1 PROPOSED METHODOLOGIES FOR BENTHIC INVERTEBRATE, STREAM SEDIMENT AND FISHERIES MONITORING

1.1 PROPOSED BENTHIC INVERTEBRATE MONITORING METHODOLOGY

The Canadian Aquatic Biomonitoring Network (CABIN) protocol is designed to assess changes in the benthic invertebrate communities at multiple long-term monitoring locations. CABIN uses the Reference Condition Approach (RCA) for assessing the overall health of the biological community (in this case benthic invertebrates) at the test sites being monitored. A bioassessment model is developed from the available reference site data, and this model defines the range of biological communities that should be found at a site if the site is not affected by human activities. Test sites are assessed against reference sites using the bioassessment model and the divergence between the benthic macroinvertebrate communities at reference sites and a test site indicate the extent of potential impairment. Habitat and stream characteristic data from the test site are combined with GIS and climate information for the area to determine the appropriate group of reference locations for comparing to the test location. All of this information, along with the taxonomy data, is entered into the CABIN database (ec.gc.ca/rcba-cabin) where users also have access to analytical tools for interpreting the data and preparing reports for each test site.

The standard protocol dictates that benthic invertebrate samples are collected over a three minute period of time using a kick net (Environment Canada 2012). A zigzag sampling pattern is used across the stream to integrate benthic invertebrates from various stream microhabitats within the erosional zone (for example, areas around large boulders, riffle, runs, bank overhang) in proportion to their occurrence in a sample reach.

The following is a description of the collection, transfer, and preservation of benthic invertebrates specific to CABIN:

- Ensure that you are in the correct location (using a GPS) for the targeted station. Define the kick area and path in the erosional zone of the sampling reach (calculated as 6 times the estimated bankfull width) before entering the stream. Inform field team members so that this area is not disturbed. At least 2 people are required; one kick-netter and one observer/timer.
- Use a 400 um triangular net designed for this purpose
- Use a watch to time the amount of time that the bottom is being actively disturbed for 3 minutes. If you have to stop or move locations in the event of impediment by roots or falls, the observer will pause the timer; re-position yourself in the stream, start again and re-start the clock.
- Start sampling at the downstream end of the kick area, place the kick net downstream of the sampler, flat side of the triangle resting on the substrate of the stream.
- Walk backward in an upstream zigzag direction, dragging the net along the bottom of the stream while walking.
- Kick the substrate to disturb it to a depth of ~5 to 10 cm if possible. For large cobble, turn over and rub your foot over the surface to dislodge macro-invertebrates clinging to the interstitial spaces. Brush the surface of large boulders with your hand or foot.

- The net should always be held close to the area that is being disturbed to ensure that most of the disturbed substrate and organisms are swept into the net by the current.
- Continuously zigzag over the stream bottom from bank to bank in an upstream direction. Stop once you have reached 3 minutes of kick time.
- Remember that if the sampler needs to stop to get around an obstruction, take a rest, or remove large cobbles from net, the timer must stop timing while the sampler lifts the mouth of the net from the water. The stopwatch is restarted when the sampler is ready to continue sampling.
- It is the responsibility of the timer to spot the sampler and alerts them of any upcoming obstructions while the sampler is traveling backwards and can't always see where they are going.
- Splash the side of the net in the river to transfer all material to the collection cup at the end of the net (ensure that the mouth of the net is out of the water).
- Remove the collection cup attached to the end of the net and empty the contents directly into a wide-mouth plastic sample jar, pail or sieve. Always work over a pail or tray in case of an accidental spill.
- Wash any material remaining in the cup/net into the sample jar/pail/sieve using a squeeze bottle and forceps to remove any clinging animals.
- Carefully rinse and discard any stones and large green leaves that have fallen into river and are not invertebrate habitat.
- Transfer sample from pail/sieve (if using) to one or more sample jars, depending on sample volume. Check pail/sieve to ensure that no organisms remain. The total volume of the sample should not exceed 50% of the volume of the sampling container to ensure there is enough space for the addition of a 10% formalin solution (Environment Canada, 2012a); use additional jars if more space is needed.
- Preserve the sample by adding buffered formalin to quickly fix the samples for future identification. Seal the jars well and circle the lids with electrical tape to prevent leakage of formalin, especially during shipping.
- Package and seal the benthic samples in a cooler or similarly sturdy transport container; advise the lab that the samples are on their way and ship with a completed chain-of-custody form.

1.2 Proposed Stream Sediment Quality Monitoring Methodology

A hand-held bilge-pump (Guzzler method) should be used to collect sediment samples from stream habitat as part of the long-term monitoring plan for Camp Creek and False Canyon Creek. This method is ideal for moderate to high gradient streams where there are few if any true depositional areas. Large grain size substrate (i.e., sand or coarser) has low metals concentrations because of the small surface to volume ratio and the low surface area to which benthic invertebrates are exposed. The Guzzler method uses suction to pump fine sediments from interstitial spaces within the gravel/cobble substrate of the stream. Sediments are preferentially collected from the middle of the stream, away from the edges or bottom of the stream bank to avoid 'bank material' and to target fine sediment within the hyporheic zone, below the gravel.

Below is an outline of the step-by-step sampling procedure:

- At the downstream edge of the sampling station, select a location where there is suitable gravel/cobble substrate in riffle or runs where fines are expected to occur. Avoid sampling in areas that are excessively steep where there may be very large material and a paucity of fine material.
- Use a clean pump to suction sediment and water from the substrate into one or two pre-cleaned 20-L buckets. Use short pump strokes to reduce the amount of water and maximize sediment volume recovered. Push intake end of pump into the substrate, dislodging gravel and cobble while pumping the fines that are dislodged. Limit the depth of penetration of the pump tip to the upper 2 to 3 cm the stream surface and avoid pockets of accumulated fines that may have been deposited from the adjacent bank. Continue moving upstream and pumping from the thalweg of the stream until the bucket is full of water/sediment. A distance of 10 – 15 m of stream is typically covered. Collect a second bucket if you do not feel that you acquired a decent enough sample of fine sediment … usually about 0.5 L.
- Using your arm or a clean stainless steel spoon, completely re-suspend the sediment in the bucket, stirring for 15 seconds.
- Let sit for 10 seconds, gently pour off or decant the water with suspended fines into a second bucket, leaving the coarse material (sand, gravel) at the bottom of the first bucket. Be careful to pour off only the silt size material or smaller
- Stow the buckets someplace where they will be moved as little as possible for a minimum of 30 to 60 minutes. This will allow fine material to settle out. Be careful not to disturb this material while allowing to settle. The longer the settling period the better. You can choose to leave overnight if you wish; to minimize differences due to sampling methodology, leave all buckets to settle for a similar amount of time.
- At the end of the settling period, carefully pour off and discard as much of the overlying water as possible from each bucket. Avoid re-suspending or losing any of the sediment that has settled at the bottom of the bucket. Retain as little water as possible
- Use a spoon to move the top layers of sediments from each bucket into a stainless steel bowl and homogenize the sediment. Avoid any sand at the bottom of the bucket when removing the fines. Using the spoon, put sediment into 2 x 250 ml glass jars supplied by the laboratory. One jar is for analysis of grain size and the other for total metals and total organic carbon.
- Determine from the analytical lab(s) the minimum acceptable sample volume or mass. If you have less than 250 ml per jar, that is probably fine. While the lab can get away with much less, it is important that you collect sufficient sediment to be representative of what is in the stream.
- Sediment samples should be kept cool in coolers with ice packs. Samples are shipped on ice to the laboratory for analysis of metals, total organic carbon (TOC), and particle size. The laboratory must be instructed to homogenize the contents of each sampling jars for a given replicate, prior to any analyses and prior to sending out any subsamples that are subcontracted (e.g., particle size and TOC). Metals analysis is conducted on the < 2 mm fraction of the sediment unless the laboratory is specified otherwise.

1.3 PROPOSED FISHERIES MONITORING METHODOLOGY

It is proposed that the methodology that has been employed in the water use licence monitoring program (EEM) be continued for continuity in the post-reclamation period. This includes electroshocking with consistent effort to collect number, species, sex and size of fish captured. Fish tissue collection could be initiated should a response to an AMP trigger dictate.