast while depositing glacial till at its base. The slopes are typically steeper on the northwest sides of the hills;

locally this creates 'crag and tail' type drumlinized terrain that indicates a direction of ice advance to the southeast. The crag tail landform can be seen in the centre of Inks Lake where bedrock outcrops on the northwest side (the crag) and glacial till forms behind to the southeast (the tail).

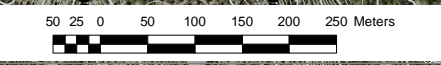
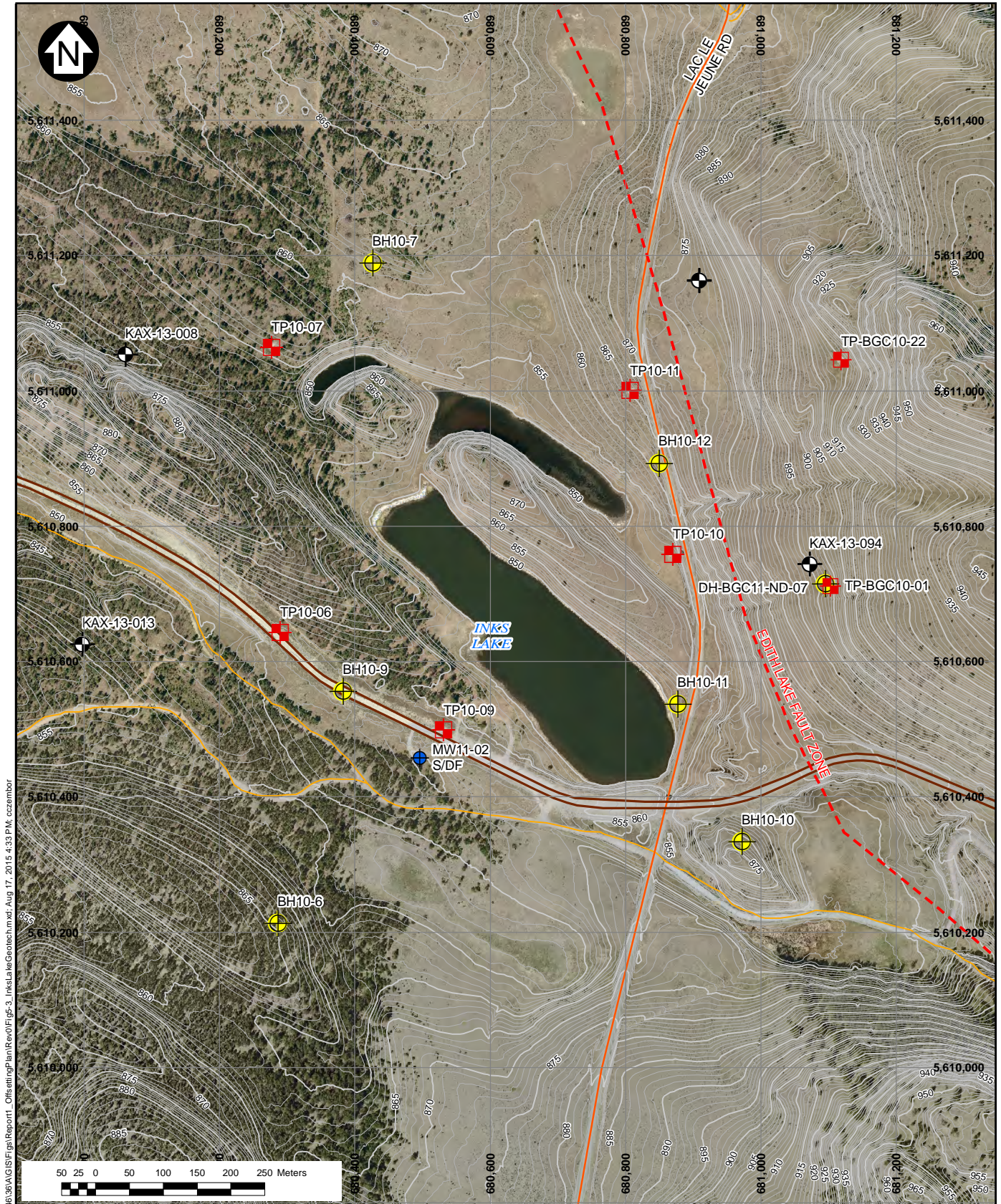
Eight drillholes, four exploration drillholes, a monitoring well, and seven test pits were completed in the vicinity of Inks Lake. The depths to bedrock are summarized in Table 5.3 and test pit and drillhole locations closest to Inks Lake are shown on Figure 5.3.

Inks Lake is characterized by variable thicknesses of glacial till deposits overlying bedrock. The glacial till is present across the site as a discontinuous, irregular layer commonly between 5 m to 15 m thick. Glacial deposits were found to be greater than 30 m thick in drillhole BH10-12, located directly to the east of Inks Lake. Bedrock is at approximately 10 m deep to the west of Inks Lake in drillholes BH10-9 and MW11-02 and close to surface at the centre lobe of Inks Lake. Hydraulic conductivity data for the glacial till collected across site found relatively lower permeability with values in the order of 10^{-6} to 10^{-7} m/s.

The bedrock geology consists of Nicola Group volcanoclastic and sedimentary rocks. In situ hydraulic conductivity testing demonstrates the rock mass has low permeability, ranging from 1×10^{-6} m/s to 8×10^{-8} m/s. The Edith Lake Fault Zone is located directly to the east of Inks Lake following the regional northwest - southeast trend, as shown on Figure 5.3.

Table 5.3 Drillholes and Test Pits Near Inks Lake

Drillholes/Test Pits	Easting (m)	Northing (m)	Elevation (masl)	Bedrock (m)
BH10-6	680286	5610213	N/A	>10.7
BH10-7	680426	5611189	N/A	>10.7
BH10-8	680307	5611806	N/A	>10.7
BH10-9	680382	5610556	N/A	10.2
BH10-10	680972	5610334	N/A	6.3
BH10-11	680877	5610537	N/A	>21.3
BH10-12	680849	5610893	N/A	>29.9
DH-BGC11-ND-07	681095	5610715	896	3.95
MW11-02 S/DF	680496	5610458	855	10
KAX-13-008	680061	5611054	854	77
KAX-13-013	679997	5610626	854	30
KAX-13-085	680909	5611164	950	26
KAX-13-087	680909	5611164	877	34
KAX-13-094	681072	5610744	895	15
TP10-06	680290	5610643	N/A	>6.0
TP10-07	680277	5611065	N/A	>5.4
TP10-09	680531	5610499	N/A	>4.0
TP10-10	680870	5610759	N/A	>5.7
TP10-11	680807	5611001	N/A	>6.0
TP-BGC10-01	681103	5610712	888	2.5
TP-BGC10-22	681119	5611046	899	5.3



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LEGEND:

GENERAL	
—	CONTOUR (1 m)
—	CONTOUR (5 m)
—	ROAD - PAVED
—	ROAD - UNPAVED
—	ROAD - HAUL
■	LAKE
⊙	CONDEMNATION DRILLHOLE
⊙	DRILLHOLE
⊙	MONITORING WELL
⊙	TEST PIT
---	THRUST FAULT

NOTES:

1. BASE MAP: 1 METRE LIDAR.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.

KGHM AJAX MINING INC.

AJAX PROJECT

**INKS LAKE AREA
GEOLOGICAL OVERVIEW**

**Knight Piésold
CONSULTING**

PIA NO. VA101-246/36 REF NO. 1

FIGURE 5.3

REV 0

REV	DATE	DESCRIPTION	MAP DESIGNED	CAC DRAWN	OG REVIEWED
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5.3.4 Hydrometeorology Inputs

This section on hydrometeorology inputs is included to assess the hydrological conditions in the Inks Lake basin for input to water balance calculations.

Mean Annual Precipitation

Precipitation in the Project area occurs either as snow, rain, or a combination of both, with the latter generally occurring during the late fall or early spring periods. Total hourly precipitation data have been collected at the AJAXMET and AJAXAQ-1 climate stations since December 2012 and August 2014, respectively. The precipitation estimate for the site was developed using short-term site data in conjunction with long-term measured data from regional climate stations operated by Environment Canada (EC) and Forests, Lands and Natural Resource Operations (FLNRO). The six regional stations include:

- EC Kamloops Airport
- EC Kamloops Afton Mines
- EC Kamloops Pratt Road
- EC Red Lake
- EC Logan Lake, and
- BC FLNRO Afton.

These stations were considered due to their geographic proximity to the site, relatively long data records, and varying elevations. A double mass curve analysis involving the linear correlation of the cumulative concurrent monthly precipitation values for Kamloops Airport and AJAXMET was conducted. The analysis indicates that AJAXMET receives approximately 25% more precipitation than Kamloops Airport. Application of this factor to the 269 mm long-term mean annual precipitation (MAP) for Kamloops Airport results in a corresponding MAP estimate of 336 mm for the project area. This precipitation value is for an elevation of 950 m, and precipitation is estimated to vary by elevation throughout the Project area according to an orographic rate of 4.8% per 100 m. Further details are provided in the 2014 Climatology Report (KP 2015c).

Wet and Dry Year Precipitation

Wet and dry year annual precipitation totals were calculated based on a normally distributed probability of occurrence. A dimensionless measure of the standard deviation is the coefficient of variation (CV), which was estimated for the site to be 0.18, based on the average value for the regional stations. This CV was multiplied by the MAP of 336 mm to produce a standard deviation estimate of 60 mm. The wet and dry annual precipitation values for the 1 in 20 year wet and 1 in 20 year dry return periods were estimated to be 434 mm and 238 mm, respectively.

Potential Evapotranspiration

There are no evaporation data available for the Project area and therefore the annual average potential evapotranspiration (PET) estimate was developed using the theoretical Thornthwaite equation (Thornthwaite 1948), which requires input of average monthly temperature. Using the long-term synthetic temperature series developed for the Project site (KP 2015c) the mean annual PET was estimated to be 585 mm/year, with mean monthly values ranging from zero in the winter to 130 mm in July. PET is defined as the amount of evapotranspiration that would occur given an infinite supply of water from a crop surface, and is believed to reasonably represent lake evaporation

conditions (Ponce 1989). PET was assumed to equal lake evaporation and was applied to the lake surface area to estimate evaporation losses.

5.3.5 Water Balance

An annual water balance was completed for Inks Lake to determine the volume required each year after the initial filling to maintain a deep freshwater lake with an outflow from April to October (213 days). The water balance was based on a lake surface elevation of 852 masl. The total lake volume at 852 masl elevation was assumed to be 450,000 m³, with a corresponding surface area of 6.07 ha based on the depth-area-capacity relationship developed for the enhanced lake and the available bathymetric survey information.

Hydrometeorological inputs to the lake include direct precipitation, watershed runoff and groundwater inputs, while hydrometeorological losses include evaporation from the lake surface and seepage. Precipitation and evaporation were estimated as described in Section 5.3.4. There is uncertainty associated with watershed runoff and the current level of the groundwater table near Inks Lake. A baseline water balance was conducted to assess runoff and groundwater contributions (inputs or seepage). Because there is currently no outflow from Inks Lake, the balance is described as follows:

$$\text{Direct precipitation (m}^3\text{/year)} - \text{Evaporation (m}^3\text{/year)} + \text{Other contributions (m}^3\text{/year)} = 0$$

“Other” contributions include watershed runoff and groundwater gains or seepage. There is currently insufficient information to accurately partition runoff and groundwater contributions, but for the purpose of this water balance assessment, distinguishing between these sources is not necessary. Runoff and/or groundwater were calculated to contribute approximately 5,200 m³/year. These estimates will be refined as part of the detailed offsetting plan required for the *Fisheries Act* authorization application.

The lake filling rate is the rate of water required to fill the entire lake volume of 450,000 m³ after initial construction. It was assumed that the lake will be filled after construction to the full volume at lake surface elevation 852 masl, with the inflow rate varying depending on water availability with other Project water needs. The filling rate will depend on additional Project water requirements from the process plant freshwater pipeline for mine construction. After the lake is full, an annual lake outflow is proposed to maintain water quality. Lake water quality modelling should be undertaken to assess the required outflow rates for more advanced designs. Lake retention or residence time is a calculated quantity expressing the mean time that water spends in a particular lake and is calculated by dividing the lake volume by the flow in or out of the lake. The Inks Lake residence time required to adequately flush the lake to provide suitable water quality (e.g. temperature, dissolved oxygen, etc.) for fish is unknown. Therefore the lake residence time of Jacko Lake was assumed to provide a suitable estimate. The residence time of Jacko Lake was calculated to be 3.9 years based on a lake volume of 3.95 Mm³ and annual outflow of 1.1 Mm³ (0.032 m³/s at the outlet). The Inks Lake outflow rate was based on the following relationship:

$$\text{Lake outflow (m}^3\text{/year)} = \text{Lake volume (m}^3\text{)} / \text{Residence time (years)}$$

Assuming a residence time of 3.9 years for Inks Lake, the required annual outflow volume was estimated to be 115,385 m³, which equates to 23 m³/hr (0.006 m³/s) over the 213 days from April to October. Once the lake is full, the lake inflow rate is required to maintain the lake year after year.

Therefore, the annual lake inflow rate required to maintain the lake volume and outflow for Inks Lake was based on the following water balance:

$$\text{Lake inflow (m}^3\text{/year)} = \text{Lake outflow (m}^3\text{/year)} + \text{Evaporation (m}^3\text{/year)} - \text{Direct precipitation (m}^3\text{/year)} - \text{Other contributions (m}^3\text{/year)}$$

The lake inflow rate was estimated based on the average, 1:20 wet and 1:20 dry annual precipitation values in order to provide a range of projected values, as summarized in the Table 5.4 below.

Table 5.4 Inks Lake Estimated Lake Inflow Rates

Annual Precipitation (mm)		Lake Inflow Rate	
		(m ³ /yr)	(m ³ /hr)
Average	336	125,393	25
1:20 year Wet	434	119,444	23
1:20 year Dry	238	131,341	26

NOTES:

- Hourly rates are based on a steady flow rate between April 1 and October 31 (213 days)

The lake inflow rates were derived as an initial estimate for input to the design of the freshwater pipeline and costing. Further studies will be undertaken at the next level of design to refine inflow rates to Inks Lake. Monitoring will be required to assess post-construction water quality conditions in Inks Lake.

5.3.6 Lake Inflow and Outflow Infrastructure

The freshwater supply for Inks Lake will be provided through a pipeline bifurcation from the main water pipeline between Kamloops Lake and the main process plant. The pipeline will discharge to the northeast corner of Inks Lake as shown on Figure 5.1. The preliminary annual lake inflow design flow to maintain lake levels and water quality is 25 m³/hr (0.007 m³/s) from April to October (213 days) over the 23-year mine life.

The lake outlet will be constructed by excavating a channel at the southwest side of the lake as shown on Figure 5.1. The channel invert will be at elevation 852 masl and be gently sloped to allow the lake outlet flow of 23 m³/hr (0.006 m³/s) to flow under the mine access road through a culvert and into a tributary of Alkali Creek. The outlet channel and culvert will be designed to pass the 1:100 year flood event based on the inflow catchment to Inks Lake to prevent flooding of Lac Le Jeune Road during this design event.

5.3.7 Construction Plan

Construction of the Inks Lake offsetting habitat consists of five main stages: dewatering, excavation and spoil disposal, riparian bench construction, inlet armouring / outlet channel construction and riparian planting. An additional stage of installing a liner on the lake bottom to prevent seepage losses is not expected; however, will be added if necessary.

The first stage in the construction plan consists of dewatering the existing Inks Lake and if necessary the unnamed northern basin. Water from the lake basin will be pumped to the Project site for construction uses using a temporary pipeline or collected for use on the mine site. The lake bottom sediments will be assessed for potential contamination and for their suitability for use as engineered fill. Any contaminated soils, or any soils that are not suitable for construction purposes, will be excavated and placed in the north basin of Inks Lake. Soils which can be used for reclamation will be excavated and stored in a temporary location.

Once the lake bottom sediments have been stripped the underlying glacial till material will be excavated and either placed in the north basin or used locally to develop a low lying bench around the lake perimeter to support riparian vegetation. If necessary any bedrock outcrops will be removed to the required elevation using drilling and blasting techniques. Alternatively bedrock will be left in place as a subsurface lake feature provided the minimum depth criteria can be met in other areas of the basin. If seepage is considered an issue the lake bottom will be lined with compacted glacial till which is assumed to be sourced from the excavated spoils from Inks Lake stockpiled in the north basin or a borrow location approximately 2 km away. Riprap will be placed at the lake inlet and outlet to mitigate erosion and if necessary in select areas around the perimeter of the lake for upland stability. The outlet channel will be constructed between the lake and a tributary to Alkali Creek. Lastly riparian planting will be completed after the lake filling has been completed as a final stage to ensure edge vegetation that requires seasonal inundation survives.

5.3.8 Operations Plan

Lake filling will commence following construction of the Inks Lake south basin. Once the lake basin is refilled the water quality conditions should be acceptable to support rainbow trout; this will be confirmed by monitoring. The lake inflow and outflow volume from April to October will maintain water quality in Inks Lake throughout Project operations. Inks Lake will be stocked annually in the spring with Fraser Valley, Pennask, or other local hatchery strains of rainbow trout.

5.3.9 Water Management at Mine Closure

The concept at mine closure is to discontinue pumping water uphill from Kamloops Lake and introduce a passive water supply system. A potential water supply option is to divert water to Inks Lake through a valve controlled gravity fed water pipeline from the northwest arm of Jacko Lake as shown on Figure 5.4. It may be possible to apply and receive a water allocation to satisfy the required inflow and outflow rates through an agreement to acquire a portion of the water allocation from Jacko Lake currently held by FLRNO (Licence No. C132063). Preliminary discussions have indicated this may be possible however additional discussions will be necessary once required flow rates have been refined. Other potential options include diversions of upper Alkali Creek to Inks Lake. Feasibility assessment of a passive water supply to Inks Lake will require:

- Discussions with FLNRO regarding a water license allocation from Jacko Lake and whether the minimum Inks Lake inflow requirements could be met while satisfying existing allocations
- Topographic assessment of potential channel alignment from Jacko Lake to Inks Lake for inflows and channel alignment from Inks Lake to Alkali Creek for outflows, and
- Channel stability assessment for Alkali Creek to ensure capacity for additional flow from Inks Lake.

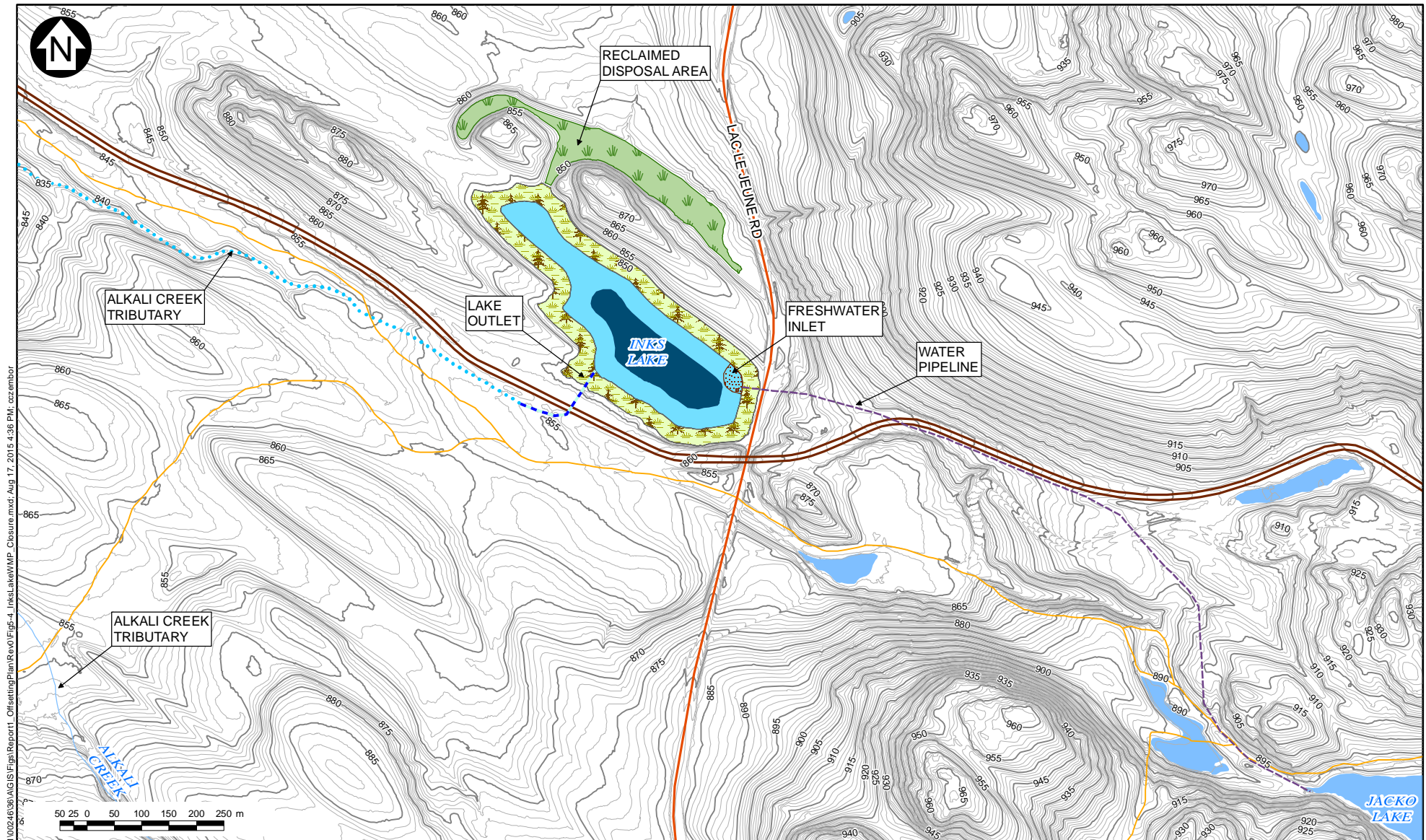
If the pipeline from Jacko Lake and water licence allocation is feasible it may be possible to establish this passive water supply system during mine operations to enable the transition from a pumped freshwater supply prior to closure.

5.3.10 Land Tenure

The land area required for the Inks Lake offsetting concept is located entirely on both Provincial Crown Land and land owned or under agreement by KAM. There are no known land ownership conflicts associated with the Offsetting Plan. Appropriate Provincial land tenure approvals will be obtained for any proposed works on Provincial Crown Land.

5.3.11 Schedule

Dewatering of Inks Lake and materials excavation will be conducted in the first year of mine construction. The water supply infrastructure will be completed to allow filling of Inks Lake during the winter between year -2 and -1. Annual stocking of the lake with rainbow trout will be initiated in the spring of the third year following the onset of construction.



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LEGEND

GENERAL		PROPOSED FACILITIES	
—	CONTOUR (1 m)	—	LAKE OUTLET
—	CONTOUR (5 m)	—	WATER PIPELINE
—	RIVER/CREEK	—	ALKALI CREEK TRIBUTARY
—	LAKE	—	INLET
—		—	INKS LAKE (0 - 10 m)
—		—	INKS LAKE (10 - 12 m)
—		—	RIPARIAN ZONE
—		—	RECLAIMED DISPOSAL AREA
—		—	

NOTES:

1. BASE MAP: 1 METRE LIDAR.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:10,000 FOR 8.5 x 11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

KGHM AJAX MINING INC.

AJAX PROJECT

INKS LAKE WATER MANAGEMENT PLAN AT MINE CLOSURE

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	PA NO. VA101-246/36	REF NO. 1
	FIGURE 5.4	

5.3.12 Screening Level Effects Assessment

5.3.12.1 Introduction

The potential effects of the Conceptual Fish Habitat Offsetting Plan were assessed to identify mitigation and determine residual effects on fish habitat and other VCs. The key Project Activity-VC interactions throughout the life of the Offsetting Plan that are likely or certain to result in one or more of these effects are summarized in Table 5.5. For the purpose of this assessment, the effects are grouped into themes by VC. Direct, indirect, and induced effects are considered.

Interactions that are marked in Table 5.5 as key (red) or potential moderate (yellow) are carried forward for further analysis in this section. Those interactions that are negligible to minor (green) will not be discussed as a residual effect, except to identify standard operating practices and mitigation measures that are well known and understood. They will be managed using industry standard best practices and mitigation measures with proven effectiveness for similar activities and regions. Industry standard best practices include compliance with project construction and operation permits, and guidance documents provided by provincial and federal regulatory agencies.

A number of the activities and components listed in Table 5.5 have the potential to affect VCs through one or more mechanisms or pathways. For example, clearing, grubbing, and access construction activities typically require the removal and disposal of trees, stumps, roots, shrubs, and grass. Draining and excavation of the Inks Lake south basin and will require disposal of excavated materials in the north basin, which will modify the character of the existing ecosystem for wildlife and recreation.

Project activities with the potential to result in a moderate or key interaction with a VC are discussed in the following section.

5.3.12.2 Key Effects on Valued Components

Surface Water

Inks Lake is contained in an isolated basin with no surface connection to Alkali Creek or surrounding waterbodies. Lake dewatering is required to excavate the lake basin and remove naturally contaminated water before stocking with fish. The existing lake basin water is unsuitable for direct release to the downstream environment due to high salt content. Lake water will be pumped to the TSF or other area of the mine site and managed as contact water. Alternatively water will be pumped to Wallender Lake, which is a nearby seasonally dry salt lake basin of similar water chemistry to Inks Lake. Provided that Inks Lake water is not released to the environment, there will be no effect on water quality related to lake dewatering.

Lake sediments and glacial till excavated from the lake bottom will potentially contain elevated levels of salts, nutrients, and metals. Testing of this material and appropriate disposal in the north basin is required to mitigate the potential leaching of these compounds to the environment. Best management practices during construction will be used to mitigate the effects of erosion, sediment, spills, and other construction related effects. Increased erosion and sedimentation are managed by implementation of measures laid out in the Erosion and Sediment Control Plan (Section 11.4 of the Application/EIS).

TABLE 5.5

**KGHM AJAX MINING INC.
AJAX PROJECT**

**CONCEPTUAL FISH HABITAT OFFSETTING PLAN
VALUED COMPONENT INTERACTION MATRIX**

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Phase	Project Activities	Valued Component									
		Groundwater	Surface Water	Geology, Landforms, and Soils	Fish and Fish Habitat	Vegetation and Terrestrial Ecosystems	Wildlife	Heritage	Economics	Social	Health
Construction	Clearing, Grubbing, and Access Construction	O	L	O	O	H	H	H	O	L	O
	Lake Dewatering and Water Disposal	L	H	O	L	H	H	H	O	L	O
	Lake Sediment Stripping and Disposal	L	L	O	O	H	H	H	O	L	O
	Earthworks and Waste Material Disposal	L	L	O	O	H	H	H	O	L	O
	Drilling and Blasting	L	L	O	O	H	H	O	O	L	O
	Recontouring, Lake Surface Preparation, and Riprap Placement	O	L	O	O	O	O	O	O	L	O
	Water Supply Infrastructure and Lake Outlet Construction	O	L	O	O	H	H	H	O	L	O
	Lake Filling	O	O	O	O	O	O	O	O	L	O
	Topsoil Layering, Revegetation, and Riparian Planting	O	O	O	O	L	L	O	O	O	O
Operation	Annual Rainbow Trout Stocking	O	M	O	M	O	O	O	O	H	O
	Annual Lake Water Supply	O	H	O	H	O	O	O	O	H	O
	Access Road Use and Maintenance	O	O	O	O	O	O	O	O	O	O
	Maintenance and Monitoring	O	L	O	L	O	O	O	O	O	O
Decommissioning and Closure	Jacko Lake Water Supply Pipeline Construction	O	L	O	L	O	M	H	O	O	O
	Annual Rainbow Trout Stocking	O	O	O	O	O	O	O	O	H	O
	Annual Lake Water Supply	O	O	O	H	O	O	O	O	H	O
Post Closure	Maintenance and Monitoring	O	O	O	O	O	O	O	O	O	O

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O	No interaction anticipated.
L	Negligible to minor interaction expected; implementation of best practices, standard mitigation and management measures; no monitoring required, no further consideration warranted.
M	Potential moderate interaction requiring unique active management/monitoring/mitigation; warrants further consideration.
H	Key interaction; warrants further consideration.

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The placement of lake sediments and glacial till excavated from the lake bottom of the south basin into the north basin will result in a loss of surface water in the north basin, as it will be converted to a terrestrial ecosystem. However the additional surface capacity provided through the excavation of the south basin will result in a net gain in surface water quantity.

Water extraction from Kamloops Lake for the Ajax Project and the potential effects on water levels and downstream flow in the Thompson River was assessed in the Application/EIS and determined to be not significant. The annual use of water for Inks Lake water supply relative to mine use is incremental and not significant to Kamloops Lake.

Fish and Fish Habitat

Inks Lake is fishless and does not support a CRA fishery. Once construction of the south basin is completed it will be re-filled with clean water pumped from Kamloops Lake. The water quality conditions should be acceptable to support rainbow trout; this will be confirmed by monitoring. Provided acceptable water quality is confirmed prior to fish stocking and monitored during the mine operations and closure phases, there should no residual impacts to fish and fish habitat in Inks Lake.

Pumping water from Kamloops Lake could potentially introduce aquatic or invasive species to the Inks Lake basin. This will be assessed as part of the operations monitoring program.

Vegetation and Terrestrial Ecosystems

Replanting with vegetation will occur in any temporarily disturbed areas associated with construction. To the extent possible, any existing trees adjacent to the construction will be retained. The Offsetting Plan includes the establishment of a 30 m wide riparian corridor around the perimeter of the south basin. The excavation material placed in the north basin will be re-contoured and a soil layer will be established to support a grassland ecosystem. Revegetation and riparian planting plans specific to the climate will be developed as mitigation and to create new habitat. There will be an increase in vegetation cover and terrestrial ecosystems in the north arm relative to baseline conditions.

Wildlife

Dewatering, excavation, and deposition of excavated material in the existing lake basin will result in direct mortality to aquatic life in the basin. Once the lake is refilled, it is assumed that aquatic life will recolonize the lake. Moderately saline lakes such as Inks Lake are unique ecosystems, with species specifically adapted to these conditions. Lake dewatering and replacement with water from Kamloops Lake will change the existing aquatic ecosystem. Relative to baseline conditions there will be a decrease in the surface area of overall Inks Lake, but the quality of wildlife habitat and volume of aquatic habitat will potentially be higher due to deepening of the lake, introduction of clean water, revegetation of disturbed areas, and the establishment of riparian vegetation around the perimeter of the south basin. The north basin will be permanently altered from a moderately saline aquatic environment to a grassland ecosystem.

Waterfowl, shorebirds, and other bird species use open water and riparian zones in Inks Lake for feeding and potential nesting. Amphibians such as the western toad (*Anaxyrus boreas*) also use Inks Lake for feeding and reproduction. Mitigation in the form of pre-construction surveys and appropriate construction timing windows may be necessary to mitigate potential impacts to bird and amphibian species. Birds and amphibians will re-colonize the south basin of the lake once the lake is refilled.

Aquatic bird and amphibian habitat in the north basin will be permanently lost during construction. The north basin area will be re-contoured and re-vegetated for use by terrestrial wildlife species.

Construction of the Jacko Lake Water Supply Pipeline will use pre-construction surveys and appropriate construction timing to conform to industry best practices for avoidance of wildlife nesting sites, habitat, and migration corridors.

Heritage

Inks Lake has been assessed for archaeological resources and there are currently no identified conflicts. Further assessment may be required once the construction footprint for the Offsetting Plan is confirmed following a more detailed level of engineering design. The potential impact on archaeological resources is associated with construction clearing or excavation on previously undisturbed ground.

Social

Inks Lake is used for recreation and cattle grazing. Construction will have a temporary effect on lake users as a result of reduced access. Increasing the volume and depth of Inks Lake will also provide a direct recreational benefit and local clean water source.

5.3.12.3 Summary

In summary, the residual effects of the Conceptual Fish Habitat Offsetting Plan are not significant after mitigation. The alteration of the existing moderately saline aquatic ecosystem and the overall reduced surface area of Inks Lake is an unavoidable residual effect of the Offsetting Plan. The benefits of the Offsetting Plan are the establishment of a new recreational fishing lake and improved water quality to support cattle grazing and wildlife. Revegetation of the north basin and the establishment of riparian vegetation will provide habitat for terrestrial wildlife species.

5.3.13 Technical Feasibility, Uncertainty, and Benefits

The Conceptual Fish Habitat Offsetting Plan involves conventional construction methods that are technically feasible. The concept as presented will be optimized through advancement of engineering designs and other analyses as required for the application for authorization of serious harm to fish as required under the *Fisheries Act*. Uncertainties that will be investigated as part of requirements of the application for the *Fisheries Act* authorization and engineering design include:

- Water balance estimates. Groundwater flux is currently assumed to be zero because the elevation of the excavated lake bottom relative to the groundwater table is currently unknown. However based on geotechnical data in the vicinity of Inks Lake it is likely that the groundwater table elevation will be above the lake bottom which will result in a net gain of groundwater flow into the lake. Another risk is seepage and loss of water to ground.
- Inlet and outlet locations. Locations for the proposed inlet during operations and outlet will be evaluated to determine the optimal locations for all project phases with the goal of providing the best flushing mechanism for the lake.
- Water quality. There is some uncertainty regarding post-construction water quality to support fish that requires further investigation. The current assumption is that the removal of existing lake water followed by replacement of freshwater from Kamloops Lake and a flow inflow and discharge from Inks Lake over the summer to mitigate potential water chemical loading will

maintain water quality for fish. The appropriate maximum lake depth considering other fish-bearing lakes in the region is 10 m to 20 m, and increased lake depth increases the likelihood of lake stratification and turnover. The depth of the lake is cost sensitive due to the high unit costs for excavation and potential to encounter bedrock.

- Post Project closure water management. The concept includes the provision of a freshwater source via a shared water source (freshwater pipeline for process water) during mining operations. At closure a passive water source will be required to provide the required water to replace evaporative losses as well as flushing flows to maintain water quality necessary to support fish. This concept requires additional investigations with respect to water availability from Jacko Lake and the feasibility of establishment of a pipeline or channel between Jacko and Inks Lake or other sources such as Alkali Creek.
- Design criteria for the lake water surface elevation in relation to Lac Le Jeune Road. Currently the concept includes no change to the existing maximum water level of Inks Lake; however this will be re-examined with input from the Ministry of Transportation and Infrastructure to ensure design criteria for the lake is consistent with requirements to prevent flooding of the road surface.

The Fish Habitat Offsetting Plan offers:

- A plan that balances Project impacts to fish habitat and an Aboriginal and recreational fishery. The Offsetting Plan offers habitat creation in the same watershed and local area as the proposed Project and impacts using an “in-kind” approach for much of the impacted habitat.
- A new recreational fishery that supports fisheries management objectives and clear benefits to the local trout fishery. Inks Lake will be similar to Jacko Lake in that it will offer early and late season fishing due to a similar elevation. Inks Lake will have good access with direct connection from the Ajax Mine Access Road via Lac Le Jeune Road.
- Providing a new freshwater ecosystem that will be self-sustaining over the long term.
- Providing a new recreational fishing lake.

In summary the concept proposed is technically feasible. However as it is a concept it warrants further investigation; the results of which will be presented as part of an application for authorization under the *Fisheries Act*. KAM has indicated interest in developing partnerships to further the value of a recreational fishery at Inks Lake beyond regulatory requirements.

5.3.14 Time Lag Considerations

The net fish habitat losses identified in the serious harm assessment will be incurred at the onset of construction of the Ajax Project. The Inks Lake offsetting works will require approximately two years to construct and fill with freshwater from Kamloops Lake. Rainbow trout will be introduced to Inks Lake in year three during the first spring following lake filling. KAM intends to complete the offsetting works during the 2.5 year construction phase of the Ajax Project.

There is no natural recruitment of fish populations associated with the fish habitat that will be lost as the result of the Ajax Project. The net loss in fish productivity between the time the fish habitat losses are incurred and when the offsetting works are completed is minimal. From a fish habitat equivalency perspective, the fish habitat created in Inks Lake will provide potentially higher benefits to the recreational fishery than the fish habitat lost in the northeast arm of Jacko Lake and in Peterson Creek. The 2-3 year time lag between when the fish habitat losses are incurred and when the Inks

Lake offsetting works are completed should not result in an additional loss of productivity that would require additional offsets.

5.4 FISH HABITAT BALANCE

The fish habitat area benefits for the proposed Offsetting Plan are presented as a habitat balance sheet against the net habitat losses for the Ajax Project in Table 5.6. The assumptions used in the table are as follows:

- Net fish habitat losses and gains for instream, lake, and riparian areas are derived from Table 4.2
- The 3.57 ha instream loss in Peterson Creek will be offset at a ratio of 1:1 based on the marginal to low quality habitat of this section of the creek
- The 2.66 ha riparian loss in Peterson Creek will be offset at a reduced ratio of 0.5:1 based on the marginal contribution of this habitat to fish productivity
- The 5.86 ha instream net habitat gain from the PCDP is applied to the habitat balance as an offsetting credit of -5.86 ha at a ratio of 1:1
- The 2.39 ha riparian vegetation loss from the PCDP will be offset at a ratio of 0.5:1 based on the marginal to low quality habitat of this section of the creek
- The 2.04 ha littoral habitat loss in the northeast arm of Jacko Lake will be offset at a ratio of 1:1 considering the proposed offsets in Inks Lake will provide similar habitat for fish
- The 0.8 ha riparian vegetation loss in the northeast arm of Jacko Lake will be offset at a ratio of 1:1 considering the proposed offsets in Inks Lake will create similar riparian vegetation
- The 0.18 ha littoral habitat gain in the northeast arm of Jacko Lake is valued as an offsetting credit of -0.18 ha in the habitat balance
- The lake surface area from the Inks Lake offsetting concept was used to calculate the littoral and limnetic habitat offsetting area of 6.1 ha, and
- The 30 m wide riparian zone from the Inks Lake offsetting concept was used to calculate the riparian offsetting area of 4.5 ha.

The net habitat balance resulting from the Offsetting Plan is 2.29 ha of instream habitat, 4.22 ha of lake habitat, and -0.12 ha of riparian habitat (Table 5.6). The net positive value of 6.39 ha demonstrates that the proposed Conceptual Fish Habitat Offsetting Plan is larger than necessary to offset the amount of serious harm to fish and fish habitat from the Ajax Project. Pending review comments and discussion with agencies further adjustments to the Offsetting Plan will be necessary so amount of fish habitat offsetting is equivalent to the magnitude of serious harm identified for the Project.

TABLE 5.6

KGHM AJAX MINING INC.
AJAX PROJECT

CONCEPTUAL FISH HABITAT OFFSETTING PLAN
FISH HABITAT BALANCE SHEET

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Waterbody	Description	Fish Habitat Type	Net Fish Habitat Losses and Gains (ha)			Proposed Offsetting Ratio	Required Fish Habitat Offsetting Area (ha)			Proposed Fish Habitat Offsetting Area (ha)			Net Fish Habitat Balance (ha)			
			Instream	Lake	Riparian		Instream	Lake	Riparian	Instream	Lake	Riparian	Instream	Lake	Riparian	Total
Fish Habitat Impacts																
Peterson Creek	3.6 km Dewatered Section	Instream channel/pond	-3.57			1.00	3.57									
Peterson Creek	3.6 km Dewatered Section	Riparian zone			-5.32	0.50			2.66							
Peterson Creek	Downstream Pond	Instream channel/pond	5.86			1.00	-5.86									
Peterson Creek	Downstream Pond	Riparian zone			-2.39	0.50			1.20							
Jacko Lake	Northeast Arm	Littoral habitat		-2.04		1.00		2.04								
Jacko Lake	Northeast Arm	Riparian zone			-0.80	1.00			0.80							
Jacko Lake	Southeast Arm	Littoral habitat		0.18		1.00		-0.18								
Offsetting Plan																
Inks Lake	Lake rehabilitation for fish	Littoral and limnetic									6.07					
Inks Lake	Lake margin vegetation	Riparian zone										4.54				
Totals			2.29	-1.85	-8.51		-2.29	1.85	4.66	0.00	6.07	4.54	2.29	4.22	-0.12	6.39

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6 – OFFSETTING PLAN IMPLEMENTATION AND MONITORING

6.1 TIMELINE AND CONSTRUCTION PHASES

The Fish Habitat Offsetting Plan will be constructed over a two year period followed by stocking with resident rainbow trout in the spring of year three. Draining the lake by pumping the water to the Project site for construction uses would occur at the initial stage of construction. Once the lake has been drained, the south basin will be excavated and waste materials deposited in the north basin. The water supply infrastructure will be installed during the first year of construction in order to fill the lake in the second year.

6.2 CONSTRUCTION MITIGATION

The construction activities associated with Inks Lake have a number of potential environmental impacts that must be mitigated. As the water quality in the existing Inks Lake is unsuitable for fish habitat, this water must be contained. Releasing the water to the open environment would have the potential to contaminate other water courses in the area, and as a result it must be pumped to the Project site or to another suitable storage basin for construction uses or stored for process make up water requirements.

Similarly, the sediments underlying the existing Inks Lake south basin have the potential to be contaminated and will be removed and disposed of in the Inks Lake north basin. Any soils that are not contaminated can be stored in a local borrow pit area. Construction activities have the potential to cause erosion of the banks around Inks Lake which would increase turbidity once the lake is filled. All construction around the lake basin will be subject to a sediment and erosion control plan to mitigate the potential impacts to the new lake.

6.3 PERMITTING

6.3.1 Application for *Fisheries Act* Authorization

The Ajax Project is undergoing a Provincial and Federal Environmental Assessment (EA) under the BCEAA and CEAA. For Project planning purposes, it is assumed that this process will result in an EA decision by BCEAA and CEAA. The provincial or federal permits directly related to the construction of the Ajax Project cannot be issued until an EA decision allowing the Project to proceed is made.

Subsection 35(1) of the *Fisheries Act* prohibits the carrying on of a work, undertaking, or activity that results in serious harm to fish that are part of a CRA fishery or to fish that support such a fishery. The Minister of Fisheries and Oceans may issue an authorization with terms and conditions in relation to a proposed work, undertaking, or activity that may result in serious harm to fish under Paragraph 35(2)(b) of the *Fisheries Act*. The *Fisheries Act* Applications Regulations set out the information requirements and documentation that must be submitted by an applicant requesting such an authorization.

DFO (2013c) provides additional guidance concerning the information requirements and review process for applications for authorization:

- All applicants are encouraged to engage DFO early in the planning process to confirm whether an authorization is required to carry on their work, undertaking, or activity and to discuss the

requirements set out in the *Fisheries Act* Applications Regulations before submitting such an application.

- All applications must be made in writing to the Minister and sent to one of the DFO Regional Offices.
- From the date of receipt of an application, the Minister has 60 calendar days to determine if the application is complete or incomplete, and to notify the applicant of this determination. If the application is not complete, the notification will identify the information or documentation that must still be provided by the applicant.
- From the date of the notification that the application is complete, the Minister has 90 calendar days to issue an authorization or notify the applicant that the authorization is denied.
- Applicants will be notified in writing when an authorization is issued or refused.

The DFO Minister cannot issue an Authorization until a federal EA decision is made that allows a project to proceed.

6.3.2 Provincial and Other Permits

The following is a list of additional permits and authorizations required for the Inks Lake offsetting plan. The list is preliminary and pending discussions with regulators.

- A licence of occupation will be required under the provincial *Land Act* for offsetting works that occur on Crown Land. The land area required for the Inks Lake offsetting concept is either on Provincial Crown Land or land owned or under agreement by KAM.
- Approvals under the provincial *Water Act* and/or the *Water Sustainability Act* that will come into force early in 2016 for the dewatering of Inks Lake, use of water from Kamloops Lake, and diversion of water from Jacko Lake.
- A water licence under the provincial *Water Act* will be required for filling and providing annual inflow to Inks Lake and will be applied for as part of the Project water source.
- A water licence under the provincial *Water Act* will be required for flows established at closure.
- A discharge permit under the provincial *Environmental Management Act* for the disposal of existing lake water and spoils from excavation.
- Additional approvals and permits from the City of Kamloops including an earthworks permit and approval under the *Riparian Areas Regulation*.

6.4 MONITORING

DFO (2013c) requires monitoring and reporting on offsetting measures as conditions of the authorization permit. Construction compliance monitoring will be conducted to minimize the environmental effects of construction activities. Effectiveness monitoring will be conducted to ensure the offsetting works are functioning as designed. Detailed monitoring plans will be developed in consultation with DFO to identify the appropriate metrics for assessing the performance of the offsetting works. The monitoring conditions suggested by DFO (2013c) include:

- Dated photographs of works undertakings, activities or operations related to mitigation measures and photographs of completed offsetting measures
- Timelines for monitoring and reporting
- Monitoring and inspection records

- Details of any mitigation changes, corrective actions or contingency measures that were followed in the event that mitigation or offsetting measures did not function as described, and
- The methodology and criteria that will be used to evaluate the success of the offsetting measures.

DFO (2013c) requires that monitoring and reporting of offsetting measures are undertaken for a period of time sufficient to allow for:

- Biological or physical changes to be reflected in the data collected
- Possible adjustments to the monitoring to better estimate changes in fishery productivity, and
- The restored habitat to reach full ecological functionality (that is, supporting fish reproduction, growth, and survival).

The proponent is normally responsible for the maintenance or repair of the offsetting measures as conditions of the *Fisheries Act* authorization. The requirements for adjustments and contingencies to the offsetting measures will be included in the terms and conditions of the authorization.

Proponents are responsible for implementing offsetting plans and monitoring their effectiveness, as well as for reporting on implementation and the results of monitoring. Monitoring must be designed to confirm that the offsetting measures have been effective in counterbalancing the serious harm to fish and may identify the need for additional measures should deficiencies be found.

Starting one year after construction, KAM will commence a five year monitoring program to demonstrate the success of the constructed offsetting measures. Surveys of stocked rainbow trout populations will be conducted annually, and will be carried out by qualified professional biologists. Fish assessment metrics such as catch per unit effort, age, length, and weight will be considered as part of the study design. Physical parameters such as lake levels, lake inflow and outflow, water temperature, lab water quality, and in-situ water quality will be incorporated to the monitoring plan. Criteria (performance measures) for the effectiveness monitoring will be developed through discussions with DFO, FLNRO, MOE, and other interested parties. If offsetting objectives have not been achieved by year three of the monitoring program, effectiveness monitoring will continue. By year five, if successful criteria still have not been achieved, a work plan will be developed and additional offsetting works will be undertaken and monitoring will continue until performance measures have been met.

The results of compliance and effectiveness monitoring will be compiled annually and submitted to DFO for review. After the third year of effectiveness monitoring, a summary report will be written with recommendations based on the success of the offsetting measures.

6.5 INFORMATION GAPS AND NEXT STEPS

This is a conceptual plan which will require detailed study and analysis in order to be implemented subject to feedback from agencies, stakeholders, and Aboriginal groups. Uncertainties as described in the preceding Section 5.3.13, will be addressed and presented in the Fish Habitat Offsetting Plan submitted as part of the application for authorization under the *Fisheries Act*. Water quality modelling is recommended to assess future water quality conditions and optimize water management of the proposed Inks Lake offsetting measures. This modelling is required to ensure that the proposed Inks Lake modifications will provide suitable aquatic habitat to support fish. Water quality modelling will require sampling of the Kamloops Lake water, as well as the acquisition of climate records for the

project area. The modelling results will provide the temperature profile in the lake, as well as the dissolved oxygen profile to better understand flow through and lake flushing requirements.

The concept proposed by this plan achieves the objectives to offset serious harm to fish and fish habitat. The concept to enhance Inks Lake has been proposed by FLNRO and potentially endorsed by DFO pending review of this plan. Therefore while the concept presented in this plan achieves the goal to provide measures to offset unavoidable residual serious harm to fish, it is subject to change upon review by FLNRO, DFO, and Aboriginal Groups as well as part of advanced engineering design and investigations related to water quality, water quantity, sustainability, costs of construction, operation, and closure as well as other unforeseen constraints and requirements (e.g., “unknown unknowns”).

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8 – CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared: 
Oscar Gustafson, R.P.Bio.
Specialist Environmental Scientist | Associate

Reviewed: 
Chris Brodie, R.P.Bio.
Manager, Environmental Services

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Approval that this document adheres to Knight Piésold Quality Systems: 

APPENDIX A

FISH AND FISH HABITAT SITE PHOTOS

(Pages A-1 to A-15)



PHOTO 1 – Southeast view downstream on Peterson Creek from the Jacko Lake dam crest.



PHOTO 2 – Potential spawning habitat in Peterson Creek below the Jacko Lake spillway.

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PHOTO 3 – Peterson Creek, downstream of Jacko Lake upstream view to the northwest.



PHOTO 4 – Peterson Creek low gradient reach downstream of Jacko Lake southwest view, historic waste rock dump in background.

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PHOTO 5 – Peterson Creek below decommissioned mine road, north of historic waste rock dump view to the west.



PHOTO 6 – Pond on Peterson Creek above Goose Lake Road, view to the southwest.

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PHOTO 7 – Footprint of the proposed Peterson Creek Downstream Pond, immediately west of Humphrey Creek.



PHOTO 8 – View upstream towards proposed dam site for Peterson Creek downstream Pond, west and downstream of Humphrey Creek confluence.

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PHOTO 9 – Jacko Lake, southeast arm view to the south, Jacko lake dam in back ground.



PHOTO 10 – Jacko Lake, southeast arm view northwest from dam crest.

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PHOTO 11 – Jacko Lake, northeast arm view to the east.



PHOTO 12 – Jacko Lake, northeast arm view to the west at existing Kinder Morgan pipeline crossing.

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PHOTO 13 – Jacko Lake, northeast arm view to the east.



PHOTO 14 – Jacko Lake, northeast arm view to the east.

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PHOTO 15 – Jacko Lake, west arm view to the east.



PHOTO 16 – Jacko Lake, west arm view to the west.

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PHOTO 17 – Jacko Lake, west arm entrance view to the east from top of bank.



PHOTO 18 – Jacko Lake, west arm entrance view to the east from north shore.

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PHOTO 19 – Upper Peterson Creek above Jacko Lake.



PHOTO 20 – Upper Peterson Creek, inflow wetland view to the southwest arm.

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PHOTO 21 – Goose Lake, view to the southwest.



PHOTO 22 – Goose Lake, surface water sampling, view to the southwest.

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PHOTO 23 – Inks Lake, view to the northwest.



PHOTO 24 – Inks Lake south basin, view to the east towards Lac La Jeune Road.

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PHOTO 25 – Inks Lake south basin, view to the north on Lac La Jeune Road.



PHOTO 26 – Inks Lake south basin, view to the south to the Lac Le Jeune haul road overpass.

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PHOTO 27 – Inks Lake north basin, view east.



PHOTO 28 –Pond northwest of north basin of Inks Lake.

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PHOTO 29 – Kamloops Lake, proposed intake location view to the east.

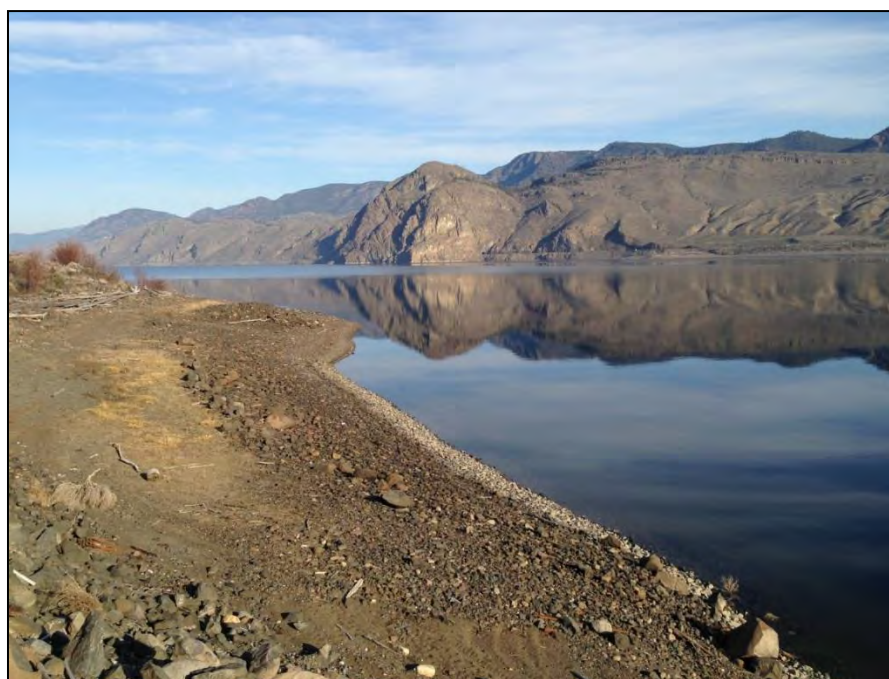


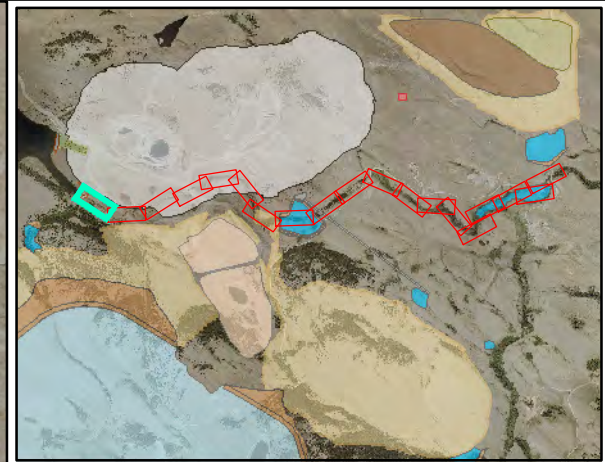
PHOTO 30 – Kamloops Lake, proposed intake location view to the west.

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APPENDIX B

PETERSON CREEK FISH HABITAT MAPPING

(Figures B-1 to B-19)



LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

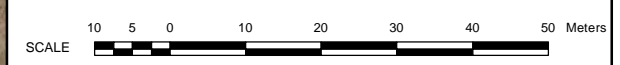
PROPOSED JACKO LAKE FACILITIES

- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA



NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NUTM10.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:65,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.



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PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B1	
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- LEGEND:**
- GENERAL**
- MAP INDEX
 - WETTED AREA (4.6 HA)
 - RIPARIAN AREA (9.7 HA)
 - EXISTING SE ARM BERM
- PROPOSED JACKO LAKE FACILITIES**
- DAM OUTLINE
 - NE ARM LOSS
 - DREDGING AREA
- PROPOSED PETERSON CREEK FACILITIES**
- DIVERSION INTAKE
 - DIVERSION
 - DIVERSION DISCHARGE
 - DOWNSTREAM POND DYKE
 - DOWNSTREAM POND

- NOTES:**
- BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
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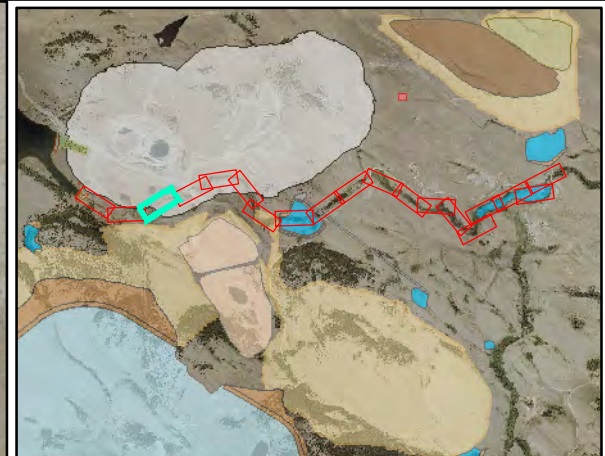
PETERSON CREEK FISH HABITAT MAPPING

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FIGURE B2	
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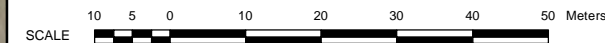
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- LEGEND:**
- GENERAL**
- MAP INDEX
 - WETTED AREA (4.6 HA)
 - RIPARIAN AREA (9.7 HA)
 - EXISTING SE ARM BERM
- PROPOSED JACKO LAKE FACILITIES**
- DAM OUTLINE
 - NE ARM LOSS
 - DREDGING AREA
- PROPOSED PETERSON CREEK FACILITIES**
- DIVERSION INTAKE
 - DIVERSION
 - DIVERSION DISCHARGE
 - DOWNSTREAM POND DYKE
 - DOWNSTREAM POND

- NOTES:**
1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
 2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NUTM10.
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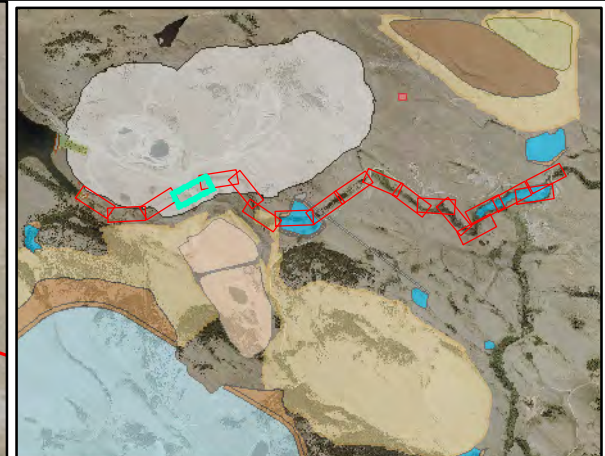
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PETERSON CREEK FISH HABITAT MAPPING

Knight Piésold CONSULTING	PIA NO. VA101-246/36	REF NO. 1
	FIGURE B3	
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LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

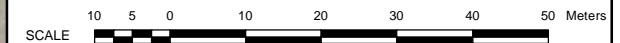
- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

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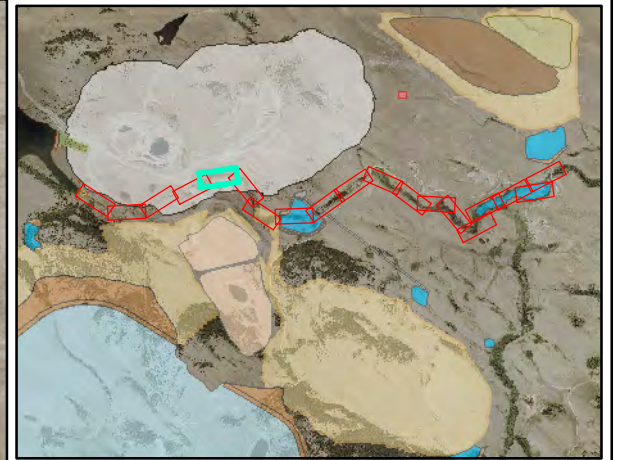
PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B4	
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LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

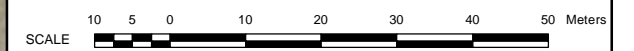
- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

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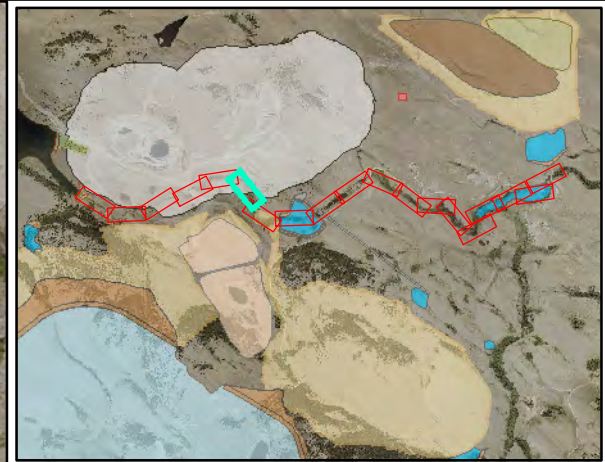
PETERSON CREEK FISH HABITAT MAPPING

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PIA NO. VA101-246/36	REF NO. 1
FIGURE B5	
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LEGEND:

GENERAL

- - - MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

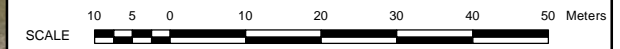
- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

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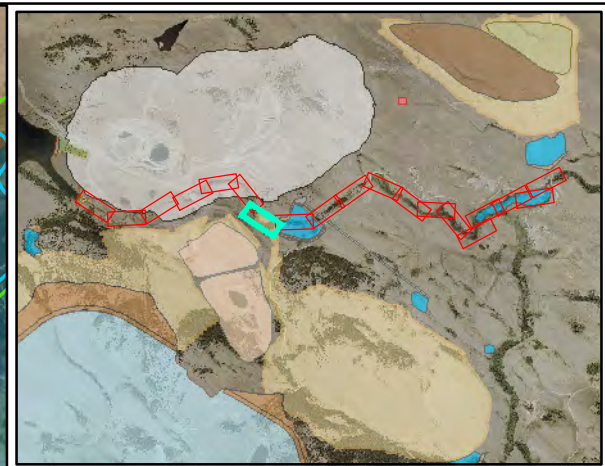
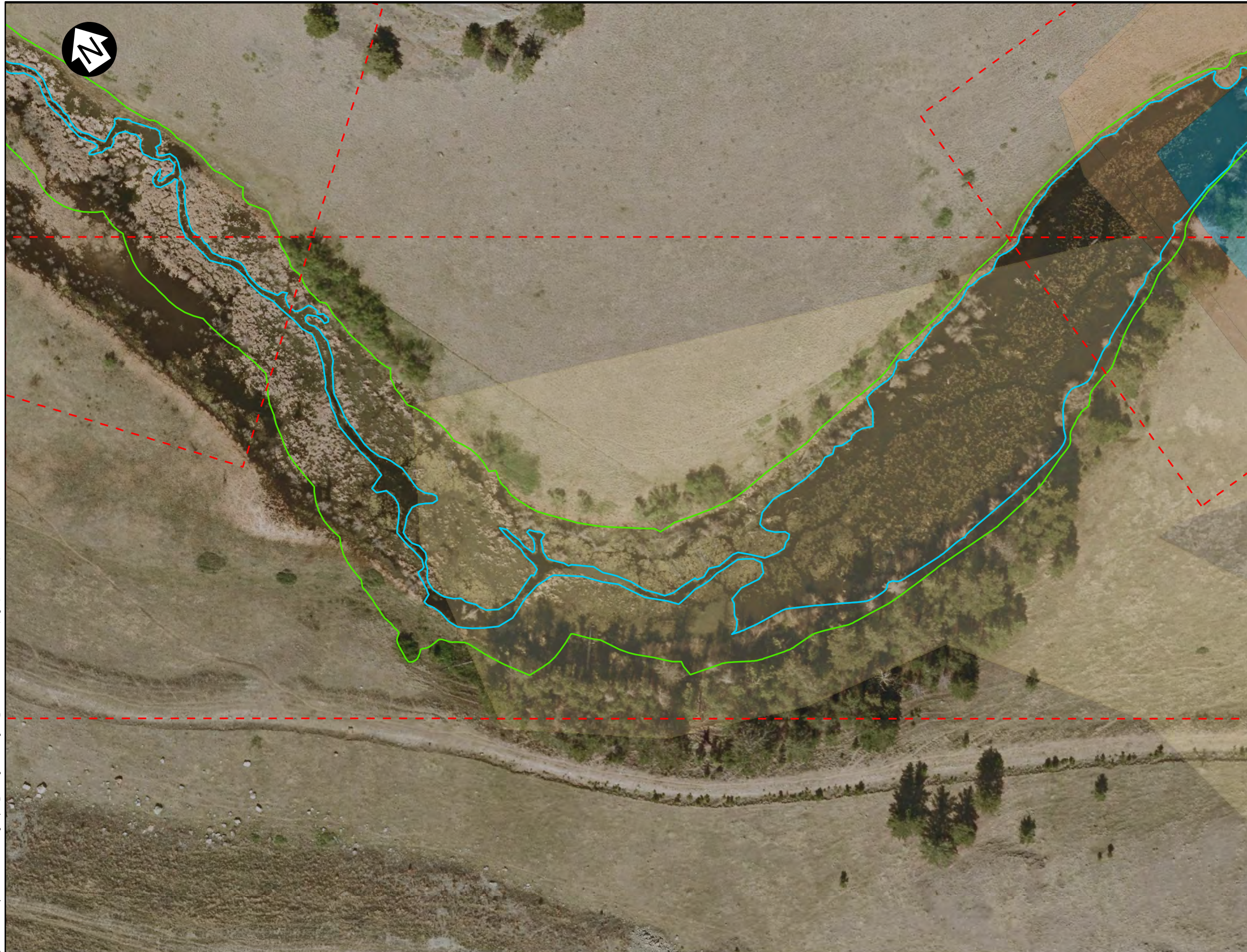
PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B6	
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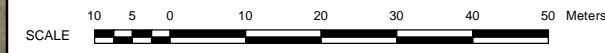
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LEGEND:

GENERAL		PROPOSED JACKO LAKE FACILITIES	
[Red dashed line]	MAP INDEX	[Brown outline]	DAM OUTLINE
[Blue outline]	WETTED AREA (4.6 HA)	[Green outline]	NE ARM LOSS
[Green outline]	RIPARIAN AREA (9.7 HA)	[Yellow area]	DREDGING AREA
[Brown area]	EXISTING SE ARM BERM		
PROPOSED PETERSON CREEK FACILITIES			
[Blue square]	DIVERSION INTAKE		
[Blue line]	DIVERSION		
[Green cross-hatch]	DIVERSION DISCHARGE		
[Brown area]	DOWNSTREAM POND DYKE		
[Blue area]	DOWNSTREAM POND		

- NOTES:**
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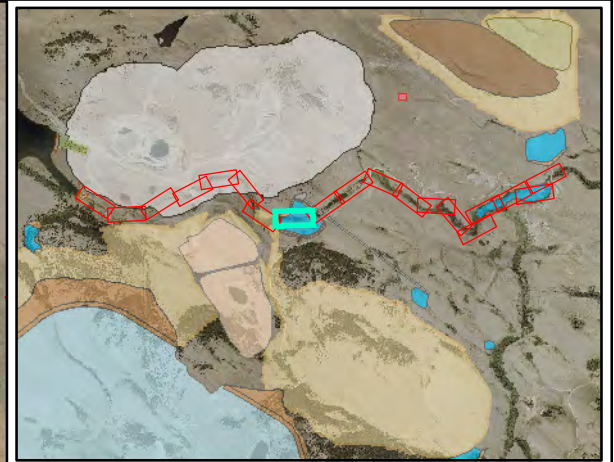


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 PETERSON CREEK FISH HABITAT MAPPING

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

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PIA NO. VA101-246/36
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FIGURE B7
 REV 0






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

GENERAL

-  MAP INDEX
-  WETTED AREA (4.6 HA)
-  RIPARIAN AREA (9.7 HA)
-  EXISTING SE ARM BERM
-  DIVERSION INTAKE
-  DIVERSION
-  DIVERSION DISCHARGE
-  DOWNSTREAM POND DYKE
-  DOWNSTREAM POND

PROPOSED JACKO LAKE FACILITIES

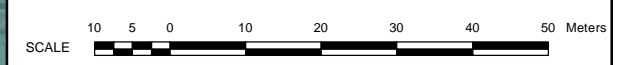
-  DAM OUTLINE
-  NE ARM LOSS
-  DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

-  DIVERSION INTAKE
-  DIVERSION
-  DIVERSION DISCHARGE
-  DOWNSTREAM POND DYKE
-  DOWNSTREAM POND

NOTES:

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AJAX PROJECT

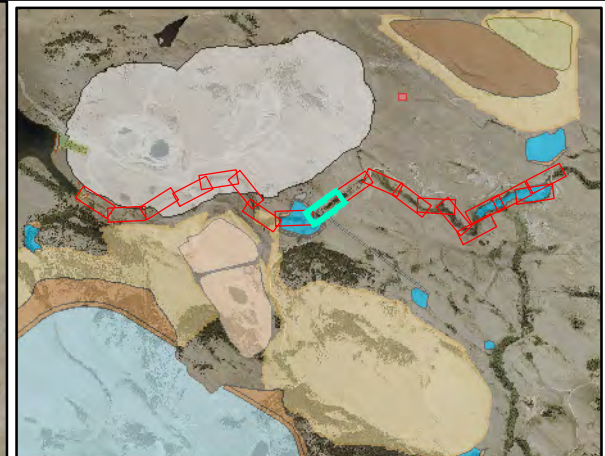
PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B8	
REV 0	

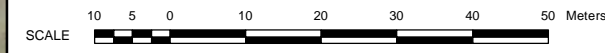
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- LEGEND:**
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| GENERAL | | PROPOSED JACKO LAKE FACILITIES | |
| | MAP INDEX | | DAM OUTLINE |
| | WETTED AREA (4.6 HA) | | NE ARM LOSS |
| | RIPARIAN AREA (9.7 HA) | | DREDGING AREA |
| | EXISTING SE ARM BERM | | |
| PROPOSED PETERSON CREEK FACILITIES | | | |
| | DIVERSION INTAKE | | |
| | DIVERSION | | |
| | DIVERSION DISCHARGE | | |
| | DOWNSTREAM POND DYKE | | |
| | DOWNSTREAM POND | | |

- NOTES:**
1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
 2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NUTM10.
 3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:65,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.



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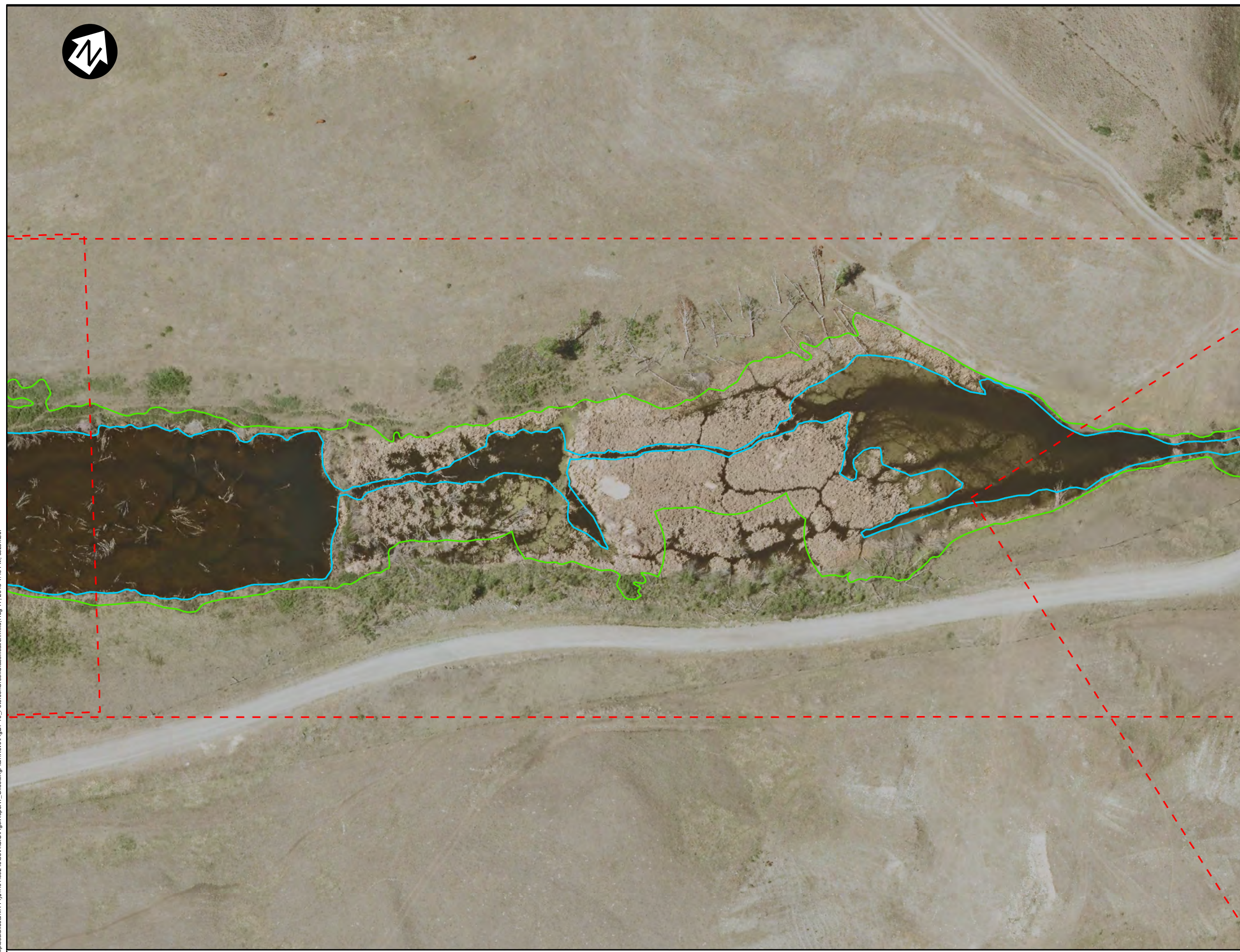
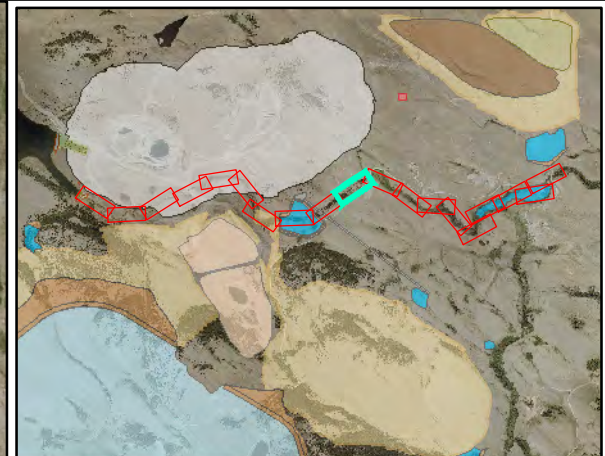
AJAX PROJECT

PETERSON CREEK FISH HABITAT MAPPING

Knight Piésold CONSULTING	PIA NO. VA101-246/36	REF NO. 1
	FIGURE B9	
	REV 0	

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0	17AUG15	ISSUED WITH REPORT	CAC	CAC	OG



LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NUTM10.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:65,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.



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PETERSON CREEK FISH HABITAT MAPPING

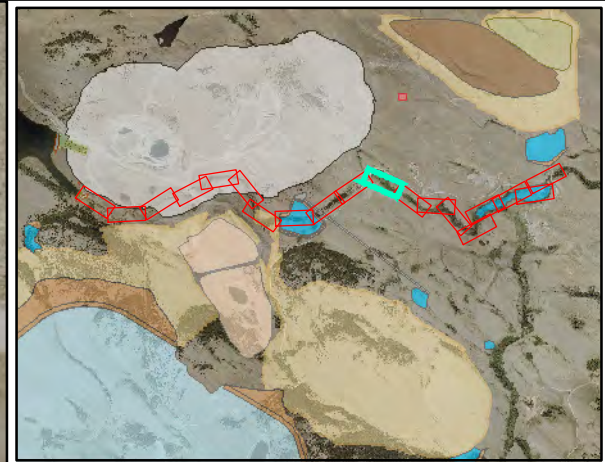
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

PIA NO. VA101-246/36 REF NO. 1

FIGURE B10 REV 0






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

GENERAL

-  MAP INDEX
-  WETTED AREA (4.6 HA)
-  RIPARIAN AREA (9.7 HA)
-  EXISTING SE ARM BERM
-  DIVERSION INTAKE
-  DIVERSION
-  DIVERSION DISCHARGE
-  DOWNSTREAM POND DYKE
-  DOWNSTREAM POND

PROPOSED JACKO LAKE FACILITIES

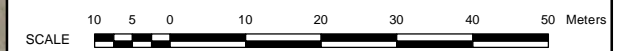
-  DAM OUTLINE
-  NE ARM LOSS
-  DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

-  DIVERSION INTAKE
-  DIVERSION
-  DIVERSION DISCHARGE
-  DOWNSTREAM POND DYKE
-  DOWNSTREAM POND

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NUTM10.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:65,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.



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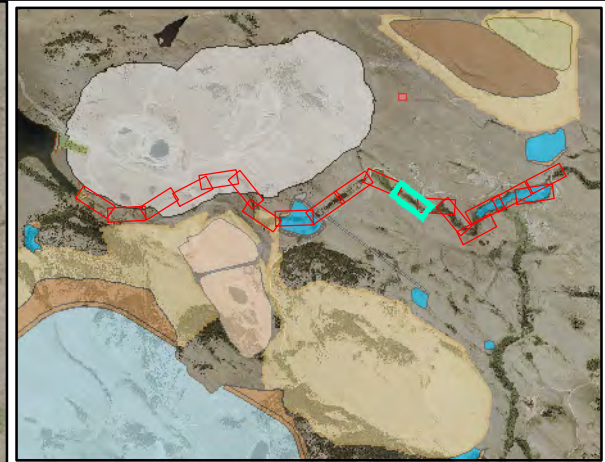
PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B11	
	REV 0

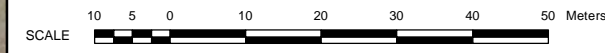
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- LEGEND:**
- GENERAL**
- MAP INDEX
 - WETTED AREA (4.6 HA)
 - RIPARIAN AREA (9.7 HA)
 - EXISTING SE ARM BERM
- PROPOSED JACKO LAKE FACILITIES**
- DAM OUTLINE
 - NE ARM LOSS
 - DREDGING AREA
- PROPOSED PETERSON CREEK FACILITIES**
- DIVERSION INTAKE
 - DIVERSION
 - DIVERSION DISCHARGE
 - DOWNSTREAM POND DYKE
 - DOWNSTREAM POND

- NOTES:**
1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
 2. COORDINATE GRID IS IN METRES.
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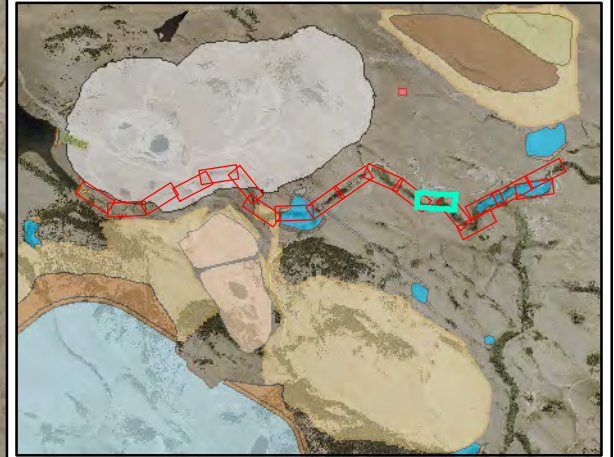
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PETERSON CREEK FISH HABITAT MAPPING

Knight Piésold CONSULTING	PIA NO. VA101-246/36	REF NO. 1	REV 0
	FIGURE B12		

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LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
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SCALE 10 5 0 10 20 30 40 50 Meters

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 PETERSON CREEK FISH HABITAT MAPPING

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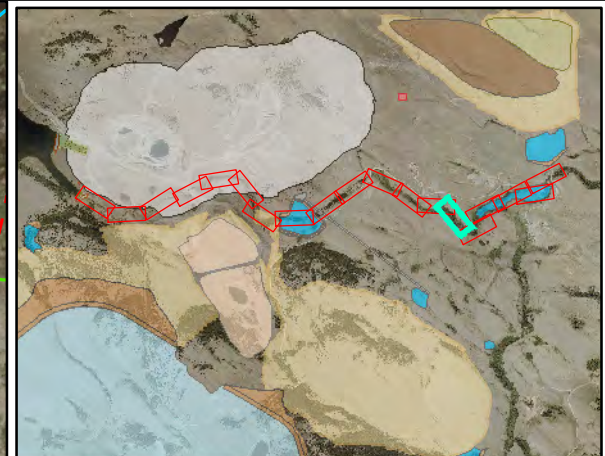
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PIA NO. VA101-246/36 REF NO. 1

FIGURE B13

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LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

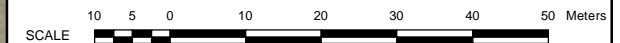
- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
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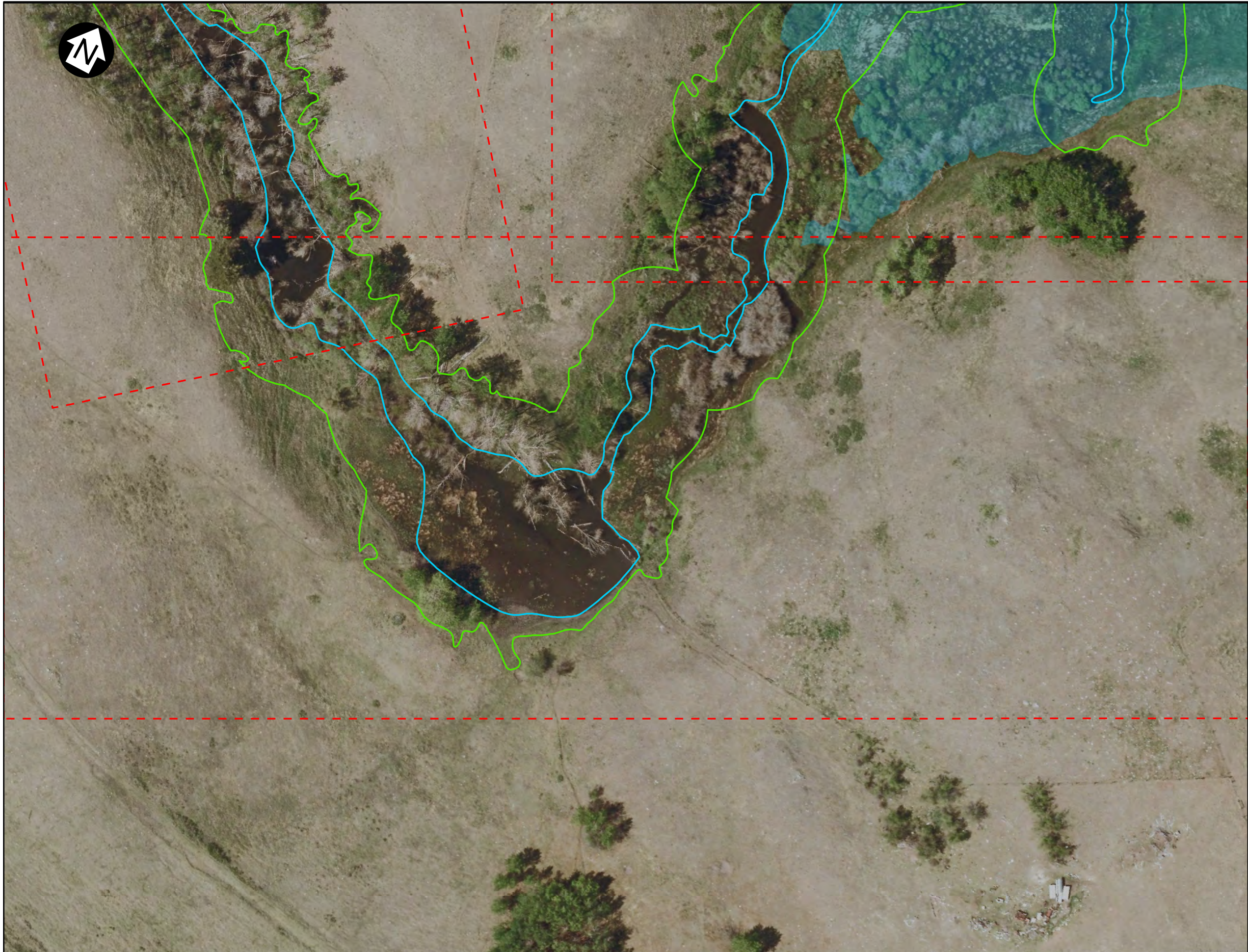
PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B14	
REV 0	

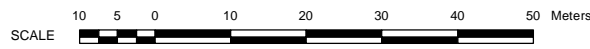
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- LEGEND:**
- GENERAL**
- MAP INDEX
 - WETTED AREA (4.6 HA)
 - RIPARIAN AREA (9.7 HA)
 - EXISTING SE ARM BERM
- PROPOSED JACKO LAKE FACILITIES**
- DAM OUTLINE
 - NE ARM LOSS
 - DREDGING AREA
- PROPOSED PETERSON CREEK FACILITIES**
- DIVERSION INTAKE
 - DIVERSION
 - DIVERSION DISCHARGE
 - DOWNSTREAM POND DYKE
 - DOWNSTREAM POND

- NOTES:**
1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
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 PETERSON CREEK FISH HABITAT MAPPING

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PIA NO. VA101-246/36	REF NO. 1
FIGURE B15	
REV 0	

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LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

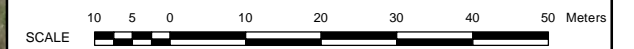
- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

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COORDINATE SYSTEM: NUTM10.
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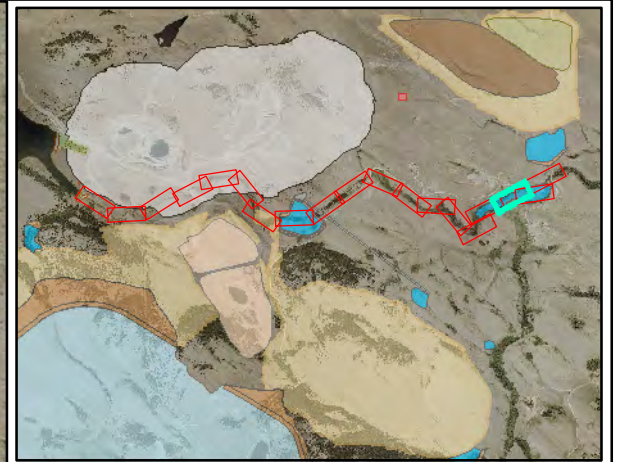
PETERSON CREEK FISH HABITAT MAPPING

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PIA NO. VA101-246/36	REF NO. 1
FIGURE B16	
REV 0	

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LEGEND:

GENERAL

- MAP INDEX
- WETTED AREA (4.6 HA)
- RIPARIAN AREA (9.7 HA)
- EXISTING SE ARM BERM

PROPOSED JACKO LAKE FACILITIES

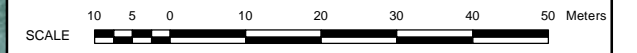
- DAM OUTLINE
- NE ARM LOSS
- DREDGING AREA

PROPOSED PETERSON CREEK FACILITIES

- DIVERSION INTAKE
- DIVERSION
- DIVERSION DISCHARGE
- DOWNSTREAM POND DYKE
- DOWNSTREAM POND

NOTES:

1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
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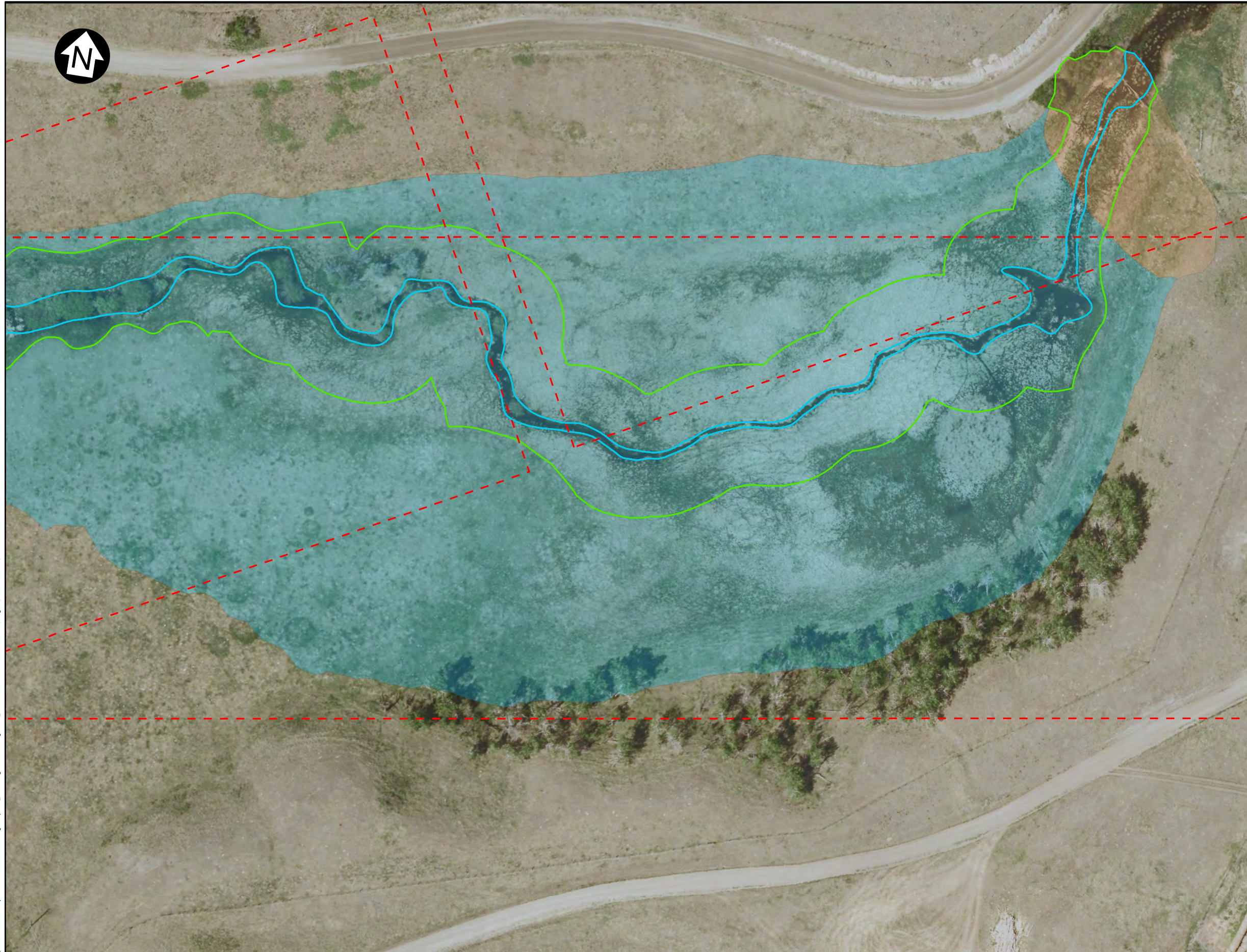
PETERSON CREEK FISH HABITAT MAPPING



PIA NO. VA101-246/36	REF NO. 1
FIGURE B17	
	REV 0

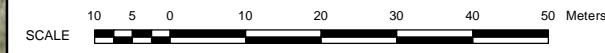
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- LEGEND:**
- GENERAL**
- MAP INDEX
 - WETTED AREA (4.6 HA)
 - RIPARIAN AREA (9.7 HA)
 - EXISTING SE ARM BERM
- PROPOSED JACKO LAKE FACILITIES**
- DAM OUTLINE
 - NE ARM LOSS
 - DREDGING AREA
- PROPOSED PETERSON CREEK FACILITIES**
- DIVERSION INTAKE
 - DIVERSION
 - DIVERSION DISCHARGE
 - DOWNSTREAM POND DYKE
 - DOWNSTREAM POND

- NOTES:**
1. BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
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PETERSON CREEK FISH HABITAT MAPPING

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PIA NO. VA101-246/36	REF NO. 1
FIGURE B18	
REV 0	REV 0

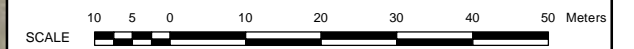
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- LEGEND:**
- GENERAL**
- MAP INDEX
 - WETTED AREA (4.6 HA)
 - RIPARIAN AREA (9.7 HA)
 - EXISTING SE ARM BERM
- PROPOSED JACKO LAKE FACILITIES**
- DAM OUTLINE
 - NE ARM LOSS
 - DREDGING AREA
- PROPOSED PETERSON CREEK FACILITIES**
- DIVERSION INTAKE
 - DIVERSION
 - DIVERSION DISCHARGE
 - DOWNSTREAM POND DYKE
 - DOWNSTREAM POND

- NOTES:**
- BASE MAP: CITY OF KAMLOOPS ORTHOIMAGERY.
 - COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NUTM10.
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PETERSON CREEK FISH HABITAT MAPPING

Knight Piésold
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PIA NO. VA101-246/36	REF NO. 1
FIGURE B19	
	REV 0

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