Shore Gold Star-Orion South Diamond Project - Fish Habitat Compensation Plan

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1.0 Introduction

As discussed in the Shore Gold Diamond Project Environmental Impact Statement (EIS), the Project will result in a harmful destruction or disruption (HADD) of fish habitat and requires the development and implementation of a Fish Habitat Compensation Plan (FHCP) in order to offset fish habitat loss caused by the Project. The objective of this report is to serve as a detailed, conceptual FHCP illustrating that the FHCP offsets the HADD of fish habitat caused by the proposed Star Orion South Diamond Project. This conceptual plan will serve as a guidance document at the detailed design stage, when the plan will be developed in detail, to the level that it can be implemented and construction can begin where required.

2.0 Description of Fish Habitat to be Lost for all Project Components

The amount of compensation required has been determined in the revised EIS based on the residual net loss of productive capacity after relocation, redesign, and mitigation are accounted for. For the majority of potential Project-related effects, Shore took the approach of avoidance and mitigation. Project infrastructure was relocated subsequent to preliminary planning to avoid fish habitat loss in the tributaries and the Saskatchewan River. For example, the overburden and rock storage pile was reconfigured to avoid habitat loss in 101 Ravine and the water management reservoir is no longer located in Duke Ravine. The diffuser design avoids loss of near shore habitat in the Saskatchewan River by running the pipeline beneath the river bed. Shore plans to mitigate effects of water drawdown on fish-bearing waterbodies by supplementing seasonal baseflow, as required, by directing water of suitable quality to 101 Ravine, Duke Ravine, and English Creek.

The habitat quantification process for the Project LSA has been unusually challenging due to the complexity of habitat types in the streams, a high level of seasonal and temporal variation, abundant beaver activity in the area, as well as other types of natural obstructions acting as barriers to upstream fish migration. A proposed approach for calculating the quality and quantity of fish habitat that will be impacted due to Project development was submitted to DFO in August 2010. The approach taken was to divide the study area into habitat types (pool, riffle, and run) based on slope differences using Light Detection and Ranging (LiDAR) imagery (taken in 2005), aerial photography (taken in 2007), and field data collected during the 2007 and 2008 baseline surveys. A habitat evaluation procedure was then used to calculate the net loss in habitat productive capacity for the test study area (the lower reach of East Ravine). Following a meeting with DFO on May 25th, 2011 to discuss the test approach, it was decided to quantify fish habitat solely by habitat type (pool, riffle, and run) rather than using species-specific habitat suitability ratings. DFO was satisfied with the desktop approach, as long as the results were compared with field data. A comprehensive report applying this approach to all nine tributaries in the LSA was submitted to DFO in December 2011

(Shore, 2012; Appendix 6.3.1-E). The desktop approach was successful in quantifying the habitat types for the purposes of developing a compensation plan.

The process of quantifying fish habitat in the LSA has been occurring over a two year time period and as mentioned previously, many Project-related effects have been minimized or avoided through changes in project design and site layout. During a meeting held with DFO on March 7th, 2012, it was agreed that flow supplementation mitigation measures in 101 Ravine, Duke Ravine, and English Creek were sufficient to avoid the need for compensation, as long as the current quantity and quality of fish habitat is maintained or improved during the life of the Project by diverting surface water down these waterbodies at appropriate times of year to replicate natural flow events. It was also agreed that the tributaries found to contain no fish during the baseline surveys (including West Ravine[1], West Perimeter Ravine, FalC Ravine, and Wapiti Ravine) did not require inclusion in the offset calculation for the FHCP. Their small size, shallow depth, limited watershed area, and barriers to fish migration make these streams unlikely to support or sustain fish populations.

The portions of the LSA included in the offset calculation for the FHCP include the following:

- all of East Ravine which will be permanently altered due to the Star pit;
- areas of 101 and Duke ravines where culverts will be situated during the construction and operation phases of the Project; and
- the portion of the Saskatchewan River that will be temporarily impacted during the construction and operation of the diffuser.

2.1 East Ravine

The upper reach of East Ravine will be preserved through water diversions throughout the life of the Project. During the initial stages of pre-stripping on Star, water will be temporarily diverted to the outlet of East Ravine. As the Star pit progresses, the natural outlet will be blocked and water from the upper reaches will be diverted to a catchment pond. During the operational period, seepage from around Star pit will be re-directed to the lower reaches of East Ravine to provide passive flow supplementation that replicates natural downstream flows. Throughout the Project, flow and fish habitat in the reaches of East Ravine located above and below the Star pit may be maintained; however, the upper reach will lose connectivity with the Saskatchewan River. At closure, the mid-reach will be re-established so that catchment water flows into the Star pit, which, when the pit refills enough to spill in approximately 350 years, will rejoin with the lower reach of East Ravine, and the Saskatchewan River (Shore EIS, Section 6.2.7). Although certain reaches of East Ravine will be retained during the operational

[1] One lake chub was captured close to the confluence of West Ravine with the Saskatchewan River.

phase of the Project, all of East Ravine is included in the offset calculation because of the alteration of fish habitat caused by changes in flow, water levels, and long-term loss of connectivity with the Saskatchewan River.

Aquatic habitat information was collected from reaches of East Ravine located near the Saskatchewan River, within the Star pit, and north of the Star pit in August 2007 and 2008. The habitat was found to be a mixture of riffles, runs, and pools with several habitat sections containing beaver dams and ponds. The desktop approach calculated that East Ravine contained 93.5% pool, 4.9% run, and 1.6% riffle habitat (Shore 2012; CanNorth 2011; Appendix 6.3.1-E). The desktop approach and field data were compared; and it was determined that the quantity of pool habitat calculated using the desktop approach is likely overestimated.

Habitat types in East Ravine are subject to frequent changes and even extensive field documentation would not accurately determine percentages and locations of each habitat type along the stream. For example, in May 2007, the lower reach of East Ravine contained a riffle area near the mouth of the stream that white sucker were using for spawning (Shore 2012; Appendix 6.3.1-C, Photo 14). However, in August 2007, the habitat type had changed entirely because a beaver dam had flooded the riffle area and formed an impoundment (Shore 2012; Appendix 6.3.1-C, Photo 15). The habitat quantification process has illustrated that habitat classifications of the streams in the Project LSA vary depending on the month that the information is collected and are not reliable predictors of future habitat availability. Considering this, it was agreed by DFO that the total areal quantity of habitat in East Ravine will be used to determine the amount of offset required without consideration of habitat types (Aaron Schweitzer, pers.comm. April 3rd, 2012).

During the desktop approach, the location of the stream channel in East Ravine was defined from an analysis of a high resolution (1 m accuracy) LiDAR-derived digital elevation model using the hydrology toolset in ArcGIS. To check the accuracy of this method, a comparison was made with the aerial photography. The comparison showed that this approach produced a close correspondence with the actual channel locations. In a few locations where the approach failed to place the stream in the correct locations within the ravine, the line was manually edited. A number of beaver ponds were apparent in the aerial photography which could not be represented as part of the stream network using the hydrology tools described above. To define these areas, a separate shapefile was created and polygons were manually digitized around the boundaries of these ponds.

The areal quantity of habitat in East Ravine was calculated by multiplying the length of the stream channel by the average stream width of riffle and run habitats measured

during the field assessments[2]. In addition, the areal quantity of pool habitat within beaver ponds was represented by summing the area within individual shapefiles created to delineate the boundaries of these ponds. The resulting areal quantity of fish habitat loss that requires offset in East Ravine is 76,103 m^2.

2.2 Road Crossing Structures

The approximate locations of the culverts to be installed in Duke, East, and 101 ravines are shown in Shore 2012; Figure 6.2.5-1. The portion of East Ravine that will be impacted by the road crossing is already accounted for in the above section since the entire stream is included in the offset calculation. Therefore, the following discussion is based solely on the road crossing structures planned for Duke and 101 ravines.

Information on fish communities and fish habitat was collected in the upper reaches of Duke and 101 ravines in August 2008 in the vicinities of where the mine roads are proposed to cross (Shore 2012; Figure 6.3.1-1). The habitat in the upper reach of 101 Ravine is characterized by beaver dams, impoundments, and wetlands and was classified as pool habitat. The fish species captured in the upper reaches were all small-bodied and included fathead minnow, northern redbelly dace, and lake chub. Although the study area contains numerous large ponds (>40 m bankfull width), there were a few sections where the creek channel narrows and is distinguishable. Considering the variability of the environment, the final crossing location will need to be determined during the detailed design phase.

The upper reach of Duke Ravine also contained beaver dams, impoundments, and pool/glide habitat; however, the beaver ponds consisted mostly of flooded terrestrial vegetation and between flooded areas the creek channel was distinct and narrow (<1 m bankfull width). The fish species captured in the upper reaches of Duke Ravine included fathead minnow, northern redbelly dace, lake chub, and longnose dace. Similar to 101 Ravine, the road crossing will be positioned at a location on the creek deemed most suitable for culvert placement and this will be established during the detailed design phase.

The crossing sites at Duke and 101 ravines do not contain migratory large-bodied fish and forage fish habitat is not limited in the watercourses. Crossing structure design is will be finalized during detailed design; however, it will be ensured that the culverts maintain stream connectivity by meeting standards for culvert embedment and will be located to minimize impacts and facilitate construction.

[2] Average wetted width and bankfull width were both 1.7 m in East Ravine.

To be conservative, for 101 Ravine it is assumed that the crossing will be constructed using earthen fill over the wetland areas, with a 4 foot (1.22 m) culvert in the main channel and two 3 foot (0.91 m) culverts on each side to accommodate peak flows. In addition, there will likely be smaller culverts within the earth filled zone to maintain hydraulic connectivity. For Duke Ravine, it is assumed that a single 5.25 foot (1.6 m) culvert installed in the main channel will be sufficient since the tributary is similar in size to East Ravine. If side channels are encountered in either stream during the detailed design phase, additional culverts will be installed.

The above estimated culvert sizes are considered an overestimation of requirements. A study done on Caution Creek at the Division road crossing recommended three, 4 foot (1.22 m) culverts to handle the 1:25 peak and the drainage area for that crossing is many times larger than that of 101 and Duke ravines (Shore 2012; Timberline 2007, Appendix 6.3.1-F). To accommodate haul traffic, conveyer, side barricade, and build-up of the road surface sufficient to cover the heavy gauge culverts, it is estimated that the crossing width of the mine roads will be 70 m. Since the culverts will extend beyond the right-of-way, a culvert length of 88 m is assumed to match the design for East Ravine.

Using the dimensions listed above, the predicted amount of fish habitat loss due to culvert placement in Duke and 101 ravines can be calculated. For Duke Ravine, assuming the installation of a single 5.25 foot (1.6 m) wide x 88 m long culvert, the total amount of habitat loss would be 140.8 m^2. For 101 Ravine, assuming the installation of one 4 foot (1.22 m) wide culvert and two 3 foot (0.91 m) wide culverts extending 88 m in length, the total amount of habitat loss would be 267.52 m^2.

The resulting areal extent of fish habitat loss that requires offset due to culvert installation in Duke Ravine and 101 Ravine is conservatively estimated to be 408.32 m^2.

2.3 Saskatchewan River

Details on the conceptual design of the diffuser that will discharge water from the Project into the Saskatchewan River are provided in Shore 2012; Appendix 6.3.1-B. It is noted that the diffuser design parameters will be refined during the detailed design phase. The footprint of the diffuser is designed to be 60 m long and will be situated mid-channel in areas that exceed 2.3 m in depth during average flows. A site survey will be conducted prior to finalization of design plans to confirm bed material composition and channel section bathymetry. At this time, it is assumed that river bed material in this reach is predominantly sand. During the detailed design phase, the exact location of the diffuser structure will be discussed with the regulators to ensure that high quality sturgeon habitat is being avoided.

To accommodate work within the channel during the installation of the diffuser, it is proposed that a vertical sheet pile or caisson coffer dam will be installed by barge. There will be an earthen access berm connected to the coffer dam by an earthen coffer

dam segment that is parallel to the flow (Shore 2012; Appendix 6.3.1-B, Figure 1). Using dimensions estimated for these structures, the area that will be impacted will measure approximately 3250 m^2. Construction will take place in the summer to avoid sensitive windows of fish spawning periods. Since the access berm and coffer dam will be temporary structures that will only impede fish use of the area during a short period of time, the offset value was weighted since all other impacts being included in the offset calculation will extend the life of the Project. The Project lifespan is predicted to be 25 years, while the installation of the diffuser is only estimated to occur during a portion of one year. Therefore, a weighting factor of 75 was used (25 years multiplied by 3 to account for construction only occurring over one third of the year). Using this factor, the resulting aerial quantity of fish habitat loss that requires offset due to the access berm and coffer dam is estimated to be 43 m^2.

The diffuser pipe being installed in the Saskatchewan River will alter fish habitat throughout the life of the Project. In order to provide erosion protection for the diffuser pipe, it is currently proposed in the conceptual design that clean riprap will be used to armour the existing bed along the segment with risers where the depth of cover is small. Initial estimates suggest that 300 mm diameter riprap, 600 mm thick, placed to a width of 3 m on both sides of the diffuser pipe would provide adequate protection along a total length of 75 m. However, it is noted that the material used for the cover will be discussed with regulators prior to being finalized since DFO expressed concern that the use of rip rap may attract fish to use the area for spawning or rearing.

Using these dimensions, the resulting areal quantity of fish habitat loss that requires offset due to the diffuser in the Saskatchewan River is estimated to be 450 m^2.

2.4 Overall Offset Amount

The total amount of fish habitat loss that requires offset by the Project is calculated to be 77,004 m^2. Table 1 provides a summary of the breakdown of the total amount.

Table 1: Summary of Fish Habitat Loss Quantification

Location	Type of Impact	Aerial Quantity (m^2)	Temporary or Permanent	Lifespan of Impact
East Ravine	Star Pit and Culvert	76,103	Permanent	Permanent
Duke Ravine	Culvert	140.8	Temporary	~25 Years
101 Ravine	Culvert	267.5	Temporary	~25 Years
Saskatchewan River	Access Berm and Coffer Dam	43	Temporary	0.3 Years
Saskatchewan River	Diffuser Pipeline	450	Temporary	~25 Years

3.0 Description of Measures Undertaken to Offset Losses

3.1 Rationale for Measure Selected

Shore is committed to completing habitat compensation that provides adequate compensation to offset fish habitat loss caused by the Project. Shore's objective is to select a habitat compensation project that provides value to local aquatic ecosystems and is of interest to local Aboriginal groups and communities. Through review of the draft EIS, the James Smith Cree Nation (JSCN) and the Muskoday First Nation (MFN) requested the opportunity to provide input on the proposed compensation projects. Efforts to obtain these opinions have been ongoing since mid-2011, with recent attempts made via email and phone with JSCN and MFN in November and December 2012. Attempts continue to discuss the FHCP.

A list of candidate habitat compensation projects was compiled and a preferred plan identified in the revised EIS. Some project options were identified during a meeting held with DFO and SMOE on March 7th, 2012, and others project options were taken from the recently published Carrot River Watershed Source Water Protection Plan (SWA 2012).

A list of potential fish habitat compensation plans amassed by Shore is provided below for evaluation. A preferred option has been selected and a plan developed as discussed below. The plan is detailed but remains flexible in order to ensure it is adequate to provide significant enough fish habitat creation and improvement to offset the losses. Any changes to the plan will be determined during the detailed design

phase of the FHCP, or if necessary, prior to that phase as a result of discussions with DFO and/or aboriginal groups. Options considered are listed below:

- Improve habitat quality in areas of Pehonan Creek that are currently impacted by agricultural practices, cultivation, recreational activities, and vehicle traffic crossing the streambed. This initiative was identified by DFO as being desirable and is moved forward as the primary compensation plan (see below for more information).
- Upgrade crossing structures where Caution Creek and English Creek cross Division Road in the Project RSA. This initiative is very local to the Project, has been identified as necessary, and would have some value in terms of fish passage, fish habitat, and public safety. This project is proposed only as a secondary compensation plan in additional to the FHCP outlined below.
- Reconnect the side channel located southwest of the bridge at MFN to the main channel in the South Saskatchewan River (Shore 2012, Appendix 6.3.1-B, Photos 26 and 27). Improving connectivity would prevent fish from becoming trapped in the side channel when water levels subside.
- Rehabilitate and improve fish passage for the Smoky Burn low-level crossing on the Carrot River. This project was given low priority in the Carrot River Watershed Source Protection Plan, but was mentioned in the meeting with DFO and SMOE on March 7th, 2012 as a desirable initiative.
- Contribute to improving passage for sturgeon at the weir located in Saskatoon. This is a large-scale project where other proponents requiring habitat compensation would likely need to pool their resources to achieve the end goal.
- Conduct a biomass balance research project on streams along the Saskatchewan River. This initiative was put forth by MOE as a relevant study since the LSA consists of numerous small tributaries whose value in terms of contributing nutrients, etc. to the Saskatchewan River is currently unknown. However, this type of information, as well as the amount of compensation offset the research study would provide, would be difficult to quantify.
- Restore fish passage at an old PFRA dam located near the downstream end of Red Deer Creek north of MFN that may be preventing fish movement up the creek from the South Saskatchewan River.
- Assist in decommissioning abandoned water wells in order to protect groundwater quality in the Carrot River watershed. This initiative was given high priority in the Carrot River Watershed Source Protection Plan; however, the amount compensation offset this initiative would provide would be difficult to quantify and Shore understands DFO has expressed concerns that this option is not likely to be accepted as an offset.
- Conduct some of the identified research needs in the Carrot River watershed which include a hydrological study, fish and fish habitat assessments, and a water quality

study. These initiatives were given different priorities and timelines in the Carrot River Watershed Source Protection Plan. High priority was given to conducting a five-year baseline water quality study using Burntout Brook as a case study. However, the amount compensation offset completing research studies would provide is difficult to quantify.

- Increase capacity of the culvert on Burntout Brook north of the Highway 23 bridge on the north-south grid road. This project was given high priority in the Carrot River Watershed Source Protection Plan.

Each of these projects was assessed based on the proximity of the compensation measures to the impacted habitat, the similarity of the habitat to the impacts, if the area of compensation or the benefits gained are comparable, the environmental benefit, and the community/Aboriginal benefit (Table 2 and 3).

Table 2: Comparison of Potential Fish Habitat Compensation Projects

Project	Proximity	Similarity	Area Equivalence	Environmental Benefit	Community/ Aboriginal Benefit	Sum
Pehonan Creek	1	1	1	0	1	4
Crossing Structures at Caution and English Creeks	1	1	0	0	1	3
South Sask. Side Channel	0	1	0	0	0	1
Smoky Burn Low Level Crossing	0	1	0	0	-1	0
Sturgeon Passage	-1	-1	1	1	-1	-1
Fish Passage at Red Deer Creek	0	1	0	0	0	1
Decommissioning Water Wells	0	-1	1	0	0	-1
Research Initiatives	0	-1	1	0	0	0
Burntout Brook Culvert	0	1	0	0	-1	0

Table 3: Ratings Used to Compare Potential Fish Habitat Compensation Projects

Classification	Criteria/Rating	Value
Proximity to Impacted Habitat	Within FalC	1
	Within RSA	0
	Outside of RSA	-1
Similarity to Impacted Habitat	Same	1
	Different	-1
Approximate Area of Compensation/Equivalence	Similar to Impacted Habitat	1
	Smaller than Impacted Habitat	0
Environmental Benefit	High	1
	Moderate	0
	Low	-1
Community/Aboriginal Benefit	High	1
	Moderate	0
	Low	-1

After evaluating the above listed options, the proposed compensation measure to offset habitat loss in the Project area is to improve habitat quality in areas of Pehonan Creek that are currently impacted by agricultural and recreational practices, roads, trails and crossings that are in poor condition but still used. This will be completed by fencing the creek and associated riparian area, installing a new crossing, and creating a new backwater channel near the mouth of Pehonan Creek where it discharges into the Saskatchewan River.

Pehonan Creek is located approximately 18 km upstream of the Project on the south side of the Saskatchewan River. It extends for approximately 50 km from Highway 3 approximately 5 km north of Birch Hills to the Saskatchewan River and flows mainly through agricultural land. The creek is part of the Saskatchewan River watershed; several streams enter along its length but none appear to flow from any major lakes. The downstream portion of the creek flows through JSCN land; thus upgrades to the corridor will positively affect JSCN.

3.2 Description of Habitat to be Improved

Pehonan Creek is one of the larger tributaries in the area and contains an abundant and diverse fish community (Table 4). In July 2011, baseline aquatic surveys were conducted in the lower reach of Pehonan Creek within 500 m of the Saskatchewan River (detailed report is provided in Shore 2012; Appendix 6.3.1-A). During the fish community survey, 11 minnow traps set overnight (total effort 241.6 hr) resulting in the capture of 154 fish. Backpack electrofishing was conducted for approximately 2,461 s across various in-stream habitat types and yielded 50 fish.

Table 4: Summary of Fish Capture Information from Pehonan Creek, July 2011

Common Name	Scientific Name	Number Captured
Burbot	*Lota lota*	4
Brook stickleback	*Culaea inconstans*	14
Fathead minnow	*Pimephales promelas*	1
Lake chub	*Couesius plumbeus*	141
Longnose dace	*Rhinichthys cataractae*	2
Northern pike	*Esox lucius*	1
Northern redbelly dace	*Phoxinus eos*	3
River shiner	*Notropis blennius*	4
Spottail shiner	*Notropis hudsonius*	1
Walleye	*Sander vitreus*	20
White sucker	*Catostomus commersoni*	12
Yellow perch	*Perca flavescens*	1
Total		204

Fish habitat in the lower reach (within 500 m of the Saskatchewan River) was characterized by a mixture of riffle, run, and pool habitat with bankfull widths ranging between 6 and 9 m and mean center depths ranging between 0.4 and 1.5 m (Shore 2012; Appendix 6.3.1-B, Photo 20). There were no major obstructions to fish migration from the Saskatchewan River into Pehonan Creek noted in July 2011 or September of 2012. Suitable white sucker spawning habitat was identified during the habitat assessment and it has been established that Pehonan Creek is highly utilized by white sucker for spawning (CanNorth, unpublished data). Juvenile white sucker, walleye, northern pike, and yellow perch were captured in the study reach, illustrating that the lower reach of Pehonan Creek provides important habitat for these large-bodied

migratory fish. In addition, both northern pike and white sucker have been documented as far up the creek as Brancepeth (Vincent Harper, pers. comm., July 2012).

Field reconnaissance was conducted in the summer of 2012, followed by detailed assessments in fall 2012. During September of 2012, 45 in-stream Habitat Assessments were completed by Canada North Environmental Services on approximately 3,740 meters of Pehonan Creek from the mouth where it meets the Saskatchewan River to approximately 6 kilometers upstream. The locations of these in-stream habitat assessments were linked to the Reach numbers identified during the Riparian Health Assessments as discussed below and shown on Figure 1 and Figure 2 below. The In-stream Habitat Assessment forms are provided as Appendix A. Results of the In-Stream Habitat Assessments show that the highest rated spawning areas are near the mouth of Pehonan Creek where it meets the Saskatchewan River. There are moderately good spawning sites for Walleye, White Sucker and Longnose Sucker in numerous areas near the mouth of Pehonan Creek and some moderate to fair sites spread out along the creek for virtually the entire length assessed.

Figure 1: Pehonan Creek Reaches - Riparian Health Assessments (West side)

Figure 2: Pehonan Creek Reaches - Riparian Health Assessments (East side)

Under higher water levels, as would be expected in the spring, it is very likely that the Spawning Suitability Indices rating would be higher, especially in areas near the mouth. There were numerous locations identified where a higher water level would have flooded suitable spawning habitat, but it did not get rated as suitable because the water level was not high enough at the time of the survey. There were no locations identified as suitable spawning habitat for Yellow Perch or Northern Pike at the current water levels, but there were some locations that would contain good potential spawning habitat if the shoreline vegetation was flooded, as would often be the case in the spring. Another factor in the moderate ratings for Spawning Suitability is the level of siltation and turbidity in the water. If the water were clearer, Spawning Suitability ratings would be higher.

Portions of Pehonan Creek contain a riparian buffer zone between the upland and the stream; however, there are sections of the creek where the buffer zone is absent or marginal. Buffers are important management tools used to reduce agricultural pollutants such as sediment, nutrients, and pesticides from entering watercourses (Shore 2012; Dosskey 2002; Teels et al. 2006; Yates et al. 2007). Research has found that streams dominated by riparian corridors without gaps or fragmentation have healthier fish and benthic invertebrate communities (Shore 2012; Wichert and Rapport 1998; Stewart et al. 2001; Teels et al. 2006). Water quality testing conducted in July 2011 in the lower reach of Pehonan Creek illustrated the creek contained elevated

concentrations of ions (total dissolved solids = 1060 mg/L), turbidity (11 NTU), and nutrients (total phosphorus levels classify the stream as hyper-eutrophic (Shore 2012; Wetzel 2001)). Nutrient enrichment is indicative of reduced water quality downstream of agricultural lands (Shore 2012; Riseng et al. 2011).

Riparian health along a stretch of Pehonan Creek extending approximately 5 km upstream from the Saskatchewan River (Figure 3 below) was described during the September 2012 surveys. Detailed results of the Riparian Health Assessment are provided in Appendix B. The survey identified that the most impacted area was near the gravel road crossing located approximately 4.6 km upstream of the Saskatchewan River near Reach 4 on Figure 1. At this location, there are roads going into the creek from both sides and this site has high potential for soil erosion impacting the creek. Discussions with JSCN members indicated that numerous crossings have been installed at this location but they have been washed out or not worked as planned and removed. The roads leading to the creek serve as travel routes for the water during precipitation events and are eroded badly. It appears as though the crossing was still being used by vehicles at low enough water levels to drive across the creek directly on the creek bed. There are homes of JSCN members on the north (west) side of the creek so the crossing provides the shortest travel route to and from the community and band office they have to travel a far distance around the creek or else use this crossing. Thus in addition to providing restoration of the riparian habitat of the creek in this area, there is also the potential to install a crossing structure that can be utilized by JSCN members. Near Reach 4 on Figure 1 there are trails leading to the river that are causing erosion. The lower reach of the study area (Reaches 25-32 on Figure 1) is showing erosion from stream flow, but the banks are generally well vegetated.

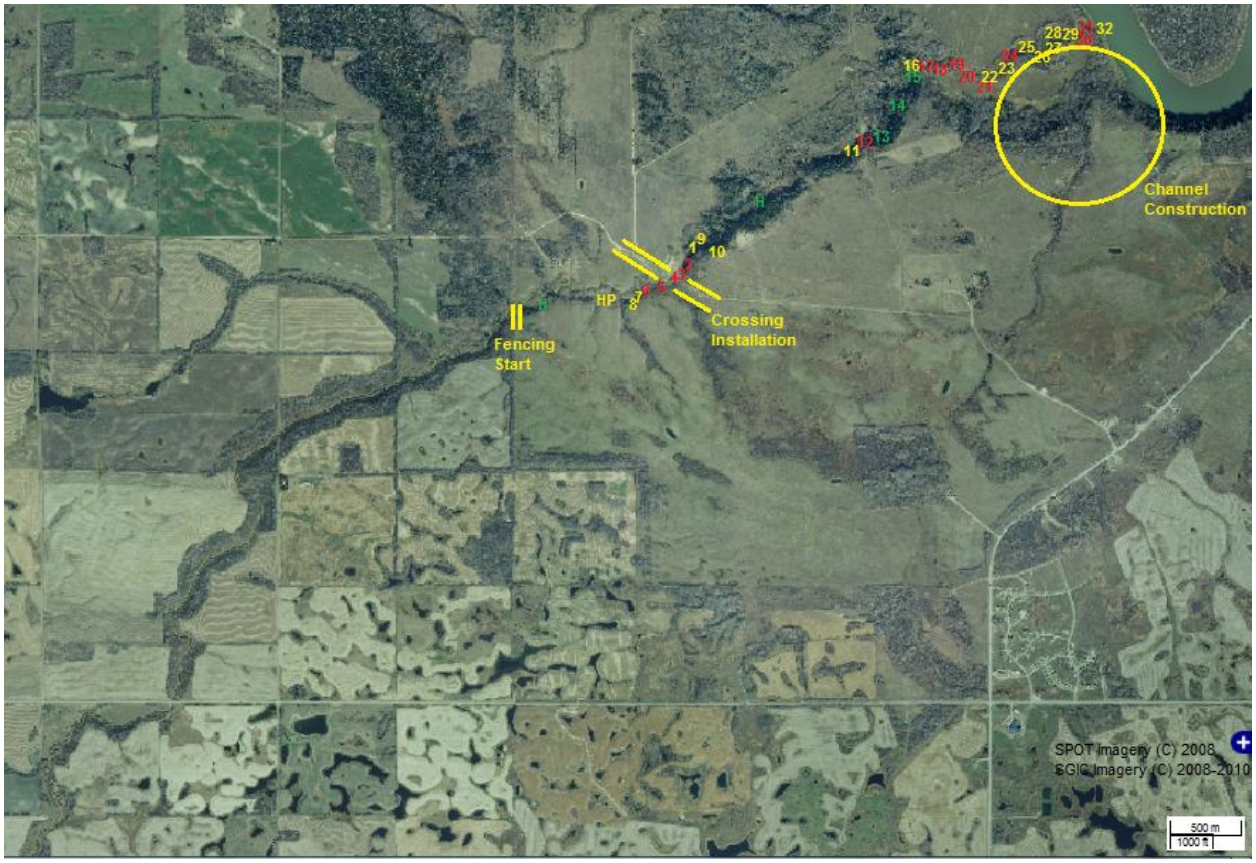

Figure 3: Pehonan Creek reaches and proposed project component locations

A Riparian Health Assessment on Pehonan Creek was completed in September of 2012 by CanNorth assisted by a member of the JSCN and an Environment Staff member from Shore Gold. The Riparian Health Assessment collected information on a number of parameters to determine the health of the riparian zone and can be used as an indicator of the health of the riparian zone on the creek. The creek to be assessed was split up into 'Reaches' which are lengths of the creek where the riparian habitat is relatively uniform. The length of each reach was between 30 and 300 meters. Parameters measured during the Riparian Health Assessment include measurements of:

- Length and width of Reach
- Vegetation cover
- Invasive species presence, cover and distribution
- Disturbance caused vegetation species presence
- Presence/absence and condition of woody vegetation

- Streambank stabilization factors such as deep rooted vegetation, human caused bare ground, human alteration, and lateral cutting.

- Compaction of the ground within the reach

- Accessibility of the floodplain

- Species of grasses, forbs, shrubs and trees

The results were complied into a Riparian Health Rating (Appendix B). Ratings are summarized in Table 5 below.

Table 5: Summary of Riparian Health Assessment on Pehonan Creek, September 2012

Riparian Health Rating	Distance (m)	% of total
Healthy	2495	38.8%
Healthy with Problems	2277	35.4%
Unhealthy	1661	25.8%
Total Length	6433	

Figure 1 and 2 also show the results of the Riparian Health Assessments as the red numbers represent 'Unhealthy' ratings, the yellow numbers represent 'Healthy with Problems' ratings and the green numbers represent 'Healthy' ratings.

The total length of the sections assessed on the ground was 3,740 meters with an additional 2,693 meters assessed to be either healthy or healthy with problems based on aerial photography. Most of the additional length was assessed to be healthy based on dense stands of mature White Spruce (Picea glauca) and/or Black Spruce (Picea banksiana) trees along both sides of the creek visible on the aerial photography. The total length assessed (6,433 meters) includes the entire length of the creek on the James Smith Cree Nation (JSCN).

The 1,661 meters of 'Unhealthy' riparian area is located where human activity immediately adjacent to the creek is the greatest. These activities include:

- Crossing the creek with vehicles

- Driving from the upland down to the creek with both vehicles and ATVs

- Use of established quad and vehicle trails in the riparian area

- livestock accessing the creek through tame pastureland directly adjacent to the creek with no buffer, and

- Historical cultivation in the riparian area right up to the edge of the creek

The areas shown to have a Riparian Health Rating of Unhealthy were virtually all impacted by human activities immediately adjacent to or in the stream bed itself. Reach 4 has a grid road approaching the creek from both sides which has major erosion issues. It is clearly evident that the creek is being regularly crossed by vehicles driving through the water. Reaches 19-21 all have no functional buffer, with grazed pasture beginning right at the stream edge and as a result, little vegetation to stabilize the area. Reach 12 is also unhealthy and appears to be regularly used as a crossing by livestock and ATV's. Reach numbers 30 and 31 have major slumps and quad trails through the riparian areas which are also grazed pasture.

Historically, the area on both sides of Pehonan Creek has been used as pasture land and has been rented to nearby farmers in order to graze cattle. Vince Burns, Assistant to the Coordinator of the JSCN/Shore Gold Consultation Agreement, provided the following historical, current and potential future usage information regarding the area adjacent to Pehonan Creek on JSCN land:

- In the past there has been as many as 300 head of cattle using the area.

- This area has not been rented out for grazing purposes for approximately 5-10 years, but it continues to be used as pasture land by members of the JSCN.

- The rental program was discontinued due to a lack of interest by potential renters, along with a feeling by the JSCN that the pasture needed a break from intensive grazing.

- At the current time, and for the short term future, the area will continue to be grazed by livestock in possession of members of the JSCN. This includes approximately 75-100 cattle and approximately 57 horses.

- There is potential in the future to reinitiate the grazing program and once again rent the pasture land to other owners of livestock.

3.3 Description of Methods to be Undertaken

The preferred compensation plan proposed by Shore is to upgrade the riparian zone along areas of Pehonan Creek most impacted by agricultural and other impacts and developments. This will include using exclusion fencing to keep livestock, recreational

activities and/or cultivation encroachment from disturbing the creek and re-vegetating disturbed areas to enhance the riparian zone. In addition, it will also include bank stabilization wherever significant issues were identified during the riparian health assessment (specifically Reach #'s 2-6, 12, 17-21, 24, 30, 31). A crossing will be installed at the approximate location of Reach #4, and a backwater channel will be constructed near the mouth of Pehonan Creek and the Saskatchewan River which will create significant new high quality habitat. This project is the preferred option for the following reasons:

- the plan meets Option 1 on DFO's hierarchy of compensation options (create or increase the productive capacity of like-for-like habitat in the same ecological unit);
- Fencing, installation of the crossing, and bank stabilization/revegetation will all be completed on the JSCN near the Saskatchewan River where access by fish populations in the Saskatchewan River will be the easiest and existing spawning habitat is the highest quality as shown by the In-Stream Habitat assessments;
- Creation of the new backwater channel attached to Pehonan Creek near the mouth at the Saskatchewan River will provide high quality fish habitat;
- the plan benefits JSCN who have a keen interest in the Project and in being involved in the habitat compensation plan; and
- literature illustrates that enhancing riparian habitat impacted by agricultural practices and recreational use improves stream ecosystem quality improving fish habitat and fish community structure.

3.3.1 Exclusion Fencing

As discussed previously, 1,661 meters of Riparian Habitat was rated as 'Unhealthy' primarily due to human activities which caused a variety of changes resulting in degradation of the Riparian Habitat and resulting decrease in water quality. Fencing of the riparian buffer and installation of a new crossing would eliminate or greatly limit the effect of these problems. A continuous page wire fence would be installed on both sides of Pehonan Creek and for the length of the creek on JSCN for a total of approximately 12866 meters of fencing. The location of the fencing would be at the top of the slope where the riparian area meets the upland, with gates installed to provide foot access to the Creek at locations to be determined in discussions with JSCN.

Fencing would allow the vegetation in the riparian a chance to grow undisturbed and re-establish itself where it has been eliminated or reduced. It would also reduce the likelihood of major erosion issues and slope failure caused by existing slopes in the area. Figure 3 shows the location where the fencing begins and it will be in place from that point to the Saskatchewan River on both sides of the creek and the constructed

channel. The location of the fencing roughly corresponds with the width of the reach recorded during the Riparian Health Assessments, which is the riparian area, where present, or an estimate of where the riparian would be, if not impacted by trails, tame pasture, cultivation, etc. Based on this information, the approximate average width from fence to fence will be approximately 30.1 meters (Average of 9.7 reach width per side plus 10.7 meters creek width). This would vary considerably as the slope dictates and as required in order to ensure the slope and riparian area is captured within the fencing. The variance would be from a maximum width of approximately 60.7 meters on Reach 1 to 16.7 meters on Reach 9. The total area that will be protected by the fencing will be a minimum of 143918.3 square meters. This is the width of each reach (which represents the riparian area), multiplied by the total length to be excluded. It is likely that the total area will be greater than this because some upland vegetation communities will be excluded where the slope requires fencing to be further back from the creek channel. This does not include the additional area that will be excluded around the crossing to be installed or the new channel that is created.

3.3.2 Revegetation / Erosion Control

The revegetation that will be completed associated with the following areas identified as 'Unhealthy' during the Riparian Health Assessment:

- the area around the crossing and areas near Reaches #2-6;
- the steeply sloped and impacted area near Reaches #12, 13; and
- the area where the pasture is right up to the creek edge with no woody vegetation present, reaches 17-21 and 24;

These are the main reaches where significant areas are impacted by human activity and vegetation is largely absent. The amount of revegetation required varies significantly from one reach to the next, but generally will occur where erosion or impact to plant communities is evident, and within the riparian area and/or on the slope to the creek. Details on each reach are outlined below:

- Reach #2-6: Figure 4 below shows the area to be revegetated. Some existing erosion control measures are in place that is assumed to be associated with the crossing that used to be in place at this location. This erosion control material (large riprap and geotextile fabric) will either be repaired or replaced as part of the crossing installation. The most significant damage to vegetation communities is around the approaching roads from each direction where the traffic appears to drive over the field area randomly. This will also be repaired and revegetated during the crossing installation. The roadbed will be built up and the road slopes vegetated as is standard practice. Replanting of vegetation will also occur along

the creek in both directions, on the numerous parking and turn outs where the vegetation has been impacted, and back to the top of the slope as required, to reduce erosion concerns. The areas that have been directly impacted by vehicle traffic are eroded down to bare soil in many areas, so both grassy and woody species will be planted. There are some areas further away from the crossing where there is a healthy population of grass species but very little woody species. In these areas only woody species will be planted. A discussion on the species to be planted and target densities is outlined below.

Figure 4: Revegetation on Reaches #2-6

- Reach # 12: Approaches from both sides of the creek at this location require significant and intensive revegetation in a relatively narrow strip (3-5m) up to the top of the slope. This is a distance of 75-100 meters and will require erosion control measures such as mulch and seeding in addition to planting due to steep slopes. For the most part, this area is eroded down to bare soil, so erosion protection measures, grassy and woody species will all be utilized throughout. The soils are very coarse and the slope steep in this area, so watering of the planted species will be conducted during establishment. Details on the watering program will also be discussed below.

Figure 5: Revegetation on Reach 12

- Reaches #17-21, 24: This area has pasture right up to the creek in some areas, on both sides. It appears as though there is an established community of grasses and some shrubs in some areas, but many areas would benefit from planting of more shrubs and woody vegetation to help stabilize the banks. The key measure in this area is the fencing because the plants are mostly there; they just need to be allowed to mature. Species planted and planting density will consider existing vegetation in order to target efforts where they will be most beneficial.

Figure 6: Revegetation on Reach #17-21, 24

Species selected for revegetation will be species that are native to the area and are already present in the surrounding area. Revegetation efforts will consist of planting of a native grass mixture, and woody plants such as Willow (Salix sp.) Chokecherry (Prunus virginiana) and Jack Pine (Pinus Banksiana) in adequate numbers and density to stabilize the ground and move the result of the Riparian Health Assessment so these areas are no longer considered 'unhealthy'. Willow species will be the most commonly utilized species because of its rapid growth and productivity at juvenile stages and

extensive, fast growing, fibrous root systems (Kuzovkina and Quigley 2001). Final species selection may change based on engagement with JSCN. Nursery stock will be sourced from a greenhouse as close to the planting site as possible (NRT in Prince Albert, for example). It is expected that the Jack Pine and Chokecherry seedlings will be plugs while the willows will be stalks. As recommended by Walter and Hughes (2005) the willow stalks will be planted with ¼ of the stalk out of the ground and ¾ of the stalk beneath the surface. As recommended in the Department of Fisheries and Oceans (DFO) Operational Statement 'Riparian Areas and Revegetation' (DFO 2006), the nursery stock will be at least 2 years old. Planting will occur in the spring once the ground is thawed enough for proper planting and seedlings are available.
In areas where the ground is disturbed down to the bare soil, seeding of grasses will also occur. A native seed mix will be utilized which will include species native to the area.

Species selection and planting/seeding density for revegetation will be based on the following criteria:

a) *Significant Erosion down to mineral soil and in areas where flooding may occur* – Seeded with native grass seed at a rate of 10 lbs/acre. Willows planted at a density of 4000 stems/acre, which is 1 meter spacing (Government of British Columbia, 1997).
b) *Significant Erosion down to mineral soil and in areas where flooding will not occur* – Seeded with native grass seed at a rate of 5 lbs/acre. Willows, Chokecherry and Jack Pine planted at a ratio of 4:1:1 respectively, at a density of 450 stems/acre (3 meter spacing).
c) *Erosion present but mineral soil is not exposed, grass established but woody plants absent* – Planted with Willow, Chokecherry and Jack Pine at a ratio of 2:1:1 at a density of 450 stems/acre (3 meter spacing).
d) *Erosion present but mineral soil not exposed, grass and woody species established but impacted* – Jack Pine planted at a rate of 450 stems/acre (3 meter spacing).

The rationale for these planting rates is as follows. The areas with significant erosion require establishment of grasses in order to stabilize the ground. Areas that are prone to flooding will be seeded at a heavier rate in order to account for more mortality and also provide additional stabilization. Willow species are the only woody species that will be planted as they are more flood tolerant. Areas with significant erosion, but out of the flood zone will also be seeded with grass, but at a lower rate in order to stabilize the ground but allow Jack Pine to become established. In these areas, Willow, Chokecherry and Jack Pine will all be planted in order to more closely resemble the surrounding environment. All of the areas that have significant erosion will also be covered with a thin layer of mulch (preferably native grass mulch, if available) to further help stabilize these areas and allow establishment of vegetation. There are also many areas where the ground has eroded in the past, but grasses now cover the area. Woody

species are absent, most often due to grazing pressure and human disturbance/haying. In these areas, no seeding is necessary, but planting of willow, jack pine and chokecherry species will be completed. Finally, some areas have both grasses and woody species present but the woody species have not been allowed to flourish due to grazing, and human disturbance/haying. In these areas, willows, chokecherries and other deciduous trees are present, but conifers are rare. Jack pine will be planted at these sites and, once fenced, it is expected that all of the woody species present will return and flourish.

The mixture of native grasses used for seeding will include species as recommended in The Native Plant Society of Saskatchewan (NPSS) *Saskatchewan Guidelines for the Use of Native Plants in Roadside Revegetation Field Guide (*Neufeld 2008). That document provides guidance on which plants to use on which soil type and location. The government of Saskatchewan (2012) also provides recommendations on species to plant in sandy soils. Most of the areas impacted on Pehonan Creek are coarse and sandy soils, and the creek is in Zone 4 (Boreal Forest) so the species, subject to availability, used may include:

- Nodding Brome (*Bromus porter)*
- Streambank Wheatgrass (*Elymus lanceolatus ssp. Lanceolatus)*
- Awned Wheatgrass *(Elymus trachycaulus ssp. Subsecundus)*
- Plains Rough Fescue (*Festuca saximontana)*
- Fowl Bluegrass (*Poa palustris)*
- Prairie Sandreed (*Calamovilfa longifolia)*
- Northern Wheatgrass (*Elymus lanceolatus)*
- Slender Wheatgrass (*Elymus trachycaulus ssp. Trachycaulus)*
- Needle and Thread (*Hesperostipa comate)*
- June Grass (*Koleria macrantha)*
- Indian Ricegrass (*Oryzopsis hymenoides)*
- Sandberg's Bluegrass (*Poa secunda ssp. Secunda)*

The NPSS also provides guidance on the mixture that should ideally be used. These recommendations will be followed as closely as possible depending on the availability of seed.

Other recommendation in the NPSS *Saskatchewan Guidelines for the Use of Native Plants in Roadside Revegetation Field Guide* will also be followed as closely as possible. Some alterations will be required because of access issues of a riparian area versus a newly constructed roadside. Some of the recommendations that will be implemented in regards to the planting of native seed include:

- Use of straw crimping, straw matting, hay mulching and/or native grass mulch in order to prevent erosion in areas where erosion is a major concern
- Cross seeding and seeding at a higher rate in areas where erosion is a concern
- Seeding will occur from mid-April to late May
- Wherever possible, the seedbed will be packed after seeding. This is likely possible in some areas near Reaches 2-6, 17-21, and 24 but is likely not possible near reach 12.
- After seeding and planting, straw, mulch or fiber (as available) will be spread over the areas where erosion is a major concern.
- Watering will occur every few days for the first 4 weeks until the seedlings are established. The schedule will be adjusted if precipitation occurs. After the first 4 weeks, watering will occur for the first year as required, and depending on the amount of precipitation received. As a guideline, watering once a week (after the first 4 weeks) will occur during periods of little precipitation.

The seed will be broadcast seeded because of the landscape and barriers which make drill seeding impossible. Seeding rates will be doubled as recommended by Neufeld (2008) when broadcast seeding.

A regular maintenance program will be established for the planted areas, to go along with the monitoring program discussed in Section 4.0.

3.3.3 Culvert Installation

The location of the proposed crossing installation has been the location of a crossing structure in the past (Figure 3). There are access roads approaching the crossing location from both directions. There are approaching slopes of approximately six meters on the east side and eight meters on the west side. The channel is cut into the ground approximately 2-3 meters to the streambed.

The approaches will be cut, along with the 'in stream' section built up as shown in Figure 7 below. The exact amount of cut and build up will be determined at the detailed design phase when engineered drawings will be created. A qualified engineering company will be contracted to supervise the installation and provide detailed installation plans, fill and cut volumes, armoring and slope requirements, and culvert sizing. There is an open bottom culvert up stream of the proposed location on Pehonan Creek at Coxby Road. It is expected the new culvert will be similar in size to that culvert, or slightly larger to account for the downstream location. During detailed design of the crossing, the site will be surveyed, including 50 meters upstream and downstream of the crossing location. Detailed, engineered drawings will be completed along with a detailed construction plan based on the conceptual plan presented here. These will be

submitted to DFO and all proper permits received before proceeding with the installation.

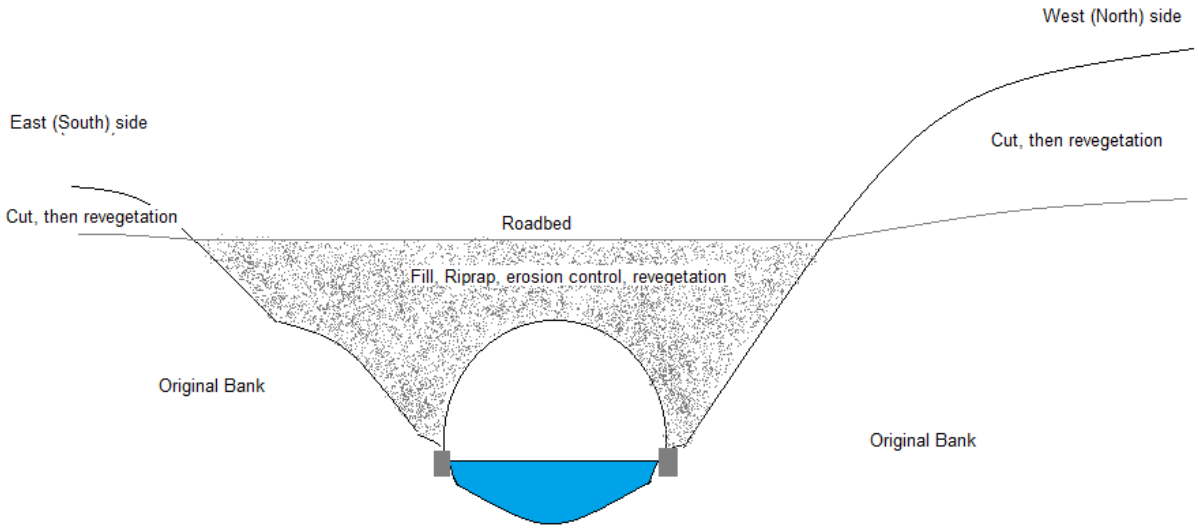

Figure 7: Proposed Crossing on Pehonan Creek (Cross Section)

There will be no access across the creek during construction so there is no need for a temporary crossing to be part of the construction planning. Key information used in designing the conceptual crossing plan includes:

- Stream data (width, grade, riparian health)
- Plan and profiles of the culvert and approaching, existing roads, and proposed cuts to the roads
- Material, installation, and other specifications (riprap, etc.)

The culvert installed will be an open bottom steel plate type culvert similar to the one currently in place on Pehonan Creek upstream of the proposed location at Coxby Road. Dimensions and thickness of the culvert will be determined during the detailed design phase. It is expected that the culvert will be very similar in size and thickness to the one installed at Coxby Road on Pehonan Creek.

The streambed at the location where the culvert will be installed will be inspected by a qualified geotechnical engineer and if required, replacement foundation material will be

installed to ensure a solid foundation that will not settle unevenly resulting in a shifting of the culvert. This will only be completed if the foundation material is shown to be poor or unsuitable for supporting the culvert. Footings of the culvert will either be placed directly on the foundation material, or on constructed concrete footings as recommended by the engineer. A geotextile liner will be placed over granular fill material and footing. Large riprap will be used to armor the footings and foundation area. During the design phase, and based on specific site requirements, the engineer will determine the amount and exact sizing of riprap required in order to provide adequate protection.

Once the open bottom culvert is in place backfilling will be completed. As the sides of the culvert are backfilled, the material will be compacted using packing equipment travelling parallel to the culvert. The same procedure will be used to build up the backfill until it covers the culvert. The manufacturer's recommendations will be followed during backfilling to ensure adequate amounts of backfill remain between the equipment and the culvert, and to ensure that adequate fill is placed on the culvert to handle the expected vehicle loads. The culvert design will be adequate to handle regular crossings by the loaded water trucks JSCN uses to haul water on the reserve.

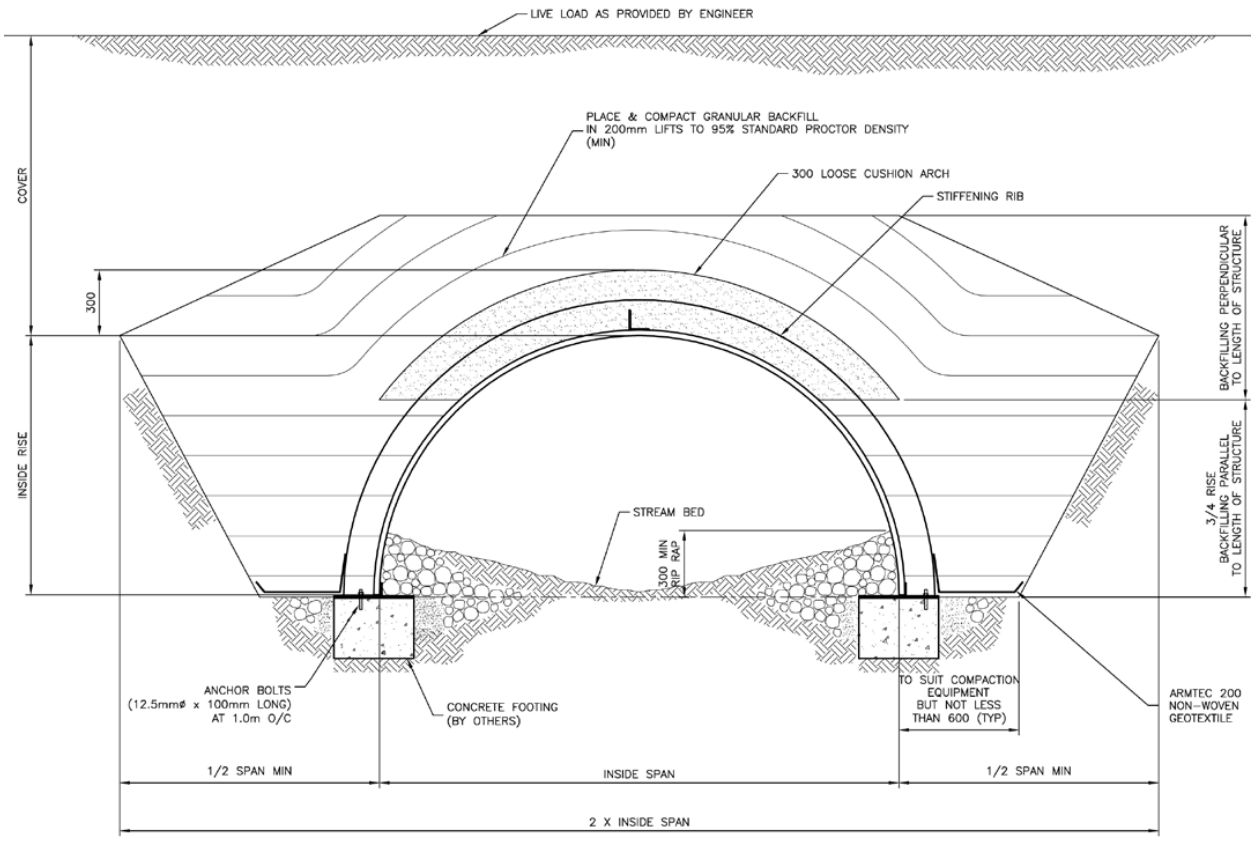

Figure 8: Example of open bottom culvert (Source: armtec.com)

Once adequate fill has been placed, construction of a gravel road bed will be completed on the crossing as well as the approaching roads from both directions. Revegetation and armoring of the slopes and ditches on the crossing and both approaches will be immediately completed. Details of the revegetation plan are discussed in Section 3.3.2. Monitoring and evaluation of success of the revegetation/armoring will be a part of the monitoring program along with the rest of the revegetation efforts along the creek. This is discussed in more detail in Section 4.0.

3.3.4 Construction of Backwater Channel

A backwater channel will be constructed joining Pehonan Creek just west of the mouth of Pehonan Creek at the Saskatchewan River. This channel will be connected to Pehonan Creek and so will be backfed from Pehonan Creek. The south edge of the constructed channel also joins a small ephemeral drainage so it is expected during the spring that there will be some minor flows entering the channel from the south side. The size of the channel will be approximately 20 meters wide and 500 meters long which will represent a creation of 10000 square meters of new, high quality fish habitat. Figure 9 below shows the proposed conceptual location of the channel. Discussions are ongoing with JSCN on the exact location of the channel so it may be altered somewhat depending on feedback received from JSCN. If the location is moved, the amount of high quality fish habitat created will remain the same as the channel contemplated in this document.

Figure 9: Proposed backwater channel

The channel will be designed as high quality spawning habitat for large bodied fish species, specifically Northern Pike (Esox Lucius). Northern Pike spawn in vegetation in areas of shallow, calm water (Inskip 1982) and this channel will be designed with stepped banks, so that there will a significant amount of shallow water with emergent vegetation at a variety of water levels (See Figure 10). The total width of usable habitat will be 20 meters, with an eight meter wide bottom step and two, three meter wide steps at intervals of one and two meters above the bottom of the constructed channel. The bottom (or level 3 habitat) will be 1 meter below the average water level of Pehonan Creek from April till Mid-May. This date range is selected as it is the time when Northern Pike most often spawn (Nelson 1992). Level 2 habitat will be at the level of the April to May water elevation, while level 1 habitat will be 1 meter above this level. With this design, it is expected that level 2 and 3 will often be flooded and provide spawning habitat for northern pike. In dry years when the water level is lower, level 3 will still contain water while the others are dry, while in wet years, level 1 will be flooded and provide spawning habitat when level 2 and 3 may be too far below the surface of the water to provide effective spawning habitat. Once the location is finalized and an agreement reached with JSCN, a water level monitor will be installed on Pehonan Creek to determine the 'average water level' that will be used as a guide elevation during channel construction.

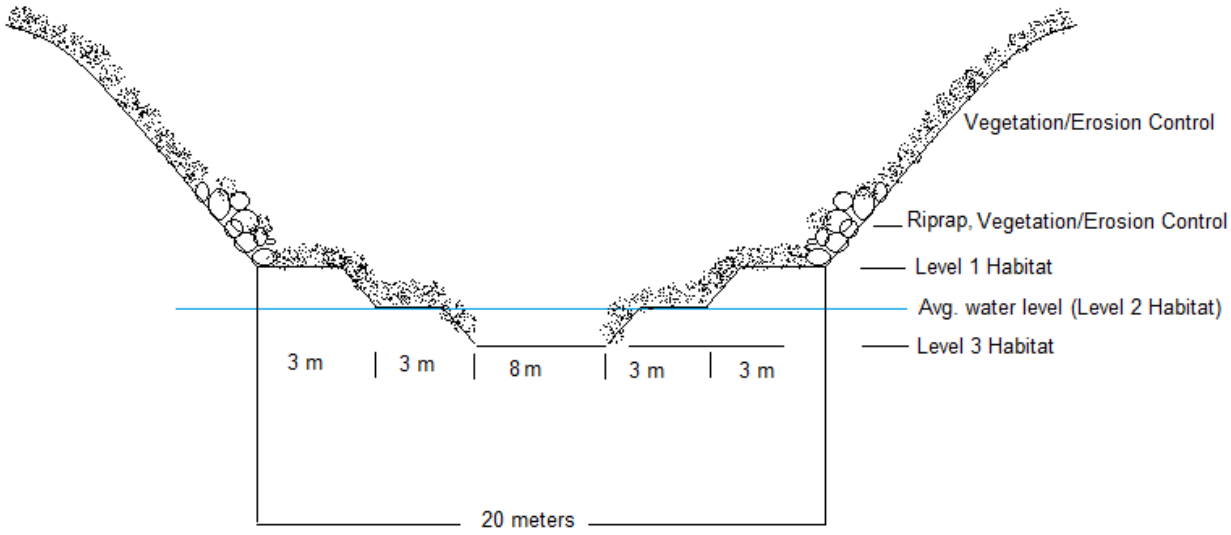

Figure 10: Conceptual design of backwater channel

Engineered erosion control and revegetation will be completed on both banks to minimize any erosion and stabilize the banks as quickly as possible. Detailed designed will also identify the slopes that will provide stability. Detailed design and engineered drawings of the channel will be completed under the guidance of an engineer to ensure that it remains open and connected to Pehonan Creek indefinitely. A fisheries biologist will also be involved in the detailed design to ensure it is constructed in such a way as to maximize potential use by, and value to, fish that enter the channel from the Saskatchewan River. Armoring with riprap, revegetation and slope engineering will be used to ensure erosion is not a concern. Revegetation will occur using the same method as the rest of the project, as described in Section 3.3.2.

4.0 Monitoring

A monitoring network will be established consisting of a minimum of five stations on Pehonan Creek and three on the constructed channel for a total of eight stations. This will ensure repeatable surveys can be completed at intervals discussed below to illustrate that the FHCP is effective at improving and/or creating fish habitat. The proposed monitoring stations on Pehonan Creek are shown on Figure 11. The stations

are positioned on, or just downstream of, the ‘unhealthy’ reaches and throughout the creek, including downstream near the Saskatchewan River. The monitoring stations on the backwater channel will be established shortly after it is constructed and will be located in areas where they are most effective at assessing the performance of the channel in terms of providing quality fish habitat, and more specifically, quality spawning habitat for Northern Pike.

Figure 11: Proposed monitoring stations on Pehonan Creek

At each of these stations, the following surveys will be completed at year one, two and three and then at three year intervals until improvements are adequately stabilized and communities are healthy and stable:

- Riparian Health Assessments (with a very quantitative approach for assessing success of revegetation, as discussed below)
- Stream Habitat Assessments
- Turbidity and limnology measurements
- Water samples for chemical analysis
- Benthic Invertebrate communities
- Fish communities

The quantitative Riparian Health Assessments will include surveys of revegetated areas. For planted shrubs and trees, two 10m x 10m plots will be established (at each

location of the riparian health assessment) and the number of seedlings counted of each species. These numbers will then be compared to the planted densities. The survival of seedlings should be compared to the planted density and at least an 80% survival rate should be seen after year one with a 75% survival rate after that. If the survival rate is less than that, then supplemental planting of the appropriate species will be completed. If the survival rates are significantly less than that, then an assessment will be completed to determine why the survival rates are so low, and adjustments made to the planting or maintenance program as required (for example, watering intervals shortened).

For the native seed mixture, two 1m x 1m plots will be established (at each location of the Riparian Health Assessment) and the number of seedlings counted for each square. Neufeld (2008) provides the following guidelines for native grass establishment which will be used:

- Average seedling per m^2 < 11 = Reseed
- Average seedling per m^2 11-32 = Reevaluate next year
- Average seedling per m^2 33-54 = Good establishment
- Average seedling per m^2 >54 = Excellent establishment

As indicated by Neufeld (2008) species composition is not critical at the early stages as the composition will change over time. The number of plots (for trees and shrubs, and native grass) will be dropped to one at each location once the establishment of the planted species is confirmed

The goal within the riparian area is to ensure that none of the reaches are rated as 'Unhealthy'. The Riparian Heath Assessments will be the tool used to assess revegetation efforts. If revegetation is not adequate this will be reflected in the Riparian Health Assessments. As discussed above, the ripple effect of improved riparian buffer can result in improved benthic invertebrate and fish communities. The monitoring discussed above is all in reference to monitoring the recovery of the riparian area, but the ultimate goal will be to establish habitat that is valuable to, and used by, benthic invertebrates and fish.

Pehonan Creek and the channel that is created will also be assessed using In Stream Habitat Assessments in year one, two, three and then three year intervals to confirm that the habitat is suitable and valuable habitat for fish. In year three and thereafter, it will also be sampled for fish to confirm that fish populations inhabit the channel.

The types of fish collection methods will include both passive and active collection. Techniques may include:

- Baited minnow traps

- Seine nets
- Hoop Nets
- Fishing
- Gill nets
- Electrofishing
- Fish community and spawning surveys (visual observation at spawning times, outmigration surveys, egg collection, etc.)

Electrofishing will be used to limit the size or species bias presented by other methods (SSRWS 2012)

If fish are not using the channel, it will be reassessed to identify why it is not providing effective habitat and will be either resampled or altered to make it effective habitat. The most important and ultimate indicator of the success of the entire FHCP will be the fish community and fish spawning surveys. Establishment of healthy populations of fish communities will be the indicator that the system is working and fish habitat has been improved in Pehonan Creek and created by the new channel.

The monitoring program will continue until there are no longer any reaches considered unhealthy using the Riparian Health assessment and until it has been shown that fish are regularly utilizing the newly constructed channel. The monitoring program will ultimately determine the success of the FHCP. If the monitoring program illustrates that the creation and improvement of fish habitat is not adequate compensation for the loss, than the contingency, as discussed below will be implemented through discussions between Shore Gold and DFO.

5.0 Contingency

A minor contingency project that will result in some fish habitat improvement is the English Creek Crossing at Division Road. It has significant erosion issues associated with it which results in deposition of a large amount a sand and material from the roadbed into the Creek every year. The roadbed and approaches of Division Road, at both approaches to the English Creek Bridge will be stabilized using geotextile, clean rock and the construction of drainage channels into the forest rather than into the creek. This will result in a significant decrease of the annual sediment deposition into English Creek and will also stabilize Division Road.

The main contingency included in the FHCP is the flexibility associated with the construction of the backwater channel near the mouth of Pehonan Creek. There is a relatively large, flat and uniformly level and cleared area to the south of Pehonan Creek near the Saskatchewan River. As shown in Figures 2 and 9, the area is well over a

kilometer long and 100 to 200 meters wide so there is adequate room for construction of a larger channel or additional channel after the construction of the initial channel. This flexibility provides a reliable contingency if needed.

The factors that will be considered in determining if the contingency is required are discussed in the monitoring section (section 4.0) above.

6.0 Schedule and timeline

The timing of the implementation of the FHCP will depend on the timing of the Star-Orion South Diamond Project. Once a positive production decision has been made, and a plan and timeline established for stripping the overburden at the Star Kimberlite, then the implementation of the FHCP will proceed (This point in time will be considered year 0). Fencing of Pehonan Creek, along with the installation of the crossing will be the first to occur. Erosion control and revegetation will then be completed on Pehonan and the crossing. Detailed engineering of the backwater channel will also be completed at this time. This may include further field work such as shallow drilling to determine the materials that will make up the banks of the channel. It is expected that all of the above work will be completed in year 1. Once detailed engineering is complete and the plan is approved by DFO and agreed upon by JSCN, the work on the backwater channel will commence. The goal will be to have the backwater channel constructed by the end of year 2. Monitoring and improvements to the projects will be ongoing after that time as discussed previously.

7.0 Engagement

Engagement with JSCN has been, and will continue to be ongoing. The exact design and location of the backwater channel will be dependent on the results of discussions with the JSCN, as well as the biologist and engineer during detailed planning. The goal of the meeting with the JSCN is to have an agreement put into place between Shore Gold and the JSCN. This agreement would be an understanding that JSCN is supportive of the FHCP.

Discussions with JSCN are, or will be ongoing in regards to:

- The location and type of infrastructure required for watering livestock
- Revegetation species
- Maintenance of the crossing and fencing
- Final location of the backwater channel

- JSCN involvement in the monitoring and maintenance programs
- Education and notification to the community members on the FHCP details and why it is important and beneficial

8.0 Summary

Table 6 provides a summary of the total aerial loss and gain of fish habitat as a result of the project and shows that the area of habitat gained is more than that lost. The majority of the loss is a permanent loss as the East Ravine will be part of the Star open pit. However, the East Ravine is the only water body with a permanent loss of fish habitat. The Duke and 101 Ravines, along with the Saskatchewan River will experience temporary, reversible losses in habitat as discussed previously. The gain in quality and quantity of habitat is also variable. The improvements on Pehonan Creek have the potential to permanently improve water quality as the revegetation and exclusion fencing effects take hold. The installation of a more permanent crossing and the construction of the backwater channel are also permanent improvements. Shore is committed to ensuring all aspects of the FHCP remain effective and working as planned to create and improve fish habitat. These aspects will remain in place for the life of the project (25 years) and then considered as part of the Project's Mine Closure Plan.

Table 6: Summary of Loss and Gain in Habitat

Location	Type of Impact	Aerial Quantity (m^2) (Loss) or gain	Temporary or Permanent	Lifespan of Impact
East Ravine	Star Pit and Culvert	-76,103	Permanent	Permanent
Duke Ravine	Culvert	-140.8	Temporary	~25 Years
101 Ravine	Culvert	-267.5	Temporary	~25 Years
Saskatchewan River	Access Berm and Coffer Dam	-43	Temporary	0.3 Years
Saskatchewan River	Diffuser Pipeline	-450	Temporary	~25 Years
Pehonan Creek	Crossing, erosion control, revegetation, fencing	68,833	Potentially Permanent	Minimum 25 years
Proposed Backwater Channel	Creation of new, high quality habitat	10,000+/-	Permanent	Permanent
Total Loss		-77,004		
Total Gain		78,833		

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