9.0 FISH AND FISH HABITAT

Fish and fish habitat is assessed as a valued component (VC) for the Berry Pit Expansion (Project Expansion) because it provides ecological, cultural, recreational, and economic value to stakeholders and is protected by federal and provincial legislation. Fish and fish habitat occur within the Project Area and will be affected by planned Project Expansion activities.

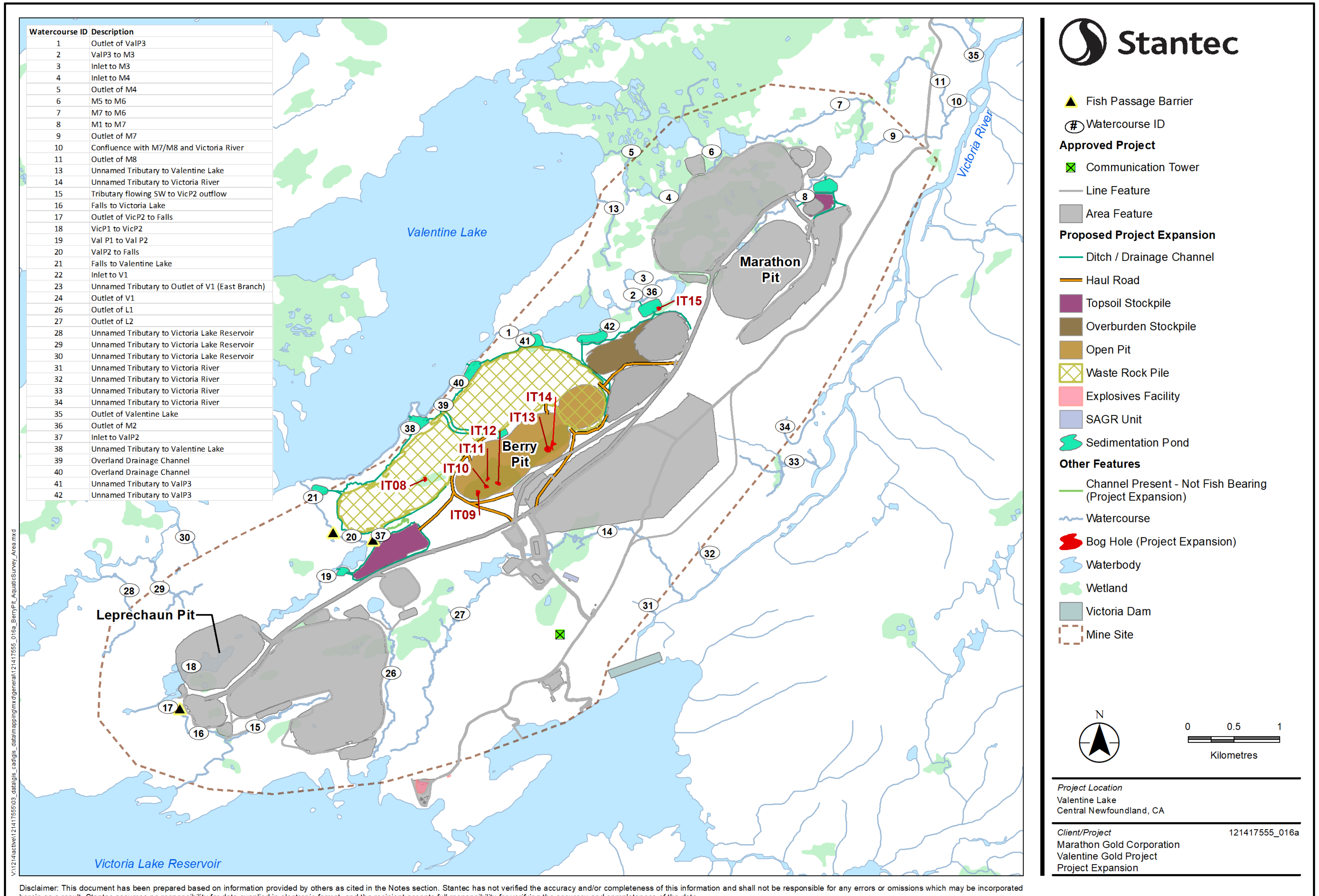
For the purposes of the assessment, the Fish and Fish Habitat VC includes fish and fish habitat and fisheries, which are defined under the federal *Fisheries Act* as follows:

- Fish includes: (i) parts of fish, (ii) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and (iii) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals
- Fish habitat means waters frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas
- Fishery includes any place where or period during which fishing may be carried out; any method of fishing used, any type of fishing gear, equipment, or fishing vessel used; and any species, populations, assemblages and stocks, whether the fish is fished or not

Fish and Fish Habitat is assessed because changes in fish and fish habitat may result from the construction, operation, and decommissioning, rehabilitation and closure of the Project Expansion.

9.1 EXISTING ENVIRONMENT

A characterization of the existing conditions within the spatial boundaries defined in Section 5.1.3, Table 5.2, for the Project Area, Local Assessment Area (LAA), and Regional Assessment Area (RAA) is provided in the following sections. These spatial boundaries are consistent with those used for the Valentine Gold Project (Approved Project) in the Valentine Gold Environmental Impact Statement (EIS) (Marathon 2020). The Aquatic Survey Area, as shown in Figure 9-1, includes Valentine Lake and its outlet, Victoria Lake Reservoir, Victoria River, and the mine site, and also encompasses survey areas for the aquatic field programs.



Watercourse ID	Description
1	Outlet of ValP3
2	ValP3 to M3
3	Inlet to M3
4	Inlet to M4
5	Outlet of M4
6	M5 to M6
7	M7 to M6
8	M1 to M7
9	Outlet of M7
10	Confluence with M7/M8 and Victoria River
11	Outlet of M8
13	Unnamed Tributary to Valentine Lake
14	Unnamed Tributary to Victoria River
15	Tributary flowing SW to VicP2 outflow
16	Falls to Victoria Lake
17	Outlet of VicP2 to Falls
18	VicP1 to VicP2
19	Val P1 to Val P2
20	ValP2 to Falls
21	Falls to Valentine Lake
22	Inlet to V1
23	Unnamed Tributary to Outlet of V1 (East Branch)
24	Outlet of V1
26	Outlet of L1
27	Outlet of L2
28	Unnamed Tributary to Victoria Lake Reservoir
29	Unnamed Tributary to Victoria Lake Reservoir
30	Unnamed Tributary to Victoria Lake Reservoir
31	Unnamed Tributary to Victoria River
32	Unnamed Tributary to Victoria River
33	Unnamed Tributary to Victoria River
34	Unnamed Tributary to Victoria River
35	Outlet of Valentine Lake
36	Outlet of M2
37	Inlet to ValP2
38	Unnamed Tributary to Valentine Lake
39	Overland Drainage Channel
40	Overland Drainage Channel
41	Unnamed Tributary to ValP3
42	Unnamed Tributary to ValP3

Figure 9-1 Aquatic Survey Area

9.1.1 Summary of Existing Environment from the Approved Project

Aquatic field studies were completed in 2011, 2018, 2019 and 2020 to support the Valentine Gold EIS and EA review process. These were presented in the Baseline Study Appendix 4: Fish, Fish Habitat and Fisheries (BSA.4) to the Valentine Gold EIS (Marathon 2020; Stantec 2021). Information on where to access these studies online is found in Table 1.8. These field studies focused on the collection of fish and fish habitat data within the Aquatic Survey Area and associated access road and were described in the Valentine Gold EIS.

Fish habitat surrounding the Valentine Gold Project (Approved Project) includes lakes, ponds, rivers and streams. Lakes include Victoria Lake Reservoir, a large 16,660-hectare (ha), deep (maximum depth of 46 metres [m]) reservoir which flows into the White Bear Watershed and Valentine Lake, a large (820 ha) and moderate depth (maximum depth of approximately 20 m) waterbody which flows unregulated into the Exploits Watershed.

Ponds within the Aquatic Survey Area are small (1.1 to 26 ha) and have maximum depths of approximately 2 m, so fish habitat occurs entirely within the littoral zone. The substrates are mainly fines with a small amount of aquatic vegetation. Bog holes within the Aquatic Survey Area were proven not to contain fish or fish habitat (Stantec 2021).

Victoria River and the outlet of Valentine Lake are the rivers surrounding the Approved Project. Both flow to the Exploits River via Beothuk Lake (formerly Red Indian Lake). Victoria River is part of the Exploits River watershed and formerly (prior to the construction of the Victoria Dam and the creation of the Victoria Lake Reservoir) drained Victoria Lake. As a result of a decrease in flow from Victoria Lake Reservoir (after the construction of the Victoria Dam), Victoria River has narrowed, and shrubs dominate the riparian area within the former riverbanks in lower lying areas. The first 5 kilometres (km) of river downstream of the dam is relatively narrow (10 to 40 m) and beaver dams are abundant. Farther downstream in Victoria River, the gradient increases, riffles/runs and pools can be observed, and the river widens. Substrates are primarily medium and coarse (e.g., cobble to boulder) (Pippy 1966; unpublished in-field observations). The outlet of Valentine Lake is a moderately sized (range 3 to 76 m in width), shallow (less than 0.5 m in depth) and swift flowing (less than 1 metre per second [m/s]) river with numerous sections of riffles/runs or cascades. Substrates are fines in slow flowing reaches and steadies and boulder or bedrock in swift flowing sections (Stantec 2021).

Streams within the Aquatic Survey Area are generally small (<5 m), shallow (<0.5 m), and slow flowing (<0.2 m/s). First order, low gradient streams that flow through bog or wetland habitats are generally characterized by shallow flats with an undefined thalweg[1], slow/negligible velocities during the summer low flow period, and fine grain substrates. The upper reaches of some streams (i.e., Stream 1/3/16) have intermittent flow, particularly during the summer low flow period from August to early September. The lower reaches of streams are generally more riffle/run habitat, associated with increased gradient and velocities, coarser substrates, well-defined channels, and generally permanent flow characteristics.

[1] A thalweg is defined as the lowest path along the entire length of a stream bed which defines its deepest channel.

Waterfalls that act as barriers to fish passage are located on the outlet of Valentine Lake, within the outlet of ValP2 (Stream 20/21) and VicP2 (Stream 16/17) (Figure 9-1).

Water temperatures in the Aquatic Survey Area are generally suitable for cold water fish species. Dissolved oxygen concentrations are generally above the Canadian Water Quality Guidelines for Protection of Freshwater Aquatic Life (CWQG-FAL) for all life stages of fish. The pH is generally slightly acidic and conductivity is low. Surface waters are soft, typically clear and contain naturally high concentrations of aluminum and iron. Grain size distributions of depositional sediments are variable. Sediments in the survey area have naturally elevated concentrations of arsenic. Naturally high arsenic levels are not uncommon and are influenced by bedrock geology, surficial and chemical processes, and proximity to areas of mineralization (particularly copper and gold) (Serpa et al. 2009).

Primary productivity is low, as assessed by chlorophyll “a” in lakes and periphyton in streams.

Secondary productivity, as assessed through the benthic invertebrate community (BIC) composition, is representative of unimpacted lakes, ponds and streams. Amphipods are the predominant taxa in ponds, Chironomids the predominant taxa in lakes and soft substrates in streams, and Ephemeroptera (mayflies) the predominant taxa in streams with coarse substrates. BIC density is variable even within similar habitat types.

Fish communities within the region are not diverse. Sea-run and landlocked (ouananiche) Atlantic salmon (*Salmo salar*), brook trout (*Salvelinus fontinalis*), Arctic char (*Salvelinus alpinus*), American eel (*Anguilla rostrata*), and threespine stickleback (*Gasterosteus aculeatus*) are known to occur upstream of Red Indian Dam (Cunjak and Newbury 2005; Porter et al. 1974).

Fish sampling conducted in support of the Approved Project captured brook trout, landlocked Atlantic salmon, Arctic char, and threespine stickleback within the ponds, lakes and streams. All life stages of each fish species are present in the vicinity of the Approved Project. There are no aquatic fish species at risk (SAR) known to occur in the Project Area (Marathon 2020).

Recreational angling for sea-run and land-locked Atlantic salmon and brook trout occurs within the RAA. Retention of land-locked Atlantic salmon and brook trout are permitted; however, only catch-and-release angling is permitted for sea-run Atlantic salmon. An outfitter operates within the RAA, offering guided land-locked salmon and brook trout fishing tours on Beothuk Lake (formerly Red Indian Lake) (Marathon 2020). There are no known commercial fisheries in the area and no known Indigenous fisheries within the boundaries of the Fish and Fish Habitat LAA and RAA. Indigenous fishing activity is known to occur in other watercourses or waterbodies within 20 km of the Project Area

A detailed description of fish habitat within the Aquatic Survey Area is contained in the Valentine Gold EIS (Marathon 2020).

9.1.2 Existing Environment Update

Additional aquatic studies were undertaken in 2021 and 2022, following the submission of the Valentine Gold EIS, to support the Approved Project and the Project Expansion. In 2021, a field study focused on the collection of fish, fish tissue, benthic invertebrate communities, sediment and water quality in Victoria Lake Reservoir and Valentine Lake (Stantec 2022a). In 2022, the field studies focused on assessing the diversity and relative abundance of fish species in Victoria Lake Reservoir and Valentine Lake using a standardized methodology (Stantec 2022b), and characterizing fish and fish habitat within the area of the Aquatic Survey Area (Stantec 2023; Appendix 9A).

The following sections describe the existing environment as it pertains to the Project Expansion. It includes both the relevant information collected from aquatic studies undertaken to support the Approved Project (in the vicinity of the Project Expansion) and Project Expansion specific studies.

9.1.2.1 Fish Habitat Characterization

Fish habitat was characterized for lacustrine (ponds, lakes and bog holes) and riverine (rivers, streams) habitats. Results of studies for each habitat type are described below.

Ponds

Three ponds (ValP2, M2 and ValP3) are potentially affected by the Project Expansion (Table 9.1). The ponds are shallow (<2.0 m) and therefore habitat occurs entirely within the littoral zone. Where aquatic vegetation is present, it is often immediately adjacent to the shore or sparsely distributed throughout the pond. Photos of each pond and representative habitats are provided in the Valentine Gold EIS (Marathon 2020, BSA.4, Attachments 4-A and 4-C).

Table 9.1 Summary of Pond Habitat Characteristics

Major Watershed	Pond	Surface Area (ha)	Dominant Substrate Grain Size[1]	Subdominant Substrate	Dominant Aquatic Vegetation
Valentine Lake	ValP2	4.2	Fines (93%)	Medium (7%)	ND
Valentine Lake	M2	1.9	Fines (100%)	-	Submergent
Valentine Lake	ValP3	26	Fines (87%)	Medium (10%)	Submergent

Notes:
ND no data
1 Coarse = bedrock and boulder; Medium = rubble, cobble, gravel; Fine = sand, silt, clay, muck

ValP2 has a surface area of 4.2 ha and drains into Valentine Lake via Streams 20 and 21 (Figure 9-1). ValP2 has a maximum depth of approximately 1 m. The substrate contains a high proportion of fines (93%). No data was collected on the proportion of aquatic vegetation. Representative photos can be found in the Valentine Gold EIS (Marathon 2020, BSA.4, Attachment 4-A; Photo 2).

M2 has a surface area of 1.9 ha and drains into ValP3 via Stream 36. M2 has a maximum depth of approximately 2 m and therefore habitat occurs entirely within the littoral zone. The substrate is fines (100%). Cover is provided predominantly by submergent aquatic vegetation. Representative photos can be found in the Valentine Gold EIS (Marathon 2020, BSA.4, Attachment 4-B; Photo 10; Appendix 9A; Photos 7 to 10).

ValP3 has a surface area of 26 ha and drains into Valentine Lake via Stream 1 (Figure 9-1). ValP3 has a maximum depth of approximately 1.5 m. The substrate consists mainly of fines (87%), with lower proportions of medium substrates (10%). Cover is provided predominantly by submergent aquatic vegetation. Representative photos can be found in the Valentine Gold EIS (Marathon 2020, BSA.4, Attachment 4-B; Photos 32 to 33).

Based on methods for rating fish habitat provided in Bradbury et al. (2001), the habitat quality of ValP3 is generally poor for spawning, young of the year (YOY), juvenile, and adult life stages of brook trout (*Salvelinus fontinalis*) and landlocked Atlantic salmon (ouananiche) (*Salmo salar*). The generally poor habitat suitability in M2 and ValP3 is a result of the large quantity of fine grain substrates, which is similar to the habitat suitability of other ponds in the Aquatic Survey Area. Habitat quality in ponds (ValP2, M2, and ValP3) is excellent for threespine stickleback (*Gasterosteus aculeatus*) spawning, YOY, juvenile and adult life stages, as a result of the large quantity of fine grain substrates and the presence of aquatic vegetation. These characteristics are similar to the habitat suitability of other ponds assessed for the Approved Project.

Bog Holes

Bog holes are isolated, small waterbodies and are common in the Project Area. During the environmental assessment (EA) of the Approved Project, a total of 28 bog holes were identified in the vicinity of the mine site. Seven of the 28 bog holes are within the footprint of the Project Expansion. An ice thickness survey completed in March 2020 determined if bog holes were frozen to the bottom, which would exclude the possibility of fish presence, or if water was present below the ice, offering a possibility of fish presence (Marathon 2020, BSA.4, Attachment 4-D). Five bog holes with adequate water depth to potentially support fish populations were fished to determine fish presence/absence, however none contained fish (Stantec 2021). These results were sufficient for Fisheries and Oceans Canada (DFO) to determine that bog holes within and adjacent to the Project Area are not fish habitat.

Although not required, to remove possible doubt of fish presence Marathon chose to conduct additional fish sampling of four bog holes (IT08, IT09/IT10, IT12 and IT13) within the Project Expansion footprint (Stantec 2023; Appendix 9A). Fish sampling confirmed that fish are not present in IT08, IT09/IT10, IT12 and IT13 (Stantec 2023; Appendix 9A). These results are consistent with the results of previous fishing effort conducted in bog holes (Stantec 2021) and demonstrates that fish are absent from bog holes within the Project Expansion footprint and from other bog holes in proximity.

Lakes

Valentine Lake is a large (approximately 820 ha) lake located within the Exploits watershed. Fish habitat within the littoral zone of Valentine Lake consists of a large rock shelf, which follows the 2 to 4 m contour and drops off steeply to the profundal zone. It has a maximum water depth of 20 m (Memorial University of NL, unpublished data; Stantec 2022a). Substrates in the littoral zone are coarse and consist predominantly of large boulder, rubble and cobble, with lesser amounts (<5%) of smaller substrates such as gravel or sand (Stantec 2023; Appendix 9A). Substrates in the profundal zone are typically muck or clumps of fines (Marathon 2020, BSA.4, Attachment 4-C; Stantec 2022a). The riparian vegetation is typically shrub (e.g., Labrador tea), changing to coniferous forest further from the lake shoreline. A detailed description of the shoreline habitat of Valentine Lake near the Project Expansion footprint is provided in Appendix 9A).

Based on methods for rating fish habitat provided in Bradbury et al. (2001), Valentine Lake contains generally good to excellent habitat for spawning, YOY, juvenile and adult life stages of brook trout, Atlantic salmon (ouananiche), and Arctic char resulting from the quantity of coarse substrates and varying habitat types. Spawning habitat and pelagic habitat for adult life stages of threespine stickleback is generally suitable, while rearing habitat for YOY and juveniles of threespine stickleback is generally poor (Bradbury et al. 2001).

Streams and Rivers

There are nine streams and rivers (Streams 1, 2, 19, 20/21, 36, 37, 38, 41 and 42) associated with the Project Expansion located within the Aquatic Survey Area.

A summary of habitat attributes for the ground and desktop surveys conducted for baseline studies is provided in Table 9.2 and includes the stream order. average wetted and channel stream width, average velocity, depth, slope, overhead and instream cover, dominant habitat type, substrate, and riparian vegetation. The complete habitat classification dataset is provided in the Valentine Gold EIS (Marathon 2020, BSA.4) and Appendix 9A. Note that stream order reflects the morphology and structure of streams within a watershed. As an example, first and second order streams are small headwater streams with uniform fish communities, and third to sixth order (or higher) streams are larger rivers with more diverse fish communities.

Fish habitat information for streams within the Aquatic Survey Area is presented in Table 9.2. Streams 1, 2, 20 and 21 were part of the Approved Project; however, they may still be affected by the Project Expansion. Stream locations 36-42 are new to the Project Expansion. The surveyed streams are generally small (<5 m), shallow (<0.5 m), and slow flowing (<0.2 m/s). First order, low gradient streams that flow through bog or wetland habitats are generally characterized by shallow flats with an undefined thalweg, slow/negligible velocities, and fine grain substrates. The upper reaches of some streams (i.e., 1, 20) have intermittent flow, particularly during the summer low flow period from August to early September. The lower reaches of streams are generally more riffle/run habitat, associated with increased gradient and velocities, coarser substrates, well-defined channels, and generally permanent flow characteristics.

Waterfalls that act as barriers to fish passage are present immediately downstream of crossing C005 on the outlet of Valentine Lake and within the inlet and outlet of ValP2 (Streams 20/21 and 37) (Figure 9-1).

Table 9.2 Summary of Habitat Characteristics for Streams within the Aquatic Survey Area Associated with the Project Expansion

Major Sub-Watershed	Location (Identifier #)4	Stream Order	Stream Length (m)	Assessment Method	Wetted Stream Width (m)	Channel Stream Width (m)	Mean Depth (m)	Mean Velocity (m/s)	Average Slope (%)	Dominant Habitat Type	Dominant Substrate Type	Dominant Riparian Vegetation	Average Overhead Cover (%)	Average Instream Cover (%)	Comments
Valentine Lake	(1) Outlet of ValP3[1,2]	1	280	Ground	4.34	-	0.21	0.3	1	Riffle / Run	Cobble/ Rubble (64%)	Shrub (49%)	-	8	Series of riffles and pools, old water level dam at the end of the lake
Valentine Lake	(2) ValP3 to M3[1]	1	600	Ground	10.9	11.6	0.33	0.00	0.5	Flat (53%)	Fines (74%)	Grass (40%) / Shrub (40%)	22	42	Stream connects a series of small steadies
Valentine Lake	(20) ValLK to ValP2 falls[2]	1	340	Ground	1.67	-	0.13	0.10	-	Riffle / Run	Boulder (47%)	Shrub (53%)	-	0	Series of riffles and runs, drop runs and cascades; barrier to fish passage at 435 m and 575 m upstream from Valentine Lake
Valentine Lake	(21) Falls to ValP2[2]	1	780	Ground	1.40		0.22	0.14	-	Riffle / Run	Boulder (73%)	Shrub (60%)	-	8	Riffle/run with series of drop runs, large beaver pond/steady at 775 m and 1,000 m downstream of VICP2; flows through wetland closer to Victoria Lake Reservoir
Valentine Lake	(36) Outlet of M2	1	430	Desktop	2	2	ND	ND	ND	Flat (50%)	Fines	Grass (40%)	ND	ND	Information derived from desktop assessment
Valentine Lake	(37) Inlet to Val P2[3]	1	80	Ground	0.86	1.21	0.14	0.15	1.0	Riffle (65%)	Rubble (50%)	Grass (40%)	0%	0%	Lower 80 m reach below natural falls is fish habitat; upstream of the barrier confirmed to not be fish habitat
Valentine Lake	(38) Inlet to V alentine[3] Lake	1	105	Ground	0.93	1.26	0.14	ND	1.3	Flat (~55%)	Muck (42%)	Trees (43%)	~45%	~5%	Lower 70 m reach has relatively steep slopes; upper reach consists of heavily braided intermittent channels
Valentine Lake	(41) Inlet to ValP3[3]	1	90	Imagery / Ground	1	1	ND	ND	1	Riffle / Run	Cobble	Shrub	ND	ND	Flows from a bog as a single defined channel into ValP3
Valentine Lake	(42) Inlet to ValP3[3]	1	50	Imagery	4	4	ND	ND	0.5	Glide	Fines	Wetland	ND	ND	Flows from a bog into ValP3

Note:
1 Surveyed in 2018 (Marathon 2020, BSA.4, Attachment 4-B)
2 Surveyed in 2011 (Marathon 2020, BSA.4, Attachment 4-A)
3 Surveyed in 2022 (Stantec 2023)
Refer to Figure 9-1

Water Quality

The description of water quality for ponds within the Project Area was completed as part of the Valentine Gold EIS (Marathon 2020). Additional studies were undertaken in Valentine Lake and streams in the Aquatic Survey Area since submission of the Valentine Gold EIS. The information as it pertains to the Project Expansion is provided below.

In situ water quality results for ponds within the Aquatic Survey Area are within the acceptable ranges for supporting cold water fish communities (Marathon 2020, BSA.4, Attachment 4-C). Key findings include the following:

- In ponds, average water temperature ranged from 10.2 degrees Celsius (°C) to 14.3°C in September (Marathon 2020, BSA.4, Attachment 4-C)
- Average dissolved oxygen concentrations in ponds ranged from 9.3 to 9.5 milligrams per litre (mg/L). One of two ponds sampled for dissolved oxygen was below the CWQG-FAL recommended minimum value of 9.5 mg/L for early life stages (ValP3); however, samples from all ponds were above the guidelines (6.5 mg/L) for all life stages (CCME 2014)
- The pH ranged from 6.4 to 6.8 and was below the CWQG-FAL recommended range (6.5 to 9.0) at one of two sampling locations (VALP2)
- Conductivity ranged from 52.9 to 55.3 microsiemens per centimetre (µS/cm)

In situ water quality results in Valentine Lake are generally within the acceptable ranges for supporting cold water fish communities (Marathon 2020, BSA.4, Attachment 4-C; Stantec 2022a):

- Conductivity levels for Valentine Lake varied between 23.5 and 27.0 µS/cm
- The pH in Valentine Lake ranged from 6.04 to 7.79; the in-situ pH within the water column was generally within or slightly below the recommended guideline CWQG-FAL of 6.5
- Secchi depth ranged from 6.00 to 7.12 m on Valentine Lake in August and September 2019, respectively
- Valentine Lake thermally stratifies in summer at depths of 10 to 11 m from the water's surface and dissipates prior to late September
- In August 2019, water temperature in the epilimnion (above the thermocline) averaged 20.1ºC and dissolved oxygen concentrations averaged 8.5 mg/L
- In August 2019, water temperatures below the thermocline averaged 16.7ºC and dissolved oxygen concentrations averaged 8.3 mg/L

In situ water quality in streams is generally within the acceptable ranges for supporting cold water fish communities (Marathon 2020, BSA.4, Attachment 4-C; Stantec 2023):

- In streams, average water temperature ranged from 13.6 to 17.4°C
- Average dissolved oxygen concentrations in streams ranged from 8.8 to 9.1 mg/L; all stations were below the CWQG-FAL recommended minimum value of 9.5 mg/L for early life stages, however were above the guideline (6.5 mg/L) for all life stages (CCME 2014)

- The pH ranged from 6.1 to 7.7 and was below the CWQG-FAL recommended range (6.5 to 9.0) at one of two sampling locations (Stream 20)
- Conductivity ranged from 56.6 to 98.0 µS/cm

In general, the Valentine Gold EIS found that the baseline surface water quality in the LAA is within the acceptable ranges for supporting cold water fish communities:

- Surface water was soft; hardness averaged 16.3 mg/L
- Alkalinity was low and suggested limited acid buffering potential in local waterbodies; the pH ranged from acidic to slightly basic (4.61 to 7.8)
- Electrical conductivity was considered low and averaged approximately 40 µS/cm
- Concentrations of major cations such as calcium, sodium, potassium, magnesium, manganese, ammonium, iron and aluminum were low, as were concentrations of major anions such as chloride, fluoride, sulphate and nitrate
- Waters were typically clear, with low total suspended solids concentrations (mean of 3 mg/L) and low turbidity (mean of 1.0 Nephelometric Turbidity unit)
- Total ammonia had a mean of 0.09 mg/L and nitrate had a mean of 0.11 mg/L
- Nutrients such as total phosphorus had a mean of 54 mg/L, indicating that nutrients likely do not limit plant or algal growth in these freshwater streams
- Total metal concentrations for arsenic, cadmium, boron, copper, lead molybdenum, selenium, silver, thallium, uranium and zinc were typically within the CWQG-FAL at most sampling locations
- Total aluminum and iron were often above CWQG-FAL at most sampling stations

The complete results for the LAA are provided in the Baseline Report (Marathon 2020, BSA.3, Attachment 3-A) and are described in more detail in Chapter 7 of the Valentine Gold EIS (Surface Water Resources).

Water Quantity

The streams within the Aquatic Survey Area are generally small and drain wetlands or small ponds near the top of their respective watershed divides. Mean discharges range from 0.010 to 0.045 cubic metres per second (m^3/s) throughout the year (Table 9.3). Mean monthly flows are highest in April and May, with the lowest flows occurring in August and September. Flows were low in early August 2019 and some flows appeared negligible or streams had become intermittent (e.g., Stream 1). More detailed information on the discharge from watersheds, ponds and streams within the Aquatic Survey Area can be found in Chapter 8 (Surface Water Resources) in this document.

Table 9.3 Calculated Select Flow Statistics for Pre-Development Watershed Areas Associated with Streams Potentially Affected by the Project Expansion

Major Watershed	Location	Mean Flow (m^3/s)		
		Low	High	Mean
Valentine Lake	WS-01 (Stream 1, 41 and 42)	0.020	0.129	0.045
Valentine Lake	WS-02 (Stream 2 and 36)	0.016	0.104	0.036

Table 9.3 Calculated Select Flow Statistics for Pre-Development Watershed Areas Associated with Streams Potentially Affected by the Project Expansion

Major Watershed	Location	Mean Flow (m^3/s)		
		Low	High	Mean
Valentine Lake	WS-34A (Stream 38)	0.010	0.066	0.023
Valentine Lake	WS-35 (Stream 37)	0.005	0.032	0.010
Valentine Lake	WS-36 (Stream 20 and 21)	0.009	0.060	0.020

Sediment Quality

In ponds, grain size distributions are variable (Marathon 2020, BSA.4, Attachment 4-C). Sediments in ValP3 are primarily sand while sediments in ValP2 are silt and clay in similar proportions. In Valentine Lake, the sediments taken from the profundal zone typically consist of larger proportions of silt and clay, whereas those from the littoral zone contain larger proportions of sand.

ValP2, ValP3 and Valentine Lake sediments had no exceedances of the Canadian Sediment Quality Guideline Probable Effects Limit (CSQG PEL) or CSQG Interim Sediment Quality Guidelines (ISQG) identified for chromium, copper, or mercury. There were exceedances above the CSQG PEL and ISQG guidelines for arsenic, cadmium, lead and zinc (Marathon 2020, BSA.4, Attachment 4-C; Stantec 2022a). Elevated baseline metal concentrations for arsenic, cadmium, lead and zinc were observed in other ponds and lakes in the Project Area (Marathon 2020; Stantec 2022a). In Newfoundland and Labrador (NL), naturally high arsenic levels are not uncommon and are influenced by bedrock geology, surficial and chemical processes, and proximity to areas of mineralization (particularly copper and gold) (Serpa et al. 2009).

Grain size distribution sampled from soft sediments in streams within the Project Area were highly variable (Marathon 2020, BSA.4, Attachment 4-C). Silt was the predominant grain size at stations sampled in Stream 20 (Marathon 2020, BSA.4, Attachment 4-C). No exceedances of the CSQG PEL or CSQG ISQG were identified for cadmium, chromium, copper, lead, mercury and zinc in Stream 20. Arsenic levels were naturally elevated and above the CSQG PEL and ISQG in the sediment sample collected from soft sediments in Stream 20 (72 mg/kg; Marathon 2020, BSA.4, Attachment 4-C). Baseline metal concentrations for arsenic, mercury and zinc were observed above the CSQG ISQG in other streams in the Project Area (Marathon 2020).

9.1.2.2 Primary Productivity

Primary production is the production of chemical energy into organic compounds by living organisms. It occurs primarily through photosynthesis and provides the base of the aquatic food web (i.e., algae or plants for other organisms to eat). Chlorophyll “a” concentration from periphyton in surface water is often positively associated with nutrient availability and is used to assess primary productivity. Chlorophyll “a” produces a food supply at the base of the food chain for many aquatic organisms. Chlorophyll in lakes and ponds originates mostly from floating algae. In streams, chlorophyll is associated with periphyton, which includes a functionally defined assemblage of algae and other species that live attached to solid surfaces such as logs and rocks.

The description of primary productivity completed as part of the Valentine Gold EIS (Marathon 2020) also applies to the Project Expansion area. No additional studies in primary productivity have been undertaken since submission of the Valentine Gold EIS.

Water samples were collected in summer and fall 2019 from Valentine Lake and two ponds (ValP2, ValP3) within the Aquatic Survey Area for the determination of chlorophyll “a” concentration (Marathon 2020, BSA.4, Attachment 4-C). There was little variation in primary productivity between the summer and fall periods, with summer concentrations in Valentine Lake, ValP2 and ValP3 ranging from non-detect (<0.5) to 1.8 micrograms per litre (µg/L), and fall concentrations ranging from 0.7 to 1.7 µg/L (Marathon 2020, BSA.4, Attachment 4-C). These results indicate low primary productivity based on chlorophyll “a” concentration <2 µg/L (Mackie 2001), which is consistent with other lakes and ponds in the area.

Periphyton samples were collected in summer and fall from two streams (Streams 1 and 20) in the Aquatic Survey Area for the determination of chlorophyll “a” concentration (Marathon 2020, BSA.4, Attachment 4-C). Primary productivity represented by chlorophyll “a” concentration in periphyton did not vary substantially between summer and fall sampling events, with summer concentrations ranging from 0.8 to 1.5 micrograms per square centimetre ($\mu g/cm^2$) and fall concentrations ranging from 2.3 to 2.5 $\mu g/cm^2$ in Streams 1 and 20 (Marathon 2020, BSA.4, Attachment 4-C). Concentrations of chlorophyll “a” in periphyton indicated oligotrophic to mesotrophic conditions (low to moderate productivity) based on Barbour et al. (1999) and are within the ranges observed for other streams in the Aquatic Survey Area (Marathon 2020, BSA.4, Attachment 4-C).

9.1.2.3 Secondary Productivity

Secondary productivity is the production of biomass by organisms that cannot produce their own food (i.e., heterotrophic). The BIC in waterbodies was sampled to determine secondary productivity. Benthic invertebrates consist of a wide range of feeding groups including shredders, gatherers, filter feeders, scrapers and predators. These organisms are responsible for converting non-living organic matter (e.g., coarse and fine particulate organic matter) and living organic matter (e.g., algal cells, microscopic multicellular animals, and other benthic invertebrates) into animal tissue. This animal tissue represents a major food resource for fish populations, particularly brook trout and Atlantic salmon (ouananiche) less than approximately 30 cm in length (Pippy 1966).

Secondary productivity can be quantified by the measurement of the density of benthic invertebrates in a given area (number of individuals per m^2). In general, areas of high density tend to have higher secondary productivity than areas of low density. Taxa richness and evenness are two metrics that, in combination, are generally used to estimate secondary production and determine how the productivity may be generated. Taxa richness includes the number of different types of organisms that may be present at a family or species level, and evenness provides a measure of how diverse a benthic community is.

The description of secondary productivity within ponds and streams in the Aquatic Survey Area was completed as part of the Valentine Gold EIS (Marathon 2020). Additional secondary productivity studies were undertaken in Valentine Lake since submission of the Valentine Gold EIS (Stantec 2022a). The updated information as it pertains to the Project Expansion is provided below.

In ponds, 17 different species from 12 different families were identified in the BIC samples collected in ValP2 and ValP3 (Marathon 2020, BSA.4, Attachment 4-C). The predominant benthic invertebrate taxon collected in ValP2 and ValP3 was Amphipoda (amphipods), which is consistent with the majority of other ponds sampled in the Aquatic Survey Area (Marathon 2020, BSA.4, Attachment 4-C).

In Valentine Lake, 26 different species from 11 different families were identified in the BIC samples. The predominant benthic invertebrate taxon collected was generally Diptera (true flies) and consisted primarily of Chironomidae. Chironomidae made up between 42% and 100% of the individuals identified in Valentine Lake (Marathon 2020, BSA.4, Attachment 4-C; Stantec 2022a).

The density was higher in BIC samples collected from ValP2 and ValP3 than from Valentine Lake, and taxon richness was similar. In other lakes and ponds in the Aquatic Survey Area both density and evenness were generally higher in ponds than lakes (Marathon 2020, BSA.4, Attachment 4-C). Evenness was variable in ValP2, ValP3 and Valentine Lake, while BIC diversity was moderate to high in both ponds and lakes (Marathon 2020, BSA.4, Attachment 4-C, Stantec 2022a).

In Stream 20, 25 different species from five different families were identified in the BIC samples collected from soft substrates (Marathon 2020, BSA.4, Attachment 4-C). The predominant benthic invertebrate taxon collected from soft substrates in streams was Diptera (true flies) and consisted primarily of Chironomidae, which is generally consistent with other streams in the Aquatic Survey Area (Marathon 2020, BSA.4, Attachment 4-C).

In Streams 1 and 20, 30 different species from 20 families were identified in the BIC samples collected from hard substrates. The predominant benthic invertebrate taxon collected from hard substrates was Ephemeroptera (mayflies) in Stream 20 and bivalves (mussels) in Stream 1.

The density of benthic invertebrates collected from soft substrates and hard substrates in Stream 20 was variable. Taxa richness was slightly lower in samples collected from soft substrates than from hard substrates in Stream 20. Evenness was low in samples collected from hard substrates and moderate from soft substrates, while diversity was moderate for samples collected from hard substrates and high from soft substrates (Marathon 2020, BSA.4, Attachment 4-C).

9.1.2.4 Fish Community

Fish community sampling was completed as part of the Valentine Gold EIS (Marathon 2020). Additional fish studies were undertaken to support the Approved Project and Project Expansion since submission of the Valentine Gold EIS (Stantec 2022a,b; Appendix 9A). The updated information as it pertains to the Project Expansion is provided below.

Within the RAA, sea-run Atlantic salmon and ouananiche, brook trout, Arctic char, American eel, and threespine stickleback are known to occur (Cunjak and Newbury 2005; Porter et al. 1974). Brook trout, Arctic char, threespine stickleback, and ouananiche comprise the resident fish species (Marathon 2020). The streams, rivers, lakes and ponds in the RAA provide adequate spawning, rearing, migratory and overwintering habitat for these species to carry out their entire life processes in freshwater.

Sea-run Atlantic salmon and American eel comprise the diadromous species in the RAA, meaning that a portion of their life cycle is carried out in the marine environment. Sea-run Atlantic salmon migrate upstream to spawn, and their offspring spend their early life stages in freshwater. Juvenile Atlantic salmon leave the freshwater environment as smolts to grow and mature in the marine environment before returning to their natal rivers to spawn. The sea-run Atlantic salmon are part of the Northeast Newfoundland Atlantic Salmon population and are designated as Not-at-Risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (COSEWIC 2010). Total returns of salmon in 2020 to the Exploits River were similar to previous years (2014 to 2019), but overall show a decline relative to the previous 16 to 18 years (DFO 2022a). Like other Atlantic salmon populations, marine survival continues to be a major factor limiting the abundance of Atlantic salmon within the NL Region (DFO 2022a). These overall declines are consistent with other Atlantic salmon populations in Atlantic Canada.

For American eel, which spawn within the marine environment in the Sargasso Sea, the RAA provides adequate rearing, overwintering and migratory habitat to carry out their life processes. American eel is considered a single breeding population and is classified as Threatened by COSEWIC (COSEWIC 2012). Threats to the population include habitat alteration, dams and turbines, fishery harvest, changes to ocean conditions related to climate change, contaminants and parasites (COSEWIC 2012).

The migratory habitat of both sea-run Atlantic salmon and American eel is interrupted by a number of hydroelectric dams which provide upstream passage, however may not facilitate optimal downstream migratory passage.

Brook trout, ouananiche, Arctic char, and threespine stickleback are known to occur within the LAA (Marathon 2020, BSA.4, Attachment 4-A, Attachments 4-B and 4-C, Stantec 2021, 2023).

Fish sampling was conducted within the Aquatic Survey Area to determine if fish were present and to provide additional information on the abundance of fish in representative lakes, ponds and streams, and bog holes. Brook trout, ouananiche, Arctic char and threespine stickleback were captured in ponds, lakes or streams (Marathon 2020; Stantec 2022a). Despite substantial effort, no fish were captured in bog holes, indicating that bog holes are not fish bearing. For the fish species captured, YOY and adult life stages were confirmed present, suggesting that the habitat within the Aquatic Survey Area provides adequate spawning, rearing, migratory and overwintering habitat on a local scale for fish to carry out their life processes.

Fish diversity within the Aquatic Survey Area is low, with four species identified as being present, including brook trout, ouananiche, Arctic char, and threespine stickleback (Stantec 2012, Stantec 2018 to 2023). A summary of fish presence / absence in ponds and lakes within the Aquatic Survey Area is provided in Table 9.4.

Table 9.4 Confirmed Fish Presence within the Aquatic Survey Area Associated with the Project Expansion (2011 to 2022)

Waterbody/Watercourse	Species			
	Brook Trout	Ouananiche	Arctic Char	Threespine Stickleback
Valentine Lake	✓	✓	✓	✓
ValP3	-	✓	-	-
M2	✓	-	-	-
ValP2	-	-	-	✓
Stream 19	-	-	-	✓
Stream 20	-	-	-	✓
Stream 21	✓	✓	-	-
Stream 1	✓	✓	-	-
Stream 2	✓	-	-	-
Stream 38	✓	-	-	-
Stream 37	-	-	-	✓

Note:
No fish sampling was conducted in Stream 36 as the survey was completed by desktop; it is assumed brook trout and threespine stickleback are present based on connectivity.

Lakes, Ponds and Bog Holes

Brook trout, ouananiche, Arctic char, and threespine stickleback occur within Valentine Lake (Table 9.4; Stantec 2018 to 2023). Ouananiche is the dominant species in Valentine Lake, making up 99% of the total catch (Stantec 2022b). Standardized gill netting methods indicated that the relative abundance was 7.1 ouananiche per gang hour (range 1.2 to 21.6 fish per gang hour), and 0.0 Arctic char and brook trout per gang hour (range 0.0 to 0.7 fish and 0.0 to 0.5 fish per gang hour, respectively). Catch per unit of effort (CPUE) for sticklebacks in Valentine Lake was 7.1 to 7.7 fish per hour for fyke nets (Marathon 2020).

In Valentine Lake, fork lengths for ouananiche ranged from 171 to 385 millimetres (mm), 125 to 209 mm for Arctic char, and 55 to 210 mm for brook trout (Stantec 2022a,b). Age ranged from three to eight years for ouananiche, two to five years for Arctic char, and one to seven years for brook trout (Stantec 2022a,b).

Brook trout and ouananiche were confirmed present in ValP3 (Table 9.5; Marathon 2020, BSA.4, Attachments 4-B and 4-C), and threespine stickleback likely occur as there is connectivity with Valentine Lake (Marathon 2020). CPUE was 1.3 ouananiche per hour for gill nets (Marathon 2020). In ValP3, fork lengths for ouananiche ranged from 175 to 355 mm (Marathon 2020, BSA.4, Attachment 4-C), and similarly sized fish likely have similar ages to other ouananiche in the area (Stantec 2022a,b).

Table 9.5 Catch Per Unit Effort for Fish Sampling in Ponds in the Aquatic Survey Area Associated with the Project Expansion (2011 to 2022)

Major Sub-Watershed	Location	Sampling Method [1]	Total Effort (hours)	Brook Trout	Ouananiche	Threespine Stickleback
Valentine Lake	ValP2	Gillnet (8)	282.7	0.0	0.0	0.0
Valentine Lake	M2	Gillnet (1)	0.1	-*	0.0	0.0
Valentine Lake	ValP3	Gillnet (1)	1.5	0.0	1.3	0.0

Notes:
[1] Number in brackets is number of gillnet sets
* Effort not representative as fish were accidentally spooked into net

Brook trout were confirmed present in M2 (Table 9.5; Stantec 2020), and threespine stickleback likely occur as there is connectivity with ValP3 (Marathon 2020). CPUE was not representative as fish were accidentally spooked into the net (Stantec 2020). In ValP3, fork lengths for ouananiche ranged from 139 to 296 mm (Stantec 2020), and similarly sized fish likely have similar ages to other brook trout in the area (Stantec 2022a,b).

Only threespine stickleback is present in ValP2 as a result of a substantial waterfall located on Stream 20/21 (Stantec 2012). No CPUE is available, however, based on other ponds with similar fish communities in the area, likely ranges from 0.4 to 1.3 fish per hour (Marathon 2020).

Bog holes in the Aquatic Survey Area were determined to be fishless (Marathon 2020, BSA.4, Attachment 4-C; Stantec 2021; Stantec 2023 [Appendix 9A]).

Streams

Salmonids were absent in Streams 19, 20 and 37, because of barriers to fish passage (Figure 9-1). Brook trout were found in Streams 1, 21 and 38, and ouananiche were found in Streams 1 and 21 (Table 9.4). Threespine stickleback were confirmed present in Streams 19, 20 and 37 (Table 9.4).

A summary of CPUE by species is provided in Table 9.5 for streams surveyed using backpack electrofishing in 2011 to 2022 within the Aquatic Survey Area associated with the Project Expansion. For Streams 19, 20 and 37, the CPUE for salmonids was zero as they were absent due to downstream barriers to fish upstream passage (Figure 9-1). In streams accessible to salmonids, brook trout CPUE ranged from 21 to 59 fish/1,000 seconds (s), ouananiche from 0 to 11 fish/1,000 s, and threespine stickleback from 0 to 101 fish/1,000 s (Table 9.6). Of the species captured, the highest overall CPUE was for brook trout.

In streams within the Aquatic Survey Area associated with the Project Expansion, ouananiche ranged from 28 to 104 mm (YOY to juvenile) and brook trout ranged from 33 to 159 mm (YOY to adult) (Marathon 2020, BSA.4, Attachments 4-A and 4-C; Stantec 2023).

Table 9.6 Summary of Catch Per Unit Effort for Fish Sampling in Streams of the Aquatic Survey Area associated with the Project Expansion (2011 to 2022)

Major Sub-Watershed	Stream	Fishing Time (seconds)	Number of Fish Captured				Catch Per Unit Effort (# per 1000 seconds)			
			Brook Trout	Ouananiche	Threespine Stickleback	All Species	Brook Trout	Ouananiche	Threespine Stickleback	All Species
Valentine Lake	(20) ValLK-ValP2	927	0	0	5	5	0	0	5	5
Valentine Lake	(19) ValP1-ValP2	207	0	0	21	21	0	0	101	101
Valentine Lake	(21) ValLK-ValP2	844	50	9	1	60	59	11	1	71
Valentine Lake	(1) Outlet of ValP3	354	14	1	0	15	40	3	0	42
Valentine Lake	(1) ValP3-ValLK	338	20	2	0	22	59	6	0	65
Valentine Lake	(2) ValP3 to M3	445	1	0	0	1	2	0	0	2
Valentine Lake	(37) Inlet to ValP2	544	0	0	0	0	0	0	0	0
Valentine Lake	(38) Inlet to Valentine Lake	374	8	0	0	8	21	0	0	21

9.1.2.5 Fish Habitat Usage

Fish habitat usage by the species that reside in those habitats was characterized for lacustrine (ponds, lakes, bog holes) and riverine (rivers, streams) habitats, as part of the Valentine Gold EIS (Marathon 2020). Fish habitat usage in the Aquatic Survey Area was updated from the Valentine Gold EIS based on the results of additional fish and fish habitat surveys.

Photos of representative habitat for each stream are provided in the Valentine Gold EIS (Marathon 2020, BSA.4) and Appendix 9A. Habitat quality in streams was highly variable. Small order streams that drained wetlands were generally poor for spawning, YOY, juvenile and adult life stages of brook trout and ouananiche due to the large quantity of fine grain substrates, while providing excellent habitat for threespine stickleback based on the habitat suitability indices in McCarthy et al. (2007). Rocky reaches of streams containing localized areas or reaches of flowing water containing sand, gravel and cobble, provided good to excellent habitat for spawning and rearing habitat for YOY, juvenile and adult life stages of brook trout. Higher order streams within flowing stream habitat and gravel and cobble substrates provided spawning habitat and rearing habitat for YOY and juvenile ouananiche.

Suitable brook trout spawning and YOY habitat was generally patchy in distribution throughout the areas surveyed and limited to areas with coarser substrates that also contained small patches of gravel suitable for brook trout spawning (Figures 9-2 and 9-3). Juvenile and adult brook trout habitat is more widely available, since smaller (fine) substrates are considered suitable (Figures 9-4 and 9-5). Based on the depths in Valentine Lake, there is an abundance of brook trout habitat along the shoreline (Figures 9-2 to 9-5).

Suitable ouananiche spawning, YOY and juvenile habitat within the LAA is patchy and mainly limited to the downstream portions of streams containing gravel / cobble substrates, with increased stream flow and depth (Figures 9-6 to 9-8). Based on the depths in Valentine Lake, there is an abundance of ouananiche habitat along the shoreline, including habitat for adult life stages (Figures 9-6 to 9-9).

Habitat suitable for threespine stickleback spawning, YOY, juvenile and adult life stages within the LAA are similar, therefore the data of suitable habitat was pooled. Overall, all life stages of threespine stickleback were found in shallow depths with soft substrates (Figure 9-10). In Valentine Lake, habitat for threespine stickleback was also associated with shallow habitat along the shoreline (Figure 9-10).

Lakes, ponds and beaver impoundments likely provide the majority of overwintering habitat for brook trout, ouananiche and threespine stickleback (Figure 9-11). Other smaller areas of groundwater input or seeps may also provide overwintering habitat in streams or ponds on a scale too small to be indicated on the figure.

Habitat suitable for Arctic char spawning, YOY and juvenile habitat within the LAA is limited to Valentine Lake and Victoria Lake Reservoir (Figures 9-12 to 9-14). Based on the depths in Victoria Lake Reservoir and Valentine Lake, there is an abundance of Arctic char habitat in deep areas, including habitat for juvenile stages (Figures 9-12 to 9-15).

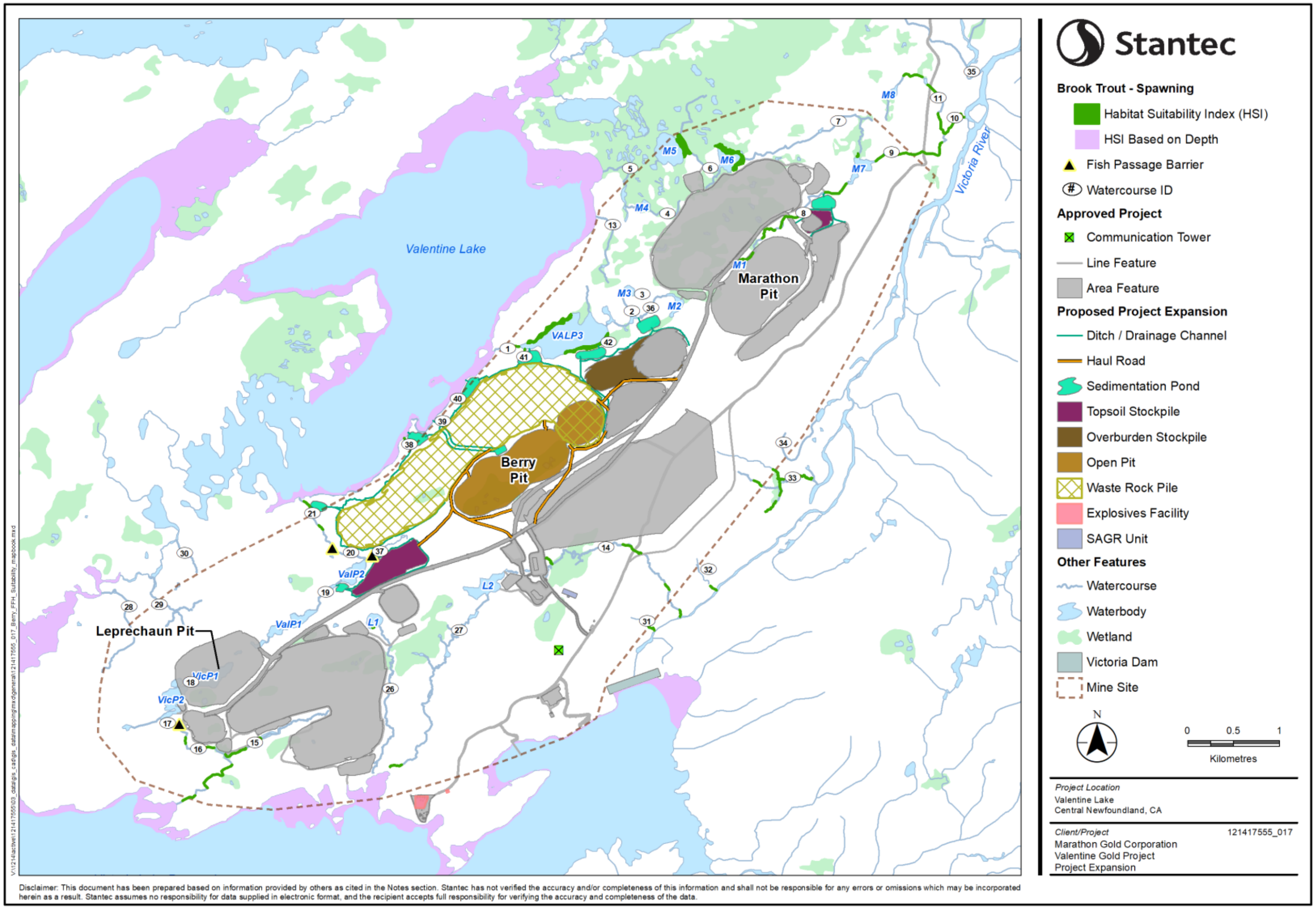


Figure 9-2 Suitable Habitat for Brook Trout – Spawning

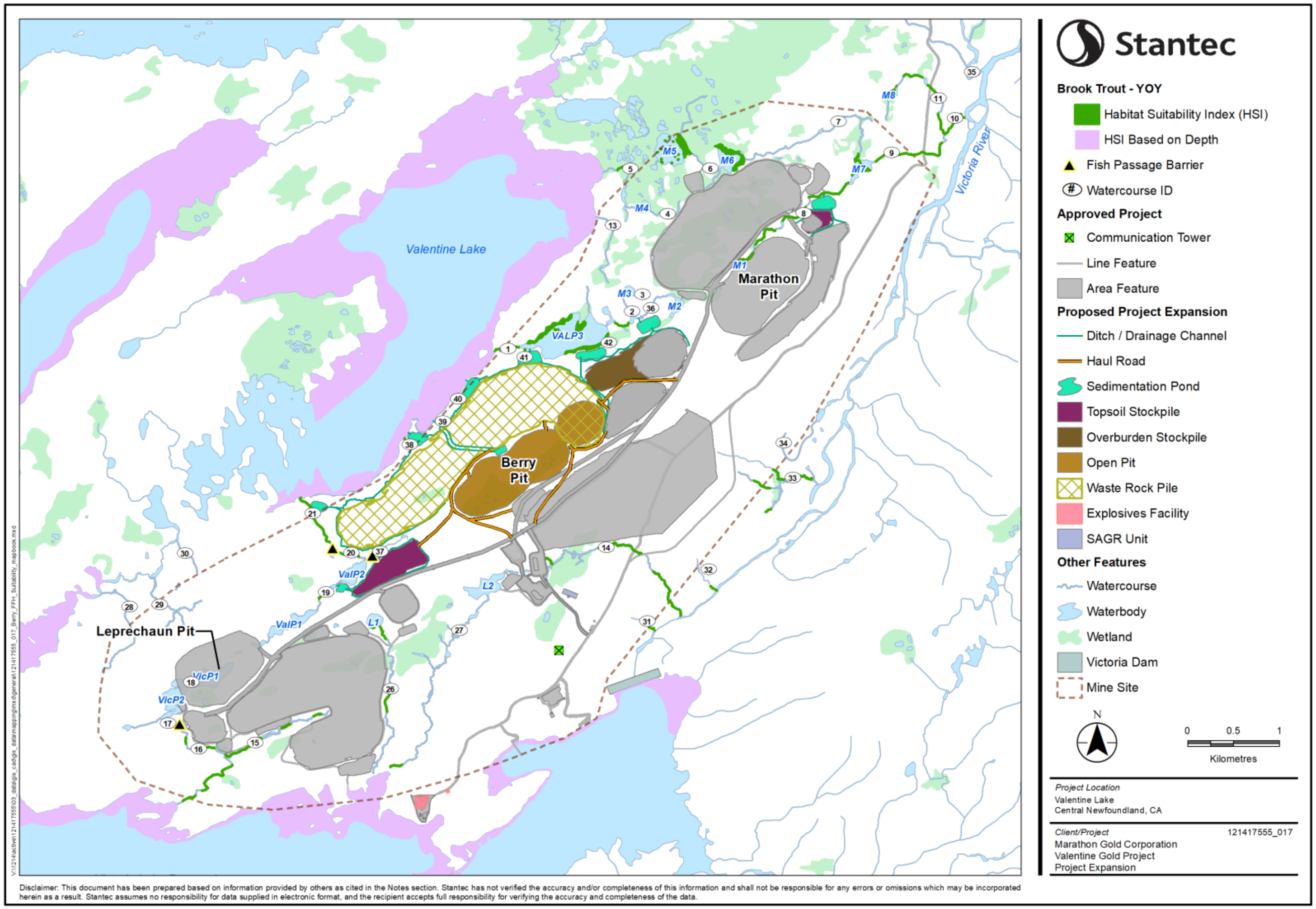


Figure 9-3 Suitable Habitat for Brook Trout – YOY

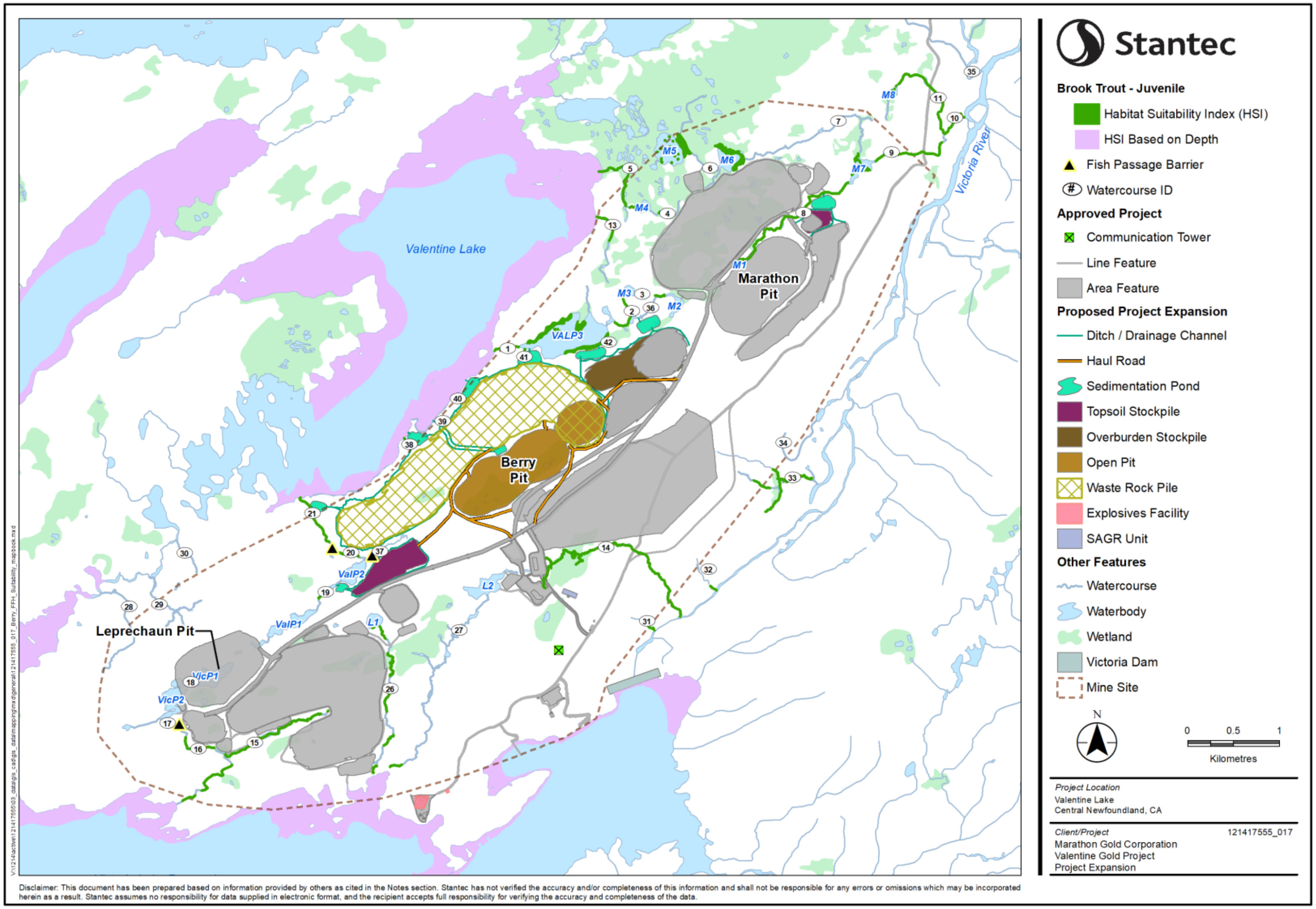


Figure 9-4 Suitable Habitat for Brook Trout – Juvenile

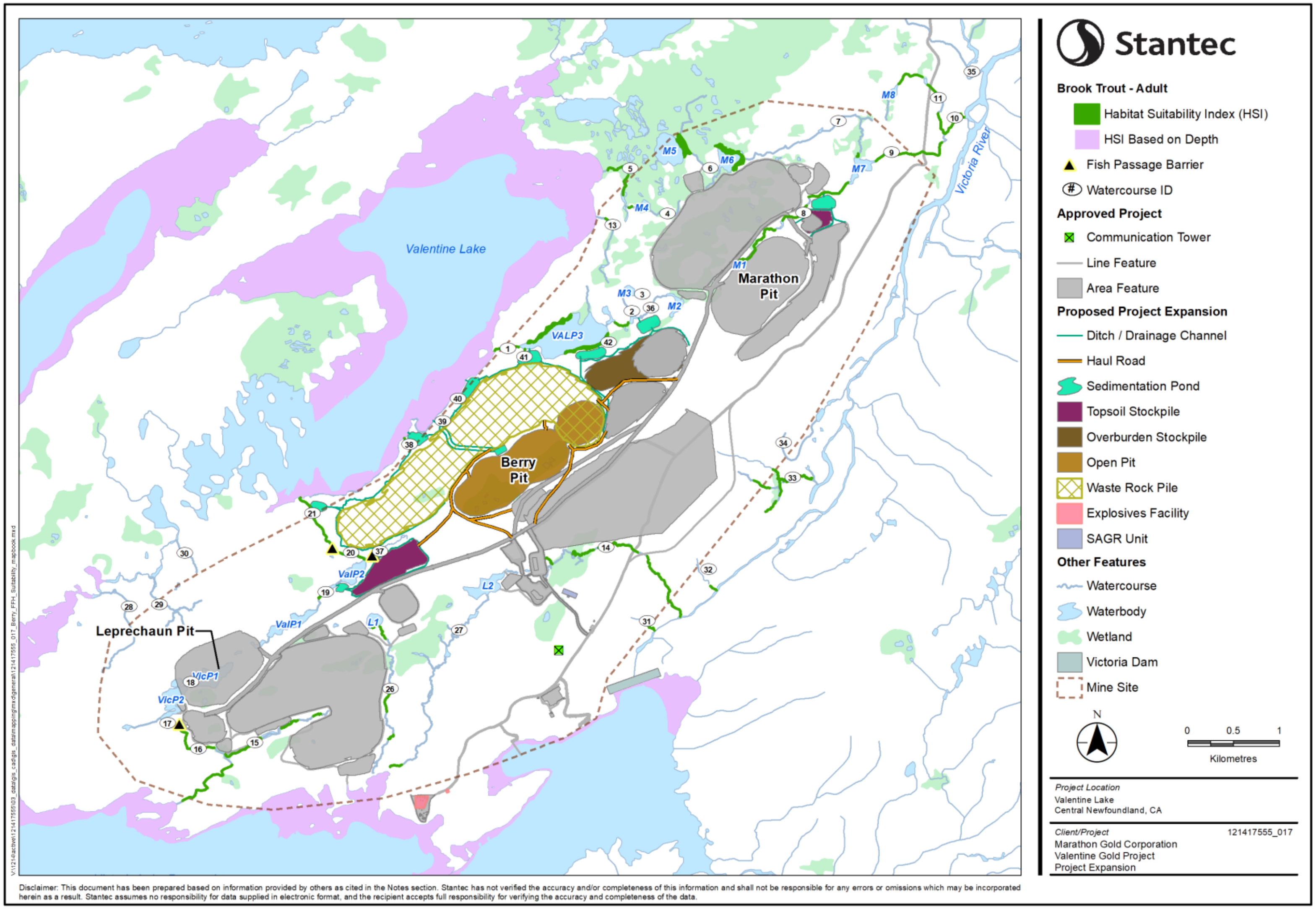


Figure 9-5 Suitable Habitat for Brook Trout – Adult

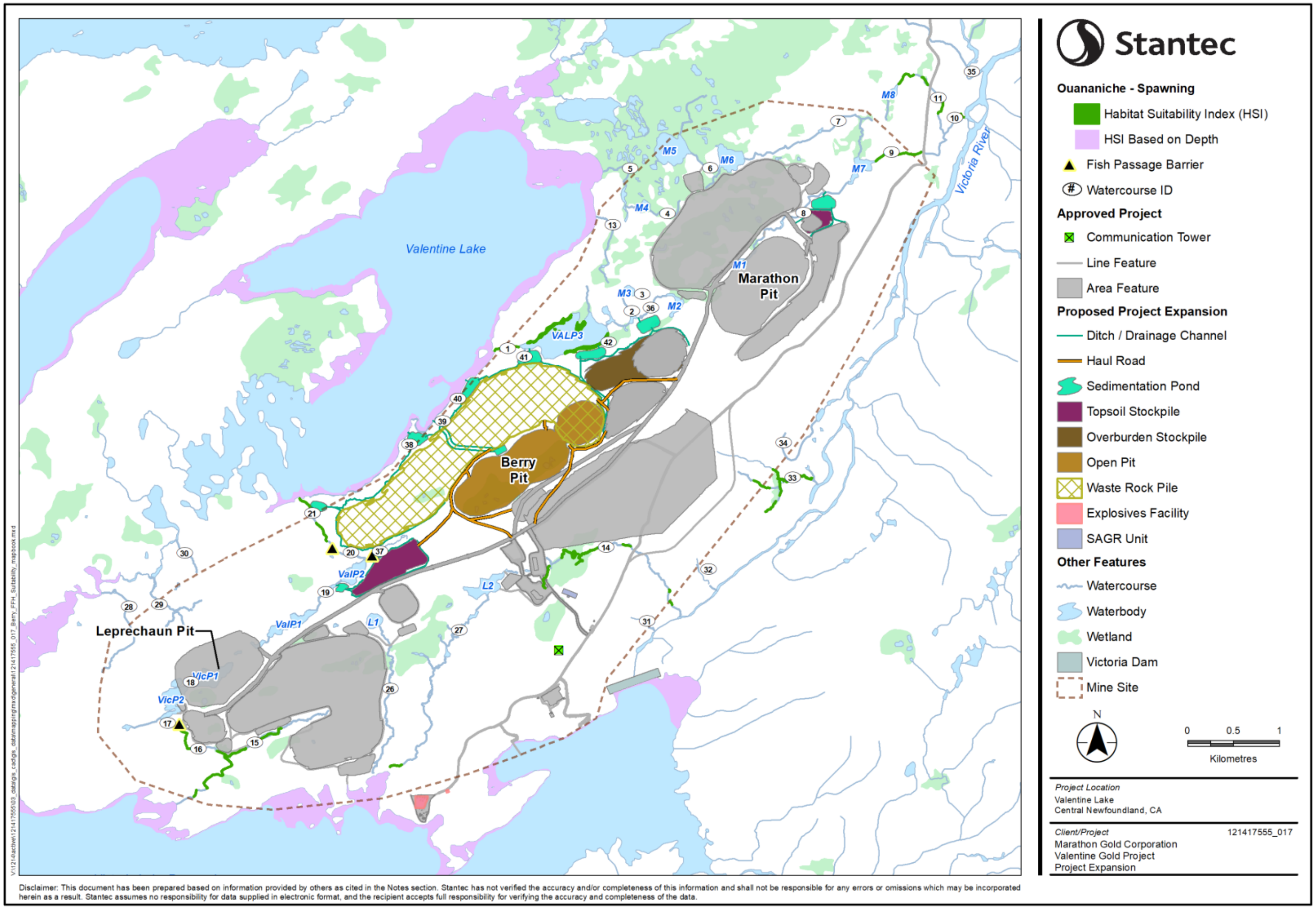


Figure 9-6 Suitable Habitat for Ouananiche – Spawning

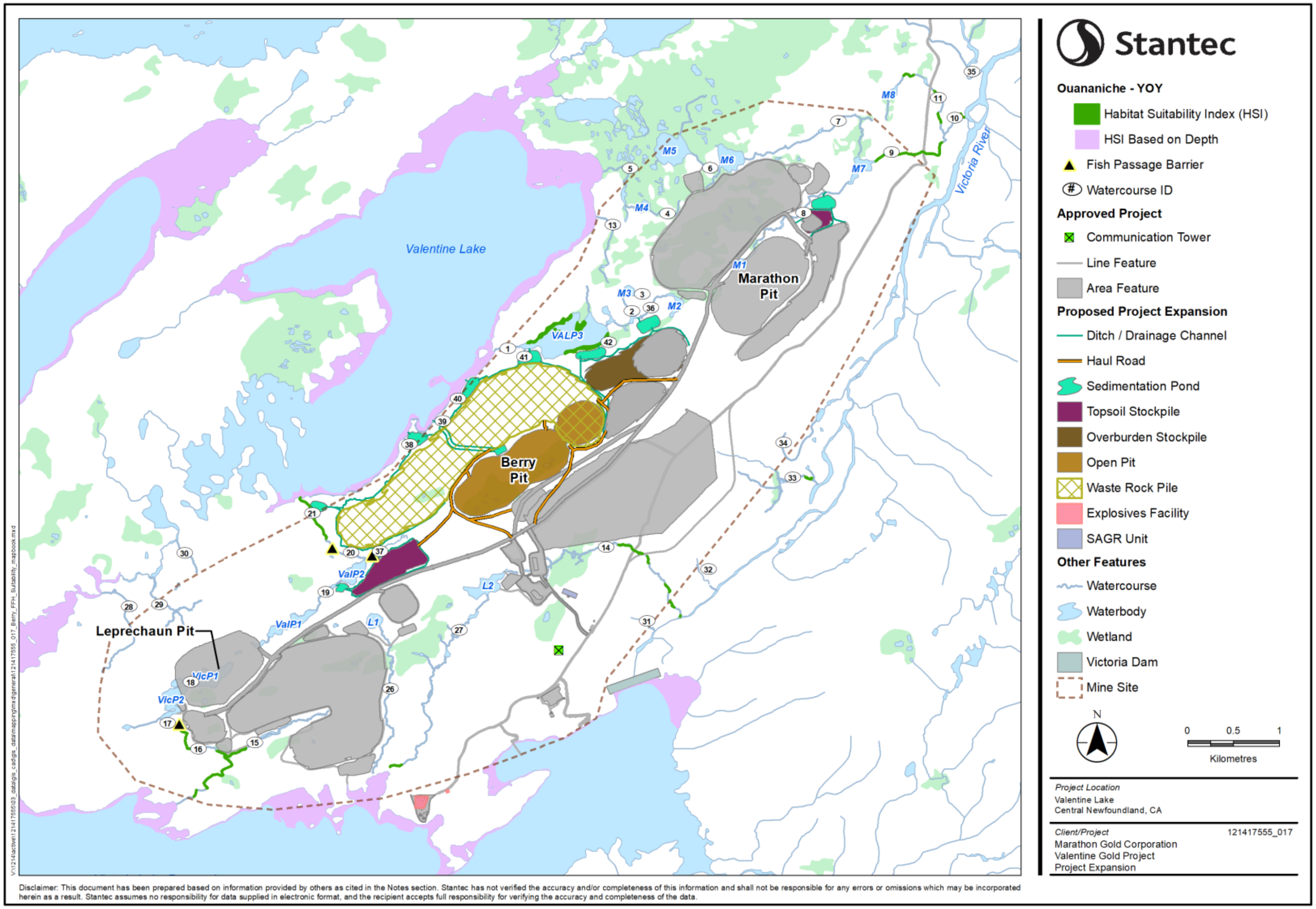


Figure 9-7 Suitable Habitat for Ouananiche – YOY

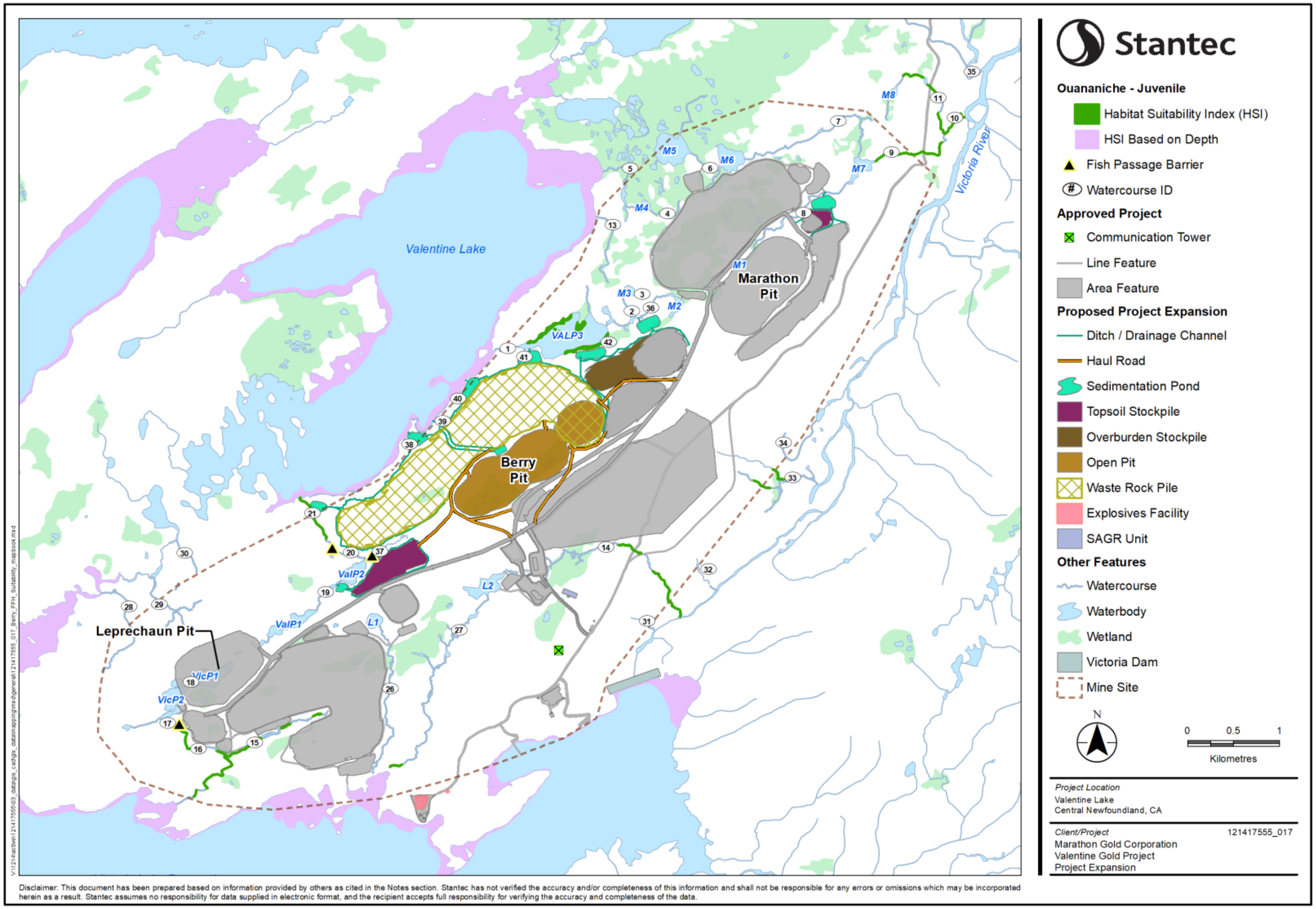


Figure 9-8 Suitable Habitat for Ouananiche – Juvenile

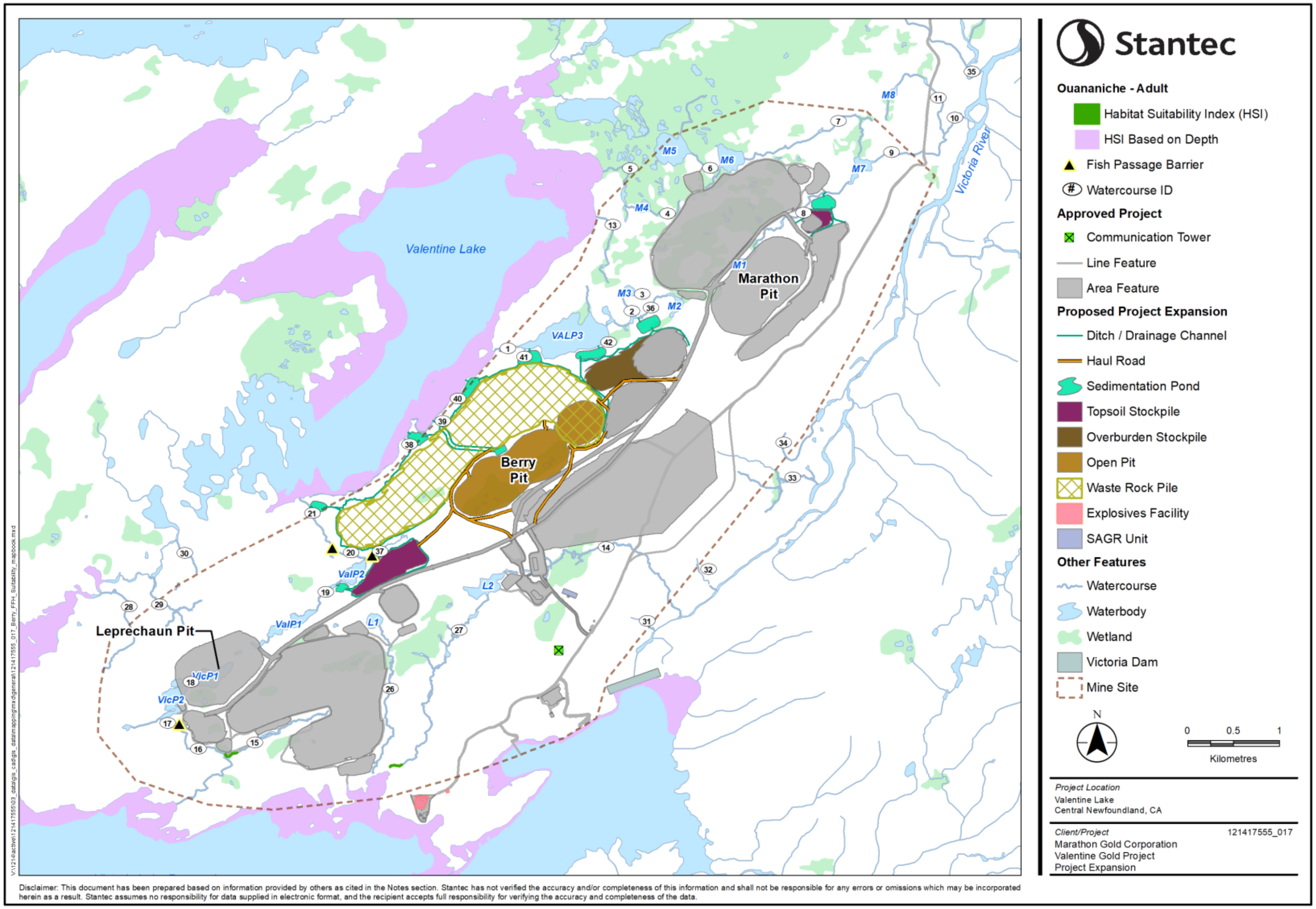


Figure 9-9 Suitable Habitat for Ouananiche – Adult

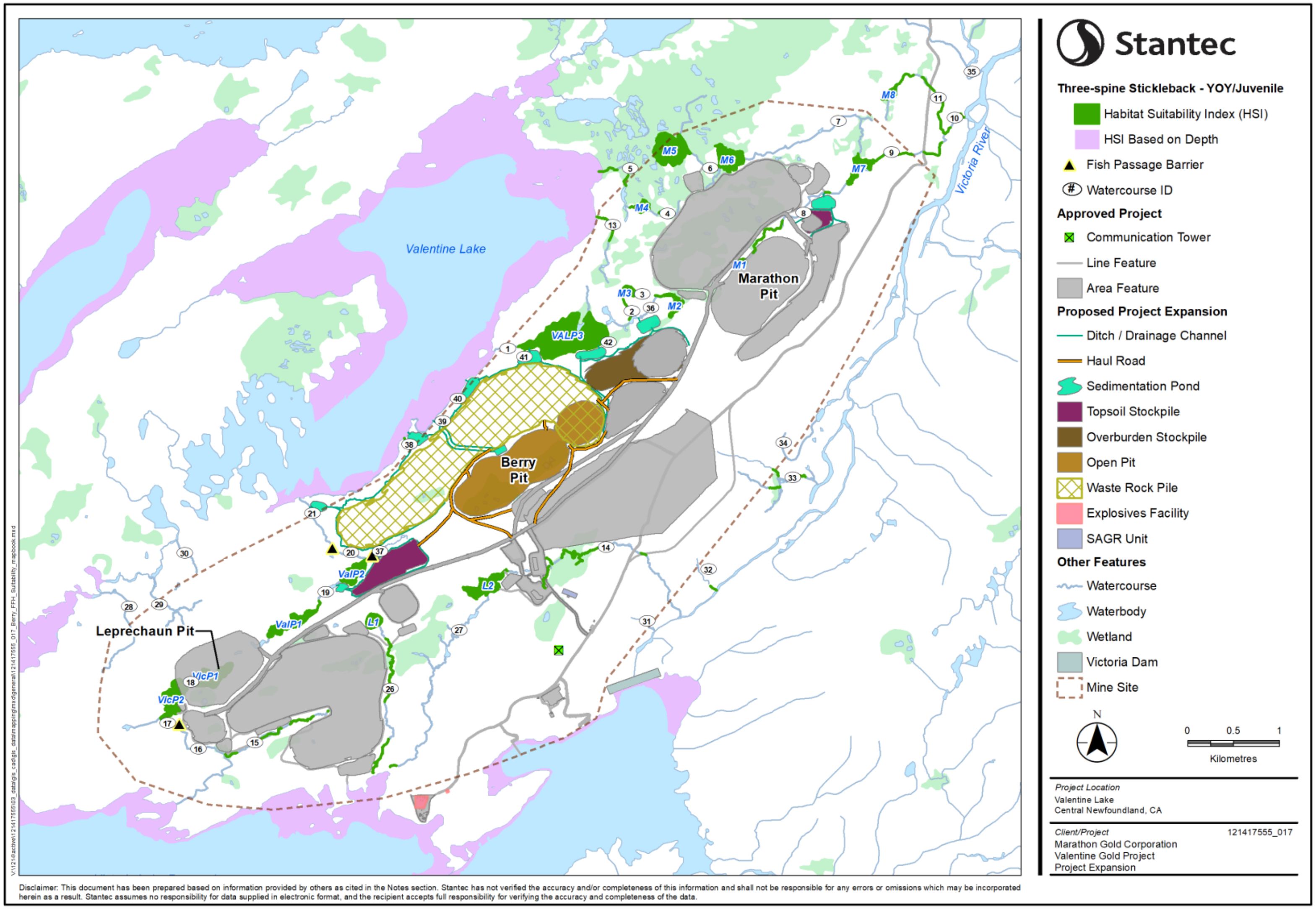


Figure 9-10 Suitable Habitat for Threespine Stickleback – YOY/Juvenile

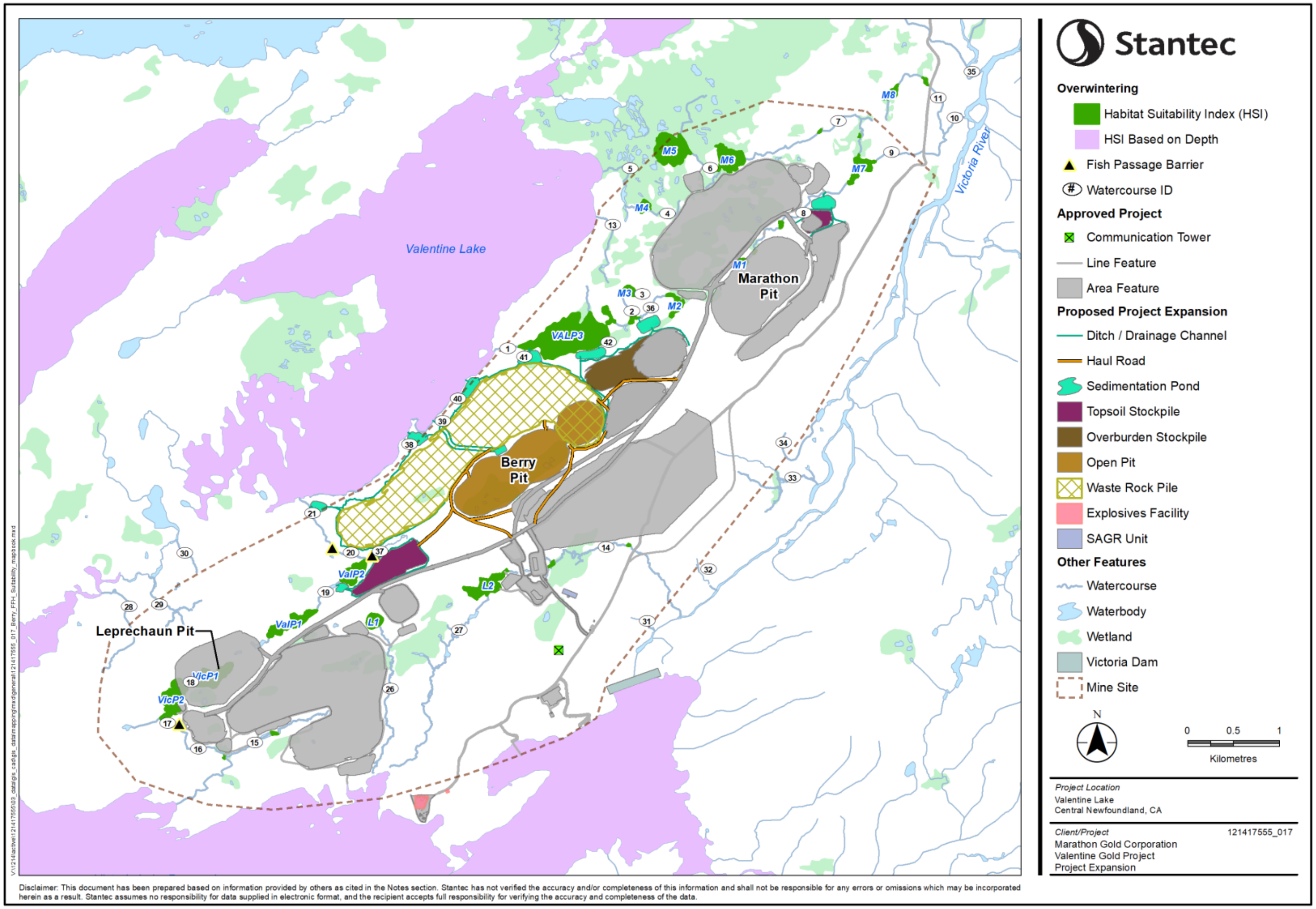


Figure 9-11 Suitable Habitat for Brook Trout, Ouananiche, Arctic Char and Threespine Stickleback – Overwintering

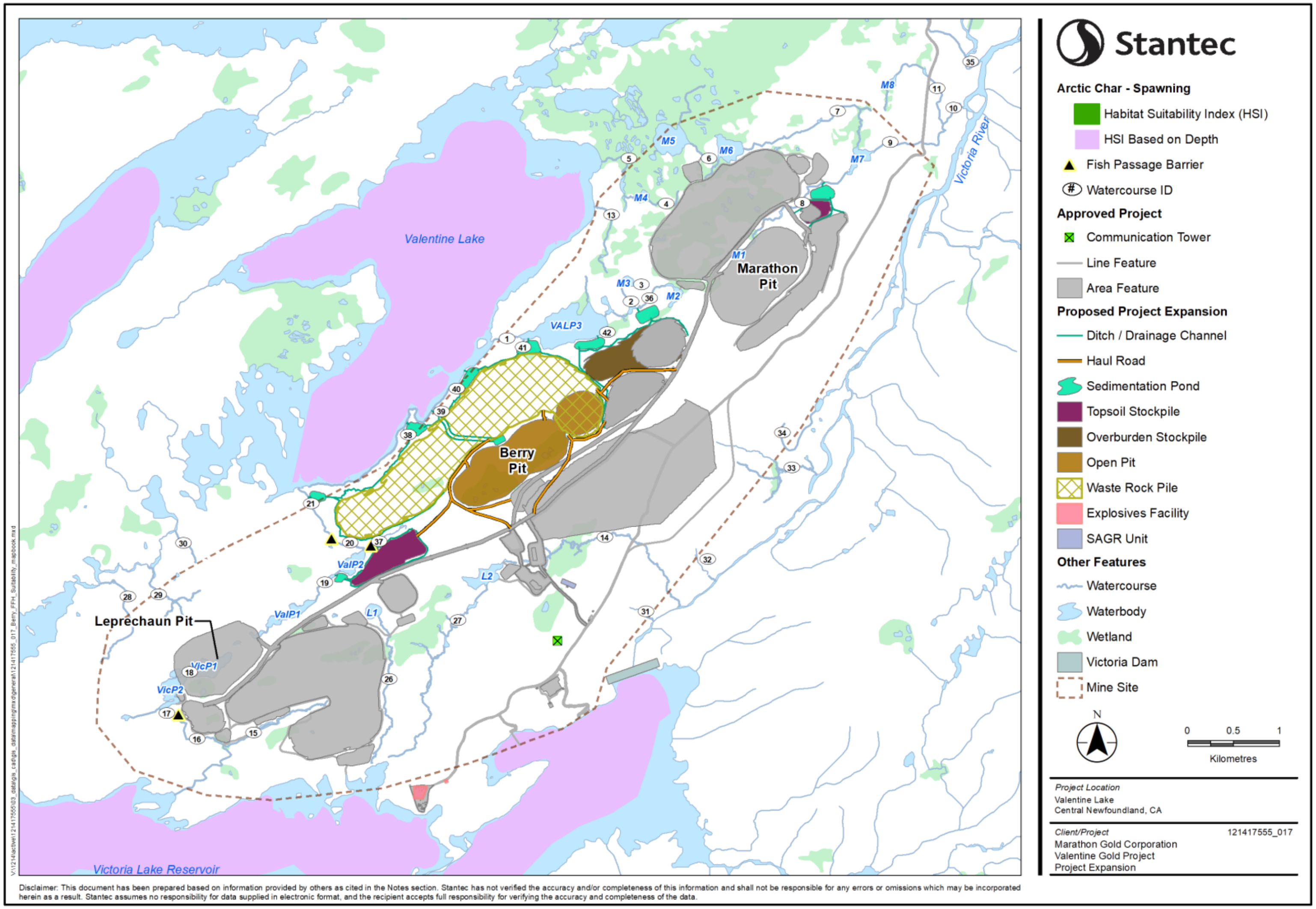


Figure 9-12 Suitable Habitat for Arctic Char – Spawning

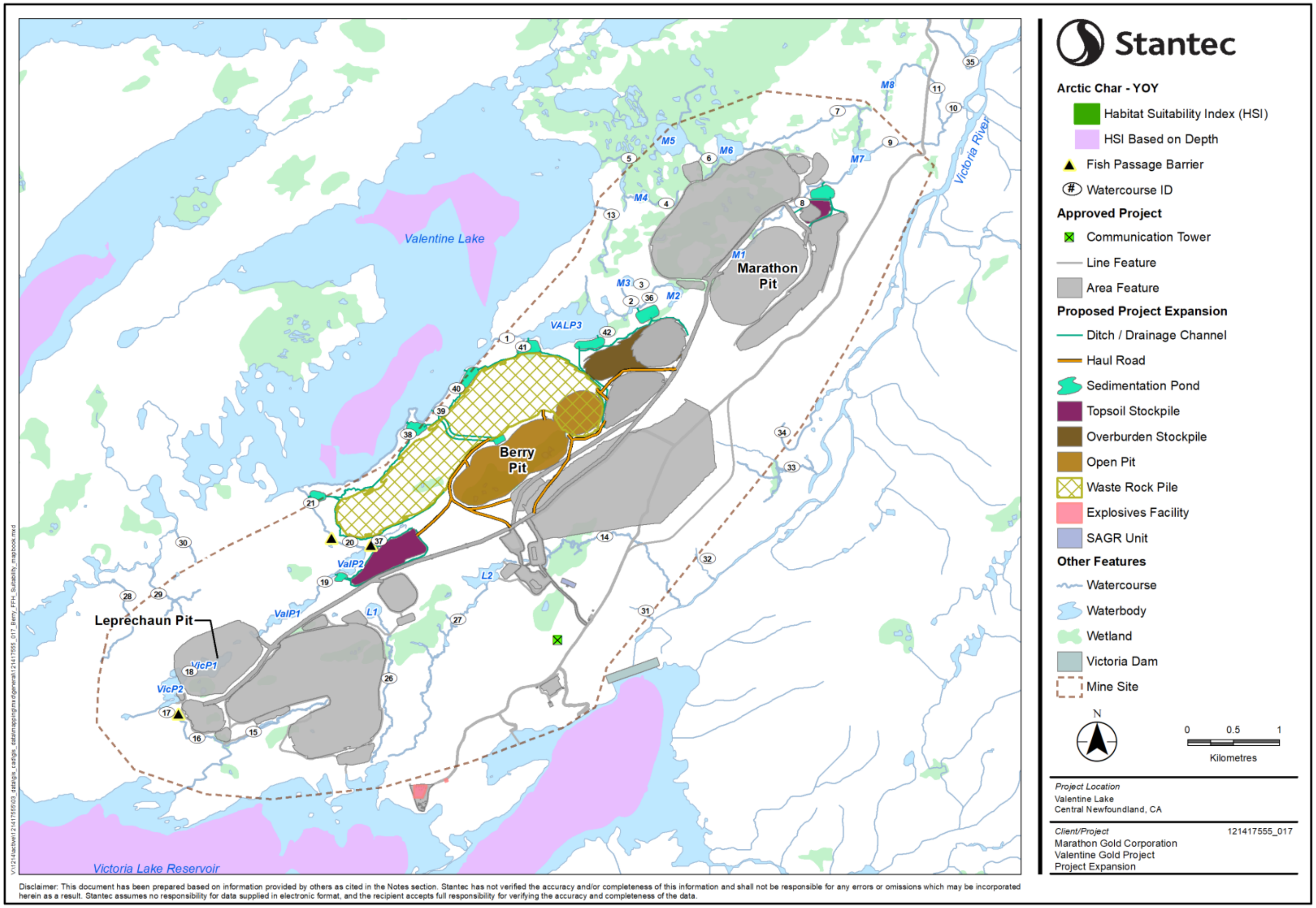


Figure 9-13 Suitable Habitat for Arctic Char – YOY

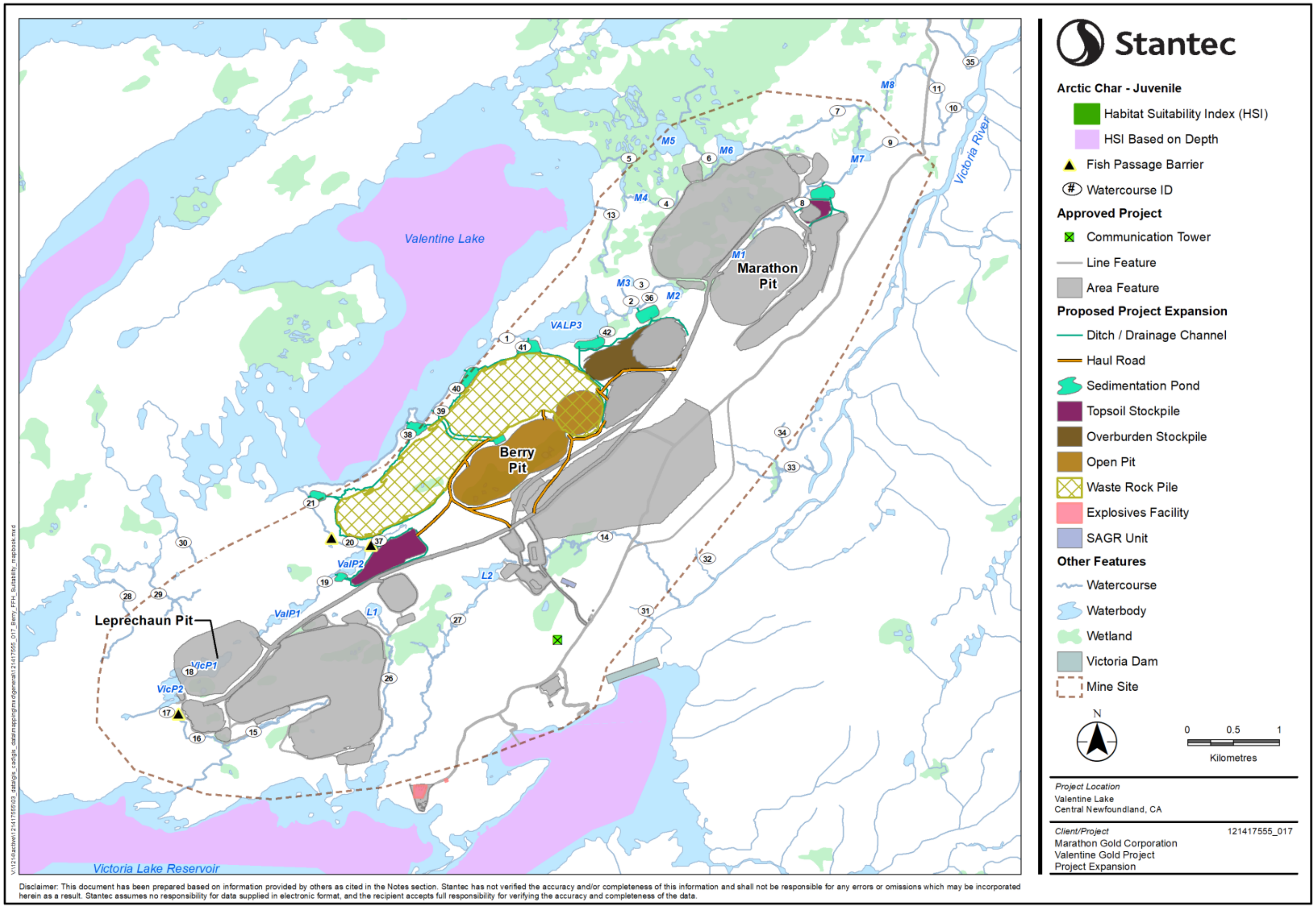


Figure 9-14 Suitable Habitat for Arctic Char – Juvenile

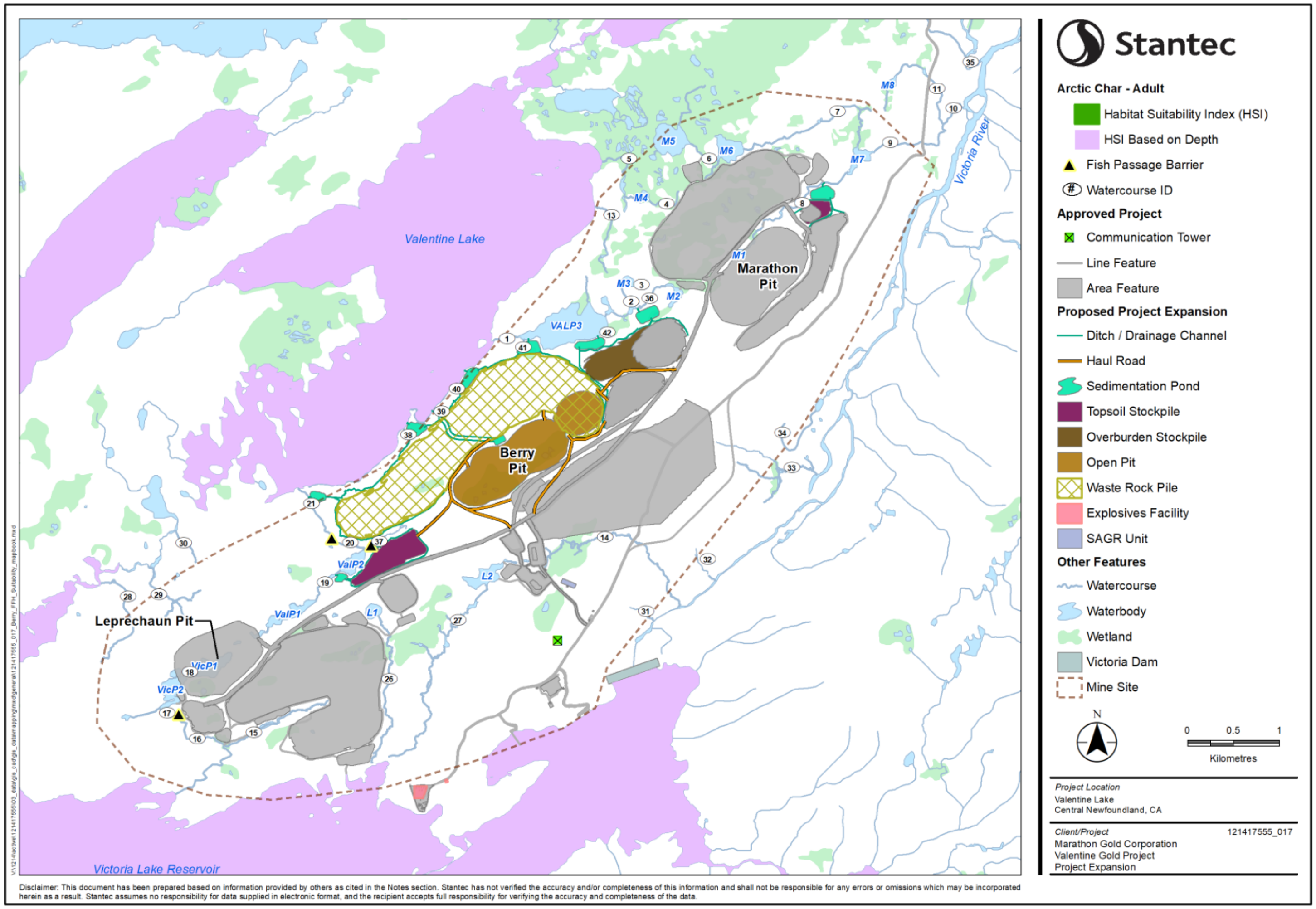


Figure 9-15 Suitable Habitat for Arctic Char – Adult

9.2 PROJECT EXPANSION INTERACTIONS AND PATHWAYS

Table 9.7 lists the potential Project Expansion effects on fish and fish habitat and provides a summary of the Project Expansion effect pathways and measurable parameters and units of measurement to assess effects. These are consistent with those used for the Approved Project in the Valentine Gold EIS. Potential environmental effects and measurable parameters were selected based on review of recent environmental assessments for mining projects in NL and other parts of Canada, comments provided during engagement, and professional judgment.

Table 9.7 Potential Effects, Effect Pathways and Measurable Parameters for Fish and Fish Habitat

Potential Environmental Effect	Effect Pathway	Measurable Parameters and Units of Measurement
Change in fish habitat quality	• Alteration of riparian vegetation • Use of industrial equipment in or near water • Change in watershed area, water level or flow • Release of deleterious substances • Mine waste / rock disposal • Wastewater management	• Habitat Suitability Index for fish (e.g., water depth, substrate, velocity, cover) • Water quality, including total suspended solids (mg/L); dissolved oxygen (mg/L); water temperature (°C); pH; nutrients, cyanide, ammonia and other contaminants of potential concern (e.g., trace metals) • Monthly flows (m^3/s) and water level (m)
Change in fish habitat quantity	• Dewatering or infilling • Change in watershed area, water level or flow	• Area (m^2) of lost habitat
Change in fish health and survival	• Use of industrial equipment in or near water • Placement of Project Expansion infrastructure in water • Release of deleterious substances • Mine waste / rock disposal • Wastewater management • Use of explosives • Increased recreational fishing pressure	• Abundance (numbers of fish) • Mortality (numbers of fish) • Sublethal effects to fish including reproduction and growth

Table 9.8 identifies the physical activities that might interact with the VC and result in the identified environmental effect. These interactions are indicated by checkmark and are discussed in detail in Section 9.4, in the context of effects pathways, standard and project-specific mitigation measures / enhancement, and residual effects. Following the table, justification is provided for where no interaction (and therefore no resulting effect) is predicted.

Table 9.8 Project Expansion-Environment Interactions with Fish and Fish Habitat

Physical Activities	Environmental Effects to Be Assessed		
	Change in Fish Habitat Quality	**Change in Fish Habitat Quantity**	**Change in Fish Health and Survival**
CONSTRUCTION			
Mine Site Preparation and Earthworks: Clearing and cutting of vegetation and removal of organic materials, development of roads, and excavation and preparation of stockpile areas within the Project Expansion footprint. For the open pit, earthworks include stripping, stockpiling of organic and overburden materials, and development of in-pit quarries to supply site development rock for infrastructure such as structural fill and road gravels. Also includes temporary surface water and groundwater management, and the presence of people and equipment on site.	✓	✓	✓
Construction / Installation of Infrastructure and Equipment: Construction of infrastructure as required for the Project Expansion. Also includes: • Installation of water control structures (including earthworks) • Presence of people and equipment on-site	✓	✓	✓
Emissions, Discharges and Wastes[A]: Noise, air emissions / greenhouse gases (GHGs), light, water discharge, and hazardous and non-hazardous wastes.	✓	–	✓
OPERATION			
Open Pit Mining: Blasting, excavation and haulage of rock from the open pits using conventional mining equipment.	✓	✓	✓
Topsoil, Overburden and Rock Management: Four types of piles: • Topsoil • Overburden • Waste rock • Low-grade ore • Rock excavated from the open pit that will not be processed for gold will be used as engineered fill for site development, maintenance and rehabilitation, assuming it is non-acid generating, deposited in mined out basins of Berry pit, or deposited in a waste rock pile.	✓	✓	✓
Tailings Management: Following treating tailings via cyanide destruction, tailings will be thickened and pumped to an engineered tailings management facility (TMF) in years 1 to 9, then pumped to the exhausted Berry open pit in year 10 to the end of operation. Marathon plans to upgrade the water treatment process by replacing the proposed polishing pond with a smaller SAGR unit that provides improved treatment of nitrogen species.	✓	–	✓
Water Management (Collection, Treatment and Release): Site contact water and process effluent will be managed on site and treated prior to discharge to the environment. Where possible, non-	✓	✓	✓

Table 9.8 Project Expansion-Environment Interactions with Fish and Fish Habitat

Physical Activities	Environmental Effects to Be Assessed		
	Change in Fish Habitat Quality	Change in Fish Habitat Quantity	Change in Fish Health and Survival
contact water will be diverted away from mine features and infrastructure, and site contact and process water will be recycled to the extent possible for use on site.			
Utilities, Infrastructure and Other Facilities: Most utilities, infrastructure and facilities remain unchanged, and are as described in the Valentine Gold EIS (Marathon 2020) and assessed as part of the Approved Project. Relocation of the explosives facility, maintenance of Berry haul road and site snow clearing will be required for the Project Expansion. Note that while the location of the explosives facility has changed, the design and activities associated with the facility have not.	–	–	–
Emissions, Discharges and Wastes[A]: Noise, air emissions / GHGs, light, water discharge, and hazardous and non-hazardous wastes.	✓	–	✓
Employment and Expenditure Operation of the combined Approved Project and Project Expansion is estimated to require a peak workforce of approximately 524 fulltime equivalents (FTEs) (44 FTEs above the Valentine Gold EIS estimate) and an average of 366 FTEs.	–	–	✓
DECOMMISSIONING, REHABILITATION AND CLOSURE			
Decommissioning of Mine Features and Infrastructure	✓	✓	✓
Progressive Rehabilitation: Erosion stabilization and re-vegetation of completed overburden and/or waste rock piles; infilling or flooding of exhausted mining areas; and completing revegetation studies and trials.	✓	–	✓
Closure Rehabilitation: Active rehabilitation based on successes of progressive rehabilitation activities. Includes: grading and revegetating cleared areas, where practicable; breaching and regrading ponds to reestablish drainage patterns; erosion stabilization and revegetation of completed overburden and/or waste rock piles; and infilling or flooding of open pit.	✓	✓	✓
Post-Closure: Long-term monitoring	–	–	–
Emissions, Discharges and Wastes[A]	✓	–	✓

Notes:
✓ = Potential interaction
– = No interaction
A Emissions, Discharges, and Wastes (e.g., air, waste, noise, light, liquid and solid effluents) are generated by many Project Expansion activities. Rather than acknowledging this by placing a checkmark against each of these activities, “Wastes and Emissions” is an additional component under each Project Expansion phase.

Avoidance measures will reduce potential direct interactions between Project Expansion components or activities and fish and fish habitat by physically relocating these components and activities away from fish and fish habitat, where practicable. The Project Expansion pathways that have been identified are consistent with those for the Approved Project (Marathon 2020). A high-level summary is provided below.

In the absence of mitigation measures, the Project Expansion may interact with fish and fish habitat in the following ways:

- Mine Site Preparation and Earthworks including clearing vegetation, stripping soils and grading for infrastructure construction may alter water quantity and quality related to runoff
- Construction / Installation of Infrastructure and Equipment including topsoil stockpiles, overburden stockpiles and waste rock piles, may result in indirect habitat loss due to a change in the quantity and quality of expected runoff
- Emissions, Discharges, and Wastes, including contact water runoff, seepage and effluent discharge, may affect water quantity, water quality, and fish health and survival
- Open Pit Mining may alter the surface water quantity and quality entering local watersheds; the Berry basins will be allowed to fill during decommissioning, rehabilitation and closure
- Tailings Management; Topsoil, Overburden and Rock Management; Water Management; and In-pit Tailings Disposal in Berry pit may alter contact water runoff and seepage if not adequately contained or treated to acceptable standards prior to entering the receiving environment, which could affect water quality
- Increased Employment during operation of the Project Expansion could interact with fish health and survival if the presence of Project workers results in increased angling activity in the area
- Progressive Rehabilitation and Closure Rehabilitation may alter water quantity and quality by changing runoff patterns. Surface water runoff quality may also be affected by possible exposure to PAG materials.

The primary Project Expansion-related activities that may result in effects to fish and fish habitat are anticipated to result from changes to local drainage areas due to construction of stockpiles and the open pit and dewatering during operation, and the introduction of treated contact water into the receiving environment through selected discharge points and indirectly through seepage.

The following Project Expansion activities and components are not expected to result in a change in fish habitat quality or quantity, or fish health and survival:

- In-pit tailings storage in Berry pit instead of Leprechaun pit is not anticipated to affect fish or fish habitat downstream; discharges from the pit will be treated as required to meet CWQG-FAL or baseline levels prior to discharge
- Utilities, Infrastructure and Other Facilities will occur on land, away from lakes, ponds and streams, and will not interact with fish and fish habitat
- While the positive effects resulting from progressive and closure rehabilitation may continue following closure, the long-term post-closure monitoring activities during decommissioning, rehabilitation and closure are not anticipated to interact with fish and fish habitat in a substantive way

9.3 MITIGATION AND MANAGEMENT MEASURES

A series of environmental management plans have been developed by Marathon for the Approved Project, and these will be updated as applicable to also apply to, and mitigate the environmental effects of, the Project Expansion. Mitigation and management measures previously committed to in relation to the Approved Project can be found in Appendix 2E. These measures will be applied to the Project Expansion, as applicable. A new Offsetting Plan will be developed for the Project Expansion (discussed further in Section 9.5.2.1); however, no other new mitigation and management measures specific to the Project Expansion are anticipated to be required.

9.4 SUMMARY OF APPROVED PROJECT RESIDUAL EFFECTS

For the Approved Project, residual effects on fish habitat quantity were reduced through commitments to the application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat". Where residual adverse effects remained, these were counterbalanced by commitments to offsetting through an authorization pursuant to the *Fisheries Act*, which aims for a net gain of fish habitat. It was determined that changes to stream flow could occur in all Approved Project phases. Streams with decreases in mean annual flow greater than 10% were considered to result in adverse effects to fish habitat. With standard mitigation, and based on the Approved Project design, the Approved Project was conservatively anticipated to result in the direct and indirect loss of 183,537 m^2 of fish habitat (habitat alteration, disruption or destruction (HADD) of fish habitat requiring authorization under the *Fisheries Act)* within the LAA. The potential HADD associated with the access road had not been determined at the time of submission of the Valentine Gold EIS. Of the fish habitat lost, 30% was used by salmonids to carry out their life processes, with the remaining 70% used by sticklebacks. Overall, the effects to fish habitat were not expected to affect sustainability and productivity of the fisheries, and fish habitat loss was planned to be offset with habitat of similar quality, and equal or higher quantity.

Residual Approved Project-related effects to fish habitat quality were anticipated to be low in magnitude with the application of best practices in accordance with DFO's *Measures to Protect Fish and Fish Habitat* and given that discharges would be authorized and in compliance with applicable regulatory requirements. The assessment of residual Project-related effects to fish habitat quality as a result of emissions, discharges and wastes released into the aquatic environment were reliant on the results of the Assimilative Capacity Model completed in support of the Surface Water Resources VC.

The residual environmental effects on surface water quality were predicted to be not significant, as effluent water quality would be below Metals and Diamond Mining Effluent Regulations (MDMER) limits at the final discharge points (FDPs), and no watershed management targets would be contravened. Local water quality immediately downstream of some FDPs and points where seepage enters surface water would experience increases of parameters of potential concern (POPC) above baseline levels and CWQG-FAL. However, these changes were expected to be contained within the boundaries of the LAA and to be dissipated within 300 m of entering one of the three ultimate receiving waterbodies. Residual Project-related effects to fish habitat quality from methylmercury production in organic soils or terrestrial vegetation (resulting from flooding the TMF) was anticipated to be negligible to low, given that prior to flooding, the TMF would be cleared to reduce the potential for methylmercury production and water collected in the TMF would be treated prior to release to meet authorized limits.

Residual Project-related effects to fish health and survival due to construction and installation of structures were not expected to occur since these structures would be designed to avoid impingement and entrainment of fish and to allow fish passage. Fish rescue would occur prior to construction of these works. Residual effects on fish survival due to increased angling by Project employees would not occur as prohibitions would be in place for all stages of the Approved Project. Workers would not be permitted to fish on the mine site and would not be permitted to bring angling gear to site. During operation, effects related to water-based discharges were not expected to result in direct mortality of fish because water would be managed and treated to meet authorized limits prior to discharge. Sublethal effects that could compromise fish health were not expected since POPCs in effluents were expected to meet the CWQG-FAL at the discharge point or within a short distance of mixing (i.e., within 300 m) in the receiving environment.

Use of explosives in or near water would be avoided and, if required, would follow DFO blasting guidelines. This approach was expected to result in few, if any, fish mortalities in nearby waterbodies. During decommissioning, rehabilitation and closure, the surface water layer of the pit lakes was expected to be well oxygenated. Given that discharge was predicted to meet MDMER limits, residual adverse effects on fish health and survival resulting from release of deleterious substances during this Project phase were anticipated to be negligible to low. To reduce the potential for stranding of fish during filling of the open pits during decommissioning, water would be sourced from areas where withdrawal should not cause stranding, and stream flows would be monitored.

The Valentine Gold EIS predicted that, with the application of mitigation and management measures, residual environmental effects on fish and fish habitat would be not significant. This conclusion was based on predictions that the Approved Project would not result in any of the following:

- HADD of fish habitat or the death of fish, as defined by the *Fisheries Act*, that cannot be mitigated, authorized or offset
- An unauthorized alteration of fish habitat
- A change to the productivity or sustainability of fish populations or fisheries within the LAA where recovery to baseline is unlikely

9.5 ASSESSMENT OF RESIDUAL EFFECTS OF PROJECT EXPANSION

9.5.1 Assessment Criteria Methods

This section describes the criteria and methods used to assess environmental effects on fish and fish habitat. Residual environmental effects are assessed and characterized using criteria defined in Section 9.5.1.1, and include direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological or socio-economic context. The methods of determining residual effects are the same as those for the Approved Project. The assessment also evaluates the significance of residual effects using threshold criteria or standards beyond which a residual environmental effect is considered to be significant. The definition of a significant effect for the Fish and Fish Habitat VC is provided in Section 9.5.1.2.

9.5.1.1 Residual Effects Characterization

Table 9.9 presents definitions for the characterization of residual environmental effects on fish and fish habitat. The criteria are used to describe the potential residual effects that remain after mitigation measures have been implemented. Quantitative measures were developed, where possible, to characterize residual effects. Qualitative considerations were used where quantitative measurement was not possible.

Table 9.9 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect	**Neutral –** no net change in measurable parameters for fish and fish habitat relative to baseline **Positive –** a residual effect that moves measurable parameters in a direction beneficial to fish and fish habitat relative to baseline **Adverse –** a residual effect that moves measurable parameters in a direction detrimental to fish and fish habitat relative to baseline
Magnitude	The amount of change in measurable parameters or the VC relative to existing conditions	**Change in Fish Habitat Quality / Quantity** **Negligible –** no measurable change in habitat area (m^2) or monthly flows or habitat quality **Low –** a measurable change in habitat area or monthly flows or habitat quality that is within the range of natural variability **Moderate –** a measurable change in habitat area or monthly flows (<10%) or habitat quality that is greater than the range of natural variability, however, that does not affect the ability of fish to use this habitat to carry out one or more of their life processes **High –** a measurable change in habitat area or monthly flows (>10%) or habitat quality that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes
		Change in Fish Health and Survival **Negligible –** no measurable change in the abundance or survival of local fish populations **Low –** a measurable change in the abundance or survival of local fish populations that is within the range of natural variability **Moderate –** a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability. However, does not affect the sustainability of fish populations **High –** a measurable change in abundance or survival of local fish populations that is greater than the range of natural

Table 9.9 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		variability and is large enough to potentially affect the sustainability of fish populations
Geographic Extent	The geographic area in which a residual effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the LAA **RAA –** residual effects extend into the RAA
Frequency	Identifies how often the residual effect occurs and how often during the Project or in a specific phase	**Single event** **Multiple irregular event –** occurs at no set schedule **Multiple regular event –** occurs at regular intervals **Continuous –** occurs continuously
Duration	The period required until the measurable parameter or the VC returns to its existing (baseline) condition, or the residual effect can no longer be measured or otherwise perceived	**Short term –** residual effect restricted to construction or decommissioning, rehabilitation and closure phases **Medium term –** residual effect extends three to nine years (one to three generations of local salmonid species, based on fish being able to spawn at age 3 years) **Long term –** residual effect extends more than nine years (three generations) of local salmonid species or beyond the life of the Project **Permanent** – recovery to baseline conditions unlikely
Reversibility	Describes whether a measurable parameter or the VC can return to its existing condition after the project activity ceases	**Reversible –** the residual effect is likely to be reversed after activity completion and rehabilitation **Irreversible –** the residual effect is unlikely to be reversed
Ecological and Socio-economic Context	Existing condition and trends in the area where residual effects occur	**Change in Fish Habitat Quality / Quantity** **Undisturbed –** area is relatively undisturbed or not adversely affected by human activity **Disturbed –** area has been substantially previously disturbed by human development or human development is still present
		Change in Fish Health and Survival **Resilient –** VC populations are stable and able to assimilate the additional change **Not Resilient –** VC populations are not stable and are not able to assimilate the additional change because of having little tolerance to imposed stresses due to fragility or near a threshold

9.5.1.2 Significance Definition

For the purposes of this environmental assessment, a significant residual environmental effect on fish and fish habitat is defined as a Project Expansion-related environmental effect that results in one or more of the following:

- HADD of fish habitat or the death of fish, as defined by the *Fisheries Act*, that cannot be mitigated, authorized or offset
- An unauthorized alteration of fish habitat
- A change to the productivity or sustainability of fish populations or fisheries within the LAA where recovery to baseline is unlikely

9.5.2 Assessment of Residual Effects

The Project Expansion pathways that have been identified are consistent with those for the Approved Project (Marathon 2020). The Project Expansion has been designed to avoid loss of fish habitat through careful planning of the placement of infrastructure and shifting locations of activities away from waterbodies. Avoidance and the application of proven mitigation measures will be used to reduce adverse effects to fish and fish habitat. The mitigation measures have been selected in consideration of the environmental effects pathways and include standard proven mitigation measures for sediment and erosion control, incorporate DFO standards and best management practices, and consider regulations and guidelines that govern fish and fish habitat protection.

Following avoidance and mitigation, the primary residual Project Expansion-related effects on fish and fish habitat will include changes to local drainage areas and runoff due to construction of stockpiles, the open pit, and water management infrastructure, as well as the introduction of treated contact water into the receiving environment through selected discharge points and indirectly through seepage.

The following sections provides an assessment of residual effects to the Fish and Fish Habitat VC following the implementation of avoidance and mitigation measures within the Project Area.

9.5.2.1 Change in Fish Habitat Quantity

The residual effects on fish habitat quantity are dependent on the results of the assessment of Project Expansion effects on the Surface Water Resources VC (Chapter 8) in this document. For the Surface Water Resources VC, residual effects for construction and operation were considered together, as changes to surface water quantity are anticipated to be limited during the construction phase, with the largest changes captured during the operation phase. In addition, as the primary concern related to this effect is loss of fish habitat, all Project Expansion phases have been assessed together to determine the total predicted extent of HADD, irrespective of the Project Expansion phase.

Pathways that affect fish habitat quantity as outlined in Section 9.2 are related to water management and associated changes in watershed areas.

As indicated previously (Section 9.5.2), the Project Expansion has been designed to avoid loss of fish habitat through careful planning of the placement of infrastructure and shifting locations of activities away from waterbodies, as practically feasible. Where avoidance is not feasible, mitigation measures will be employed to reduce the potential for effects as described below. Residual Project Expansion-related effects to fish habitat quantity are reduced through the application of best practices in accordance with DFO's "Measures to Protect Fish and Fish Habitat". When working near water, DFO standards and codes of practice will be used to reduce the potential for change in fish habitat quantity.

Where there are residual adverse effects, these will be counterbalanced through habitat offsetting, as required by the *Fisheries Act*, through Ministerial authorization. A cautionary approach to offsetting will be taken in developing a Fish Habitat Offsetting Plan to account for uncertainty in predicting the loss of fish habitat; it will aim for a net gain of fish habitat. The Fish Habitat Offsetting Plan will take into account input from consultation and engagement and will be developed and implemented in consultation with DFO and in consideration of the "Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act" (DFO 2019).

The Fish Habitat Offsetting Plan will address the direct and indirect loss of fish habitat associated with the following:

- Placement of sedimentation pond drainage channel outlets at the confluence of receiving watercourses or waterbodies
- Changes in flow due to changes in watershed area
- Changes in flow due to water management (e.g., diversion of runoff to sedimentation ponds for treatment)

Placement of sedimentation pond drainage channel outlets at the confluence of receiving watercourses or waterbodies may result in a direct loss of fish habitat and reduce the available habitat for fish to carry out their life processes. As described in Chapter 8 (Surface Water Resources), changes in stream flow are anticipated during construction due to changes in watershed area. During operation, changes in flow are anticipated due to water management, including collection and treatment of site contact water through sedimentation ponds. As no accelerated pit filling is anticipated to be required for the Berry pit, additional changes in flow are not anticipated in Valentine Lake or the outlet of Valentine Lake as a result of the Project Expansion.

As per the Approved Project, streams with changes in mean annual flow (MAF) of less than 10% were considered to not result in adverse effects to fish habitat (DFO 2013). While some streams are anticipated to have reductions in flow, a few streams may have increased flow as a result of increased discharge via sedimentation ponds or changes in watershed area. These flows will be attenuated through the sedimentation ponds to reduce peaks and extend baseflows during low flow periods, as described in the Water Management Plan (Appendix 2A). Attenuated flows from the sedimentation ponds that result in an increase in stream flow may result in a small localized positive effect of the Project Expansion on fish habitat. Increased stream flow may increase habitat quality, primary and secondary productivity, and fisheries productivity, thereby increasing the quantity of suitable fish habitat.

Streams with decreases in MAF greater than 10% were considered to result in adverse effects to fish habitat. The effects to fish habitat were predicted to be greatest during the summer low flow period when stream discharges are typically below 30% of MAF. For streams and ponds, adverse effects to fish and fish habitat are anticipated as a result of decreases in stream flows during construction and operation, and decommissioning, rehabilitation and closure. Streams experiencing indirect loss are anticipated to continue to support fisheries at a reduced level of productivity for the duration of the Project Expansion. These streams will likely be less productive and contain primary (e.g., periphyton) and secondary (e.g., benthic invertebrates) producers representative of low flow headwater communities. Pre-development, many of the Project Area streams are small headwater streams with intermittent flows during the summer low flow period, which may currently limit primary, secondary and fisheries productivity. The magnitude of changes in MAF throughout the various Project Expansion phases in comparison to pre-development conditions for each watershed are described in more detail in Chapter 8.

A summary of the anticipated loss of fish habitat due to the Project Expansion is provided in Table 9.10, and areas of predicted habitat loss, direct and indirect, are shown on Figure 9-16. There are approximately 350 m^2 of direct habitat loss spread over eight different locations in the Project Area (red dots on Figure 9-16).

Table 9.10 Summary of Anticipated Loss of Fish Habitat Quantity in the LAA during All Project Expansion Phases

Loss	Type of Loss	Feature	Location	Amount (m^2)
Direct	Harmful Alteration, Disruption or Destruction	Lake, Pond, Stream	Valentine Lake, ValP2, Stream 21, ValP3	350
Indirect	Harmful Alteration or Disruption	Streams	Streams 2, 36, 37, 38, 41, 42	2,213
			Total	**2,563**

With standard mitigation measures, and based on the existing Project Expansion design, the Project Expansion is conservatively anticipated to result in the loss of 2,563 m^2 of fish habitat within the LAA. The HADD of fish habitat will occur during construction and operation phases of the Project.

The Fish Habitat Offsetting Plan will be implemented to counterbalance the loss of fish habitat in the LAA, such that no significant residual effects to fish habitat are anticipated. The quantity of fish habitat offset will be based on the quantity and quality of fish habitat lost within the Project Area, in consultation with DFO. Should the location of Project Expansion components shift, the loss of the habitat associated with the Project Expansion may be revised, as required, and the offset adjusted accordingly.

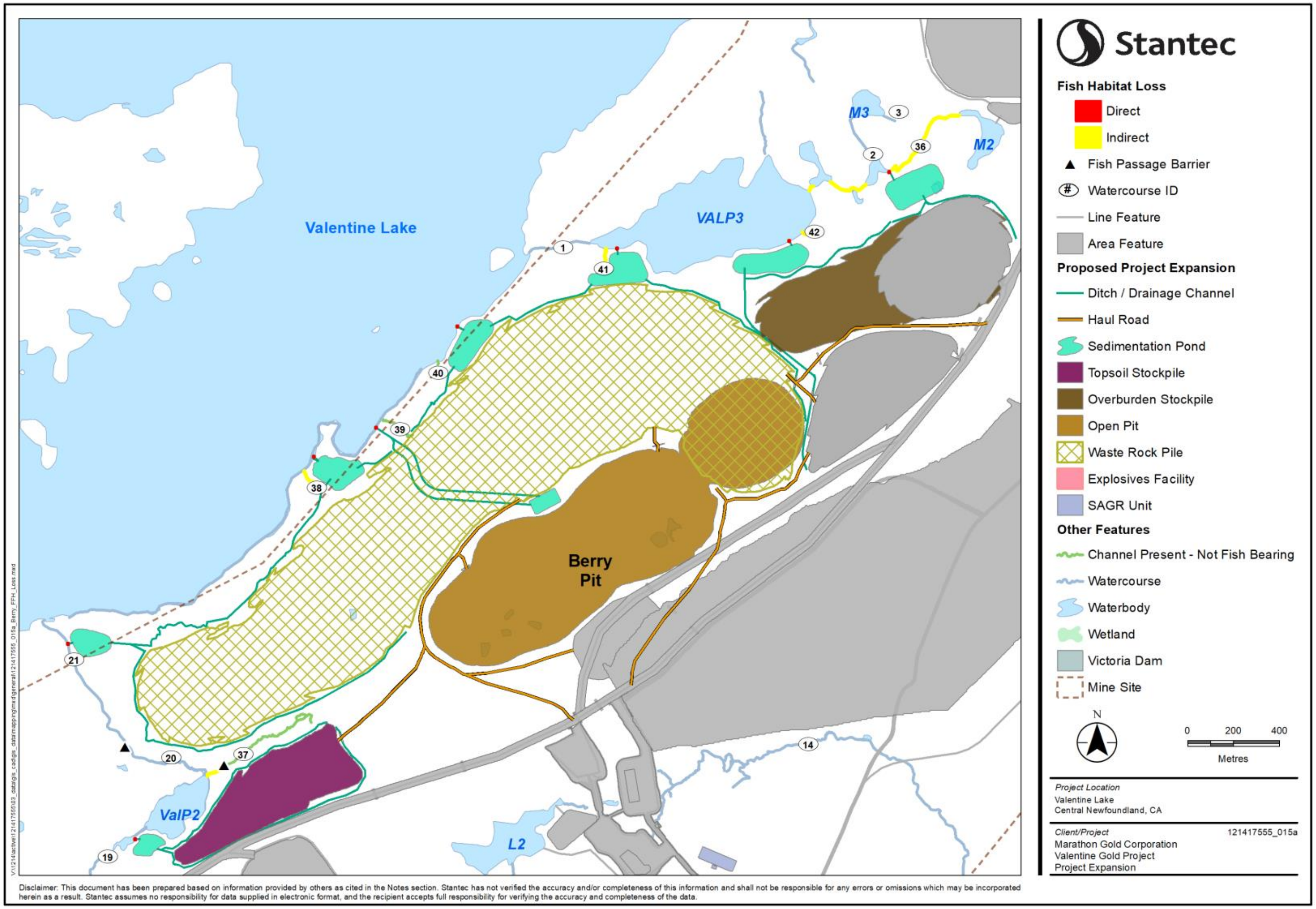


Figure 9-16 Fish Habitat Loss – Project Expansion

9.5.2.2 Change in Fish Habitat Quality

Construction and Operation

The residual effects on fish habitat quality are also dependent on the results of the assessment of Project Expansion effects on the Surface Water Resources VC (Chapter 8). For Surface Water Resources, residual effects for construction and operation were considered together, as changes to surface water quality are anticipated to be limited through construction activities, with the greatest changes occurring during the operation phase. The assessment of residual effects on fish habitat quality has therefore taken a similar approach.

Pathways that affect fish habitat quality as outlined in Section 9.2 are related to surface runoff from areas of disturbance, direct discharges of wastewater to waterbodies and watercourses, and changes to watershed areas.

The Project Expansion has been designed to avoid these pathways to the extent practicable through shifting the placement of infrastructure and locations of activities away from waterbodies. Where avoidance is not feasible, mitigation measures will be used to reduce the potential for effects as outlined below. When working near water, interactions with fish and fish habitat are well known and documented, and DFO standards and codes of practice will be followed. Consequently, with the application of best practices in accordance with DFO's *Measures to Protect Fish and Fish Habitat,* residual Project related effects are anticipated to be low in magnitude for fish habitat quality.

The assessment of residual Project Expansion-related effects to fish habitat quality as a result of emissions, discharges and wastes released into the aquatic environment are reliant on the results of the Assimilative Capacity Study (Appendix 8B) completed in support of the Surface Water Resources VC (Chapter 8).

During the operation and closure phases, residual Project Expansion-related effects to the quality of fish habitat are anticipated to occur due to changes in water quality from discharge of effluent or seepage containing contaminants above the CWQG-FAL into watercourses and waterbodies. Water-based discharges will be managed and treated to meet authorized limits prior to discharge. Changes in fish habitat suitability are not expected if parameters in effluent meet the CWQG-FAL at the discharge point, or within a short distance of mixing in the receiving environment. Five years of water quality monitoring post-closure is currently planned, as described in the updated Water Management Plan (Appendix 2A). Following the results of the water quality monitoring, adaptive management, including additional monitoring or mitigation measures, may be implemented as required. An environmental effects monitoring (EEM) program will also be implemented in accordance with Schedule 5 of the MDMER, including during the closure phase, as required by Environment and Climate Change Canada (ECCC).

In general, for the regulatory scenario (i.e., "worst case"), the Assimilative Capacity Study (Appendix 8C) suggests that water quality parameters will meet the CWQG-FAL within the first 100 m of the mixing zone at most sediment pond FDPs. This aligns with predictions made in the Valentine Gold EIS. Local water quality immediately downstream of BER-FDP-05 and points of seepage inflow will experience increases of POPC above baseline levels and CWQG-FAL; however, these changes are expected to be contained within the boundaries of the LAA and to be dissipated within 300 m of entering the Valentine Lake ultimate receiver (Appendix 8B). Water quality monitoring will be conducted during operation to verify these assumptions.

Residual effects on the quality of fish habitat from Project Expansion effluents and discharges are anticipated to be low, as these will be authorized and in compliance with applicable regulatory requirements. The EEM program will be implemented in accordance with Schedule 5 of the MDMER, as required by ECCC. The updated Water Management Plan will be followed and modified if required using an adaptive management process.

Changes to stream flow may occur in construction and operation, as described in Section 9.5.2.1 in relation to change in habitat quantity. These changes in habitat quantity can result in indirect effects to habitat quality and vary depending on the magnitude of the effect.

Decommissioning, Rehabilitation and Closure

During post-closure, seepage from the tailings impoundment is conservatively predicted to resurface in Victoria River and exceed MDMER limits for cyanide, un-ionized ammonia, and copper in post-closure. If follow-up monitoring over the life of the Project confirms this prediction, passive treatment systems will be required to treat TMF seepage to regulated limits. The selection and design of passive treatment system(s) will be based on water chemistry, flow rate, local topography, and/or site characteristics.

Based on the groundwater modelling report (Appendix 7A), following closure, groundwater from the Berry waste rock pile is predicted to resurface in Valentine Lake. The seepage water quality is anticipated to exceed the CWQG-FAL for POPC, however the seepage is expected to mix with the waters of Valentine Lake and assimilate within 300 m of the shoreline.

Given that seepage will assimilate in Valentine Lake and Victoria River within 300 m for POPC, residual adverse effects on fish habitat quality resulting from the release of deleterious substances during this phase are anticipated to be low.

9.5.2.3 Change in Fish Health and Survival

Construction

For in-water works (e.g., installation of sedimentation pond drainage channel outlets at the confluence of receiving watercourses or waterbodies), fish will be rescued from the site area in advance of in-water work to avoid the death of fish. Construction of in-water works will be planned to respect the DFO timing windows for the Island of Newfoundland, where feasible, thereby protecting fish and avoiding direct mortality of fish larvae or eggs. If in-water work activities related to construction during the restricted activity timing windows must be completed, Marathon will develop and implement additional mitigation measures, in consultation with DFO, to protect fish during sensitive life stages, including migration and spawning. Per federal EA Release Condition 3.12, Marathon will submit these measures to DFO and IAAC prior to implementing them. With implementation of mitigation measures, residual effects to fish health and survival are not anticipated.

Operation

During operation, residual Project Expansion-related effects to fish health and survival are anticipated to occur due to changes in water quality from discharge of effluent containing contaminants above the CWQG-FAL into streams or lakes. Water-based discharges are not expected to result in direct mortality of fish because water will be managed and treated to meet authorized limits prior to discharge. Sublethal effects that could compromise fish health are not expected assuming parameters in effluents meet the CWQG-FAL at the discharge point or within a short distance of mixing in the receiving environment (i.e., within 300 m), as anticipated. An EEM program will also be implemented in accordance with Schedule 5 of MDMER, as required by ECCC.

Decommissioning, Rehabilitation and Closure

During closure, seepage from the tailings impoundment is conservatively predicted to resurface in Victoria River and exceed MDMER limits for cyanide, un-ionized ammonia, and copper in post-closure. As described previously, if follow-up monitoring over the life of the Project confirms this prediction, passive treatment systems will be required to treat TMF seepage to regulated limits. The selection and design of passive treatment system(s) will be based on water chemistry, flow rate, local topography, and/or site characteristics. As discussed in Section 9.5.2.2, given that discharge is predicted to meet baseline or CWQG-FAL for POPC in Victoria River 300 m downstream, residual adverse effects on fish health and survival resulting from the release of deleterious substances during this phase are anticipated to be low.

Following closure, overflow from the Berry northern basin will discharge to Valentine Lake during post-closure (i.e., once the discharge limits are met). As discussed in Section 9.5.2.2, given that discharge is predicted to meet baseline or CWQG-FAL for POPC within 300 m of the shoreline, residual adverse effects on fish health and survival resulting from release of deleterious substances during this phase are anticipated to be low.

A five-year post-closure water quality monitoring program is currently planned, as described in the updated Water Management Plan (Appendix 2A). Based on results of the water quality monitoring, adaptive management, including additional monitoring or mitigation measures, may be implemented as required. An EEM program will also be implemented in accordance with Schedule 5 MDMER, as required by ECCC.

9.5.3 Summary of Project Expansion Residual Effects

Residual environmental effects that are likely to occur as a result of the Project Expansion are summarized in Table 9.11. The significance of residual adverse effects is considered in Section 9.5.4.

Table 9.11 Project Expansion Residual Effects on Fish Habitat

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic
Change in Fish Habitat Quantity	C	A	M	PA	LT	C	I	D
	O	A	M	PA	LT	C	I	D
	D	A	M	PA	LT	C	I	D
Change in Fish Habitat Quality	C	A	L	LAA	LT	C	R / I	D
	O	A	L	LAA	LT	C	R / I	D
	D	A	L	LAA	LT	C	R / I	D
Change in Fish Health and Survival	C	A	L/M	LAA	LT	C	R / I	R
	O	A	N/L	LAA	LT	C	R / I	R
	D	A	L/M	LAA	LT	C	R / I	R

KEY
See Table 9.9 for detailed definitions.
Project Phase:
C: Construction
O: Operation
D: Decommissioning

Direction:
P: Positive
A: Adverse
N: Neutral

Magnitude:
N: Negligible
L: Low
M: Moderate
H: High

Geographic Extent:
PA: Project Area
LAA: Local Assessment Area
RAA: Regional Assessment Area

Duration:
ST: Short term
MT: Medium term
LT: Long term

N/A: Not applicable
Frequency:
S: Single event
IR: Irregular event
R: Regular event
C: Continuous

Reversibility:
R: Reversible
I: Irreversible

Ecological/Socio-Economic Context (Fish Habitat):
D: Disturbed
U: Undisturbed

Ecological/Socio-Economic Context (Fish Health and Survival):
R: Resilient
NR: Not Resilient

9.5.4 Determination of Significance

With mitigation measures, offsetting, and environmental protection measures in place, the residual adverse environmental effects on fish and fish habitat are predicted to be not significant. Best management practices and the use of standard mitigation measures will be followed for work in or near water during construction. Fish habitat that is lost as a result of the Project Expansion will be counterbalanced through implementation of a Fish Habitat Offsetting Plan to be developed in consultation with DFO. The Plan will include follow-up monitoring to confirm that the required offset is achieved, and contingency measures in the event that the offsetting is not as successful as planned.

During all phases of the Project Expansion, discharges will be managed, as required, to meet regulatory requirements and/or site-specific guidelines. Effects on water quality for most of the watercourses / waterbodies assessed are considered reversible as conditions will return to baseline conditions once Project Expansion discharges cease. Irreversible effects may occur as a result of seepage from mine infrastructure (TMF and waste rock pile). However, with the implementation of vegetated covers, seepage quality is expected to be mitigated to meet regulations prior to reaching the ultimate receiver. Following rehabilitation and closure, a change to the productivity or sustainability of fish populations or fisheries within the LAA is not anticipated. Given the planned mitigation measures, Project Expansion-related mortality of individual fish is not anticipated and therefore is unlikely to affect the likelihood of their long-term survival or sustainability within the RAA.

9.6 COMBINED RESIDUAL EFFECTS OF THE PROJECT EXPANSION AND APPROVED PROJECT

The effect pathways for Fish and Fish Habitat are similar for the Approved Project and Project Expansion. In the absence of mitigation measures, the combined effect pathways associated with the Approved Project and Project Expansion include:

- Removal of riparian vegetation
- Placement of material or structures in water
- Alterations to stream flow
- Introduction of sediments and contaminants
- Direct injury or death of fish from industrial equipment or stranding
- Emissions, discharges and wastes
- Alteration of surface water and groundwater quantity and quality

Following the application of avoidance and mitigation measures, the combined residual effects of the Project Expansion and Approved Project are anticipated to include:

- Placement of material or structures in water (direct loss)
- Alterations to stream flow and associated indirect loss of fish habitat
- Emissions, discharges and wastes
- Alteration of surface water and groundwater quantity and quality

9.6.1 Change in Fish Habitat Quantity

The residual adverse effects for the combined Project Expansion and the Approved Project on change in fish habitat quantity will be low. Changes in habitat quantity related to the direct loss (HADD) and indirect loss (change in stream flow) of fish habitat will result from direct placement of infrastructure in fish habitat and changes in stream flow resulting from changes in watershed areas and water management.

With standard mitigation measures, and based on the existing Project Expansion design, the Project Expansion is conservatively anticipated to result in an additional loss of 2,563 m^2 of fish habitat within the

LAA. This represents an increase of approximately 1% in the loss of fish habitat compared to the Approved Project (186,705 m^2).

A Fish Habitat Offset Plan, which will be submitted as part of a *Fisheries Act* Authorization for the Project Expansion, will offset the loss of additional fish habitat in the LAA.

9.6.2 Change in Fish Habitat Quality

The residual adverse effects for the combined Project Expansion and the Approved Project on a change in fish habitat quality will be low. The change in habitat quality is primarily related to discharges of effluent to waterbodies, seepage and stream flows.

Changes in habitat quantity are anticipated to result in indirect effects to habitat quality and vary depending on the magnitude of the effect. Streams experiencing indirect loss are anticipated to continue to support fisheries at a reduced level of productivity and will contain primary (e.g., periphyton) and secondary (e.g., benthic invertebrates) producers, representative of low flow headwater communities.

Discharges into streams or lakes will be authorized and in compliance with applicable regulatory discharge limits and testing. In Valentine Lake, the effluent from the Project Expansion and the Approved Project will be assimilated within a short distance (approximately 300 m) of the receiving environment (similar distance as Approved Project; within 300 m of the ultimate receiver). The contribution of combined residual adverse effects of the Project Expansion and the Approved Project to residual effects on change in fish habitat quality are anticipated to be low. The potential changes in habitat quality are associated with seepage and discharges of effluent to waterbodies.

9.6.3 Change in Fish Health and Survival

The residual adverse effects for the combined Project Expansion and the Approved Project on change in fish health and survival are anticipated to be low to moderate. Changes in fish health and survival are primarily associated with discharges of effluent to waterbodies and seepage.

Discharges into streams or lakes will be authorized and in compliance with applicable regulatory discharge limits and testing. In Valentine Lake, the effluent from the Project Expansion and the Approved Project will be assimilated within a short distance (approximately 300 m) of the ultimate receiving environment (similar distance as Approved Project). Residual effects may result in a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability, however, will not affect the sustainability of fish populations.

9.6.4 Summary of Changes from the Approved Project

The Project Expansion will result in an additional loss of 2,563 m^2 of fish habitat within the LAA (increase of approximately 1%) compared to the Approved Project (186,705 m^2). A Fish Habitat Offset Plan to offset the loss of additional fish habitat in the LAA will be submitted as part of a *Fisheries Act* Authorization application for the Project Expansion. With avoidance, mitigation and offsetting, the residual adverse environmental effects to fish and fish habitat from combined effects of the Project Expansion and

Approved Project are predicted to be not significant, as defined in Section 9.4.3. DFO's "*Measures to Protect Fish and Fish Habitat*" (DFO 2022b), standard mitigation measures, and best management practices will be followed for work in or near water to mitigate effects to fish and fish habitat, to the extent practicable. Where residual effects to fish habitat remain, fish habitat that is lost as a result of the Project Expansion will be counterbalanced through implementation of an Offsetting Plan to be developed in consultation with DFO, using the same approach as the Approved Project. The Project Expansion Offsetting Plan will include follow-up monitoring to confirm that the required offset is achieved, and contingency measures that can be implemented if the offsetting is not as successful as planned.

The Project Expansion will result in an increased number of discharges of effluent to waterbodies, seepage and increase in the number of streams with changes in flow. During all phases of the Project Expansion and Approved Project, discharges will meet regulatory requirements and/or site-specific guidelines and be assimilated at similar distances within the ultimate receiver as the Approved Project (approximately within 300 m of the ultimate receiver). Following rehabilitation and closure, a change to the productivity or sustainability of fish populations or fisheries within the LAA is not anticipated. Given the planned mitigation measures, changes to fish health and survival that may result from the Project Expansion are not anticipated to affect the long-term survival or sustainability of fish populations for fisheries within the LAA.

Overall, there are no changes to the residual effects characterization of the Approved Project compared to the Approved Project plus the Project Expansion. Residual environmental effects that are likely to occur as a result of the Approved Project and Project Expansion are presented in Table 9.12 for comparison.

Table 9.12 Residual Effects on Fish and Fish Habitat for Approved Project and Project Expansion

Residual Effect	Residual Effects Characterization for Approved Project								Change in Residual Effect Characterization with Addition of Project Expansion (i.e., Combined Effects of Approved Project and Project Expansion)
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context	
Change in Fish Habitat Quantity	C	A	M	PA	LT	C	I	D	No change
	O	A	M	PA	LT	C	I	D	No change
	D	A	M	PA	LT	C	I	D	No change
Change in Fish Habitat Quality	C	A	L	LAA	LT	C	R / I*	D	No change
	O	A	L	LAA	LT	C	R / I*	D	No change
	D	A	L	LAA	LT	C	R / I*	D	No change
Change in Fish Health and Survival	C	A	L/M	LAA	LT	C	R / I*	R	No change
	O	A	N/L	LAA	LT	C	R / I*	R	No change
	D	A	L/M	LAA	LT	C	R / I*	R	No change

Table 9.12 Residual Effects on Fish and Fish Habitat for Approved Project and Project Expansion

Residual Effect	Residual Effects Characterization for Approved Project								Change in Residual Effect Characterization with Addition of Project Expansion (i.e., Combined Effects of Approved Project and Project Expansion)
	Project Phase	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context	
KEY See Table 9.9 for detailed definitions. Project Phase: C: Construction O: Operation D: Decommissioning Direction: P: Positive A: Adverse N: Neutral Magnitude: N: Negligible L: Low M: Moderate H: High	Geographic Extent: PA: Project Area LAA: Local Assessment Area RAA: Regional Assessment Area Duration: ST: Short term MT: Medium term LT: Long term N/A: Not applicable Frequency: S: Single event IR: Irregular event R: Regular event C: Continuous				Reversibility: R: Reversible I: Irreversible Ecological/Socio-Economic Context (Fish Habitat): D: Disturbed U: Undisturbed Ecological/Socio-Economic Context (Fish Health and Survival): R: Resilient NR: Not Resilient *The Valentine Gold EIS predicted Irreversible (as a conservative approach without mitigation) but was modified to Reversible during the IR process as Marathon will develop a passive treatment assessment program.				

9.7 ASSESSMENT OF CUMULATIVE EFFECTS

This cumulative effects assessment (CEA) focuses on incremental changes in the residual effects of the Approved Project in combination with the Project Expansion, which are summarized in Section 9.6.4, as well as incremental changes in potential cumulative effects due to differences in on-going and likely future activities since the Approved Project was released from the EA process.

9.7.1 Past and Ongoing Effects

As described in the Valentine Gold EIS (Chapter 20), fish and fish habitat in the RAA are already subject to natural and anthropogenic disturbance to varying degrees. Past and present projects / activities in the vicinity of the Project Expansion and Approved Project that may contribute to anthropogenic pressures on fish and fish habitat include hydroelectric development, forestry, other mining and exploration, hunting, outfitting, trapping, fishing, aquaculture, and existing linear features. These pressures may cause a change in fish habitat or fish health and survival for fish within the region. In addition, fish and fish habitat have been and continue to be affected by a variety of natural processes (e.g., water temperature changes, flow changes, changes in prey species abundance).

The effects of previous activities and natural environmental influences are reflected in the existing conditions for the Fish and Fish Habitat VC (Section 9.1), and the assessment of residual effects (Section 9.5). The assessment includes consideration of the current condition (e.g., health or quality) of potentially affected fish populations and their habitats, as well as their potential resiliency or sensitivity to further environmental change resulting from the Project Expansion in combination with other ongoing projects and activities that may affect the same VC.

9.7.2 Potential Project-Related Contributions to Cumulative Effects

As described in Section 9.2, Project Expansion and Approved Project routine activities and components have the potential to interact with fish and fish habitat via a number of pathways, including the use of industrial equipment, vegetation clearing, excavating, grading and installation of infrastructure in or near streams or lakes, removal of riparian vegetation, the introduction of sediments and contaminants, and injury or death from heavy equipment working in water. Other pathways include emissions, discharges and wastes, water management activities, alterations to stream flow, increased recreational fishing pressure, use of explosives in or near water that could cause death or injury to fish and decommissioning, rehabilitation and closure activities.

The Project Expansion, therefore, has potential to result in the following residual effects on fish and fish habitat:

- A change in fish habitat quantity
- A change in fish habitat quality
- A change in fish health and survival

With the implementation of mitigation measures, the combined effects of the Project Expansion and Approved Project activities on fish and fish habitat are predicted to be not significant (Section 9.5).

9.7.3 Other Projects and Activities and Their Effects

Table 5.6 summarizes past, present, ongoing and future projects and activities in the RAA that have potential to cause a change in fish habitat quality and quantity, and/or a change in fish health and survival, thereby affecting fish and fish habitat. A full discussion of other projects and activities and their effects is provided in the Valentine Gold EIS. As indicated above, the focus of this CEA is on incremental changes in potential cumulative effects due to differences in on-going and likely future activities since the Approved Project was released from the EA process.

9.7.4 Potential Cumulative Environmental Effects

As indicated in Section 9.7.1, fish are subject to numerous influences, which can affect distribution, abundance and health. These include hydroelectric dams, mining / industrial development, fishing activities, fishing restrictions, emissions, pesticides and other pollution. Key cumulative effects pathways associated with the Project Expansion include:

- Removal of riparian vegetation
- Alterations to stream flow
- The introduction of sediments and contaminants
- Direct injury or death of fish from industrial equipment conducting in-water work
- Emissions, discharges and wastes
- Alteration of surface water and groundwater
- Stratified pit lakes
- Increased fishing pressure due to workers on site
- The use of explosives in or near water

Each of these pathways could potentially result in cumulative changes in fish habitat quantity and quality, and fish health and survival. This section describes the pathways of the cumulative effects resulting from the combined Project Expansion and Approved Project and other projects identified in Table 5.6, mitigation measures that could be implemented to reduce cumulative effects, and the nature of the cumulative effects in the context of the residual effects of other projects.

Past and present activities / projects that are predicted to contribute to cumulative effects on fish and fish habitat include other mining and exploration, forestry, hunting, outfitting, trapping, and/or fishing, aquaculture, hydroelectric development, and existing linear facilities features (Table 5.6). However, potential cumulative effects of these projects / activities have been accounted for in the existing conditions and residual environmental effects (Section 9.5.3) and are not discussed further.

Future planned and proposed activities / projects that were not considered in the Valentine Gold EIS and are predicted to contribute to cumulative effects on fish and fish habitat include advancement of activities at the Buchans Resources Limited Project and the Victoria River Quarry (Table 5.6). These projects potentially have similar pathways as effects arising from the Project Expansion and Approved Project, including a change in fish habitat quantity and quality, and a change in fish health and survival.

9.7.4.1 Change in Fish Habitat Quantity

The cumulative residual adverse effects for the combined Project Expansion and Approved Project on change in fish habitat quantity are predicted to be low to moderate. Habitat quantity is related to the direct loss (removal or destruction of fish habitat) and indirect loss (change in stream flow) of fish habitat results from a change in watershed areas and stream water flow, fish passage, water extraction, and direct placement of infrastructure in fish habitat.

With the application of standard mitigation measures and based on the existing Project Expansion and Approved Project design, the combined Projects are conservatively anticipated to result in the direct and indirect loss of 189,268 m^2 of fish habitat within the LAA. An Offsetting Plan has been approved through the *Fisheries Act* Authorization for the Approved Project. An Offsetting Plan for the Project Expansion will be submitted as part of a *Fisheries Act* Authorization application to offset additional residual effects resulting from the additional loss of fish habitat in the LAA.

Newcrete Investments Limited was issued Environmental Preview Report (EPR) guidelines in March 2023 for their proposed Victoria River Quarry. The proposed quarry is located less than 500 m from the mine site and is expected to cover an area of 5.5 ha on a site adjacent to the Victoria River. The EPR guidelines issued by the provincial EA Division are requiring Newcrete to justify sourcing sand and gravel in this relatively remote region and to provide an analysis of alternate quarry locations and access routes to minimize the potential effects on the Victoria River watershed and caribou migration routes. Newcrete has also been asked to provide an analysis of potential cumulative effects of their project on the Victoria River watershed, and wildlife and wildlife habitat in the area in consideration of existing and proposed mining activities, road and transmission line development, and other development near the proposed project area. The proposed quarry is located outside of sub-watershed areas associated with the Project Expansion. The Registration document for this proposed project indicates that watercourses will be avoided, and no installation of water crossing infrastructure is anticipated (Newcrete 2022). In addition, aggregate extraction will occur above the groundwater table. Given the level of analysis required for this proposed project, it is anticipated that, should it be approved, there will be no additional cumulative effects to fish habitat quantity in the RAA.

Buchans Resources Limited has not submitted a Project Description or Project Registration to regulators describing their project, a project area has not been defined, and the existing environment has not been described. A description of the Lundberg deposit on their website states that resources are contained within an optimized model pit shell measuring 860 m by 650 m and extends to a maximum depth of 240 m (Buchans Resources 2020), equal to less than 100 ha of surface area, which is less than both the Marathon and Leprechaun pits. Given that the proposed Buchans Resources Limited Project will have similar project activities, the potential effects on change in habitat quantity for fish may be at a smaller or similar scale as the Approved Project and Project Expansion, which has been determined to be not significant (Section 9.5.3). It is therefore anticipated that the resulting contribution to cumulative effects would not result in changes in fish habitat quantity that affect the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

9.7.4.2 Change in Fish Habitat Quality

The cumulative residual adverse effects for the combined Project Expansion and Approved Project on change in fish habitat quality is anticipated to be low to moderate. The primary effects on habitat quality relate to surface runoff from areas of disturbance, direct discharges of effluent to waterbodies, changes to watershed areas and stream water flow, and work within water.

As described in Newcrete (2022), the proposed Victoria River Quarry will avoid watercourses, and site runoff will be treated through settling on the quarry floor, erosion control ditches with check dams, straw bales, and silt fencing to filter water leaving the quarry site. The Registration document also indicates that site runoff will then be released into vegetated areas. As the proposed Victoria River Quarry is located at least 30 m from watercourses, no changes in fish habitat quality resulting from runoff are anticipated. Given the level of analysis required for this project, it is anticipated that appropriate surface water mitigation measures will be in place for this proposed project, should it be approved, such that the resulting contribution to cumulative effects will not result in changes in fish habitat quality that affect the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

As described above, Buchans Resources Limited has not submitted a Project Description or Project Registration to regulators describing their project. It is anticipated that the greatest potential for effects would be related to surface runoff from areas of disturbance, direct discharges of wastewater to waterbodies and watercourses, and changes to watershed areas as a result of water management. Other metal mining projects will be required to comply with similar regulatory standards. Given that the proposed Buchans Resources Limited Project would have similar project activities, the potential changes in fish habitat quality are likely to be at a smaller or similar scale as the Approved Project and Project Expansion, which has been determined to be not significant (Section 9.5.3). It is therefore anticipated that the resulting contribution to cumulative effects will not result in changes in fish habitat quality that affect the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

9.7.4.3 Change in Fish Health and Survival

The Project Expansion and Approved Project-related residual adverse effects on fish health and survival are associated with seepage or the discharge of effluent containing contaminants. However, with the application of mitigation measures, and given that discharges into streams or lakes will be authorized and in compliance with applicable regulatory discharge limits and testing, residual environmental effects are anticipated to be low to moderate (Section 9.5.2.3). Residual effects may result in a measurable change in the abundance or survival of local fish populations that is greater than the range of natural variability; however, these will not affect the sustainability of fish populations.

As described in Newcrete 2022, the proposed Victoria River Quarry will avoid watercourses, and site runoff will be treated through settling on the quarry floor, erosion control ditches with check dams, straw bales, and silt fencing to filter water leaving the quarry site. Site runoff will then be released into vegetated areas. As the proposed Victoria River Quarry is located at least 30 m from watercourses no changes in fish health and survival resulting from runoff are anticipated. Given the level of analysis required for this project, it is anticipated that appropriate surface water mitigation measures will be in place for this proposed project, should it be approved, such that the resulting contribution to cumulative effects will not result in changes in fish health and survival that affect the productivity or sustainability of fish populations or fisheries within the cumulative effects RAA.

The future Buchans Resources Limited mining project could also contribute seepage or effluent containing contaminants to the local aquatic environment. However, it would also be required to implement mitigation measures and be subject to the same applicable regulatory discharge limits and testing as the Project Expansion. Effects to fish health and survival from other projects would likely also be limited to a localized area downstream of the future Buchans Resources Limited mining projects. The potential Buchans Resources Limited mining projects are located outside of the LAA where Project residual effects have been identified so would not overlap spatially; therefore, cumulative effects are not anticipated.

There are multiple combined Project-related interactions that have the potential to result in a change in fish health and survival; however, the application of mitigation measures will reduce the residual adverse effects. This is also generally considered to be the case for other future physical activities within the RAA. With the implementation of mitigation measures for the combined Project and other projects, it is anticipated that the cumulative environmental effects to fish health and survival will not result in a change to the productivity or sustainability of fish populations or fisheries within the RAA.

9.7.5 Cumulative Effects Assessment Summary and Evaluation

The potential cumulative effects on fish and fish habitat of past, present, ongoing, and reasonably foreseeable projects and activities, in combination with the environmental effects of the Project Expansion and Approved Project, are summarized in Table 9.13.

Two future projects, not previously considered in the Valentine Gold EIS, are anticipated to have effects similar to or reduced compared with those of the Project Expansion and Approved Project. The Project Expansion and these two potential future projects are predicted to result in a low magnitude change in fish habitat quantity and quality in the RAA. It is assumed that other projects will be required to meet similar regulatory standards (e.g., measures to protect fish and fish habitat and federal effluent discharge limits and testing).

With the implementation of mitigation measures, the potential cumulative effects of the Project Expansion and Approved Project and other reasonably foreseeable projects are predicted to be low in magnitude (a measurable change in the abundance or survival of local fish populations that is within the range of natural variability). The geographic extent is anticipated to occur within the RAA. Cumulative effects are predicted to be long-term in duration, continuous in frequency, reversible, and occurring in an ecological and socio-economic context that has been subject to past disturbance.

With mitigation measures, the cumulative effects from the Project Expansion and Approved Project and reasonably foreseeable future activities are expected to be not significant (Significance Definition provided in Section 9.4.5). The overall determination of significance is made with a high level of confidence for the direct loss of fish habitat quantity, and moderate level of confidence for indirect loss of fish habitat quantity. A moderate level of confidence is given for a change in fish habitat quality and fish health and survival, since the Approved Project and Project Expansion-related effects to fish habitat (i.e., water quality) are based on the water quality modelling; however, modelling used a conservative approach, the potentially affected fish species are well studied, and their habitat preferences are well known.

Table 9.13 Summary of Potential Cumulative Effects for Fish and Fish Habitat

Residual Cumulative Effect[A]	Direction	Magnitude	Geographic Extent	Duration	Frequency	Reversibility	Ecological and Socio-economic Context
	A	L	RAA	LT	IR/C	R	R/D
Contribution from the Project Expansion and Approved Project to the Residual Cumulative Effect[A]	The contribution of Project Expansion and Approved Project related residual adverse effects to cumulative effects on habitat quality and quantity is anticipated to be low. The Approved Project and Project Expansion are anticipated to result in a change in water quality as a result of effluents and discharges and changes to stream flow which affect habitat quality. The combined Projects will result in habitat loss of 189,268 m^2 within the LAA (of which 2,563 m^2 is attributable to the Project Expansion). This represents a small portion of available fish habitat within the cumulative effects RAA and the Fish Habitat Offsetting Plan will offset residual fish habitat lost in the LAA. With mitigation measures, residual adverse effects on fish health and survival are also anticipated to be low, with a measurable change in the abundance or survival of local fish populations that is within the range of natural variability.						
Significance[B]	With mitigation, offsetting and environmental protection measures in place, the residual adverse cumulative environmental effects on fish and fish habitat are predicted to be not significant. Although there are limitations in the available information of the effects from other present, past and future physical activities, a conservative approach was taken to estimate the cumulative effects (e.g., loss of project areas and footprints of future physical activities). The predicted effects are similar to those that have occurred during other mining and quarry projects / activities, thereby increasing the confidence in the assessment. The overall determination is made with a high level of confidence for the direct loss of fish habitat quantity, and moderate level for indirect loss of fish habitat quantity. A moderate level of confidence is given for a change in fish habitat quality and fish health and survival, since the Approved Project and Project Expansion-related effects to fish habitat (i.e., water quality) are based on the water quality modelling which used a conservative approach; however, the potentially affected fish species are well studied and their habitat preferences are well known to allow for prediction of effects associated with reasonably foreseeable future projects.						

Notes:
[A] Descriptors are provided in the respective VC chapters.
[B] Significance definitions are provided in the respective VC chapters.

9.8 FOLLOW-UP AND MONITORING

Follow-up and monitoring is intended to verify the accuracy of predictions made during the EA, to assess the implementation and effectiveness of mitigation and the nature of the residual effects, and to manage adaptively, if required. Compliance monitoring will be conducted to confirm that mitigation measures are properly implemented. Should an unexpected deterioration of the environment be observed during follow-up and/or monitoring, intervention mechanisms will include initiating the adaptive management process. This may include an investigation of the cause of the deterioration and identification of existing and/or new mitigation measures to be implemented to address it. Follow-up and monitoring will be implemented as part of the updated Water Management Plan and/or existing Fish and Fish Habitat Monitoring Plan for the Approved Project. Additional monitoring for the Project Expansion related to fish and fish habitat will include:

- Surface water quality monitoring at proposed FDPs and within the receiving environment, as described in the Surface Water Monitoring Plan and Water Management Plan
- Compliance and effectiveness monitoring of the Fish Habitat Offsetting Plan upon implementation, as authorized pursuant to the *Fisheries Act*
- An EEM Program pursuant to Schedule 5 of the MDMER for Project Expansion FDPs.

9.9 REFERENCES

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