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**Appendix A4**  
**Preliminary Habitat Offsetting Plan**

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# Grassy Mountain Coal Project Preliminary Habitat Offsetting Plan

January 2017

*Prepared for:*

**Benga Mining Limited**  
Blairmore, Alberta



# GRASSY MOUNTAIN COAL PROJECT: PRELIMINARY HABITAT OFFSETTING PLAN

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## LIST OF ACRONYMS

<b>AEP</b>	Alberta Environment and Parks
<b>CHPP</b>	Coal handling and preparation plant
<b>ELC</b>	Ecological land classification
<b>DFO</b>	Fisheries and Oceans Canada
<b>FPP</b>	Fisheries Protection Provisions
<b>FRL</b>	Fisheries Research Licence
<b>LSA</b>	Local study area
<b>LWD</b>	Large woody debris
<b>SARA</b>	Species at Risk Act
<b>WSCT</b>	Westslope cutthroat trout
<b>YOY</b>	Young-of-the-year

## ACKNOWLEDGEMENTS

This report was prepared for Benga Mining Limited by Hatfield Consultants. Cory Bettles (M.Sc., R.P.Bio. FP-C) managed the 2016 data collection and report compilation for the Project. This report was written by Sarah Thomasen (M.Sc., R.P.Bio) and reviewed by Cory Bettles and Martin Davies (M.E.S., R.P.Bio.).

# EXECUTIVE SUMMARY

This report provides the framework for a proposed Offsetting Plan to counterbalance any residual *serious harm to fish* that may result from development of the Grassy Mountain Coal Project (the Project) proposed by Benga Mining Limited (Benga). The fisheries protection provisions of the *Fisheries Act* and the Habitat Protection Order under the *Species at Risk Act* have been considered. The local study area (LSA) contains 16.5 km of westslope cutthroat trout (*Oncorhynchus clarkii lewisi*; WSCT) critical habitat as defined by the Recovery Plan. Anticipated primary effects from the Project, which may cause *serious harm to fish* include:

- Changes to tributary and mainstem aquatic and/or riparian habitat in Gold and Blairmore creeks as a result of the Project footprint; and
- Changes to hydrology in Gold and Blairmore creeks resulting in alterations to WSCT habitat.

Once the residual *serious harm to fish* has been accepted by regulators, the appropriate equivalency metrics and offsetting measures will be selected. Five potential offsetting measures have been compiled based on an assessment of existing baseline conditions in the LSA (Gold Creek and Blairmore Creek watersheds), the identification of limiting critical habitat for WSCT, and the type and quantity of anticipated residual effects as a result of the Project. The following potential offsetting measures have been described at a conceptual level in this report:

1. **Reconnection of isolated high-quality fish habitat on Gold Creek:** Reestablish flow and enhance habitat in a portion of mainstem Gold Creek that is seasonally dry;
2. **Habitat enhancement on Morin Creek:** Mitigate existing (non-Project) anthropogenic effects on fish and fish habitat in Morin Creek, including the area currently identified as critical habitat for WSCT;
3. **Overwintering habitat enhancement:** Increase overwintering habitat for WSCT in Gold Creek and Blairmore Creek watersheds to improve survival, fish recruitment and production;
4. **Enhancement of riparian processes:** Restore riparian habitat that has been identified as degraded in the LSA; and
5. **Data collection and scientific research:** Provision of collected data associated with WSCT knowledge gaps and research needs identified in the Recovery Plan.

In consultation with federal and provincial regulators, measures will be selected to offset residual effects to WSCT, aimed at creating a net increase in fish production. Once the offsetting measures and equivalency metrics have been established, an effectiveness monitoring program will be designed to confirm that the offsetting measures are effective in counterbalancing the *serious harm to fish* as well as identify any potential needs for contingency measures if any deficiencies are detected.

## DISTRIBUTION LIST

The following individuals/firms have received this document:

Name	Firm	Hardcopies	CDs	Email	FTP
Mike Bartlett	Millennium EMS Solutions	-	-	-	✓

## AMENDMENT RECORD

This report has been issued and amended as follows:

Issue	Description	Date	Approved by	
1	Preliminary Habitat Offsetting Plan – Draft	20170113		
2	Preliminary Habitat Offsetting Plan – Final	20170125	<Original signed by>	<Original signed by>
			Martin Davies Project Director	Cory Bettles Project Manager

## 1.0 INTRODUCTION

This report describes a preliminary list of options aimed to offset any potential residual effects on fish and fish habitat that are associated with the development of the Grassy Mountain Coal Project (the Project) proposed by Benga Mining Limited (Benga). This report considers the requirements of the fisheries protection provisions of the *Fisheries Act* and the Habitat Protection Order under the *Species at Risk Act* (SARA).

Section 35(1) of the *Fisheries Act* (DFO 1985, amended in 2012) states that “no person shall carry on any work, undertaking or activity that results in *serious harm to fish*<sup>1</sup> that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery”. Proponents are responsible for avoiding and mitigating the *serious harm to fish* such that could result from their projects. If residual *serious harm to fish* remains, they must seek an authorization under paragraph 35(2) of the *Fisheries Act* to carry on the work. When considering the application for an authorization, the Minister considers 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.

The following preliminary Offsetting Plan has been developed to provide a framework for executing potential offsetting measures necessary to counterbalance remaining residual *serious harm to fish*. This plan has been prepared in accordance with the information requirements set out in the *Applications for Authorization under Paragraph 35(2) of the Fisheries Act Regulations*.

The local study area (LSA) for the Project contains westslope cutthroat trout (*Oncorhynchus clarkii lewisi*; WSCT). The Alberta population was listed as threatened under the federal *Species at Risk Act* (SARA) and provincial Wildlife Regulation (under the *Wildlife Act*). The SARA prohibits activities that harm aquatic species listed under the *Act* as threatened, endangered, or extirpated. SARA also prohibits activities that destroy any listed species’ “critical habitat,” as identified in federally adopted “recovery strategies” for listed threatened or endangered species. The critical habitat and recovery strategy for WSCT has been considered throughout the development of this preliminary Offsetting Plan.

This report includes a summary description of Project activities that will potentially affect fish habitat after mitigation, descriptions of the watercourses affected by the proposed Project, the approach to quantifying habitat losses and gains, descriptions of the identified offsetting options, and an outline of a program to monitor effectiveness of the offsetting measures.

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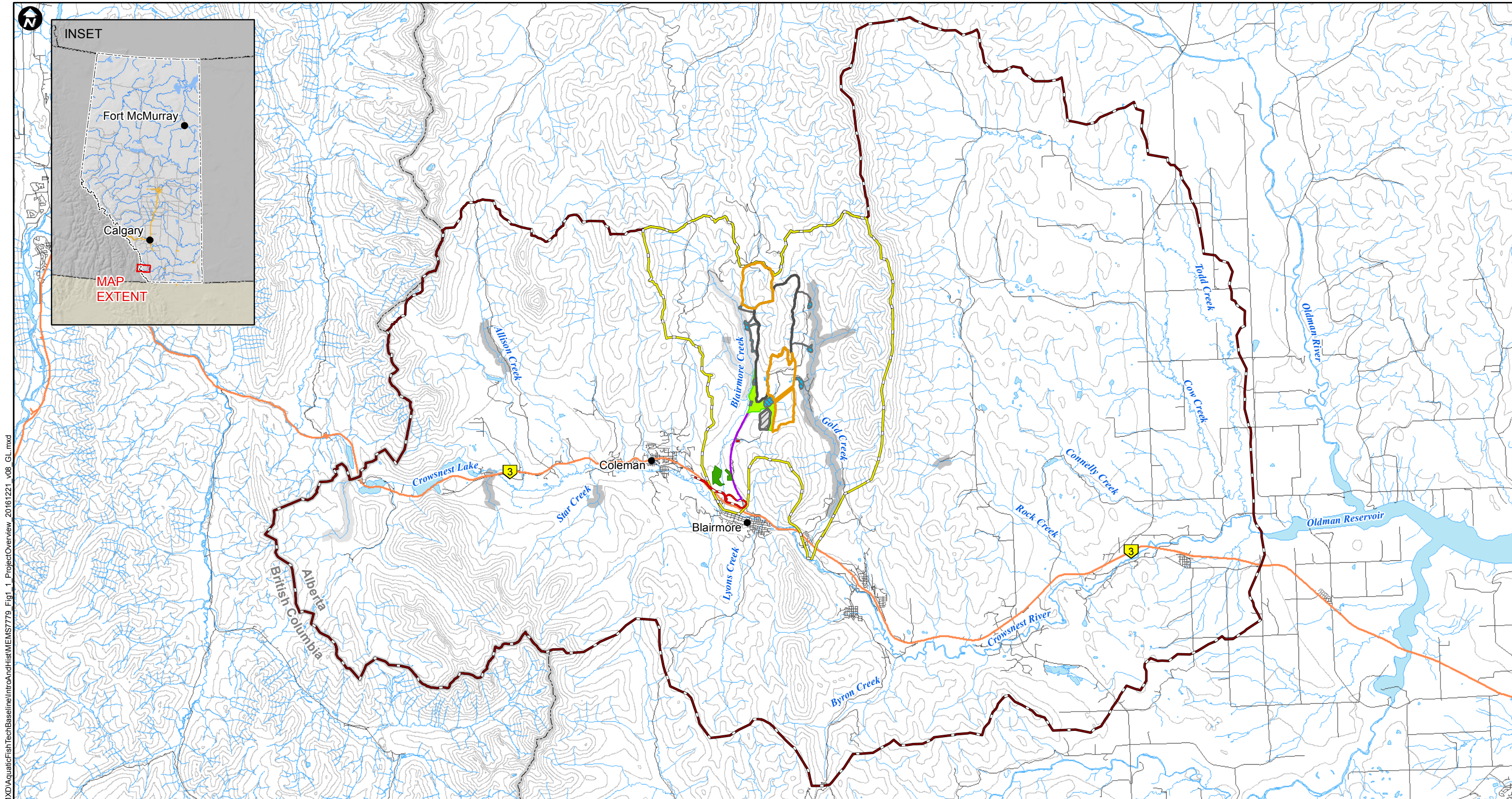
<sup>1</sup> “*Serious harm to fish*” is defined in Subsection 2(2) of the *Fisheries Act* as “the death of fish, or permanent alteration to or destruction of fish habitat”.

## 1.1 APPROACH

The development of this preliminary Offsetting Plan follows the structure recommended by DFO (2013), which can be divided into five main steps as described in [Table 1.1](#). An assessment of residual *serious harm to fish* from the Project is currently under evaluation by regulators (i.e., Step 1). The offsetting measures presented herein are described at a conceptual level to provide a framework for future work.

**Table 1.1 Key steps in preparing the Offsetting Plan (adapted from DFO 2013).**

Step	Consideration	Applicable Document
1. Characterize the residual <i>serious harm to fish</i> .	Quantify project impacts	<ul style="list-style-type: none"> <li>▪ Aquatic Ecology Effects Assessment Addendum Report, CR#6 (Hatfield 2017)</li> <li>▪ Summarized in Sections 2, 3 &amp; 4 of this document</li> </ul>
2. Select offsetting measures	Follow guiding principles for offsetting measures	<ul style="list-style-type: none"> <li>▪ Sections 5 of this Report</li> </ul>
3. Determine the amount of offsetting required	Quantify offset benefits, balance offset benefits with project effects, account for uncertainty, address implementation time lags	<ul style="list-style-type: none"> <li>▪ Aquatic Ecology Effects Assessment Addendum Report, CR#6 (Hatfield 2017)</li> <li>▪ Section 4 of this Report</li> </ul>
4. Establish the monitoring and reporting of conditions	Assess offset effectiveness Describe contingency measures	<ul style="list-style-type: none"> <li>▪ Section 6 of this Report</li> </ul>
5. Submit plan to DFO	Letter of credit Estimate of offset implementation costs Secure access to lands and waterbodies	<ul style="list-style-type: none"> <li>▪ Application for Authorization</li> </ul>



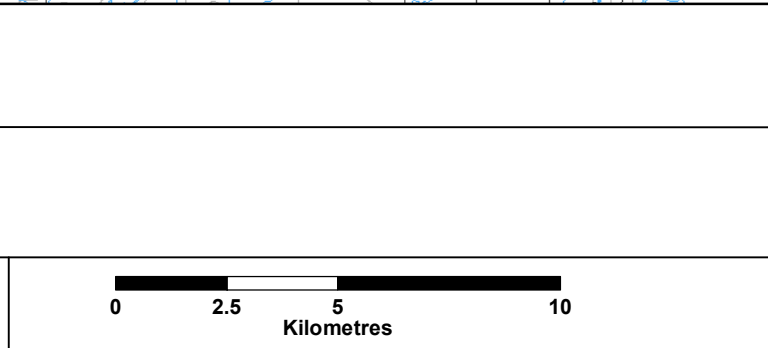
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LEGEND		
Identified Westslope Cutthroat Trout Critical Habitat	Watercourse	Ponds and Ditches
Near Pure WSCT (95% to 99% pure) Provincial Conservation Designation	Waterbody	Construction Camp
Primary Highway	Local Study Area	Covered Conveyor, Access Road and Powerline ROW
Road	Regional Study Area	Coal Handling Processing Plant and Infrastructure
100m Contour	Ultimate Pit Extent	Proposed Golf Course Area
	Ultimate Rock Disposal Area Extent	Railway Loop
	Topsoil Storage	

**PROJECT**  
**RIVERSDALE RESOURCES** **GRASSY MOUNTAIN COAL PROJECT**

**TITLE**  
**OVERVIEW OF PROJECT LOCATION**

**NOTES**  
 Data Sources: Government of Canada, Government of Alberta  
 Datum/Projection: UTM NAD 83 Zone 11



**Hatfield CONSULTANTS**

PROJECT: 7779  
 DRAWN BY: SS / EDITED BY: GL  
 CHECKED BY: CB  
 DATE: December 21, 2016

**FIGURE**  
**1.1**

## 2.0 ACTIVITIES AFFECTING FISH AND FISH HABITAT IN THE PROJECT AREA

The Project will involve a surface open pit mine for steelmaking coal, a coal handling and preparation plant (CHPP) with associated infrastructure, an overland conveyor system, which will parallel an existing high grade access corridor and connect to a rail load-out facility, and a new section of rail track (Figure 2.1). Anticipated primary effect pathways from the Project activities that will result in residual effects (*serious harm to fish*) include:

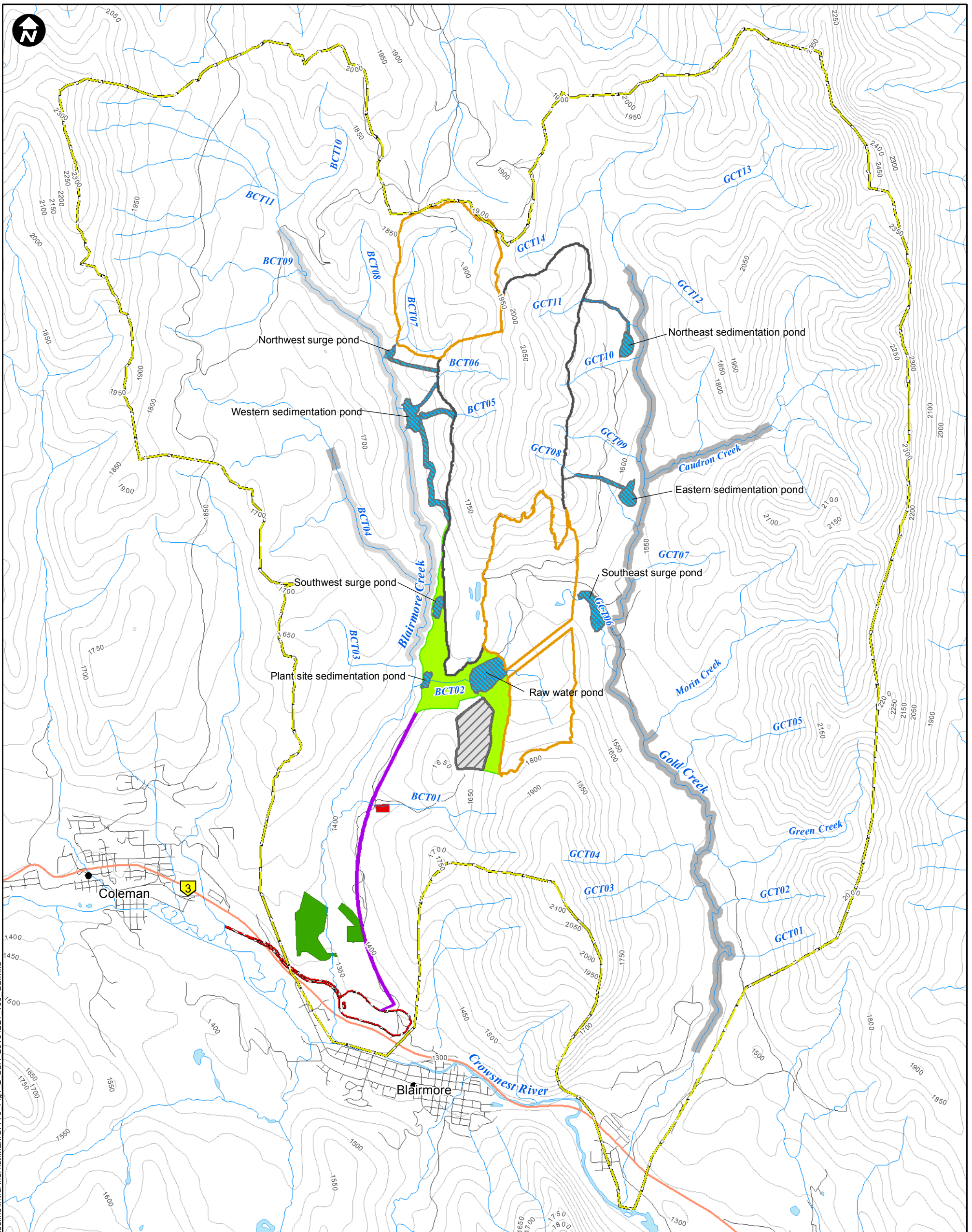
- Changes to tributary and mainstem aquatic and/or riparian habitat in Gold and Blairmore creeks as a result of the Project footprint; and
- Changes to hydrology in Gold and Blairmore creeks resulting in alterations to WSCT habitat.

By understanding the nature of the residual effects it is possible to estimate the potential consequences on WSCT productivity. The residual effects have been determined and quantified for each primary effect in the *Aquatic Ecology Effects Assessment Addendum Report* (Hatfield 2017) and are summarized in Table 2.1. This assessment included evaluating the extent, duration and magnitude of the effects on WSCT in terms of area of habitat permanently altered or lost that could affect the ongoing productivity of WSCT.

**Table 2.1 Summary of quantified residual effects on fish habitat for the Project from Hatifeld 2017 (pending regulator approval).**

Valued Component	Watercourse	Issue	Residual Effect	Quantity (m <sup>2</sup> )
Westslope Cutthroat Trout	Gold Creek	Permanent change to Fish Habitat in the LSA due to Project Footprint	Aquatic Habitat	-758
			Riparian Habitat <sup>1</sup>	-18,868
		Changes to hydrology causing alterations to Critical Habitat <sup>2</sup>	Spawning/Incubation	-27
			Adult Holding	-288
			Juvenile Rearing	-205
			Fry Rearing	+96
			Overwintering	-10
Blairmore Creek	Blairmore Creek	Permanent change to Fish Habitat in the LSA due to Project Footprint	Aquatic Habitat	0
			Riparian Habitat <sup>1</sup>	-402
		Changes to hydrology causing alterations to aquatic habitat <sup>2</sup>	Spawning/Incubation	+18
			Adult Holding	+192
			Juvenile Rearing	+155
			Fry Rearing	+121
			Overwintering	+12

Overall, it is estimated that the Project will cause a loss of 758 m<sup>2</sup> of aquatic habitat, 18,868 m<sup>2</sup> of riparian habitat and 530 m<sup>2</sup> of functional habitat (i.e., spawning/incubation, adult holding, juvenile rearing, overwintering) in Gold Creek (Table 2.1). The project will cause a loss of 402 m<sup>2</sup> of riparian habitat in Blairmore Creek (Table 2.1). Changes in hydrology will cause an increase in 96 m<sup>2</sup> of functional habitat (i.e., fry rearing) on Gold Creek and 498 m<sup>2</sup> (i.e., spawning/incubation, adult holding, juvenile rearing, fry rearing and overwintering) on Blairmore Creek (Table 2.1). All residual effects will be counterbalanced by offsetting. A preliminary list of options is identified and described in this report.



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**LEGEND**

- |   |   |
|---|---|
| Identified Westslope Cutthroat Trout Critical Habitat (greater than 99% pure) | Ultimate Pit Extent                               |
| Near Pure WSCT (95% to 99% pure) Provincial Conservation Designation          | Ultimate Rock Disposal Area Extent                |
| Primary Highway   | Topsoil Storage                                   |
| Road  | Ponds and Ditches                                 |
| 50 m Contour  | Construction Camp                                 |
| Watercourse   | Covered Conveyor, Access Road and Powerline ROW   |
| Waterbody   | Coal Handling Processing Plant and Infrastructure |
| Local Study Area  | Proposed Golf Course Area                         |
|   | Railway Loop                                      |

**PROJECT**



**TITLE**

**FISHERIES AND AQUATICS LOCAL STUDY AREA**

**NOTES**

Data Sources: Government of Canada, Government of Alberta  
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 7779  
DRAWN BY: SS / EDITED BY: GL  
CHECKED BY: CB  
DATE: December 21, 2016

**FIGURE 2.1**



## 3.0 FISH AND FISH HABITAT IN THE PROJECT AREA

The baseline conditions of the fish and fish habitat in Gold Creek and Blairmore Creek watersheds were characterized in the *Fisheries and Aquatics Technical Baseline Report* through multiple field-based sampling programs executed from 2014 to 2016 (Hatfield 2016). Sampling was completed in the LSA to describe habitat quantity, quality and use in potentially affected areas, potential fish distribution both spatially and temporally, and lower trophic dynamics. The level of detail for habitat assessment ranged from biophysical habitat surveys to detailed macrohabitat and mesohabitat characterization. Fish sampling was guided by standard protocol and designed to meet requirements of the Fisheries Research Licences (FRL 16-2611, 14-2724) and *Species at Risk Act* (SARA) Permit (16-PCAA-00026). Less invasive methods, such as snorkeling, were given preference over methods that have a higher potential to cause harm to fish, such as electrofishing, angling, and/or minnow trapping. Field-based surveys were driven primarily by seasonality and life history characteristics (i.e., spawning, overwintering, and rearing).

Results indicate that fish habitat in Gold and Blairmore creeks is fairly similar. Both watercourses are dominated by coarse substrate with fast-flowing pool-riffle, riffle and riffle-run-pool habitat units (>80% by area). Stream temperatures in Gold Creek tended to be cooler (5.4°C) than Blairmore Creek (8.0 °C), on average. The coldest average stream temperatures were observed at Caudron Creek (4.3°C), a tributary to Gold Creek. WSCT is the only native species that has been detected within the LSA. Non-native rainbow trout (*Oncorhynchus mykiss*), rainbow trout x WSCT, and brook trout (*Salvelinus fontinalis*) are present in Gold Creek and Blairmore Creek, with the presence of barriers largely determining their distribution. Estimated fish density varies, with upper reaches of both Gold and Blairmore creeks containing a high density of smaller-sized fish and lower reaches containing lower densities, mostly of larger fish. Results from a mark-recapture survey estimated total sub-adult/adult fish populations in Gold and Blairmore creeks at 1,625 and 3,210, respectively. Levels of the 34 metals tested in collected fish tissues were all low, and mercury levels were below federal consumption guidelines. Density of macroinvertebrates ranged from 3,892 individuals/m<sup>2</sup> in the LSA to 14,302 individuals/m<sup>2</sup> in the RSA. Diversity and evenness were fairly high across all sites and community composition at all sites representing good water quality.

### 3.1 CRITICAL HABITAT IN LSA

Gold Creek and Blairmore Creek watersheds contain watercourses and parts of watercourses identified as critical habitat for WSCT. In November 2015, Fisheries and Oceans Canada (DFO) issued a formal habitat protection order under SARA for the designated areas identified in the Gold Creek watershed. In addition to (and prior to) the Governments of Alberta (Alberta Westslope Cutthroat Trout Recovery Team 2013) and Canada (DFO 2014) have developed a recovery plan and strategy for WSCT (these two documents are collectively referred to as “the Recovery Plan” in this report). The Recovery Plan was developed with the primary objective: “*To protect and maintain the existing ≥0.99% pure populations at self-sustaining levels and re-establish additional pure populations to self-sustaining levels, within the species historical range in Alberta*” (Alberta Westslope Cutthroat Trout Recovery Team 2013).

The Recovery Plan identifies parts of four watercourses in the LSA (total 16.5 km in the LSA) as critical habitat, each containing a population “*that has no evidence of recent or contemporary introgression as*

determined by genetic testing (i.e., >0.99 pure on average)<sup>2</sup>. Three of these are in the Gold Creek watershed, including almost 14 km of the Gold Creek mainstem, while one is located on a tributary to Blairmore Creek (Table 3.1, Figure 2.1). Fish recovered in these designated critical habitats were determined to be 99% genetically-pure (Alberta Westslope Cutthroat Trout Recovery Team 2013, DFO 2014)<sup>3</sup>. Areas identified as critical habitat in these two watersheds are upstream of barriers that prevent immigration of other fish species and populations. In addition, the Recovery Plan identifies parts of two Blairmore Creek watercourses, totaling approximately 10 km in length, as containing near-pure WSCT and these have been assigned conservation status (Table 3.1, Figure 2.1).

**Table 3.1 Watercourses in the Local Study Area designated as critical habitat (greater than 99% genetically pure) and near-pure (95% to 99% genetically pure) westslope cutthroat trout.**

<b>Watercourse</b>	<b>Length of Watercourse (km)</b>
<b>Critical Habitat (&gt;99% genetically pure)</b>	
Gold Creek mainstem*	14.0
Caudron Creek in Gold Creek Watershed*	2.1
Morin Creek in Gold Creek Watershed*	0.3
BCT04 in Blairmore Creek Watershed*	0.3
<b>Near-Pure (95% to 99% genetically pure)</b>	
Blairmore Creek mainstem	7.7
BCT04 in Blairmore Creek watershed	2.2

\* Under DFO SARA Habitat Protection Order (November 2015)

<sup>2</sup> page 33 of Alberta Westslope Cutthroat Trout Recovery Team (2013)

<sup>3</sup> Westslope cutthroat trout can only be reliably identified using genetic testing and the Recovery Plan considers a population to be genetically pure if the average genetic purity of a sample of fish from a creek is greater than 0.99.

## 4.0 EQUIVALENCY METRICS: QUANTIFICATION OF HABITAT LOSSES AND GAINS

The Fisheries Protection Provisions (FPP) of the *Fisheries Act* specify that development projects that cause unavoidable *serious harm to fish* must provide offsets, such that the benefits from offsetting measures should balance project residual effects. Equivalency metrics are common currencies used to describe both offset benefits and project effects. These metrics are used in equivalency analysis to determine the amount of offsetting required to counterbalance the *serious harm* (Bradford et al. 2016). Equivalency metrics vary depending on the extent and nature of the *serious harm*. An equivalency metric is the unit of loss or gain that is used to determine how much offsetting is needed to counterbalance unavoidable losses (Bradford et al. 2016). The following is a description of the general approach that we will take to quantify habitat losses and species use.

The FPP identifies several types of equivalency metrics which can be used for the development of offsetting plans. Four metrics have been identified as applicable to the Project (Table 4.1) and the detailed quantification of these metrics will be developed for the Project.

**Table 4.1 Equivalency metrics applicable to offset requirements for the Project (adapted from Bradford et al. 2016).**

Metric class	Example application	Example metric
Habitat	In-kind habitat replacement	Area (e.g., m <sup>2</sup> ) and type
Habitat or ecosystem function	Replacement of lost function (e.g., overwintering pools) potentially using out-of-kind offset measures	Habitat function metrics e.g., cover, substrate, depth
Habitat suitability or capacity for select species (e.g., WSCT)	Reductions in habitat quality or quantity offset by out-of-kind improvements to habitat quality	Weighted usable area, habitat suitability indices
Fish abundance	Creation of new habitats with similar expected fish communities. Created habitat may be unlike affected ones.	Biomass, density either observed (baseline) or predicted (offset). Regional fish density reference data may be used.

The objective of the offsetting measures is guided by the extent, duration and magnitude of the residual *effect*. The measures can either be “in-kind”, where the same kind of habitat and fisheries that are lost are replaced, or they can be “out-of-kind”, where factors limiting productivity are targeted, rather than replacing exactly what was lost. In-kind measures are prioritized due to the presence of WSCT within the Project area. To determine the amount of offsetting required to counterbalance the effects of the Project, the following measures will be considered:

- Provide benefits proportional to loss caused by the Project;
- Potential to be increased depending on the magnitude of uncertainty associated with the proposed offset; and
- Potential to be increased when there is a time lag between the impact and the time it takes for the offsetting to become functional.

Although, in-kind measures are the priority due to WSCT presence and DFO policies (e.g., DFO 2013) out-of-kind measures are still being considered during this conceptual planning stage since they allow for the flexibility of providing an alternate ecosystem habitat or function that is scarce or limiting. Through future consultation with federal and provincial regulators, the identified out-of-kind measures targeting limiting habitat (e.g., overwintering pools) may be found to be more beneficial (and feasible) to WSCT populations within the LSA.

## 5.0 PRELIMINARY OFFSETTING OPTIONS

Offsetting measures can be grouped into three general categories: habitat restoration and enhancement, habitat creation, and chemical or biological manipulations (DFO 2013). Habitat restoration and enhancement is applicable to areas where habitat conditions are considered poor or degraded. The existing habitat is physically manipulated to improve habitat function and productivity, such as re-vegetation of riparian areas or improving access to off-channel habitats. Habitat creation is generally used when productivity that was destroyed or degraded cannot be restored by manipulation of the original aquatic habitat. The created habitat should maintain or improve current productivity. Examples of habitat creation include the creation or expansion of natural stream channels or side channel habitats. The third category of offsetting measures includes chemical or biological manipulations, such as chemical manipulation of water bodies, stocking of fish, and control of aquatic invasive species.

In addition to habitat restoration and enhancement, habitat creation, and chemical or biological manipulations, investments in data collection and scientific research are considered complementary measures that can contribute to up to 10% of the overall project offsets (DFO 2013). Data collection and scientific research should fill any significant knowledge gaps regarding fisheries productivity such that fisheries management objectives or local restoration priorities may be effectively established. The Recovery Plan was used as a guiding document for relevant data collection and scientific research as well as discussions with regulators.

In general, it is recommended that restoration should focus on restoring natural processes that create and maintain habitat rather than manipulating instream habitats (Roni et al. 2002, Trout Unlimited Canada n.d.). A hierarchical strategy to offsetting includes:

1. Watershed assessment;
2. Reconnection of isolated high-quality fish habitat (e.g., mitigation of barriers);
3. Restore hydrologic, geologic (e.g., sediment delivery), and riparian processes; and
4. Instream habitat enhancement.

In addition to the general hierarchical strategy for offsetting, criteria specific to fish and fish habitat in the LSA was considered in selecting the preliminary list of offsetting options proposed in this plan including:

- Biological effectiveness and potential to benefit Gold Creek and Blairmore Creek WSCT populations;
- Certainty of construction feasibility, including site accessibility;
- Potential to provide diverse habitats (relates to WSCT Recovery Plan objectives); and
- Potential to provide habitats for all life stages of WSCT.

As stated in the *Fisheries Productivity Investment Policy* (DFO 2013) offsetting measures can vary, ranging from localized improvements to fish habitat to more complex measures to address factors limiting fish production. The offsetting measures must meet the following principles:

- Support fisheries management objectives or local restoration priorities e.g., Recovery Plan for WSCT;
- Benefits from offsetting measures must balance project effects;
- Provide additional benefits to the fishery; and
- Self-sustaining over the long-term.

Identification and evaluation of requirements for fish habitat offsetting requires an understanding of the fish community and the habitat requirements of the species present, as well as an assessment of the available habitat. This information is used to assess the quantity and quality of fish habitat present for the fish species and its respective life stages. The following information is required to complete this assessment:

- Determination of the total surface area (i.e., m<sup>2</sup>) of habitat that may be disturbed, including information on component habitat types (e.g., run, riffle, pool);
- Description of the physical characteristics of the potentially affected habitats, including the substrate composition (e.g., boulder, gravel, sand, vegetation), habitat features (e.g., instream woody debris, aquatic macrophytes and bank characteristics) and other variables such as water quality (e.g., pH, conductivity, dissolved oxygen); and
- Knowledge of the habitat requirements of each fish species including specific requirements during various life stages (e.g. fry, juvenile, adult) and life history functions (e.g., spawning, rearing, overwintering).

These principles form the basis of effectively evaluating offsetting options. To date, five potential offset options have been identified ([Figure 5.1](#), [Table 5.1](#)). As the Project progresses these options will be further assessed for feasibility from an ecological, economic and engineering perspective as well as potential benefits to WSCT in the LSA. The following sections describe these options conceptually.

**Table 5.1 Potential habitat offsetting options for the Project.**

<b>Option</b>	<b>Location</b>	<b>Description</b>	<b>Target Species</b>	<b>Approximate Habitat Area</b>
Permanent Reconnection of isolated high-quality habitat	Gold Creek, mainstem	Flow is altered in Reach 6 of Gold Creek near legacy coal pile. Reestablish surface flow and enhance habitat to include overwintering and spawning habitat.	WSCT	9,370 m <sup>2</sup>
Morin Creek habitat enhancement	Morin Creek, tributary to Gold Creek	Recreational use has caused degradation to banks, channel and riparian areas. Replace recreational fords with bridge/culvert, enhance riparian area and install instream features.	WSCT	770 m long ~ 2 m width = 1,540 m <sup>2</sup>
Overwintering habitat enhancement	Gold Creek and Blairmore Creek, mainstem	Overwintering pools are deficient in the LSA. Create more high-quality overwintering habitat.	WSCT	6,100 m long ~ 6.5 m width = 39,650 m <sup>2</sup>
Riparian habitat enhancement	Tributaries in LSA	Based on ecological land classification and fish-bearing presence riparian habitat value has been assigned. Target low value riparian outside of the project footprint but within the LSA for enhancement.	WSCT	173,151 m <sup>2</sup>
Data collection and scientific research	LSA	Surveys completed for baseline characterization and any additional surveys necessary throughout the life of the project and post-construction/ effectiveness monitoring.	WSCT	Not applicable



**LEGEND**

- Primary Highway
- Waterbody
- Near Pure WSCT (95% to 99% pure) Provincial Conservation Designation
- Local Study
- Identified Westslope Cutthroat Trout Critical Habitat (greater than 99% pure)
- Overwintering Candidate Site
- Watercourse
- Candidate Area for Riparian Enhancement
- Potential Area for Flow Reestablishment
- Potential Area for Habitat Enhancement

**PROJECT**

**RIVERSDALE GRASSY MOUNTAIN COAL PROJECT**  
RESOURCES



**TITLE**

**POTENTIAL OFFSETTING OPTIONS IN THE LOCAL STUDY AREA**

**NOTES**

Data Sources: Government of Canada, Government of Alberta, ESRI Basemap  
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 7779

DRAWN BY: JSM

CHECKED BY:

DATE: January 24, 2017

**FIGURE**

**5.1**



## 5.1 PERMANENT RECONNECTION OF ISOLATED HIGH-QUALITY FISH HABITAT

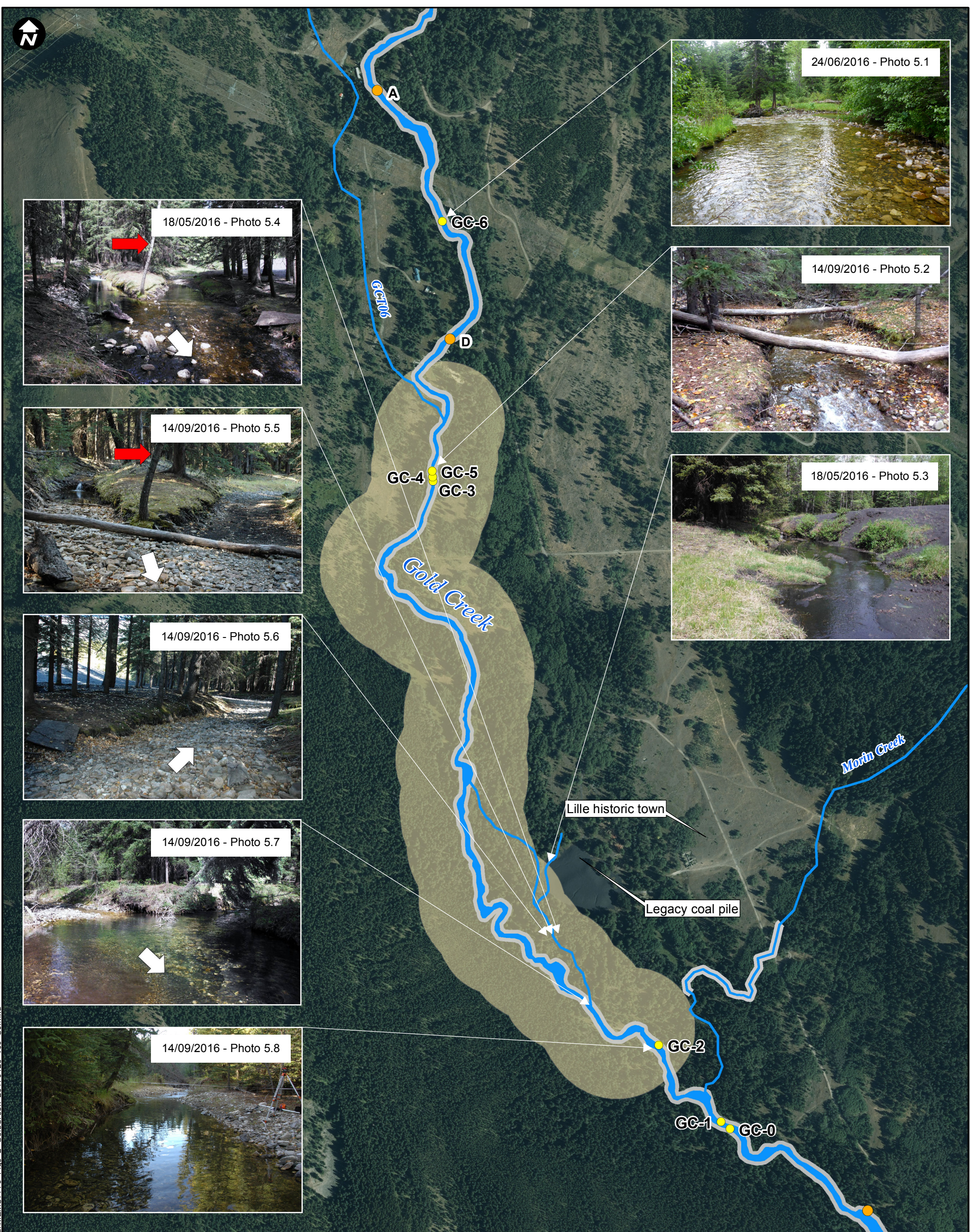
Baseline surveys identified substantial surface flow loss and historical channelization of Gold Creek adjacent to a legacy coal pile and the historic town of Lille (Figure 5.2). Field surveys have identified a low number of fish utilizing this segment of Gold Creek mainstem. Overwintering habitat surveys (Hatfield 2016) detected two pools near the upstream end of this region with 23 to 32 WSCT, most of which were larger than 200 mm fork length (Pools A and D, Figure 5.2). This relatively high density of large fish suggests that suitable deep pool habitat for overwintering is deficient in this part of Gold Creek and likely in the Gold Creek system overall. Anticipated benefits from reestablishing surface flow and enhancing habitat in Gold Creek mainstem include:

- Permanent reconnection of isolated high-quality Gold Creek mainstem fish habitat;
- Providing connectivity for fish movement;
- Increasing habitat available for fish use;
- Creating additional overwintering and spawning habitat in the reach; and
- Diluting coldwater input from Caudron Creek, which may be influencing juvenile recruitment (Hatfield 2016).

Flow in the mainstem of Gold Creek begins to decrease around hydrometric station GC-6 (Photos 5.1 and 5.2, Figure 5.2). Further downstream the channel forms braids and there are areas that are dry under low flow conditions (Photos 5.4, 5.5 and 5.6 in Figure 5.2). Adjacent to the legacy coal pile, the flow is subsurface, creating a seasonal barrier to fish movement (Photos 5.5 and 5.6 in Figure 5.2). This area has been classified as a seasonal barrier to fish movement as surveys during May 2016 did identify surface flow connectivity in various channels (Photos 5.3 and 5.4 in Figure 5.2). Flow in the mainstem of Gold Creek returns just upstream of the confluence with Morin Creek near hydrometric station GC-2 (Photos 5.7 and 5.8 in Figure 5.2). This area is approximately 9,370 m<sup>2</sup>. Further detailed investigations to determine the feasibility should include:

- Investigation of surficial geology and hydrogeology; and
- Habitat characterization under a variety of seasonal flow conditions.

WSCT have been captured and observed above and below this reach of Gold Creek, therefore it is expected that by improving surface flows, additional habitat would be available for all life stages of WSCT. Enhancement will target creating habitat suitable for spawning and overwintering. This area is also above a permanent barrier on Gold Creek, which prevents the upstream migration of nonnative brook trout. This is important because competition with brook trout has been identified as a potential threat to WSCT (DFO 2014). Increasing the extent and availability of suitable habitat in the Gold Creek mainstem with no competition from invasive species is of high value to maintaining a self-sustaining population of WSCT.



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**LEGEND**

- Instream Flow Transect
- Overwintering Pool
- Watercourse
- Identified Westslope Cutthroat Trout Critical Habitat (greater than 99% pure)
- Potential Area for Flow Reestablishment

**PROJECT**

**RIVERSDALE GRASSY MOUNTAIN COAL PROJECT**  
RESOURCES



**TITLE**

**FLOW REESTABLISHMENT AND HABITAT ENHANCEMENT ON GOLD CREEK**

**NOTES**

Data Sources: Government of Canada, Government of Alberta, ESRI Basemap  
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 7779

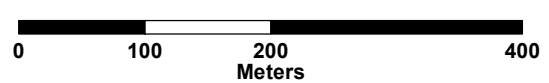
DRAWN BY: JSM

CHECKED BY:

DATE: January 24, 2017

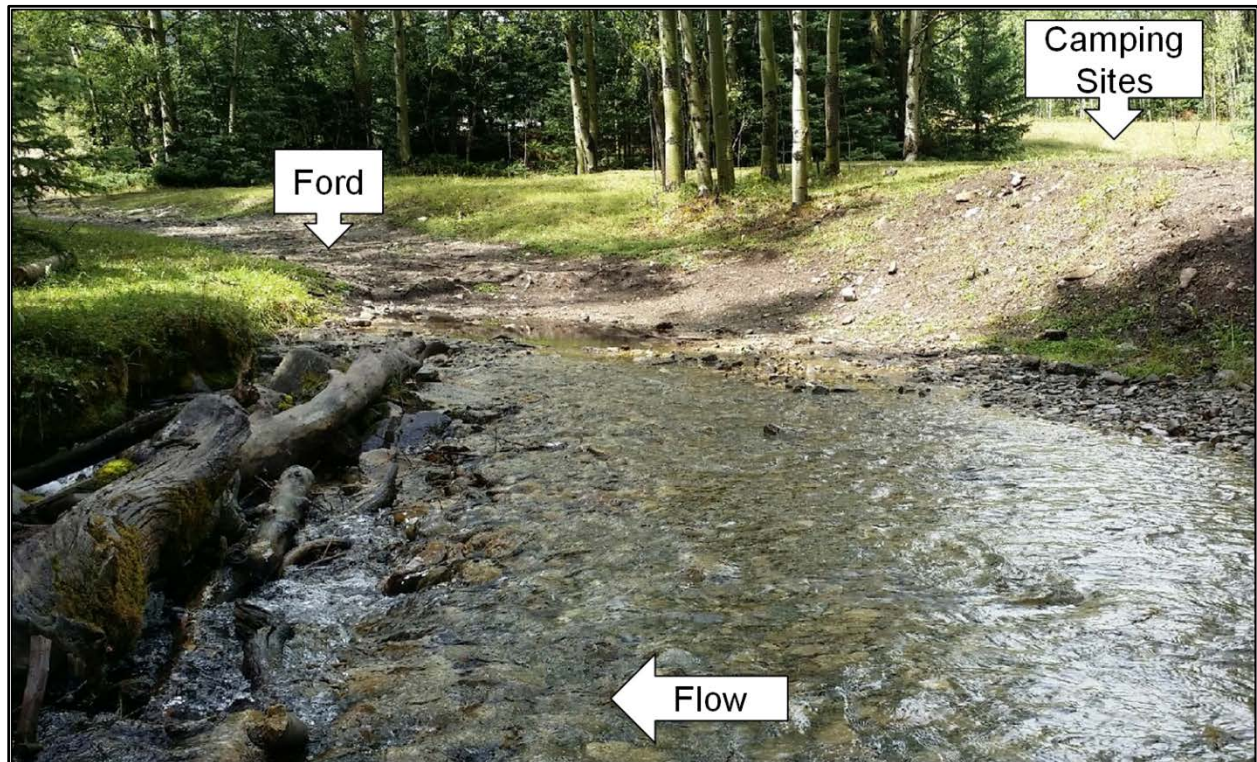
**FIGURE**

**5.2**



## 5.2 MORIN CREEK HABITAT ENHANCEMENT

A small portion (303 m) of Morin Creek, a tributary to Gold Creek is currently covered by the Habitat Protection Order (DFO 2014). Baseline surveys observed recreational use in the area, including fords and camping sites which have caused degradation to the banks, channel and riparian area (Photo 5.9). Debris (e.g., metal, garbage) is also common in the stream and the surrounding riparian areas. By improving the habitat in Morin Creek it is expected that the range of WSCT will expand.



**Photo 5.9** Visible degradation of the right bank and riparian area of Morin Creek due to recreational use (August 10, 2016).

Potential features that have been identified to enhance Morin Creek include installing a formal road crossing in place of existing fords, riparian enhancement, and installation of instream features to improve habitat diversity (Table 5.2, Figure 5.3). Prioritizing these actions is based on a number of factors, including the needs of the WSCT, locations of refugia, cost-effectiveness, response time, probability and variability of success, and duration of the proposed action. In general, it is recommended that road improvements and riparian restoration are prioritized over the installation of in-stream features (Roni et al. 2002, Trout Unlimited Canada n.d.); however, a more detailed site investigation of Morin Creek must be completed first to confirm habitat deficiencies and establish habitat enhancement priorities for WSCT.

**Table 5.2 Recommended features that are predicted to enhance habitat in Morin Creek.**

Feature	Predicted Benefit
Install culvert or bridge to replace existing recreational fords	<ul style="list-style-type: none"> <li>▪ Reduced sedimentation</li> <li>▪ Decrease physical damage to channel and banks</li> <li>▪ Control crossing of Morin Creek</li> </ul>
Public outreach and education, including signage identifying fish habitat as sensitive	<ul style="list-style-type: none"> <li>▪ Encourage low-impact use of the area</li> </ul>
Bank revegetation and stabilization, cattle exclusion	<ul style="list-style-type: none"> <li>▪ Decrease erosion and sedimentation</li> <li>▪ Provide natural source of large woody debris (LWD)</li> <li>▪ Create cover from overhanging vegetation, LWD deposition</li> <li>▪ Provide allochthonous input</li> <li>▪ Improve water quality</li> </ul>
Install in-stream features e.g., LWD	<ul style="list-style-type: none"> <li>▪ Improve hydraulic diversity e.g., create deeper pools</li> <li>▪ Create cover and provide refuge for aquatic life</li> <li>▪ Provide bank stability</li> </ul>

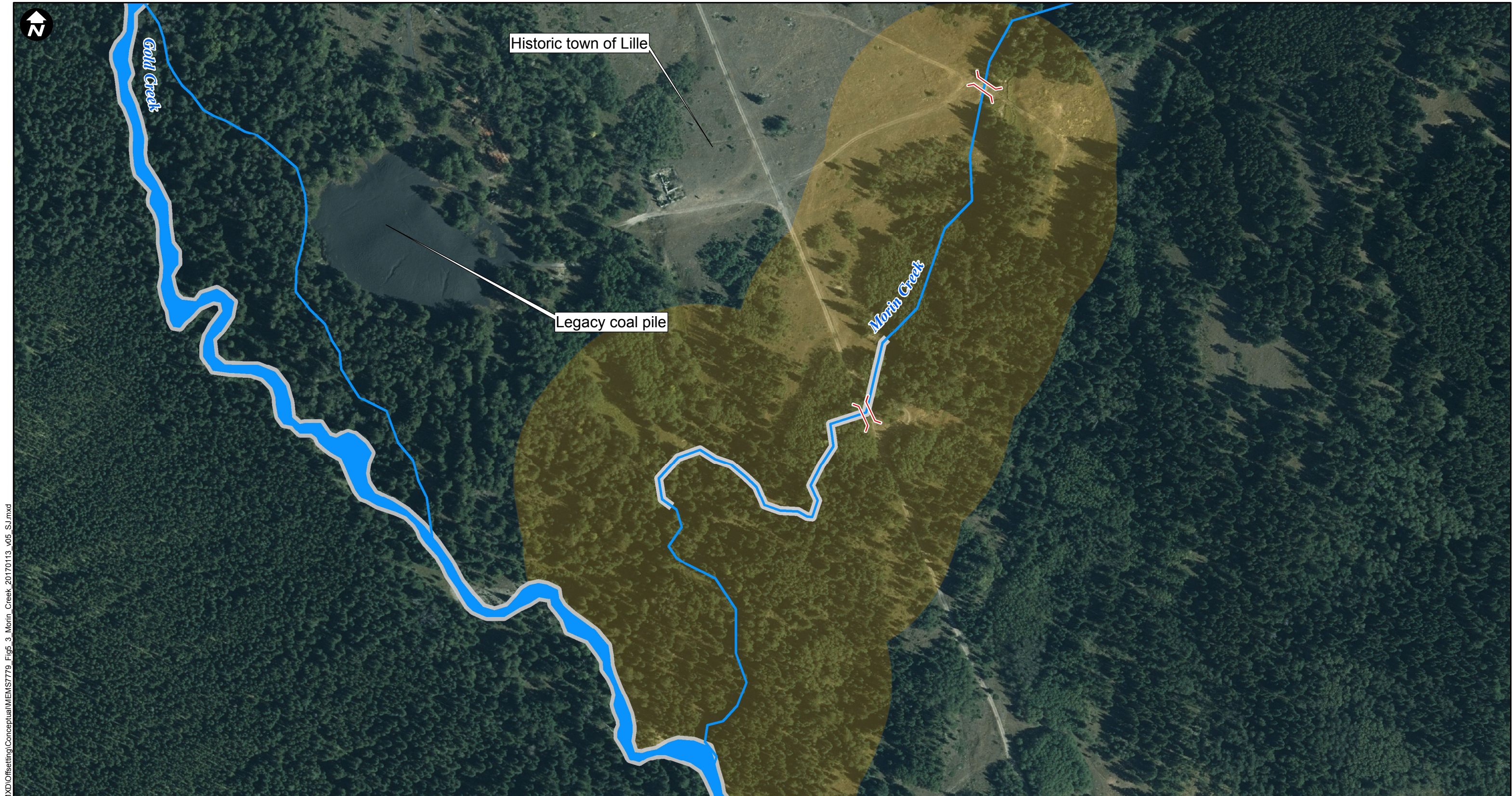
Baseline surveys of Morin Creek near its confluence with Gold Creek show an abundance of large woody debris (LWD), step-pool habitat and a generally high quality riparian zone (Photos 5.10 and 5.11). The degradation observed upstream of this area (Photo 5.9) is likely caused by anthropogenic activities. By restricting access to the creek (e.g., replacing fords with formal crossings, excluding cattle) and revegetating the banks, more direct instream work may not be necessary. Further investigations at this site are recommended.



Photo 5.10 Looking upstream at Morin Creek near its confluence with Gold Creek (May 18, 2016).



Photo 5.11 Looking upstream at Morin Creek near its confluence with Gold Creek (May 18, 2016).



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**LEGEND**

	Proposed culvert/bridge
	Watercourse
	Identified Westslope Cutthroat Trout Critical Habitat (greater than 99% pure)
	Potential Area for Enhancement

**PROJECT**



**GRASSY MOUNTAIN COAL PROJECT**



**Hatfield**  
CONSULTANTS

**TITLE**

**MORIN CREEK HABITAT ENHANCEMENT**

PROJECT: 7779
DRAWN BY: JSM
CHECKED BY:
DATE: January 13, 2017

**NOTES**  
 Data Sources: Government of Canada, Government of Alberta, Aerial Photo, 0.25 m resolution, Tarin Resource Services Ltd.  
 Datum/Projection: UTM NAD 83 Zone 11



**FIGURE**

**5.3**

## 5.3 MAINSTEM OVERWINTERING HABITAT ENHANCEMENT

Fluctuations in water temperature, discharge and ice conditions create highly variable environmental conditions during the winter (Brown et al. 2011), which can create many challenges for fish. The decrease in water temperature triggers a behavioural change in fish, as their metabolism slows down they feed less and move from shallow areas with high velocities to deeper areas with slower water velocities (Jakober et al. 1998, Brown et al. 2011). These habitat features require minimum energy expenditure, which is important for minimizing the depletion of energy reserves during the winter (Handy 2007, Brown et al. 2011). Fish tend to aggregate, likely because of the availability of limited suitable habitat (Brown et al. 2011).

Salmonids tend to prefer winter habitats offering suitable depth, low velocity flows, overhead shading, and lateral concealment (Table 5.3). After the formation of surface ice, salmonids show an increased preference for sites with less submerged cover such as beaver ponds and pools lacking LWD likely due to the formation of anchor ice (Brown and Mackay 1995, Jakober et al. 1998). Baseline surveys suggest that both Gold and Blairmore mainstems are lacking high quality and sufficient overwintering habitat (Hatfield 2016). During 2016, over 20 km of Gold and Blairmore creeks were surveyed and only four good quality overwintering pools were detected in each creek. Overwintering habitat likely creates a bottleneck to the existing population(s).

**Table 5.3 Generalized criteria for winter habitat selection by fishes in coldwater streams, listed in order of relative importance (adapted from Jakober et al. 1998).**

Relative priority <sup>1</sup>	Habitat criterion	Example(s) of selected habitat
1	Protection from adverse conditions (e.g., ice, low oxygen), access to refugia or alternate winter habitat	<ul style="list-style-type: none"> <li>▪ Suitable water depth (generally &gt; 1.5 m deep recommended by Alberta Transportation 2009)</li> <li>▪ Instream cover</li> <li>▪ Groundwater discharge</li> </ul>
2	Protection from predators	<ul style="list-style-type: none"> <li>▪ Suitable water depth</li> <li>▪ Instream cover</li> </ul>
3	Access to food	<ul style="list-style-type: none"> <li>▪ Low-velocity microhabitats</li> </ul>

<sup>1</sup> Relative priority can vary based on factors such as life stage, food availability, water temperature and predators.

Understanding winter habitat needs are difficult, since weather conditions can affect access to rivers and also visibility of fish habitat (i.e., ice and snow cover on the river surface). North of the LSA in Ram River, Alberta, Brown and Mackay (1995) reported that cutthroat trout move in two stages during the fall and winter. In response to declining temperatures in mid-September, fish moved up to 3 km to overwinter habitats of deep pools with LWD or undercut banks. Later in the fall, subsurface (frazil and anchor) ice formed in these sites, adhering to cover and filling pools. This triggered a second-stage movement by trout for several kilometers to groundwater-fed pools and other areas lacking subsurface ice. Movement in response to changing habitat conditions, such as the formation of anchor ice has also been observed by other researchers (Jakober et al. 1998, Brown et al. 2011).

Given the large range of environmental fluctuations that occur during the winter, it is clear that access to a diverse range of habitats is essential for the survival of WSCT. Fish need the ability to move between habitats based on the changing habitat conditions. Therefore both habitat access and availability are important features to high quality habitat. Preliminary investigations within the LSA have identified a deficiency of deep pools in both Gold and Blairmore creeks (Hatfield 2016). Further investigation into the fluvial geomorphology and hydrology of these systems is important to determine why large deep pools are not forming as sediment transport and flow are likely contributing factors. Benga has partially funded a research project that specifically investigates the quality, extent and use of overwintering habitat by WSCT in Gold and Blairmore creeks. This research is ongoing and is being run through the University of Lethbridge (Dr. Joseph Rasmussen). This information will build upon the baseline overwintering habitat data collected as part of the *Aquatic Ecology Effects Assessment Addendum Report* (Hatfield 2017) and provide valuable information moving forward to ensure the Gold and Blairmore populations of WSCT are well protected. Any consideration to improve the quantity and suitability of overwintering habitat in these systems will be developed in consultation with these researchers to ensure the best available information is applied.










For the purposes of the Preliminary Offsetting Plan, candidate areas for the creation and enhancement of overwintering habitat have been identified ([Figure 5.4](#)) based on the observed habitat and WSCT presence and distribution during surveys characterizing baseline conditions within the LSA (Hatfield 2016). Prior to any instream works, these areas must be ground-truthed and further evaluated for potential to create new and suitable overwintering pools by considering the following factors:

- Geology, groundwater, hydrology;
- Fluvial geomorphology;
- Potential for fish movement; and
- Access and construction feasibility.



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**LEGEND**

-  Overwintering Pool
-  Road
-  Primary Highway
-  Near Pure WSCT (95% to 99% pure)  
Provincial Conservation Designation
-  Identified Westslope Cutthroat Trout  
Critical Habitat (greater than 99% pure)
-  Watercourse
-  Waterbody
-  Local Study
-  Candidate Site for Overwintering  
Enhancement

**PROJECT**



**RIVERSDALE GRASSY MOUNTAIN  
COAL PROJECT**  
RESOURCES



**TITLE**

**CANDIDATE SITES FOR OVERWINTERING HABITAT ENHANCEMENT**

**NOTES**

Data Sources: Government of Canada, Government of Alberta, ESRI Basemap  
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 7779

DRAWN BY: JSM

CHECKED BY:

DATE: January 13, 2017

**FIGURE**

**5.4**



## 5.4 ENHANCEMENT OF RIPARIAN PROCESSES

Riparian areas are the transitional zone between terrestrial and aquatic systems, exhibiting characteristics of both systems and performing essential ecological functions. These functions include protecting aquatic ecosystems by removing sediments from surface runoff, decreasing flooding, maintaining appropriate water conditions for aquatic life, and providing organic material vital for productivity and structure of aquatic ecosystems (Liepins 2003, Trout Unlimited Canada, n.d.). They also provide excellent wildlife habitat, offering not only a water source, but food and shelter, as well.

Riparian areas are beneficial to WSCT in several ways. Structurally and functionally diverse vegetation traps sediment contained in surface runoff, thereby reducing siltation of spawning substrates (Machtinger 2007). The buffer also filters nutrients and contaminants in surface runoff, thus protecting water quality (Liepins 2003). Vegetation roots and foliage serve to stabilize streambanks (ASRD and ACA 2006), which is particularly important during high flow events (Machtinger 2007). Trees and shrubs provide shade that maintains cool water temperatures and habitat for riparian species including terrestrial insects that serve as food for juvenile WSCT (Behnke 1992, ASRD and ACA 2006, Ree 2014). Lastly, riparian vegetation, especially trees and shrubs, provides wood and organic matter to the stream for use by fish and other aquatic species (ASRD and ACA 2006, Machtinger 2007). The wider and more structurally diverse the riparian area or buffer, the more value it will have for WSCT.

The riparian habitat within the LSA was evaluated during the *Vegetation and Wetlands Assessment* (Millenium 2015) and assigned low, medium or high value based on the ecological land classification (ELC) and fish presence in the *Aquatic Ecology Effects Assessment Addendum Report* (Hatfield 2017). We propose to enhance the riparian buffers in the areas of low value riparian habitat that occur within the LSA but outside of the project footprint (Figure 5.5). Most of these areas have been classified as disturbed land (168,292 m<sup>2</sup>, Table 5.4) with the exception of 4,859 m<sup>2</sup> of moderate conifer forest on BCT04 (Table 5.4).

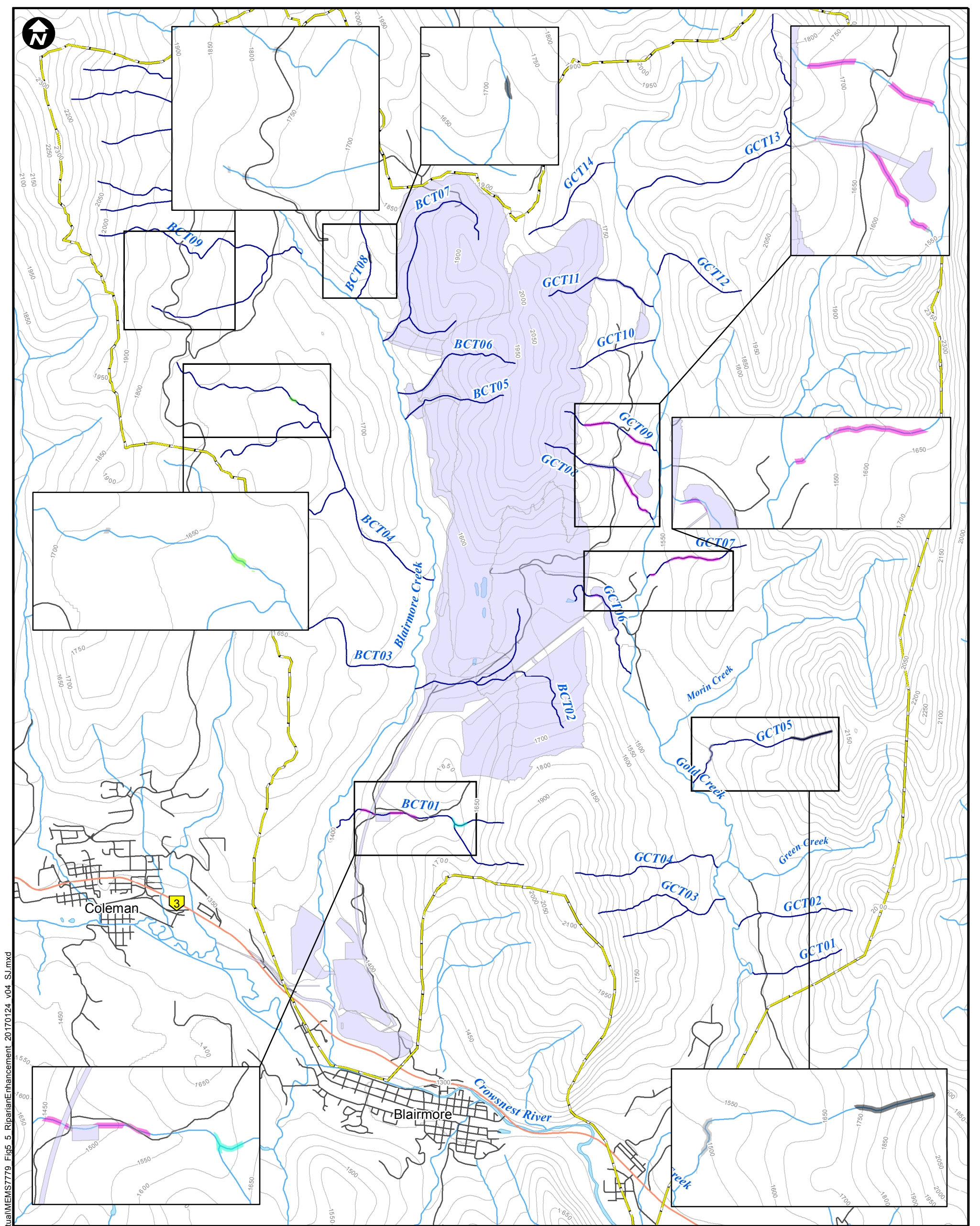
**Table 5.4 Ecological land classes of candidate areas for riparian enhancement in the LSA.**

Ecological land classes	Area (m <sup>2</sup> )
<b>Upland Forested Communities</b>	
Moderate Conifer Forest (young)	4,859
<b>Disturbed Land</b>	
Open Regeneration - Herbaceous	3,351
Open Regeneration - Shrub	93,909
Barren Land	27,358
Industrial (Mining)	10,589
Linear Disturbance	33,085
<b>Total Land</b>	<b>173,151</b>

All of these areas occur on non-fish bearing watercourses. If degraded riparian areas are identified on WSCT-bearing watercourses during future surveys, it may be beneficial to prioritize these areas for enhancement. Further investigation is required to assess the cause of degradation and identify

site-specific enhancement options. For example, some of the areas occur near road crossings (e.g. BCT09), therefore enhancing the watercourse crossing may also be an option. Livestock grazing is common throughout the LSA. Grazing within stream riparian corridors can harm riparian ecosystems and stream channels by altering natural riparian and channel processes, causing erosion, channel sedimentation and widening, decreased water quality, and changes in the water table (Roni et al. 2002). Site-specific investigations should identify if management for livestock grazing and access to water are possible.

Once the sources of riparian degradation are confirmed, the enhancement areas will be prioritized and site-specific planting plans will be developed. In riparian areas that are degraded or no buffer exists, native grasses, sedges, forbs, shrubs, and trees should be planted. The ideal riparian buffer zone incorporates the native plant community appropriate to the site. Riparian areas adjacent to WSCT habitats would ideally be forested. Managing riparian areas or buffers for mature stands of trees spaced sufficiently far apart to allow an understory of grasses and shrubs will improve WSCT habitat over time (Machtinger 2007). Trees should be close enough to the stream so that some of the tree's roots are exposed to supply cover and allow stable undercut banks to develop. This proximity to the channel also assures that some trees will fall into the stream, providing wood for habitat complexity.



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LEGEND	
	Primary Highway
	Road
	50 m Contour
	Watercourse
	Waterbody
	Local Study Area
	Project Footprint
Ecological Land Cover Classification (low value)	
	Moderate Conifer Forest (young)
	Open Regeneration Herbaceous
	Open Regeneration Shrub
	Barren Land
	Industrial (e.g. Mining)
	Linear Anthropogenic

**PROJECT**



**RIVERSDALE GRASSY MOUNTAIN COAL PROJECT**  
RESOURCES



**TITLE**

**CANDIDATE AREAS FOR RIPARIAN ENHANCEMENT**

**NOTES**

Data Sources: Government of Canada, Government of Alberta, Ecological Land Cover Classification (ELC) 2016  
Datum/Projection: UTM NAD 83 Zone 11

PROJECT: 7779  
DRAWN BY: SS / EDITED BY: JSM  
CHECKED BY: CB  
DATE: January 10, 2017



**FIGURE**

**5.5**

## 5.5 DATA COLLECTION AND SCIENTIFIC RESEARCH

The Alberta Recovery Plan (Alberta Westslope Cutthroat Trout Recovery Team 2013) identifies a number of knowledge gaps and research needs for WSCT:

- Life history and biology e.g., Strategy R2, Action A4: Describe habitat use by life stage for WSCT, urgent priority;
- Habitat e.g., Strategy R6, Action A13: Identify and classify barriers in WSCT habitat, urgent priority; and
- Distribution and abundance e.g., Strategy R3, Action A5: Conduct surveys to characterize genetic status of populations in native range, urgent priority.

Characterization of the baseline conditions within the LSA included mark-recapture studies for WSCT, collection of genetic samples, and assessment of habitat use by life stage (Hatfield 2016). These data provide meaningful information on the productivity of a SARA-listed fish. It is anticipated that additional surveys will be necessary throughout the life of the project and post-construction/effectiveness monitoring. These could include additional work describing key habitat components for each life stage (e.g., spawning and overwintering areas) as well as locations of critical habitat and habitat characteristics that limit invasion by non-native species (e.g., temperature, barriers). This work is proposed as potential offsetting, targeting the knowledge gaps and research needs identified in the Recovery Plan. Further, as highlighted above, Benga is partially funding ongoing research on WSCT overwintering habitat use in both Gold and Blairmore creeks; this research directly benefits the Recovery Strategy for WSCT.

## 6.0 EFFECTIVENESS MONITORING FOR OFFSETTING MEASURES

Effectiveness monitoring is rigorous, science-based monitoring that requires a standardized and transferable design, to determine if ‘No net loss of the productive capacity of fish habitat’ (DFO 1986) is achieved from the offsetting for the Project (Smokorowski et al. 2015). This monitoring is designed to confirm that implemented offsetting measures have been effective in counterbalancing the *serious harm to fish* and identify the need for contingency measures if deficiencies are found. It will be important to identify quantitative targets to establish the effectiveness of the offsetting activity. These measures of success (i.e., Equivalency Metrics, [Section 4.0](#)) will be finalized in consultation with regulators and will depend on the nature of the final offsetting measures selected. The framework for the monitoring plan will follow seven general steps designed to assess the effectiveness of offsetting at meeting success criteria (i.e., biological targets, equivalency metrics) and ultimately to determine if the offsetting activity is ecological stable and self-sustaining ([Table 6.1](#)).

**Table 6.1 Framework for the effectiveness monitoring program (adapted from Smokorowski et al. 2015).**

Step	Description
1	Establish goals of monitoring
2	Establish quantitative targets, based on equivalency metrics described in <a href="#">Section 4.0</a> of this report
3	Determine likelihood of success of offsetting, monitoring frequency and intensity to be adjusted based on uncertainty
4	Define monitoring metrics, based on equivalency metrics and metrics used to characterize baseline data
5	Create monitoring design e.g., reference site, control, sampling intensity
6	Determine duration of monitoring (pre- and post-offsetting)
7	Report, following standardized format

## 7.0 SUMMARY

This report provides the framework for the Offsetting Plan required for any residual *serious harm to fish* that may result from development of the Project proposed by Benga. The FPP of the *Fisheries Act* and the Habitat Protection Order under the SARA have been considered. Once the residual *serious harm to fish* has been accepted, the appropriate equivalency metrics and offsetting measures will be selected. Five offsetting measures that could be used for the Project have been described at a conceptual level in this report:

1. **Reconnection of isolated high-quality fish habitat:** Reestablish flow and enhance habitat in mainstem Gold Creek near the legacy coal mining site. This option would reconnect high quality habitat used by WSCT.
2. **Morin Creek habitat enhancement:** Mitigate the anthropogenic effects on Morin Creek, including area that has been identified as critical habitat for WSCT. This mainly involves reducing the impacts of recreational use in the area, through the creation of formal watercourse crossings and riparian restoration.
3. **Overwintering habitat enhancement:** Restore hydraulic and fluvial processes to create overwintering habitat in Gold Creek and Blairmore Creek watersheds. The deficiency of this habitat is likely causing a bottleneck to the existing WSCT population(s) in the LSA.
4. **Enhancement of riparian processes:** 173,151 m<sup>2</sup> of low value riparian habitat has been identified. By enhancing certain areas, WSCT habitat could benefit through improved riparian function, which provides services such as improved water quality and stabilized stream temperatures.
5. **Data collection and scientific research:** Provision of collected data associated with WSCT knowledge gaps and research needs identified in the Recovery Plan.

In consultation with federal and provincial regulators, measures will be selected to offset residual effects to fish and fish habitat, creating a net increase in fish production. Once the offsetting measures and equivalency metrics have been established, a comprehensive effectiveness monitoring program will be designed to confirm that the offsetting measures are effective in counterbalancing the *serious harm to fish* and identify the need for contingency measures if any deficiencies are detected.

## 8.0 REFERENCES

- Alberta Transportation. 2009. Fish Habitat Manual: Guidelines and procedures for watercourse crossings in Alberta. Alberta, Canada, 163 pp.
- Alberta Westslope Cutthroat Trout Recovery Team. 2013. Alberta Westslope Cutthroat Trout Recovery Plan 2012-2017. Alberta Environment and Sustainable Resource Development, Alberta Species at Risk Recovery Plan No. 28. Edmonton, AB. 77pp.
- [ASRD] Alberta Sustainable Resource Development and [ACA] Alberta Conservation Association. 2006. Status of the westslope cutthroat trout (*Oncorhynchus clarkii lewisii*) in Alberta. Alberta Sustainable Resource Development, Wildlife Status Report No. 61, Edmonton, AB. 33 pp.
- Behnke RJ. 1992. Native trout of western North America. American Fisheries Society Monograph 6. 238 pp.
- Bradford MJ, Smokorowski KE, Clarke KD, Keatley BE, Wong MC. Equivalency metrics for the determination of offset requirements for the Fisheries Protection Program. Fisheries and Oceans Canada, Canadian Science Advisory Secretariat Doc. 2016/046: Ottawa. pp32 + Appendices.
- Brown RS, McKay WC. 1995. Fall and winter movements and habitat use by cutthroat trout in the Ram River, Alberta. Transactions of the American Fisheries Society 124: 873-885.
- Brown RS, Hubert WA, Daly SF. 2011. A primer on winter, ice and fish: what fisheries biologists should know about winter ice processes and stream-dwelling fish. Fisheries 36(1):8-26.
- [DFO] Fisheries and Oceans Canada. 2013. Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting. 19pp.
- DFO. 2014. Recovery Strategy for the Alberta populations of Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*) in Canada [Final]. Species at Risk Act Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. iv + 28 pp + Appendices.
- Handy MJ. 2007. Overwinter survival of westslope cutthroat trout in Cache Creek, Montana [Thesis]. Montana State University, pp. 73.
- [Hatfield] Hatfield Consultants. 2016. Grassy Mountain Coal Project: Fisheries and Aquatics Technical Baseline Report. Prepared for Benga Mining Ltd.
- [Hatfield] Hatfield Consultants. 2017. Grassy Mountain Coal Project: Aquatic Ecology Effects Assessment Addendum Report – Consultant Report #6. Prepared for Benga Mining Ltd.
- Jakober M, McMahon T, Thurow R, Clancy C. 1998. Role of stream ice on fall and winter movements and habitat use by bull trout and cutthroat trout in Montana headwater streams. Transactions of the American Fisheries Society. 127: 223-235.
- Liepins S. 2003. Aquatic and riparian habitat and values in the North Coast. Ministry of Environment, Lands and Parks, British Columbia, Canada.

- Machtinger ET. 2007. Cutthroat trout (*Oncorhynchus clarki*) – Fish and Wildlife Habitat Management Leaflet. U.S. Department of Agriculture: Washington, DC, pp.12
- [Millennium] Millennium EMS Solutions Ltd. 2015. Vegetation Baseline and Effects Assessment. Prepared for Benga Mining Ltd.
- Ree M. 2014. Spatial and temporal variation of benthic macroinvertebrate communities in three Westslope Cutthroat Trout tributaries in the Rocky Mountains. Undergraduate Thesis. Concordia University College of Alberta. 27 pp.
- Roni P, Beechie TJ, Bilby RE, Leonetti FE, Pollock MM, Pess GR. 2002. A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific northwest watersheds. North American Journal of Fisheries Management 22(1): 1-20
- Smokorowski KE, Bradford MJ, Clarke KD, Clément M, Gregory RS, Randall RG. 2015. Assessing the effectiveness of habitat offset activities in Canada: Monitoring design and metrics. Fisheries and Oceans Canada, Canadian Technical Report of Fisheries and Aquatic Sciences 3132: Ottawa. pp 48.
- Trout Unlimited Canada. n.d. Aquatic Renewal Stream Rehabilitation Training Manual. Trout Unlimited Canada: Guelph, Ontario.