Skimlik Creek & Dump Creek Watershed Assessment & GPS Mapping

Bella Coola Valley

Prepared for: **Bella Coola Watershed Conservation Society**

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Skimlik Creek & Dump Creek Overview Assessment Prepared for

BCWCS

& GPS Mapping

Appendices

Appendix 1: Digital Site Photos
Appendix 2: Iron Bacteria Information

1.0 Introduction

Between February 18, 2011 and March 31, 2011, Kynoch Resources of Bella Coola, BC completed an overview watershed assessment and detailed GPS mapping, of creek channels within the Skimlik Creek Watershed (Watershed Code not assigned; MOE, 2011) and the stream channel of the creek locally referred to as Dump Creek (Watershed Code not assigned; MOE, 2011), located in the lower Bella Coola River watershed. More specifically these streams are tributaries to Thorsen Creek within the Bella Coola Valley, British Columbia. Funding and support for this project was made available from grants provided by Department of Fisheries and Oceans (DFO) Canada / BC program to advance Watershed Planning, with additional support from the DFO Central Coast Community Advisor. The project was administered through the Bella Coola Watershed Conservation Society (BCWCS). Kynoch Resources and subcontractors completed the field work, data collection, analysis and presentation under contract to BCWCS.

1.1 Project Background & Scope

Between 2004 and 2008, the BCWCS undertook comprehensive Watershed Based Fish Sustainability Planning (WBFSP) for the Bella Coola River Watershed, creating comprehensive Stage II and Stage III watershed planning reports (BCWCS, 2007 and Kynoch Resources, 2008) to identify opportunities and lay out a framework for addressing these opportunities. The WBFSP Stage II and Stage III reports identified mapping as priority items for streams within the Bella Coola Valley. Owing to poor or non-existent line-work on TRIM and TRIM II map sheets, it was determined in 2008 that BCWCS undertake small project mapping using ground-truthed GPS coverage and existing orthographically corrected aerial images to collect map data for small stream channels.
In 2008-2009, BCWCS developed capacity in ground-GPS mapping through successful creation of maps of Snooka Creek and Fish Creek, within the Bella Coola River Watershed (Kynoch Resources, 2009; 2010). Continuing with small stream mapping, the BCWCS chose areas of Lower Bella Coola River drainages for additional project areas. Originally (Summer 2010) the mainstem of Thorsen Creek was

selected for this mapping project; however, in late September,
2010 a large flood event in the Bella Coola River watershed significantly altered Thorsen Creek mainstem, and large scale restorative and flood mitigation prescriptions were implemented by Ministry of Transportation and Infrastructure (MOTI). Owing to these in-stream works through winter and spring of 2010-11 BCWCS and Kynoch Resources determined it would be most beneficial to collect stream channel and GPS data from adjoining small tributaries, namely Skimlik and Dump Creeks.

1.2 Stream Overviews

Skimlik and Dump Creeks are tributaries to lower Thorsen Creek drainages (Watershed Code 910-290700-10000). For more information regarding Thorsen Creek and its preliminary (WBFSP Stage II and III) assessment, and data gap analysis, refer to the WBFSP Reports (BCWCS, 2007; Kynoch Resources, 2008). Similar mapping report results for Snooka Creek, east of Skimlik and Dump Creeks are available in the BCWCS Snooka Creek report (Kynoch Resources, 2009). The Project Map produced for Skimlik Creek is attached to this report and shows the locations of these creeks.

1.2.1 Skimlik Creek

Skimlik Creek flows North into Thorsen Creek approximately 400 m upstream of the Thorsen Creek – Bella Coola River confluence, which is situated approximately 200 m west of the Hwy 20 bridge crossing of Thorsen Creek within the lower Bella Coola Valley, BC. Skimlik Creek is a second order stream channel originating from ground water seepage on the west side of Thorsen Creek. A network of five groundwater tributaries comprised Skimlik Creek drainage. The stream channel is 2.52 km in total length, with the mainstem being the logest continuous channel measured as 740 m. Skimlik Creek is isolated from Thorsen Creek mainstem by dikes on Thorsen Creek's left (west) bank. Skimlik Creek is characterized by numerous small first order

tributaries and occasional beaver dams and ponds in the low-gradient flat valley bottom floodplain of the Bella Coola River and Thorsen Creek alluvial fan.
Hwy 20 crosses Skimlik Creek at a free span concrete bridge 15 m upstream from its confluence with Thorsen Creek (Map 1). Skimlik Creek flows through areas of Crown Land, Nuxalk First Nation IR, and private property. The drainage subbasin is 12.5 ha, most of which had been cleared for forest harvesting, road and dike development, and private residential development over the past several decades.
Skimlik Creek was not reported as having an assigned watershed code (BC Fisheries Watershed Code Availability maps did not have Skimlik Creek delineated at 1:50,000 scale, MOE, 2011). Nor were fish presence or distribution data available for this stream (MOE, 2011, Habitat Wizard). Observations of juvenile coho salmon during this project were noted, indicating juvenile salmonid presence and use of Skimlik Creek.
Appendix 1 shows photographs of habitat and stream channel characteristics of each of the five main tributaries of Skimlik Creek, with more detailed habitat descriptions in Section 2.0 of this report.

1.2.2 Dump Creek

Dump Creek is a second order groundwater fed channel on the east side of Thorsen creek (Map

1). Dump Creek is a local alias for the unnamed stream channel with no assigned Watershed Code (MOE, 2011). This stream is entirely within private property, with some apparent ephemeral groundwater channel connectivity to Central Coast Regional District (CCRD) Solid Waste Landfill site, located to the southeast of the main channel (Map 1). The Dump Creek drainage basin is 6.5 ha in area, comprising a network of three primary groundwater tributaries originating from the alluvial fan of Thorsen Creek. Similar to Skimlik Creek, mainstem flow of Thorsen Creek into Dump Creek is restricted by dikes on the east bank of Thorsen Creek (right stream bank). Most of the drainage basin of Dump Creek had been previously cleared of mature conifer trees in past decades and is primarily young deciduous and mixed forest cover.

Dump Creek flows north into Snooka Creek (a tributary to Thorsen Creek) approximately 200 m upstream of the Snooka Creek – Thorsen Creek confluence (Map 1). In 2008 Snooka Creek was mapped in a similar project by the BCWCS and Snooka creek characteristics are described in the 2009 report (Kynoch, 2009).

Similar to Skimlik Creek, Dump Creek is a series of groundwater channels and periodic (historic) beaver dams and ponds. A large beaver dam and pond complex is located south of Highway 20, where Dump Creek flows through a 1200 mm steel culvert (Map 1). This culvert was installed in the early 1980s to replace a wooden bridge. The culvert was installed at a perched elevation of approximately 1.5 m above Snooka Creek elevation (on the North side of Highway 20), resulting in considerable backwatering of upstream areas of Dump Creek, contributing to the pond and wetland complex south of the highway (Map 1). Culvert blockage by beavers has been a maintenance issue since installation and trash racks and beaver barriers have been used with varying success at the culvert inlet. Owing to the perched outlet height (1.5 m) an aluminum *Denali* style fish ladder was installed to provide upstream fish passage from Snooka Creek into the culvert and upstream areas of Dump Creek (Map 1).

Appendix 1 shows photographs of the culvert and fish ladder areas of Dump creek; however, as Dump Creek was also selected as a candidate for fish habitat compensation by MOTI detailed stream channel assessment of habitat characteristics and photo documentation were not completed for upstream areas to reduce potential data duplication. The status of the MOTI compensation project remained undefined at the time of preparation of this report.

Dump Creek had no referenced fish species presence or distribution data (MOE, 2011); however is known locally to contain coho salmon (as observed in this project).

2.0 Methods

Kynoch Resources drew on a project team of local technicians and biologists to complete ecological field components, map data collection, map production and watershed reporting. The project team was comprised of personnel with specific experience in the following personnel:

• Fraser Koroluk (R.P.Bio)- Project Management, fish habitat biology/assessment;

• Geoff Mullins - GPS/GIS mapping procedures; and,

• Tim Degrace - field assessment and data recording.

Where practical the project team used recognized methods of stream habitat classification, GIS mapping, and data analysis, as described below; however, some methods were modified or streamlined specifically for this project. Habitat measurements and estimates were based on standards described for Watershed Restoration Program (WRP) Fish Habitat Assessment Procedures (Johnston and Slaney, 1996).

2.1 GPS Data Collection & Mapping

Owing to high level Differentially Corrected GPS (DGPS) being unavailable in Bella Coola Valley, and having limited project funding to access and utilize appropriate equipment to collect these data, the Project Team selected a practical recreational grade GPS unit (Garmin GPSmap 60CSX, with a 30dB external antenna; WAAS enabled), that was used previously with high success in local stream mapping (Snooka Creek map project; Kynoch Resources, 2009).

Through visual averaging data points were collected to within 5m accuracy 95% of the time. Data were collected digitally in the field and later imported to Quantum GIS software. These waypoints were used to delineate the stream channel as well as demarcate points of interest (e.g., bridges, culverts, etc.). GPS Map data collection of Skimlik Creek was completed in the field with the GPS unit on March 8 to 11, and Dump Creek from March 11 to 12, 2011. Supplemental site photos and habitat assessment of Skimlik Creek was completed on April 18, 2011.

As the scope of this mapping project was to determine larger macro-habitat features of the Fish subject drainages (e.g., stream location, approximate length, etc.), specific data recording relevant to habitat was limited on the GPS unit. GIS software was also used to calculate stream section lengths as mapped. Shape files produced from the GIS software are compatible with other GIS standards and software. Final map data were overlaid as a shape file on orthographically rectified aerial photography from the TRIM II data set. A section of Mapsheet 93D037 was then increased to 1:3,000 scale to show the stream channel and relevant features for this report. Digital data deliverables for map layers are provided with this report.

2.2 Fish Habitat Assessment

Fish habitat assessment and description was done at an overview level to characterize general fish habitat units and distribution. These methods followed watershed restoration program (WRP) fish habitat assessment (Johnston and Slaney, 1996). Site assessment included measuring and assessing the following site characteristics:

- wetted and bankfull widths;
- wetted and bankfull depths;
- substrate type;
- channel gradient (where applicable);
- habitat cover type and composition;
- disturbance indicators;
- pool / riffle / glide frequency and characteristics; and,
- riparian vegetation composition.

Habitat data were collected in field notebooks with site photographs of representative habitat features or other points of interest (e.g., tributary streams, stream crossings, etc.). Photographs appear in Appendix

3.0 Fish Habitat Assessment

Owing to the small stream channels and numerous tributaries of the Skimlik and Dump Creek drainages, it was determined overview level fish habitat assessments would be most appropriate (i.e., general characteristics of each tributary were described, rather than detailed macro habitat analysis of each habitat unit). Overview fish habitat of Skimlik Creek was assessed by visual observations, estimates and measurements to establish approximate width, depth, gradient, substrate, and channel type information for each small tributary stream comprising each of the drainage networks

3.1 Skimlik Creek Drainage

The Skimlik Creek drainage was divided into five major tributaries for mapping and assessment. Tributaries were identified numerically from the confluence of Skimlik – Thorsen Creek increasing upstream. While it was difficult to ascertain which channel comprised the mainstem of Skimlik Creek, it was determined Tributary 5 was the longest continual reach of water from the confluence to the headwaters, and thus was used as the mainstem for reporting and mapping purposes. Tributaries were not further divided into reaches, owing to relatively homogenous small channel characteristics and often short stream sections constituting a tributary channel.
Summarized data and observations collected from each tributary of Skimlik Creek are provided below and photographs appear as digital appendix 1.

3.1.1 Skimlik Creek Mainstem (Tributary 5)

The mainstem of Skimlik Creek was mapped as 740 m in length, and appeared to be groundwater fed from residual water of the Thorsen Creek floodplain and fan. With recent (2010-2011) improved diking on the west bank of Thorsen Creek it is unlikely that any surface water from Thorsen creek would reach Skimlik Creek unless the dike was overtopped or failed at some point. General habitat characteristics of the mainstem are summarized in Table 1 below.

Table 1: Habitat Features of Mainstem Skimlik Creek	
Habitat Feature	**Measurement/Description**
Channel Length	740 m
Wetted Width	1.5 m in channel areas to >3 m in ponds
Bankfull Width	3 m to 4 m
Wetted Depth	0.25 to 0.45 m
Bankfull Depth	0.50 m
Gradient	<1%

General Morphology	Glide with ponds and wetlands, small scour patched
Substrate Type (Dom/Sub-dom)	Fines/ sand-gravel
Spawning gravel presence / abundance	Gravel present in small scour pockets, limited abundance
Riparian Cover	Mixed young forest
LWD presence / abundance	LWD present throughout, abundant cover

Stream Morphology & Habitat

The attached digital photos in Appendix 1 show characteristics of Skimlik Creek drainage. Skimlik Creek was a low gradient drainage, typically <1.0% gradient . Wetted width of the mainstem was approximately 1.5 m with bankfull width approximately 3.5 m. Average wetted depth was approximately 0.30 m and bankfull depth of 0.50 m. The channel was moderately entrenched in lower stream sections (Photo 11), with little or no entrenchment in headwater areas near seepage

sources (Photo 39). Ponds and wetland areas were also noted in the mainstem channel (Photos 33 and 34) as well as Tributary 2 (Photo 65).

Substrate of the mainstem varied from organics, sand and limited gravel (Photos 12 and 50). Where LWD or other structures created riffle complexes, gravel was generally present in small amounts (i.e., 1m^2 – 3m^2 Photo 19). Infilling of pools and glides with organic matter was noted as a potential limiting factor to primary pool distribution in this low gradient stream system.

Iron fixing bacteria, common in Bella Coola Valley streams, was present, resulting in varying amounts of iron-oxide deposits in areas of Skimlik Creek drainage (Photo 19 and 41). Appendix 2 provides background information available on these bacteria. LWD was abundant throughout the mainstem and provided cover, stream complexing (Photos 23 and 26) and in areas may periodically present barriers to upstream adult fish migration owing to combined LWD and SWD accumulations/jams (Photo 27).

Riparian Cover

Riparian cover of the Skimlik Creek drainage varied over the length of the mainstem. Lower stream sections were adjacent to Hwy 20 and private property, resulting in past land and stream bank clearing for development and infrastructure. These areas typically exhibited shrub riparian cover and young mixed forests (Photos 9 and 15). Areas upstream of the private property development exhibited areas of young and mature mixed forest with varied canopy closure and structure, providing cover, over stream vegetation and LWD recruitment potential (Photo 55).

Disturbance Indicators

A concrete bridge crossing at Highway 20 was present approximately 15 m upstream from the Skimlik – Thorsen Creek confluence (Photos 2 and 78). An existing foot bridge on private property (Photo 16) and an abandoned small log bridge was noted on Tributary 2 (Photo 83). However none of these structures appeared to have a measurable negative affect on fish habitat of Skimlik Creek. Iron fixing bacteria was present throughout the drainage, and while not a direct influence of fish, this bacteria has the potential to blanket substrates and limit benthic invertebrate productivity. Primary pools with sufficient residual depth (i.e., 0.40 m or greater) that would offer rearing and refugia in potential low flow periods or overwinter habitat were noted as limited in distribution in Skimlik mainstem.

Enhancement or Restoration Opportunities (Mainstem)

Fish habitat of mainstem sections of Skimlik Creek would likely benefit from increased primary pool distribution and frequency to increase rearing and refugia habitat in various stream flows. Primary channel scour to expose gravel through LWD placement or restoration may increase spawning habitat for trout and salmon (e.g., trout/char and coho salmon). Gravel placement at these sites may also increase spawning habitat and/or replace or rehabilitate gravel potentially smothered by organic material in years past.

A more complete fish presence and distribution assessment would be beneficial in establishing target habitat suited for rehabilitation/restoration or enhancement.

Photo SKIM-13- LWD in mainstem Skimlik Creek

Photo SKIM-15 upstream view towards private home on right bank of Skimlik Creek.

3.1.2 Tributary 1

Tributary 1 was 268 m in total wetted length, comprising two small channels (sub-tribs 1a and 1b) that flowed into the mainstem of Skimlik Creek approximately 53 m from the stream mouth on the right bank. Photos 78 through 86 show general habitat characteristics of this tributary channel.
General habitat characteristics of the mainstem are summarized in Table 2 below.

Table 2 : Habitat Features of Tributary 1 Skimlik Creek	
Habitat Feature	**Measurement/Description**
Channel Length	268 m
Wetted Width	1.0 m
Bankfull Width	2.0 m
Wetted Depth	0.20 m
Bankfull Depth	0.80 m
Gradient	<1%

General Morphology	Small channel, partially ephemeral in upper stream sections glide-riffle with limited scour
Substrate Type (Dom/Sub-dom)	Sand / fines and gravel
Spawning gravel presence / abundance	Gravel present in small patches, limited abundance and distribution
Riparian Cover	Mixed mature forest
LWD presence / abundance	Present and abundant throughout

Tributary 1 Overview

Tributary 1 exhibited similar general morphology and habitat as Skimlik mainstem, being smaller and shorter in general character, as would be expected of a groundwater fed tributary. Of note was slightly more gravel present in Trib 1 compared to similar channel length of the mainstem. This is potentially associated with less disturbance to the riparian forests which were typically mature conifer adjacent to Trib 1 (Photo 78 through 86). Mature conifer forest is less likely to contribute organic material (leaf litter, etc.) and also more likely to contribute functioning LWD to create localized scour.

The stream channel appeared to be ephemeral in upper stream sections, as was evident by dry channel sections and ponded water in areas (particularly in sub-tributary 1a).

Rehabilitation of existing pockets of spawning gravel may increase salmonid spawning value of Tributary 1.

Photo SKIM-79- confluence of Tributary 1a with Tributary 1 (flowing into left bank of Tributary 1). Mature mixed forest with abundant conifers.

Photo SKIM-80 highly complexed small stream channel of Tributary 1 with small pockets of gravel within the mature mixed forest riparian cover.

3.1.3 Tributary 2

Tributary 2 was 366 m in total wetted length, comprising three small channels (Sub-tribs 2a, 2b and 2c) that flowed into the mainstem of Skimlik Creek approximately 243 m from the stream mouth on the right bank. Photos 63 through 76 show general habitat characteristics of this tributary channel. Stream channels comprising Tributary 2 were complex in nature owing to a series of abandoned beaver dams creating ponds, wetlands and associated drainge chennels. The Project Map shows these areas and further divides the channels into Sub-Tributaries 2a, 2b and 2c. This report only addresses those habitat points of interest and does not specifically describe each sub-tributary. Where applicable the sub-tributary location is identified in the photographs attached as Digital Appendix 1.
General habitat characteristics of the mainstem are summarized in Table 2 below.

Table 3: Habitat Features of Tributary 2 Skimlik Creek	
Habitat Feature	**Measurement/Description**
Channel Length	366 m
Wetted Width	1.25 m

Bankfull Width	1.75 m
Wetted Depth	0.65 m
Depth Bankfull	1.0 m
Gradient	<0.5 %
General Morphology	Mixed stream channel (glide) and pond wetlands, historic beaver dam noted
Substrate Type (Dom/Sub-dom)	fines
Spawning gravel presence / abundance	Little or no spawning gravel present
Riparian Cover	Mixed young forest with some mature conifers in western areas (e.g., sub-tributary 2a)
LWD presence / abundance	LWD was present and abundant throughout all subtributaries

Tributary 2 Overview

Approximately 80 m upstream from the Tributary 2 confluence with the mainstem an abandoned beaver dam provided a pond and wetland complex approximately 300 m^2 (Photo 65). Remaining sub-tributaries of this channel flowed into this pond and wetland complex as indicated on the project map.
Each sub-tributary exhibited similar small-channel habitat characteristics as indicated in Photos 67 through 76. Of notable difference were additional upstream wetlands and ponds in an apparent oxbow formed in Sub-Tributary 2b, providing additional rearing habitat. Tributary 2 and sub-tributaries provided abundant juvenile rearing habitat (Photos 65, 71, 65); however, provided little spawning gravel or suitable adult salmon (anadromous species) holding or migration channels. Access to rearing habitat (i.e., ponds) by fish at various life cycles or water flows was not assessed; however, no notable barriers were observed.
Riparian cover of Tributary 2 and sub-tributaries varied from shrub grass in wetland areas to mature conifer forests in westerly areas nearer to Tributary 1 channels, as indicated on the orthographic photo of forest cover of the Project Map.

Photo SKIM-63- cross section view looking upstream of Tributary 2, width 1.5 m depth 0.40 m

Photo SKIM-65 abandoned/historic beaver dam and pond complex on Tributary 2, approximately 20 m by 15 m and 1.5 m depth

3.1.4 Tributary 3

Tributary 3 was a relatively short and small right bank tributary of Skimlik Creek (Map 1, Photos 20, 61 and 62). The channel length was mapped as 68 m in total wetted length, flowing into Skimlik Creek 360 m upstream from the mouth. The channel appeared to be a drainage channel that had potentially been excavated in the past to drain wetland areas on or adjacent to private property. The exact timeline or history of these potential excavations cannot be confirmed.
Tributary 3 had no sub-tributaries.
General habitat characteristics of the mainstem are summarized in Table 2 below.

Table 4: Habitat Features of Tributary 3 Skimlik Creek	
Habitat Feature	**Measurement/Description**
Channel Length	68 m
Wetted Width	0.75 m
Bankfull Width	1.25 m
Wetted Depth	0.20 m
Bankfull Depth	0.80
Gradient	<0.5%
General Morphology	Ditch-like channel draining wetland and shallow pond areas
Substrate Type (Dom/Sub-dom)	Fines (organic layer and iron fixing bacteria abundant)
Spawning gravel presence / abundance	No gravel noted
Riparian Cover	Mixed young forest and wetland shrub/grass vegetation
LWD presence / abundance	Limited WD and SWD present in small channel

Tributary 3 Overview

Tributary 3 provided very little in-stream fish habitat owing to its small size and limited channel length (Map 1). However, the channel likely provides ephemeral fish access to upstream rearing habitat potentially associated with upstream wetland areas. These wetlands also likely contribute to steady stream discharge of Skimlik Creek during water level fluctuations, possibly acting as a reservoir and flow regulator within the drainage system. Tributary 3 provided little physical habitat for salmonids; however, likely functioned in regulating stream flow of the Skimlik Creek drainage basin. The only noted potential for further enhancement of Tributary 3 would be to assess juvenile or resident salmonid accessibility to ponds, and ensure continual passage to these rearing areas as may be required for seasonal salmonid migrations. Riparian cover of Trib 3 was open grasses and shrubs with numerous standing dead deciduous trees evidence of regional flooding/inundations.

Photo SKIM-20- cross channel view (towards east) of Tributary 3, showing the ditch like characteristics of this small Tributary.

Photo SKIM-62 upstream view of Trib 3, small channel with deciduous riparian vegetation and iron-oxide bacteria on sand substrate.

3.1.5 Tributary 4

Tributary 4 was 191 m in total wetted length, comprising two small channels (Sub-Tributaries 4a and 4b) that flowed into the mainstem of Skimlik Creek approximately 392 m from the stream mouth on the right bank. Photos 56 through 60 show general habitat characteristics of this tributary channel, which was typically a small channel stream with sand and silt substrate and notable iron fixing bacteria present. Where applicable the sub-tributary location is identified in the photographs attached as Digital Appendix 1.
General habitat characteristics of Tributary 4 are summarized in Table 5 below.

Table 5: Habitat Features of Tributary 4 Skimlik Creek	
Habitat Feature	**Measurement/Description**
Channel Length	191 m
Wetted Width	1.0 - 2.0 m
Bankfull Width	3.0 m
Wetted Depth	0.20 m
Bankfull Depth	0.75 m
Gradient	<0.5%
General Morphology	Low gradient glide
Substrate Type (Dom/Sub-dom)	Sand / fines (organic layer and iron fixing bacteria abundant)
Spawning gravel presence / abundance	Little or no suitable spawing gravel noted
Riparian Cover	Young deciduous
LWD presence / abundance	LWS and SWD present, little scour from LWD

<u>Tributary 4 Overview</u>

Tributary 4 (and sub tributaries 4a and 4b) were small stream channels with wetted width of approximately 1.0 m and bankfull width of approximately 3.0 m. Stream wetted depth was approximately 0.20 m with no notable pools or glides in this small channel (Photos 56 through 60). LWD and SWD provided abundant stream cover; however, owing to the homogenous sand and sediment substrate and limited pool or glide habitat, Tributary 4 likely provided marginal quality rearing habitat for juvenile salmonids and no apparent suitable spawning habitat for adults
Riparian cover of Tributary 4 and sub-tributaries was typically mixed young forest with deciduous trees dominating the canopy.

3.2 Dump Creek Drainage

Dump Creek was mapped using GPS in the field on March 13 and 14, 2011. Field assessment of fish habitat, riparian cover or other habitat characteristics were not completed as part of this project. As the project site is entirely on private property, at the land owners request, field teams did not return to the site after March 14 to collect any additional data.

Photo SKIM-56- upstream view of channel of TRIB 4 showing iron-oxide coloured water and sandy substrate.

Photo SKIM-59 upstream view of channel of TRIB 4b (from confluence

4a/4b) showing iron-oxide coloured water and sandy substrate.

4.0 Summary & Recommendations

This mapping and fish habitat assessment project has resulted in collection of accurate stream channel locations and confirmed the extent of the Skimlik Creek and Dump Creek drainage networks. In total 2.52 km of mainstem and Tributary channel of Skimlik Creek and 1.42 m of Dump Creek were mapped. Habitat characteristics were summarized on Skimlik Creek with a detailed photo reference created for all channels and tributaries of Skimlik Creek (Appendix 1).

4.1 Habitat & Mapping Summary

Habitat data and summaries were only completed for Skimlik Creek. Areas of Dump Creek were mapped, but owing to changing circumstances of landowner agreements and other projects in the area, the opportunity to complete detailed habitat assessment was beyond the scope of this project.

4.1.1 Skimlik Creek Habitat Summary

Skimlik Creek is a small drainage basin within a confined groundwater supply area of 12.5 ha. Dikes to the east (Thorsen left bank) and west (Thorsen Offset Dike adjacent to Four Mile subdivision) as well as downstream confinement by Highway 20, result in a complex network of groundwater channels, wetlands, ponds and potential historic ditches (e.g., Tributary 3).

GIS analysis of land use adjacent to the stream channel was not completed as part of this project; however, it was observed that very little channel length of Skimlik Creek flowed through naturally remaining (old growth) forest, with a high majority of areas having been previously cleared/logged (now second growth) or being maintained as private land holdings or Federal Indian Reserve. Much of the stream cover and riparian forests are naturally regenerating in pioneer deciduous species, as is normal in early and mid seral stages in coastal forests. This abundant deciduous stream cover may create a lapse over several decades in conifer LWD recruitment to the stream channel (possibly influencing stream morphology), and may contribute large amounts of leaf-litter or SWD to the stream channel, potentially covering naturally occurring gravel or cobble substrates, as was observed in sections of Skimlik Creek.

Skimlik Creek exhibited small but relatively stable channel characteristics, largely owing to its groundwater sources. However, aside from wetland and pond complexes, a lack of abundant primary pools providing rearing and holding habitat for salmonids was noted in the mainstem channels. Similarly, there was little spawning habitat as riffles and gravel substrate were scarce in mainstem and tributary sections of Skimlik Creek. Where localized scour associated with LWD complexing was noted, these areas appeared suitable for localized salmonid spawning. However, these areas were limited in distribution and physical size.

Water quality of Skimlik Creek was not assessed as part of this project. Iron bacteria (likely the Sphaerotilus-Leptothrix group of bacteria; various photos in Appendix 1) appeared to be a natural occurrence throughout most of the stream channel of Skimlik Creek and did not appear to negatively influence fish habitat. However, abundant deposits of these bacteria can have a detrimental affect on benthic invertebrate productivity of a stream channel, therefore potentially negatively affecting food sources for fish. This bacteria is endemic in areas of iron rich groundwater and there is little or no likelihood of remediation once the bacteria are established.

Table 6 provides an overview salmonid habitat suitability matrix based on assessed habitat characteristics of each section of Stream Channel in Skimlik Creek.

* Higher presence of iron oxide may result in lower habitat quality (refer to Appendix 2).

4.2 Recommendations

Recommendations for small scale stream enhancement or habitat restoration can be made for mainstem areas of Skimlik Creek. It is beyond the scope of this project to complete site specific prescriptions; however, general recommendations for fish habitat improvements can be made.
Land owner approval would be required for any activities in areas of either Skimlik Creek or Dump Creek. This approval has not been sought; however the land owner of the property of Dump Creek stated that projects would require his consent and detailed negotiations. For that reason, specific recommendations for habitat enhancement or restoration of Dump Creek have not been made at this time. Other agencies and resources have also considered enhancement of this area of Dump Creek for fish habitat compensation works as part of Ministry of Transportation and Infrastructure, 2010-11 flood rehabilitation projects. State of those negotiations is uncertain at this time.

4.2.1 Opportunities for Restoration

Restoration and rehabilitation of fish habitat of Skimlik Creek could potentially benefit the following ecological components:

• riparian habitat;

• localized adult spawning habitat; and,

• increased juvenile rearing habitat.

Specific restoration prescriptions for these activities have not been developed as part of this project; however, some options/recommendations are provided below.

Riparian Habitat

Riparian habitat rehabilitation would require private landowner/stakeholder buy in. Diversification of the riparian canopy to include more conifer trees would benefit longer-term goals of LWD recruitment and reduce organic loading of the stream channel. Riparian prescriptions for deciduous thinning in conjunction with vigorous conifer riparian planting would be an option in already treed areas, along with establishing riparian corridors/buffers of conifers in already cleared stream sections.
Sections of all tributaries of Skimlik Creek mainstem could potentially benefit from one or the other of these rehabilitation procedures.

Spawning Habitat

Spawning habitat of Skimlik Creek is limited in abundance and distribution throughout all tributaries. Localized gravel-riffles provide pockets of spawning habitat throughout larger tributary sections; however overall low stream gradient of the Skimlik Drainage system limit distribution of these spawning areas. Spawning areas are further impeded in distribution and quality by an over abundance of organic material in some areas, potentially associated with leaf litter from the predominantly deciduous riparian vegetation. This was noted more in areas of Deciduous riparian cover (Tribs 3 through 5), and less so in areas of Tribs 1 and 2, where mature conifers were present.
Similar to other small streams of the Bella Coola Valley floor, prescriptions to remove excessive existing SWD (limbs, non-functioning deciduous branches, etc.) could be explored to increase flushing of organic material, particularly in site specific locations where localized spawning habitat may be present. These activities would likely best be done in conjunction with riparian rehabilitation and would be most suited to Tributaries 2 through 5 of Skimlik Creek.
Options for site specific gravel placement may also benefit spawning habitat of sections of Tributaries 1, 2 and 4 as well as localized mainstem sections.

Pool Habitat

Enhancement of tributary channels of Skimlik Creek to create in-stream primary pools or off- channel groundwater fed ponds may be beneficial in providing over winter habitat for juvenile fish. Although there are existing natural wetlands and ponds, these areas appeared to be formed by overland flooding associated with drainage and beaver dams, and pool depth and complexity was likely limited by these factors (i.e., shallow wetlands with emergent vegetation). Deeper, more complex off-channel or mainstem pool habitat would likely be higher quality rearing habitat than some of the observed wetland areas and may contribute to salmonid rearing of the lower Bella Coola River and Thorsen Creek watersheds.

4.2.2 Opportunities for Further Assessment

Further assessments potentially warranted on Skimlik Creek may include ground water monitoring for flow and seasonal fluctuations. This type of site monitoring may be of particular relevance in 2011 as considerable excavation and diking was completed in Thorsen Creek mainstem, adjacent to Skimlik Creek, and flow patterns and groundwater influences of this work are largely unknown.

It is recommended that regular stream discharge data be collected at a downstream channel cross-section on a regular basis over the next 3 to 5 years to see if there is a possible decrease or general change of water flow in Skimlik Creek. Although there is likely no apparent pre- construction discharge data (prior to works on Thorsen Creek in 2010-2011) there may be an opportunity to identify potentially obvious changes in discharge. A possible location for these measurements would be beneath the Hwy 20 bridge, where the channel is relatively stable and unchanging.

Further assessment of fish use in Skimlik Creek, including species presence, distribution and use by life-cycle would also be beneficial in further determining restorative or enhancement opportunities in this system.

References

BC Ministry of Environment, (BCMoE*)*,2011
1:50,000 Watershed Code Maps.
http://www.env.gov.bc.ca/appsdata/wsca/pdf/r5/bela/093d_037.pdf
Website visited March, 2011
BCWCS, 2007.
Bella Coola Watershed-based Fish Sustainability Plan Stage II. Bella Coola.
Johnston N.S., and P. Slaney, 1996.
Fish Habitat Assessment Procedures. Watershed Restoration Program Technical Circular #8. MELP.
Kynoch Resources, 2008.
Bella Coola Watershed-based Fish Sustainability Plan Stage III Final Report. Prepared for
BCWCS, International Forest Products & the Midcoast TSA Group of Licensees
(FIA Project # MC6603009-07). Bella Coola.
Kynoch Resources, 2009.
Snooka Creek Field Mapping Project. Prepared for Bella Coola Watershed Conservation Society. Bella Coola BC.

Appendix 1:

Digital Photo Key

& Waypoint Map

Skimlik Creek Dump Creek Overview Assessment

GPS Mapping

Prepared for BCWCS

NOTE: The accompanying DIGITAL PDF file entitled 'Digital Photo Map' shows the location of the noted waypoints.			
Photo No.	**Tributary**	**Waypoint**	**Description**
SKIMM-001	Mainstem	SK-2	DS view of mainstem at confluence with Thorsen Creek
SKIMM-002	Mainstem	SK-2	US view of mainstem from below (downstream) Hwy 20 bridge crossing
SKIMM-003	Mainstem	SK-3	us view of mainstem showing small channel size and sandy substrate
SKIMM-004	Mainstem	SK-3	small pool and channel characteristics with sand substrate
SKIMM-005	Mainstem	SK-6	small channel characteristics with sand substrate
SKIMM-006	Mainstem	SK-6	LWD in small scour pool of mainstem Skimlik Creek
SKIMM-007	Mainstem	SK-7	incised channel with cutbank habitat and glide morphology
SKIMM-008	Mainstem	SK-8	overstream vegetation and LWD provide habitat and stream cover, Hwy 20 in background
SKIMM-009	Mainstem	SK-9	overstream vegetation and LWD provide habitat and stream cover, Hwy 20 in background
SKIMM-010	Mainstem	SK-9	overstream vegetation and LWD provide habitat and stream cover, Hwy 20 in background
SKIMM-011	Mainstem	SK-10	glide morphology with overstream and LWD cover
SKIMM-012	Mainstem	SK-10	previously cut/notched LWD of mainstem, note iron bacteria accumulations
SKIMM-013	Mainstem	SKCON-2	LWD in mainstem Skimlik Creek
SKIMM-014	TRIB 2	SKCON-2	looking upstream at confluence of Tributary 2, entering on Left Bank of Skimlik Mainstem
SKIMM-015	mainstem	SK-12	upstream view towards private home on right bank of Skimlik Creek
SKIMM-016	Mainstem	SK-13	upstream view towards private footbridge of Skimlik Creek

SKIMM-017	Mainstem	SKBR2	DS view of mainstem from private footbridge
SKIMM-018	Mainstem	SKBR2	US view of mainstem from private footbridge
SKIMM-019	Mainstem	SK-15	localized gravel deposition at LWD scour, note iron deposition on substrate
SKIMM-020	TRIB 3	SKCON-3	cross channel view (towards east) of Tributary 3, showing the ditch like characteristics of this small Tributary.
SKIMM-021	Mainstem	SKCON-3	upstream view from Tributary 3
SKIMM-022	TRIB-4	SKCON-4	Right bank confluence
SKIMM-023	Mainstem	SKCON-4	heavy LWD cover looking upstream
SKIMM-024	Mainstem	SK-28	glide with LWD cover
SKIMM-025	Mainstem	SK-28	Downstream view of glide from spanning LWD
SKIMM-026	Mainstem	SK-28	Upstream view of glide from spanning LWD
SKIMM-027	Mainstem	SKJAM1	LWD and SWD jam, possible migration barrier
SKIMM-028	Mainstem	SKJAM1	downstream view from jam
SKIMM-029	Mainstem	SKJAM1	upstream view from jam
SKIMM-030	TRIB -5a	SKCON 5	Confluence of Trib 5a (upstream view- 5a on right of frame, left bank tributary). TRIB 5a had less notable iron bacteria
SKIMM-031	TRIB-5a	SKCON5a	Downstream view of TRIB 5a
SKIMM-032	TRIB-5a	SKCON5a	Upstream view of TRIB 5a
SKIMM-033	TRIB 5a	SKPOND1	Upstream view of Pond and glide habitat of TRIB 5a
SKIMM-034	TRIB-5a	SKPOND1	Downstream view of pond and glide habitat of TRIB 5a
SKIMM-035	TRIB-5a	NA	Mainstem groundwater flow of TRIB 5a
SKIMM-036	TRIB-5a	SKCON-6	small left bank groundwater pond (20 m length by 3 m width 0.25 m depth)
SKIMM-037	TRIB-5a	SK-50	downstream view of headwater section of TRIB 5a
SKIMM-038	TRIB-5a	SK-50	upstream view of headwater section of TRIB 5a
SKIMM-039	TRIB-5a	SK-POT	headwater seepage from ground at upstream POT of TRIB 5a
SKIMM-040	TRIB-5a	SK-POT	headwater seepage from ground at upstream POT of TRIB 5a
SKIMM-041	Mainstem	CON-5	downstream view of mainstem channel at confluence of mainstem and TRIB 5a
SKIMM-042	TRIB-5b	SKCON5b	view of rust coloured side-channel of TRIB 5b showing accumulations of iron fixing bacteria

SKIMM-043	TRIB-5b	SKCON-5b	cross channel view of short 20 m side-channel seepage with rust coloured iron fixing bacteria, channel not assessed
SKIMM-044	Mainstem	SK-35	mainstem shallow glide with comparatively little or no rust coloured bacteria, deciduous riparian forest and sand substrate.

SKIMM-045	Mainstem	SK-36	isolated gravel pocket of mainstem channel
SKIMM-046	Trib-5c	SKCON-5c	TRIB 5c was a short (30 m) channel with isolated gravel pockets at confluence with mainstem
SKIMM-047	Mainstem	SKCON-5c	isolated gravel pocket of mainstem channel, upstream of TRIB 5c
SKIMM-048	Mainstem	SK-39	DS view glide-riffle morphology of headwater sections of mainstem, upstream of TRIB 5c width 3 m, deth 0.25m
SKIMM-049	Mainstem	SK-39	US view glide-riffle morphology of headwater sections of mainstem, upstream of TRIB 5c, juvenile CO noted
SKIMM-050	Mainstem	SK-40	glide-riffle morphology of headwater sections of mainstem, upstream of TRIB 5c, juvenile CO noted
SKIMM-051	Mainstem	SK-45	upstream view of headwater seepage and POT of mainstem of Skimlik Creek (April 18, 2011).
SKIMM-052	Mainstem	SK-45	downstream view from headwater seepage of Skimlik Creek
SKIMM-053	Mainstem	Con-5c-POT	dry ephemeral channle upstream of photo 51 (POT)
SKIMM-054	Mainstem	Con-5c-POT	dry ephemeral channle upstream of photo 51 (POT)
SKIMM-055	Mainstem	Con-5c-POT	residual wetted area of ephemeral headwaters of the mainstem of Skimlik Creek ~30 m upstream of Photo 51 (POT)
SKIMM-056	TRIB-4	CON-4	upstream view of channel of TRIB 4 showing rust coloured water and sandy substrate
SKIMM-057	TRIB-4	CON-4	downstream view of TRIB 4 from confluence Trib 4a/4b
SKIMM-058	TRIB-4a	CON-4	US view of of TRIB 4a showing small channel size, iron-oxide and sandy substrate. Thorsen Dike visible in background
SKIMM-059	TRIB-4b	SK-20	upstream view of channel of TRIB 4b (from confluence 4a/4b) showing rust coloured water and sandy substrate
SKIMM-060	TRIB-4a	SK-21	upstream view of TRIB 4a towards Thorsen Dike. Juvenile CO noted. Small stream channel infilling with detritus, little or no scour
SKIMM-061	TRIB-3	SK-76	downstream view of Trib 3, small channel possibly previously excavated as a drainage ditch
SKIMM-062	TRIB-3	SK-76	upstream view of Trib 3, small channel with deciduous riparian vegetation and rust couloured bacteria on sand substrate.
SKIMM-063	TRIB -2	CON-2	cross section view looking upstream of Tributary 2, width 1.5 m depth 0.40 m
SKIMM-064	TRIB-2	SK-52	upstream view of Tributary 2 showing dense overstream vegetation
SKIMM-065	TRIB-2	CON-2a	abandoned/historic beaver dam and pond complex on Tributary 2, aproximately 20 m by 15 m and 1.5 m depth
SKIMM-066	TRIB-2	SKCON-2a	old beaver trap
SKIMM-067	TRIB-2	SK-73	inlet of Tributary 2 into beaver pond, dense LWD/SWD cover
SKIMM-068	TRIB-2	SK-72	tributary 2 flowing to ponds, 0.75 m width, 0.15 m depth. Riparian cover mature conifers.
SKIMM-069	TRIB-2	SK-70	downstream view of habitat of Tributary 2 with mature mixed forest
SKIMM-070	TRIB-2	SK-64	upper areas of Tributary 2 that appear to have been cleared in the past, deciduous and mixed stumps
SKIMM-071	TRIB-2b	SK-54	pond area of Tributary 2b upstream of beaver ponds

SKIMM-072	TRIB-2b	SK-55	oxbow of Tributary 2b showing mixed forest and LWD/SWD cover. Width 3.0 m depth 0.40 m fine substrate with in-stream veg.
SKIMM-073	TRIB-2b	SK-57	in-stream grasses of Tributary 2b
SKIMM-074	TRIB-2c	CON-2c	small tributary channel 2c. Mixed forest riparian, sand and fines substrate
SKIMM-075	TRIB-2c	SK-58	small pondd area of Tributary 2c, little or no rust coloured bacteria present, mixed forest cover and fines substrate
SKIMM-076	TRIB-2c	SKCON-2c-POT	wetland area at headwaters of Tributary 2c. Possible fish barriers owing to low flow and unconsolidated channel
SKIMM-077	TRIB-1	SKCON-1	cross section view looking upstream of Tributary 1, width 1.5 m depth 0.30 m
SKIMM-078	TRIB-1	SKCON-1	downstream view of HWY 20 bridge from confluence of Tributary 1
SKIMM-079	TRIB-1a	SKCON-1a	confluence of Tributary 1a with Tributary 1 (flowing into left bank of Tributary 1). Mature mixed forest with abundant conifers.
SKIMM-080	TRIB-1	SK-78	small incised channel of Tributary 1. Approximate 1.0 m width, 0.20 m depth. Sand and fines substrate
SKIMM-081	TRIB-1	SK-79	highly complexed small stream channel of Tributary 1 with small pockets of gravel within the mature mixed forest riparian cover
SKIMM-082	TRIB-1	SK-81	upstream view of small channel of Tributary 1, possibly ephemeral
SKIMM-083	TRIB-1	SKCON-1a-BRID	Old bridge deck spanning Tributary 1
SKIMM-084	TRIB-1a	SK-86	ponded water near headwaters of Tributary 1a. Likely limited access by fish owing to possible ephemeral nature of channel
SKIMM-085	TRIB-1a	SK-85	ponded water near headwaters of Tributary 1a. Likely limited access by fish owing to possible ephemeral nature of channel
SKIMM-086	TRIB-1a	SKCON-1-POT	apparent groundwater seepage headwater of Tributary 1a. Ephemeral flow suspected. Mature conifer forest riparian cover.

Skimlik Creek Drainag

Digital Photo Map Showing Waypoint Locations of Attached Photos. Note. This Image is intended for digital viewing as resolution is too sm

Skimlik and Dump Creek Waypoints Prepared for BCWCS

Skimlik Mapping Project

Grid UTM Datum WGS 84

Skimlik Creek Waypoints

Name	Date of Measurement	Position (UTM Zone, Easting, Northing)
Sk1	08-MAR-11 9:21:17AM	9 U 656608 5804411
Sk10	09-MAR-11 9:46:00AM	9 U 656748 5804392
Sk11	09-MAR-11 9:49:01AM	9 U 656768 5804383
Sk12	09-MAR-11 9:54:37AM	9 U 656797 5804377
Sk13	09-MAR-11 9:57:59AM	9 U 656814 5804371
Sk14	09-MAR-11 9:59:49AM	9 U 656842 5804354
Sk15	09-MAR-11 10:01:15AM	9 U 656850 5804343
Sk16	09-MAR-11 10:02:28AM	9 U 656864 5804333
Sk17	09-MAR-11 10:06:25AM	9 U 656869 5804295
Sk18	09-MAR-11 10:09:36AM	9 U 656881 5804270
Sk19	09-MAR-11 10:12:09AM	9 U 656900 5804260
Sk2	08-MAR-11 9:24:38AM	9 U 656620 5804396
Sk20	09-MAR-11 10:14:32AM	9 U 656929 5804246
Sk21	09-MAR-11 10:17:31AM	9 U 656902 5804235
Sk22	09-MAR-11 10:18:45AM	9 U 656890 5804224
Sk23	09-MAR-11 10:19:40AM	9 U 656876 5804226
Sk24	09-MAR-11 10:21:08AM	9 U 656866 5804204
Sk25	09-MAR-11 10:22:32AM	9 U 656881 5804193
Sk26	09-MAR-11 10:23:34AM	9 U 656867 5804174
Sk27		9 U 656852 5804279

Sk28	09-MAR-11 10:36:22AM	9 U 656848 5804262
Sk29	09-MAR-11 10:39:34AM	9 U 656839 5804237
Sk30	09-MAR-11 10:44:17AM	9 U 656833 5804204
Sk31	09-MAR-11 10:51:39AM	9 U 656848 5804164
Sk32	09-MAR-11 10:56:54AM	9 U 656844 5804144
Sk33	09-MAR-11 10:58:42AM	9 U 656849 5804140
Sk34	09-MAR-11 11:01:27AM	9 U 656846 5804129
Sk35	09-MAR-11 11:03:29AM	9 U 656827 5804165
Sk36	09-MAR-11 11:16:45AM	9 U 656826 5804154
Sk37	09-MAR-11 11:20:11AM	9 U 656818 5804135
Sk38	09-MAR-11 11:23:09AM	9 U 656823 5804121
Sk39	09-MAR-11 11:26:34AM	9 U 656831 5804100
Sk3CON1	09-MAR-11 11:28:59AM	9 U 656626 5804363
Sk4	08-MAR-11 9:26:10AM	9 U 656649 5804371
Sk40	08-MAR-11 9:29:07AM	9 U 656840 5804080
Sk41	09-MAR-11 11:31:26AM	9 U 656844 5804071
	09-MAR-11 11:33:07AM	

Skimlik and Dump Creek Waypoints Prepared for BCWCS

Sk42 09-MAR-11 11:36:01AM 9 U 656862 5804065

Sk43 09-MAR-11 11:37:33AM 9 U 656855 5804040

Sk44 09-MAR-11 11:39:05AM 9 U 656863 5804038

Sk45 09-MAR-11 11:42:27AM 9 U 656839 5804015

Sk46 09-MAR-11 12:13:07PM 9 U 656816 5804096

Sk47 09-MAR-11 12:16:36PM 9 U 656811 5804115

Sk48 09-MAR-11 12:34:36PM 9 U 656816 5804184

Sk49 09-MAR-11 12:58:43PM 9 U 656779 5804151

Sk4CON4POT 08-MAR-11 11:31:11AM 9 U 656938 5804230

Sk5 08-MAR-11 9:32:14AM 9 U 656669 5804373

Sk50 09-MAR-11 1:22:53PM 9 U 656773 5804109

Sk51 09-MAR-11 1:42:18PM 9 U 656765 5804354

Sk52 09-MAR-11 1:43:56PM 9 U 656765 5804324

Sk53 09-MAR-11 1:51:27PM 9 U 656784 5804297

Sk54 09-MAR-11 1:53:54PM 9 U 656791 5804258

Sk55 09-MAR-11 1:55:10PM 9 U 656777 5804253

Sk56 09-MAR-11 1:59:06PM 9 U 656797 5804244

Sk57 09-MAR-11 2:00:35PM 9 U 656793 5804233

Sk58 09-MAR-11 2:05:12PM 9 U 656794 5804198

Sk59 09-MAR-11 2:10:38PM 9 U 656780 5804203

Sk6 08-MAR-11 9:35:47AM 9 U 656677 5804394

Sk60 09-MAR-11 2:12:04PM 9 U 656760 5804195

Sk61 09-MAR-11 2:15:02PM 9 U 656738 5804163

Sk62 09-MAR-11 2:20:12PM 9 U 656724 5804142

Sk63 09-MAR-11 2:24:03PM 9 U 656718 5804116

Sk64 09-MAR-11 2:29:28PM 9 U 656706 5804107

Sk65 09-MAR-11 2:32:42PM 9 U 656702 5804089

Sk67 09-MAR-11 2:39:44PM 9 U 656674 5804148

Sk68 09-MAR-11 2:43:16PM 9 U 656673 5804173

Sk69 09-MAR-11 2:48:13PM 9 U 656681 5804194

Sk7 08-MAR-11 9:38:18AM 9 U 656691 5804389

Sk70 09-MAR-11 2:53:16PM 9 U 656692 5804211

Sk71 09-MAR-11 2:56:52PM 9 U 656715 5804222

Sk72 09-MAR-11 3:00:37PM 9 U 656725 5804262

Sk73 09-MAR-11 3:08:28PM 9 U 656748 5804292

Sk75 10-MAR-11 9:18:37AM 9 U 656904 5804342

Sk76 10-MAR-11 9:20:48AM 9 U 656889 5804320

Sk77 10-MAR-11 9:38:10AM 9 U 656674 5804343

Sk78 10-MAR-11 9:42:08AM 9 U 656681 5804320

Sk79 10-MAR-11 9:46:32AM 9 U 656672 5804308

Sk8 08-MAR-11 9:44:06AM 9 U 656712 5804404

Sk80 10-MAR-11 9:50:21AM 9 U 656672 5804289

Sk81 10-MAR-11 9:52:26AM 9 U 656677 5804258

Sk82 10-MAR-11 10:02:01AM 9 U 656661 5804215

Sk83 10-MAR-11 10:05:16AM 9 U 656655 5804198

Sk84 10-MAR-11 10:07:28AM 9 U 656658 5804178

Sk85 10-MAR-11 10:21:49AM 9 U 656611 5804261

Sk86 10-MAR-11 10:23:24AM 9 U 656622 5804280

Dump Creek West Waypoints

Name	Date of Measurement	Position (UTM Zone, Easting, Northing)
Dp1	16-MAR-11 9:18:42AM	9 U 657058 5804265

Skimlik and Dump Creek Waypoints Prepared for BCWCS

Dp10 16-MAR-11 9:33:21AM 9 U 657086 5804180

Dp11 16-MAR-11 9:34:42AM 9 U 657080 5804179

Dp12 16-MAR-11 9:36:42AM 9 U 657070 5804166

Dp13 16-MAR-11 9:37:38AM 9 U 657063 5804172

Dp14 16-MAR-11 9:39:18AM 9 U 657069 5804183

Dp15 16-MAR-11 9:41:49AM 9 U 657071 5804193

Dp16 16-MAR-11 9:43:42AM 9 U 657076 5804205

Dp17 16-MAR-11 9:45:52AM 9 U 657077 5804219

Dp18 16-MAR-11 9:49:31AM 9 U 657072 5804234

Dp19 16-MAR-11 9:52:31AM 9 U 657066 5804242

Dp2 16-MAR-11 9:20:36AM 9 U 657068 5804263

Dp20 16-MAR-11 10:00:01AM 9 U 657058 5804248

Dp21 16-MAR-11 10:02:11AM 9 U 657047 5804245

Dp22 16-MAR-11 10:04:14AM 9 U 657051 5804255

Dp23 16-MAR-11 10:07:58AM 9 U 657053 5804271

Dp3 16-MAR-11 9:21:35AM 9 U 657075 5804258

Dp4 16-MAR-11 9:22:24AM 9 U 657080 5804249

Dp5 16-MAR-11 9:24:48AM 9 U 657086 5804236

Dp6 16-MAR-11 9:26:44AM 9 U 657088 5804225

Dp7 16-MAR-11 9:27:55AM 9 U 657092 5804212

Dp8 16-MAR-11 9:29:54AM 9 U 657093 5804203

Dp9 16-MAR-11 9:31:55AM 9 U 657087 5804191

DPOC 15-MAR-11 9:18:47AM 9 U 657067 5804356

Du1 15-MAR-11 9:21:11AM 9 U 657062 5804321

Du10 15-MAR-11 10:17:25AM 9 U 656991 5804106

Du11 15-MAR-11 10:21:25AM 9 U 657020 5804109

Du12 15-MAR-11 10:24:19AM 9 U 657025 5804091

Du13 15-MAR-11 10:29:41AM 9 U 657016 5804059

Du14 15-MAR-11 10:33:22AM 9 U 657029 5804061

Du15 15-MAR-11 10:34:58AM 9 U 657024 5804048

Du16 15-MAR-11 10:36:31AM 9 U 657004 5804033

Du17 15-MAR-11 10:40:01AM 9 U 657002 5804020

Du18 15-MAR-11 10:41:44AM 9 U 656995 5804003

Du19 15-MAR-11 10:48:40AM 9 U 656984 5803986

Du2 15-MAR-11 9:34:40AM 9 U 657053 5804174

Du20 15-MAR-11 10:49:58AM 9 U 656975 5803970

Du21 15-MAR-11 10:54:31AM 9 U 657010 5803990

Du22 15-MAR-11 10:56:45AM 9 U 656997 5803977

Du23 15-MAR-11 10:57:33AM 9 U 656994 5803973

Du24 15-MAR-11 11:16:51AM 9 U 657044 5804139

Du25 15-MAR-11 11:19:03AM 9 U 657049 5804127

Du26 15-MAR-11 11:23:29AM 9 U 657057 5804108

Du27 15-MAR-11 11:25:04AM 9 U 657057 5804094

Du28 15-MAR-11 11:30:49AM 9 U 657062 5804116

Du29 15-MAR-11 11:32:31AM 9 U 657077 5804113

Du3 15-MAR-11 9:37:12AM 9 U 657039 5804167

Du30 15-MAR-11 11:35:01AM 9 U 657084 5804098

Du31 15-MAR-11 11:41:22AM 9 U 657079 5804060

Dump Creek East Waypoints

Name Date of Measurement Position (UTM Zone, Easting, Northing)

5

Skimlik and Dump Creek Waypoints Prepared for BCWCS

Mt1 Mt10 Mt11 Mt12 Mt13 Mt14 Mt15 Mt16 Mt17 Mt18 Mt19 Mt2 Mt20 Mt21 Mt22 Mt23 Mt24 Mt3	15-MAR-11 1:45:09PM 15-MAR-11 2:25:26PM 15-MAR-11 2:26:31PM 15-MAR-11 2:28:17PM 16-MAR-11 10:17:55AM 16-MAR-11 10:20:01AM 16-MAR-11 10:28:05AM 16-MAR-11 10:29:57AM 16-MAR-11 10:40:22AM 16-MAR-11 10:41:39AM 16-MAR-11 10:44:59AM 15-MAR-11 1:55:16PM	9 U 657128 5804001 9 U 657110 5803895 9 U 657105 5803882 9 U 657103 5803865 9 U 657084 5803849 9 U 657069 5803837 9 U 657107 5803844 9 U 657106 5803833 9 U 657170 5804006 9 U 657182 5804008 9 U 657203 5804021 9 U 657112 5803956

Mt4 Mt5 Mt6 Mt7 Mt8 Mt9 MtBR1 MtCON1 MtCON1POT MtCON2 MtCON2A MtCON2APOT MtCON2B MtCON2BPOT MtCON2POT MtCON3 MtCON3POT MtCON4 MtCON5 MtCON6 MtCON7 MtCONPOT MtCUL1 MtCUL2	16-MAR-11 10:47:09AM 16-MAR-11 10:48:42AM 16-MAR-11 10:54:06AM 16-MAR-11 10:55:09AM 16-MAR-11 10:56:07AM 15-MAR-11 1:59:07PM 15-MAR-11 2:09:56PM 15-MAR-11 2:11:11PM 15-MAR-11 2:12:48PM 15-MAR-11 2:18:34PM 15-MAR-11 2:21:17PM 15-MAR-11 2:24:18PM 16-MAR-11 10:51:26AM 15-MAR-11 1:48:49PM 15-MAR-11 1:52:09PM 15-MAR-11 1:57:32PM	9 U 657227 5804035 9 U 657246 5804038 9 U 657301 5804078 9 U 657312 5804093 9 U 657326 5804104 9 U 657094 5803943 9 U 657071 5803917 9 U 657061 5803904 9 U 657048 5803893 9 U 657103 5803932 9 U 657087 5803900 9 U 657104 5803906 9 U 657273 5804051 9 U 657121 5803982 9 U 657123 5803969 9 U 657109 5803948

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	15-MAR-11 2:22:19PM	9 U 657087 5803888
	15-MAR-11 2:29:14PM	9 U 657098 5803853
	16-MAR-11 10:23:11AM	9 U 657058 5803827
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	15-MAR-11 2:05:35PM	9 U 657087 5803932
	15-MAR-11 2:08:22PM	9 U 657063 5803939
	16-MAR-11 10:43:27AM	9 U 657192 5804009
	16-MAR-11 10:50:08AM	9 U 657266 5804045
	16-MAR-11 10:52:41AM	9 U 657287 5804061
	16-MAR-11 10:57:24AM	9 U 657340 5804112
	15-MAR-11 2:14:35PM	9 U 657047 5803871
	15-MAR-11 1:41:08PM	9 U 657144 5803989
	16-MAR-11 10:37:07AM	9 U 657157 5804006

6

Appendix 2:

Iron Oxide information

BB-18 1997

Iron Bacteria in Surface Water

What are iron bacteria?

Iron bacteria are bacteria that 'feed' on iron. Unlike most bacteria, which feed on organic matter, iron fullfill their energy requirements by oxidizing ferrous iron into ferric iron. When ferrous iron is converted to ferric iron, it becomes insoluble and precipitates out of the water as a rust-colored deposit. This process can occur simply by exposing iron-rich groundwater to the atmosphere. However, if the deposit is slimey and clumpy, it is probably caused by iron bacteria.

Are iron bacteria harmful?

Iron bacteria are of no threat to human health. They are found naturally in soils and water. However, the orange slime in the water or leaching from the shore is often considered to be an aesthetic problem. The oily sheens created by the decomposing bacteria cells are often mistaken for petroleum sheens.

What causes iron bacteria?

Iron is a common element in New Hampshire soils. Consequently, iron-fixing bacteria have existed in our natural waters for over a million years. Iron-rich fill material or bedrock can create an iron bacteria problem whenever it is located near water. In general, wherever there is oxygen, water and iron there is

the potential for an iron bacteria problem.

How can we identify iron bacteria?

Orange or brown slime (precipitate) and oily sheens are often the first indication that these bacteria are present. Unlike petroleum sheens the iron bacteria sheens break apart when they are disturbed. The orange or brown slime may be collected in a jar and analyzed microscopically at DES to identify the bacteria type.

What can we do about iron bacteria?

The best treatment for an iron bacteria problem is prevention. To thwart these obnoxious bacteria, have all fill material analyzed for iron content before using or exposing it. Unfortunately, once established, iron bacteria problems are difficult, if not impossible to correct. Sometimes iron-rich fill can be replaced by fill with a lower iron content. However, this may be extremely costly and have other environmental impacts. Since iron bacteria are not harmful, sometimes the only feasible thing that people can do is simply to accept it for the natural occurrence that it is.

For further information: For more information on iron bacteria, please contact DES's Biology Bureau 603-271-3503.