Biosolids Land Application Plan - 2013

Norm Wood Environmental Centre
City of Campbell River

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Introduction

The Norm Wood Environmental Centre (NWEC) is a secondary treatment facility located approximately 2 kms north of Campbell River. It is owned and operated by the City of Campbell River and is designed to treat the waste water generated by a population of about 52,000 people. The plant produces about 400 dry tonnes of Class B biosolids per year.

In 2002, the City of Campbell River approved a strategy to beneficially re-use the biosolids produced at NWEC by land applying to a 10+ hectare site adjacent to the treatment plant. That site was cleared and fenced and appropriate drainage was installed in the late summer of 2003. From 2003 to 2011, the NWEC biosolids were applied to the site in accordance with the Organic Matter Recycling Regulation (OMRR) based on annual land application plans. This site will be rested indefinitely because copper concentration in the soil has increased to the maximum safe threshold established by the OMRR.

In 2011, the City acquired 31.5 hectares of land on DL 52, adjacent to the previous application area. This land has been amalgamated into the NWEC site so it is within the same legal parcel as the treatment plant. About 7.0+/- ha (17.3+/- acres) of DL 52, (the 2012 application site plus some surrounding buffer and access areas) was cleared in February/March of 2012 in preparation for a 2012 application of biosolids. An additional 4.4 ha (10.9 acres) was cleared in late summer bringing the total application area currently available on the new site to 10.85 ha (27.1 acres). The soils on the site are coarse sand, very similar to the soils on the west end of the previous application area. These soils have proven to be very well suited to biosolids application. They are hot and dry in the summer so they dry quickly. The area is almost level (average slopes are less than 1.8% with minor undulations within the site) and it is stone free.

Pre-application soil samples were taken at the site on April 10, 2013. The soils will be sampled again after the 2013 application.

In May 2012, four observation wells were installed, around the perimeter of the site, for groundwater monitoring. The sites were selected with direction from Steve Carballeira, P.Geo, of H2O Environmental. Samples were taken from 3 of these wells, before, during and after, the 2012 land application; there was not enough water in the 4th well to collect a proper sample. There is a ditch between the new site and the old site. It is dry during the application season but was sampled before, and after, application. As with the previous application site, the plan is to collect groundwater and surface water samples before, during and after each annual application, if water is available.

The site will be planted to barley for the summer months. This will be cultivated into the soil and the site will be planted to a winter cereal cover crop in September. The intent is to condition the soil, allow areas to settle, identify any possible challenge areas, before planting to perennial crops. Long term crop options will be reviewed during 2013.

This document describes the proposed land application plan on DL 52 for 2013. It is based on and aims to address all of the requirements of BC's *Organic Matter Recycling Regulation (OMRR), the BC Municipal Sewage Regulation* and the *Best Management Practices Guidelines for the Land Application of Managed Organic Matter in British Columbia*. The 2013 application will continue to use the pivot irrigation system that has been used since 2010.

The plan is to apply up to 592.1 dry tonnes of biosolids on the 10.85 ha available for application. The application will occur during dry weather between June 3 and September 15.

This plan was prepared by Gary Rolston PAg. of From the Ground Up Rural Resource Consultants Inc. in Courtenay, BC.

Appendices 1 and 2 contain the requirements of Schedules 7 and 13 of OMRR which summarize the land application plan.

Land Application Objectives

The objective of this land application plan is to determine an appropriate rate and method of application for beneficial use of Class B biosolids from the NWEC as a soil amendment on District Lot 52 which is adjacent to the Norm Wood Environmental Centre. The land was cleared in 2012. The trees on the site were chipped and the woody land clearing debris was incorporated into the top 15 to 30 cms of the soil using a Fecon RT400 self-propelled mulching machine.

The plan, for 2013, is to apply the volume of biosolids recommended by this Land Application Plan, between June 1st and September 15th. The proposed start date is subject to soil conditions being suitable for application. Application will be delayed if the water table is above the required 1 meter depth. Likewise, application will cease in September if the conditions become too wet due to early fall rains.

The biosolids will be applied with a pivot irrigation system which was relocated from the old site, to this site, in the spring of 2012. This application system allows planting of a crop that provides full ground cover. The pivot move operates with wheeled A-frame towers every 54 to 63 m. These are the only contact points in the field so the application equipment will have very little direct contact or effect on the crop.

The pivot irrigation system has been used for the past 3 applications; 2 on the previous site, immediately north of DL 52, and on the current site in 2012. There were some issues in the first year (2010) with pump and nozzles blockages due to a poor filtration system. These were resolved over the course of the year and the 2011 application went smoothly. In the past 2 years, the material was applied entirely during warm, dry weather, when it was most needed by the crop and when it had the lowest risk to the surrounding environment.

The solids content may require adjustment and fine-tuning over the application season. It is preferable to apply 3%+ but the average moisture content applied in 2012 was 2.3%. Based on the average rate of application in 2012, of 1.3 dry tonnes per hour, the proposed application will require about 450 hours of operating time. The system will only be operated during working hours and during warm dry weather – an average of about 5 hours per day over 90 days over the course of the summer.

The goals of the land application plan for 2013 are:

- Primary goal is to improve the condition of the soils on the newly cleared area using a combination of a summer cereal crop which will be tilled under and followed by a winter cereal cover crop. This will allow conditioning and further assessment of the new site on DL 52.
- To further fine-tune application of biosolids using the pivot irrigation system. There may be some minor new issues at the new site because of increased pumping distances and elevations.
- To provide a combination of moisture and nutrient to the crop at the time it is needed most.
- To add organic matter to the soil, and
- To accomplish the above objectives without causing environmental or health risks, and with as little nuisance odour as possible.

Site Characteristics

Location

Address: 4000 Island Highway North, Campbell River. Note: This is the address for the Norm Wood Environmental Centre which will be the only road access to the application site.

Parcel Identifier: 028-650-689

Legal Description: Lot A District Lots 52 and 120, Sayward District, Plan EPP9665

Land Owner: City of Campbell River

This site was assessed by Gary Rolston, P.Ag. in 2010 and found to be very similar to west end of the previously used application site and therefore, well suited for biosolids application. The site is adjacent to the treatment plant (source of the biosolids) and is part of one contiguous block of land owned by the City of Campbell River (see Figure 1). The soils and topography are very well suited to biosolids application and for establishment of a suitable crop. The nearest residents to this site are over 400 meters (of dense second growth timber) from the southeast corner of the site.

Soil Properties

The soils on the majority of the new site (80% to 90% of the area) are known as Kye soils (BCMoE Technical Report 30, 1989). Kye soils are well to rapidly drained and are found on nearly level to moderately sloping lands. They are stone free with loamy sand or sandy loam surface layers. At depth (1 m+), the texture tends to become sandier and soil structure is compacted or weakly cemented. These soils are identical to the west half of the previous application area and, as such, are capable of accepting large volumes of biosolids.

The area cleared in the summer of 2012 (northwest portion of the new site) is also mainly Kye soil but there are pockets of shallower sandy to silt loam soils in the areas identified as wetlands. These pockets have perched water tables due to underlying cemented layers. The soil surface undulates slightly so there were areas where biosolids would pond if localized application was too heavy within short periods. The City had a full time staff person dedicated to monitoring and adjusting the application. This generally reduced issues with ponding because those areas would receive less material or could be avoided entirely if they became too wet.

Two soil samples were collected from the site on April 10, 2013. The samples were collected and analyzed according to the protocol described in the BCMAF publication “Soil Sampling” (BCMAFF, 2002). A composite sample from each soil type was prepared from at least 12 sub-samples taken from random representative sites within the soil type. Each sub-sample consisted of a core from zero to 20 cm depth taken with a 50 mm Dutch auger. The composite samples were sent to Exova Laboratories, via North Island Laboratories. They were analyzed for fertility, pH, electrical conductivity, organic matter, and trace mineral levels. The complete analyses are included in Appendix 3.

The organic matter content in the soil samples was higher than expected – average of 6.94% (6.82% and 7.06%) in the two samples. Carbon to nitrogen was very low at 5.6 and 7.5 – average of 6.35. The carbon to nitrogen ratio is not truly representative of the site. There is a mat of woody debris on the surface which would increase the C:N ratio in the surface layer significantly. It is difficult to compile a representative sample and/or to estimate the volume of this material.

Slope and Topography

The application site has an average slope of 1.7% and slopes from a high point of about 32.1 meters above sea level in the southwest part of the site down to 27.0 meters near the proposed anchor point for the pivot - in the northeast corner. Overall slopes are very gentle. Biosolids only flow across the surface on compacted areas (wheel ruts from the pivot move) with slopes over 3%. This site has minor short slopes of this magnitude that can be managed by turning off the application nozzles in these areas. Unlike the previous site, the pivot wheel tracks follow arcs that are across the contour, not down the slope. The total application per ha in 2013 will be lower than prior applications because there is a limited volume of biosolids which will be applied to a larger area. This will allow better management of the application to prevent ponding and overland flow.

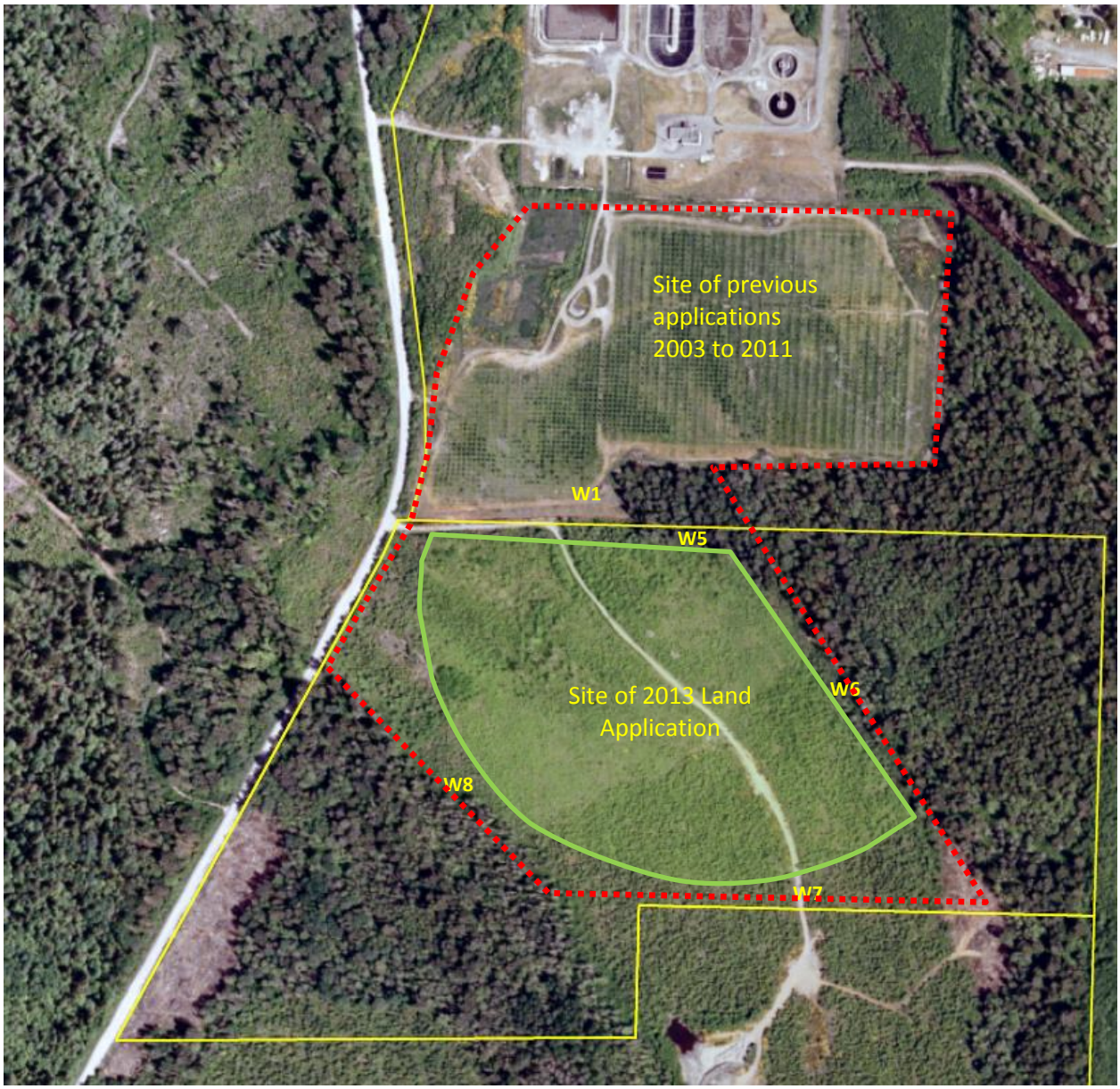

Figure 1 Site of proposed biosolids application for 2013 (green). The green area indicates the perimeter of the application area to be covered by the pivot irrigation system in 2013. The red dotted line denotes the fence

line around the application site (including the old fence around the previous application area. Groundwater observation wells are shown as W1, W5, W6, W7 and W8.

Depth to Groundwater Table

There is a groundwater observation well on the boundary between the previous application site and the proposed application site (labeled W1 in Figure 1). The depth to groundwater was measured at this well, quarterly, over the past 8 years. The depth to groundwater at Well 1 ranged from 0.15 m (12 inches) below the surface when samples were taken during wet fall or winter periods to 1.5 m (60 inches) in mid-summer. From May to early October, the depth to water table at Well 1 was generally below 1 meter (40 inches). When it was not (if there were heavy summer rainfall events), the site (previous application area) would not support vehicle or equipment traffic.

W5 is located in similar conditions to W1. It is slightly downslope from the pivot and has very high water tables (at or near the surface) in winter months. Range from 0.22 m below the surface in November to 0.84 m in August 2012.

W6 and W7 are at equal elevations to the application area and in the same soil type. The water table in these wells ranged from 1.67 meters below the surface on November 5, 2012 to over 3.0 meters below when sampled in June and August 2012.

W8 was suggested as a control site by the geologist because it was above the elevation of the site and well beyond the application area. The water table in W8 was 0.39 meters below the surface in April, 2013, 0.5 meters in June 2012, 1.27 meters in August and 0.93 meters in November.

The depth to groundwater will be monitored at observation wells before and during the proposed application season. The intent is to use the system for irrigation which means it will only be operated when there is a soil moisture deficit within the root zone of the crop.

A search of MoE groundwater well inventory shows wells on Duncan Bay Road, Iron River Road and Gordon Road, all over 1 km away from the application site. A current search of the BC Water Resource Atlas http://www.env.gov.bc.ca/wsd/data_searches/wrbc/ shows no wells in the vicinity, or down gradient, of the application site.

Potentially Sensitive Sites

An Environmental Inventory of the site was conducted in 2010 by Warren Fleenor, R.P.Bio of Current Environmental in Courtenay. The work identified four wetland areas within the property – see Figure 2. The most important of these (W1 – Aspen/Slough Sedge Wetland and W4 – Northeast of the site) is well outside the application area and appropriately buffered. The other 2 wetlands were considered to be "*highly degraded from previous logging activity*" and *low in species diversity and wildlife utilization*. *"As these two wetlands lie within an area that has been clear-cut, they lack the contiguous mature riparian forested area and structural diversity that make wetlands W1 and W4 biologically rich. Wetland W2 does not appear to have surface flow connected to any watercourse; as such this polygon does not have any mandated level of protection."*

The inventory study recommended options to compensate for the elimination of wetlands W2 and W3 to accommodate the use of the site for biosolids application. In 2012, the city negotiated, and agreed, with the appropriate agencies, to enhance the ecological value of other wetland areas in the area in exchange for approval to clear and make use of these wetland areas (W2 and W3) for future biosolids applications. Approval was granted and in the summer of 2012, the area including, and surrounding the 2 wetlands was cleared and incorporated into the application area as shown in Figure 1 and Figure 2.

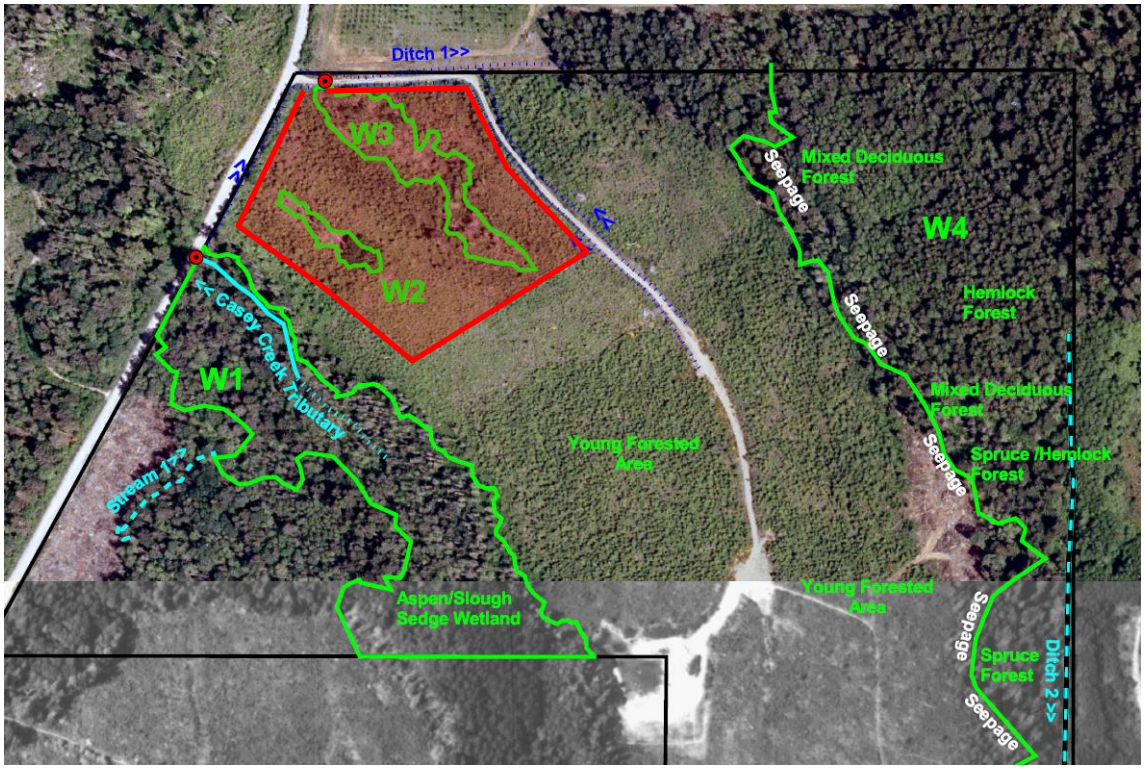

Figure 2 Valued Ecosystem Components (VECs) identified by Current Environmental in 2010 include 3 wetlands (W1, W2 and W3). Area outlined in red was cleared and incorporated into the application area on the new site in late summer 2012.

Based on applications over the past 7 years, and the related water monitoring, biosolids applications have had minimal impact on surrounding areas.

The application site is relatively isolated; the nearest residents are at least 400 meters from the southeast corner of the application area. There is a dense stand of second growth timber between the site and these residences which will provide an adequate buffer against noise and potential odour. There have been no odour complaints during the previous biosolids applications.

Biosolids Characteristics

The site will be seeded to the following crops:

- Summer crop of barley which will be incorporated/cultivated into the soil in September 2013 and then reseeded to a winter cereal cover crop.

These crops will be fertilized with biosolids from the NWEC's biosolids storage basin. These biosolids meet the Class B requirements as defined by OMRR.

Pathogen Reduction Processes and Limits

The fecal coliform densities in the biosolids have been measured 3 times in the past four months. The average of these samples was 843,333 MPN/100 gm dry weight. The highest count was 2,200,000 MPN/100 gm. *These counts are very high relative to past samples*; the average count of 26 samples taken over the past 9 years, including these samples, is 124,780 CFU/100 gms.

The OMRR pathogen reduction limit for Class B biosolids is *<2,000,000 MPN **per gram** of dry solids or one of the following processes must be used:*

(a) The aerobic digestion process whereby Class B biosolids are agitated with air or oxygen to maintain aerobic conditions for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature must be between 40 days at 20 degrees Celsius and 60 days at 15 degrees Celsius…….

Although the fecal coliform counts in 2013 are high, they are reported in MPN **per 100 grams** whereas the standard is 2 million MPN **per gram** so they still meet the Class B requirement. Furthermore, biosolids treated, later in the year, are far more likely to meet the specific mean cell residence times outlined in OMRR (above).

In the past, samples taken at NWEC during land applications have never exceeded 170,000 CFU/100 gms. The biosolids have always met the fecal coliform standard for Class B.

Biosolids have always been applied at the NWEC site in accordance with the standards listed in Section 1 of Schedule 8 – for fecal coliform counts greater than 1,000 MPN per gram.

Vector Attraction Reduction

Specific Oxygen Uptake Rate (SOUR) has been measured three times, to date[1], in 2013. The values ranged from 0.02 to 0.50 with an average of 0.185. All of these samples were well below the required rate of 1.50 milligrams of oxygen per hour per gram stated in OMRR. These rates are slightly lower overall than past years; the plant has reduced the frequency of testing because the rates have been consistently low.

Trace Elements and Nutrients

Concentrations in the biosolids of the eleven substances listed in Schedule 4 of the OMRR have been measured 4 times in the past four months. The results in one of the samples were clearly skewed; most of the metals were between 40 and 50% lower than historical normals. The average

[1] Lorne Sandberg - Jan 21st 0.50, Jan 30th 0.02, May 2nd 0.034

concentration of each substance in the 3 samples used is shown in Table 1, and compared with maximum allowable concentrations for Class B biosolids.

All of these are well within the limits of Class B biosolids as defined by OMRR and the concentrations are consistent with concentrations from previous years.

Table 1. Average concentrations in biosolids of the eleven substances listed in Schedule 4 of the OMRR compared with maximum allowable concentrations for Class B biosolids (based on 3 samples collected in early 2013; one sample was excluded because it was clearly skewed – most metals in it were 40 to 50% lower than past averages)

Substance	Concentration in biosolids (µg/g of dry weight)	Maximum allowable concentration for Class B biosolids (µg/g dry weight)
Arsenic	3.9	75
Cadmium	2.73	20
Chromium	20.7	1060
Cobalt	3.3	150
Copper	1069	2200
Lead	99	500
Mercury	0.90	15
Molybdenum	8.7	20
Nickel	16.5	180
Selenium	6.5	14
Zinc	853	1850

Dioxin and Furans

No samples were analyzed for dioxins and furans in the past year, however, 6 samples were analyzed for various forms of dioxins in 2010. All of the results were below the detection levels.

Foreign Matter

Foreign matter is screened when it enters the treatment plant. There is also a macerator, incorporated into the pump on the edge of the lagoon, which helps to ensure that minimal amounts of the remaining foreign matter are applied with the biosolids.

Public Process

The *Best Management Practices Guidelines for the Land Application of Managed Organic Matter in British Columbia* recommend that the local public be notified of a pending biosolids application.

Public information and stakeholder considerations

The public information process for the upcoming biosolids application will be as follows:

1. Written notification to the Public Health Officer, Regional Waste Manager and Land Reserve Commission as required by OMRR.
2. Written notification to the City of Campbell River Council. Each member of council will be advised, in advance, of the intent to apply biosolids at NWEC.
3. Notification to adjacent landowners, in writing, at least 30 days prior to land application. The notice will include an invitation to contact either the supervising agrologist or the appropriate City staff person to discuss any questions or concerns.
4. City staff and/or the supervising agrologist will deal with any resulting phone and office enquiries. Stakeholders will be provided with the appropriate information in an attempt to allay their concerns early on OR they will be referred to the appropriate government contact person. The nature of the concerns will be recorded.

Based on the experiences of the past eight years, it is expected that there will be no opposition to the application. In 2003, two parties expressed concern about odour *prior to the land application*. Local horseback riders expressed concern before the initial application because the perimeter fencing prevented them from 'trespassing' across the site to access areas beyond. This concern was alleviated by providing access for horses around the perimeter of the fenced application site. Two people attended the Open House held in the fall of 2003. There were no actual calls or concerns during or after the 2003 application. In 2004, there were no calls or concerns expressed to City staff and only 2 people attended the Open House – both were supportive of the biosolids application. Given the low attendance at the earlier Open House sessions, there were no Open Houses in 2005 through 2012. Nothing (aside from the above) is planned for 2013.

Signage and access restriction

The new site has been surrounded by a 2.03 meter tall, woven wire, fence built to the Ministry of Transportation's Type A standard. The previous site, which is within the same enclosed area, was fenced with a 2 meter high 12.5 gauge woven wire fence in the fall of 2003. The fence is 10 years old but it remains in reasonable condition. Repairs were made throughout, and parts of the fence were upgraded in, 2010 to accommodate the centre pivot.

The only vehicle access point to the site is through the NWEC compound which is surrounded by chain link fence and has limited public access. Signs were posted (and remain posted) around the perimeter of the application site with the following wording:

No Public Access. Hybrid Poplar Plantation. Biosolids from the Norm Wood Environmental Centre were applied to this site on and after September 15, 2003. No harvesting of feed for livestock from site for 60 days. The public should avoid ingesting plant material from above ground portions of plants for 18 months and should avoid ingesting plant material from below-ground parts of plants for 38 months. For more information contact: District of Campbell River Public Works Dept 250-286-4033 or Engineering Dept. 250-286-5745.

Similar signs will be posted at any point where a trail or abandoned road has crossed into the application site.

Biosolids Application

Climate and season of application

According to the *BMP Guidelines*, the preferred seasons for biosolids applications in South Coastal BC are spring and summer (April through August). The proposed application will begin on, or after, June 1, 2013 and will be completed by September 15, 2013. The material will be applied (ie the system will be turned on) whenever the soil is dry enough to justify irrigation as described below in the "Biosolids Application" section.

Buffers

The buffer requirements for Class B biosolids are listed in Schedule 8 of the OMRR and are summarized below in Table 2.

Table 2. Buffers required for Class B biosolids application.

Feature	Required buffer (m)
Potable water sources – wells	*30*
Irrigation wells	*30*
Lakes, rivers, streams	*30*
On-site dwellings	*30*
Off-property occupied dwellings	*30*
Boundaries of property zoned residential or recreational	*30*
Major arterial roads and highways	*20*
Minor public roads	*10*

The layout for the pivot system has been designed to ensure that these buffers are observed. The southernmost point on the arc of the pivot (see Figure 1) is more than 30 meters from the property line.

There is a minor public road (logging road) along the west side of the site. The fence along that side of the site is at least 10 meters from the road so that buffer will inherently be observed at all times.

Public access is restricted to the extent that individuals will not be able to get close enough to be exposed to wind drift from the irrigation system. The irrigation system is designed, with drop down hoses and applicators, to minimize drift.

Crop Suitability and post-application waiting period

Barley will be planted when the application begins. This will provide complete groundcover and make good use of the nutrients and moisture in the biosolids, over the summer. In September, the barley will be cultivated in to improve the condition of the soil and smooth the site (make it more trafficable for future crops). A winter cereal (winter wheat or rye) will be seeded after cultivation to provide a winter cover, make use of nutrients and prevent erosion.

The proposed crops will not be harvested for food or animal feed. The site has been fenced, as noted above, to exclude wildlife and domestic livestock. Even with fencing, it is expected that the site will be grazed, in the winter, by waterfowl (Canada Geese and some Trumpeter Swans) and elk. Grazing restrictions are only applicable where the biosolids have fecal coliform contents greater than 1000 MPN per gram. The NWEC biosolids have consistently been below this level, until this year. The

cereal heads on the barley were randomly sampled on September 11, 2012 – only 4 days after the 2012 application was completed. The fecal coliform count in the sample was only 170 MPN per 100 gm.

Biosolids samples will be taken, as applied, during the summer to determine actual in season fecal coliform counts.

Site management

The site for the 2012 and 2013 land applications was cleared in February and March of 2012. Clearing was done with an RT400 Fecon self-propelled mulcher grinder which mows down and shreds trees, into a fine mulch, in one pass. The Fecon also has an in ground milling head which mixes the woody debris into the top 15 to 45 cms (6 inches to 18 inches) of soil in a second pass. Old growth stumps on the site were also ground into mulch. This process left the soil well aerated with an even mix of soil and woody debris. Minor drainage and leveling were done with excavators and bulldozers. This left a nicely leveled site in very good condition for land application with few concerns about surface flows or drainage. A low value wetland was identified in the northwest corner of the new site during the site assessment process. The City negotiated to construct offsetting environmental improvements at another location so the wetland site could be incorporated into the application area. This allowed clearing of an additional 4.4 ha in June/July 2012. The combined area available for application in 2013 is 10.85 ha.

The entire site was fenced with 2 meter woven wire fence in early May 2012.

The entire application area was cultivated several times over with a heavy breaking disc, after the 2012 application. The intent was to soften the soil surface (which was significantly compacted by clearing in many areas), incorporate more of the woody debris into the top 20 to 30 cm (8 to 12”) and to fill some of the low areas. Winter cereal was seeded on the site after the cultivation.

The old application site was also cultivated to seedbed condition and seeded to perennial grass.

For 2013, the following site management is planned:

1) Final site inspection prior to application. This includes checking to ensure that the water table is 1 m below the surface of the soil within the application area (June 1, 2013).

2) Begin the 2013 application. This will likely start on June 3, Monday rather than Friday. The site will be seeded at the same time. A heavy initial application, subject to weather, will help to ensure strong germination. No pre-application cultivation is planned. The surface of the site will be left alone. Woody debris on the surface will help to ensure that there are minimal surface flows of biosolids within the site.

3) Monitor the application site to identify areas of potential concern. The post application cultivation of the site, in 2012, improved the general condition of the soil. There may still be minor areas of concern for ponding and overland flow. Areas of concern can be dealt with when the site is cultivated, after the application, and prior to reseeding in the fall.

Biosolids application logistics and techniques

Site condition challenges

The site is relatively flat (slopes of less than 2%) with minor internal undulations which resulted in some ponding and overland flow in 2012. Beyond this, there are no challenges with this site (see Figure 3). The soil is coarse red sand, similar to the previous site, and, as such, is very capable of accepting significant volumes of biosolids. It is free of stones. The clearing process has left the site well aerated with significant volumes of finely chipped woody debris which will help absorb moisture and nutrients.

Proposed 2013 Application

In 2010 through 2012, material has been applied through a pivot irrigation system. This method had its challenges which were resolved during the 2010-11 applications.

Figure 3 Biosolids application site during 2012 application

For 2013, the plan is to continue to use the pivot system on the entire 10.85 ha site. The pivot is anchored in the northeast corner of the site (as shown in Figure 1). In 2013, the irrigation line will move in an approximate 130° arc, covering 10.85 ha. Biosolids will be pumped from the lagoon, located within the Norm Woods Environmental Center, directly to the centre pivot. Fresh (clean) water can be added to the supply line if dilution is required for better flow and nozzle performance. The pivot is operated at a speed which will allow effective application and infiltration, and in accordance with crop requirements. The system was designed by a Certified Irrigation Engineer, in accordance with the B.C. Irrigation Association standards. Modifications and adjustments to the system have been made to improve performance. The system is set up so individual nozzles and/or complete spans can be turned on or off at any given time (as can be seen in Figure 3 above, with the near nozzles not operating). There is a full time staff person who can adjust which spans or nozzles operate to allow even application and/or skip over problem areas where there is potential for ponding or surface flow. The available area for application, in 2013, is almost 70% larger than the 2012 site giving more options for managing these conditions.

This system includes the following operational and safety features to minimize the risk of spills, blowouts, etc.:

- Switching mechanisms which shut off and/or reverse the direction of the line when it reaches the end of its arc,
- Automatic shutoffs if there is a significant change in pressure,

- Drop-down nozzles to minimize drift of the applied material and to apply it close to the surface of the soil and/or crop canopy,
- Nozzle design, size and shape that ensures even application throughout the coverage area. Nozzles close to the pivot cover a smaller area during a sweep than the more distant nozzles so the size, shape and pressure at each nozzle is part of the design specifications,
- A lined pipe to reduce the wear caused by grit that will inevitably be pumped through the system, and
- Appropriate pump recommendations, connections and control mechanisms to simplify the operation of the system while ensuring it is safe and efficient.
- Computerized control so the system can be set to apply for specific times, durations, areas.

On-site storage of biosolids

There will be no storage of biosolids at the application site. Biosolids are stored in an existing poly lined lagoon at the Norm Wood Environmental Centre. The lagoon is located about 500 meters from the nearest point on the biosolids application site. The biosolids in the lagoon will be mixed and kept in suspension by recirculating them through the pump and back into the lagoon to ensure uniform consistency. The agitated material will be pumped through a macerator to chop large particles and debris, and then, through HDPE pipe directly to the centre pivot. Clean water can be introduced into the supply line to dilute biosolids and to clean the system; appropriate backflow prevention is in place. The output nozzles in the irrigation system are designed to minimize drift (by hanging just above the crop), minimize plugging and to evenly distribute (apply) the material, at the desired rate, over the entire application area. This system of delivering the material minimizes energy requirements and storage and virtually eliminates human handling/exposure.

If the weather or other factors (breakdowns or blockages) do not permit full application of the desired amount of biosolids through the pivot system, additional biosolids may be applied with a tractor and tanker to the application area, and the adjacent headlands. In this case, the tanker would draw biosolids from the lagoon noted above. This application system, if needed, would be similar to the system used, on the previous site, for applications prior to 2010.

Leachate management plan

Biosolids will not be stored on-site with this application plan. The material will be pumped directly from a lagoon or holding tank within the NWEC boundaries. If needed, it may be diluted and pumped directly through the irrigation system.

Nutrient management and application rate determination

Based on previous Land Application Plan and applications, a tentative total application rate for the entire growing season was determined using nitrogen as the limiting factor. This application rate was then used to project the post application concentrations of nutrients and post application soil conditions. The projections were compared to the limits established by OMRR.

Nitrogen Requirements of the Crop

Nitrogen in biosolids is in three main forms: ammonia/ammonium, nitrate, and organic. The first two forms are readily available to plants, while the organic nitrogen is released slowly as the organic matter decomposes.

Nitrogen Demand

To determine the appropriate agronomic application rate, based on nitrogen, the amount of available nitrogen required to meet the needs of the crop is estimated on a per hectare basis. The *BMP Guidelines for Managed Organic Matter Land Application in BC (p.168)* indicate that nitrogen demand will be roughly as follows:

Summer barley – expected to require 190 kg of N per hectare; a prorated amount equivalent to 5 tonnes per ha dry matter for cereals, single cut for forage on a very low fertility site.

Winter cereal cover crop – expected to require 160 kg of N per hectare; requirement for a 6 tonne dry matter per hectare crop of cereal on a low fertility site.

Immobilization – 200 kg of N per hectare is expected to be immobilized. This is a high level but it is based on high carbon to nitrogen ratios on the soil surface which are a result of the land clearing process. All of the woody debris from land clearing was chipped/shredded and spread and incorporated into the soil. The volume of this material is not known but some parts ot the site have a 5 cm (2") thick layer of debris on the surface. According to the *BMP Guidelines*, this rate of immobilization is consistent with a medium to poor Coastal Douglas Fir site.

Based on the above, the total available nitrogen required at the NWEC site in 2013 is estimated to be 550 kg per ha.

Nitrogen Supply

The amount of nitrogen that will be available from the biosolids is determined by estimating the proportion of inorganic (ammonia/ammonium and nitrate) nitrogen that will be available to the crop, and the rate at which the organic nitrogen will be mineralized to become available to the crop.

All of the inorganic nitrogen in the biosolids is potentially available to the crop. In practice, there will be some losses of ammonia/ammonium nitrogen due to volatilization. The proposed application will occur during dry and generally windy weather, and will be applied to warm soils. The *Guidelines for Managed Organic Matter Land Application in BC* indicate volatilization losses of 15 to 25% for an open stand, summer incorporated into moist soils and 50 to 90% for an open stand, surface applied onto moist soils. The conditions at NWEC are believed to be mid-way between these two scenarios so the losses due to volatilization are assumed to be 40%.

Note: 4 samples were analyzed for nitrogen, metals, etc. however, only three were used in the calculations below because one sample was clearly not consistent with the other 3 or with past biosolids samples (TKN, for example was only .01% in that sample compared to an average of 5.57% in the other 3).

The mean value for ammonia/ammonium nitrogen, in the 3 samples used, was 76 mg/kg (dry weight basis) or 0.0076%.

The average concentration of nitrate nitrogen, in the 3 samples used, was 177 mg/kg (dry weight basis) or .0177%. However, one sample was high at 480 mg/kg; the other 2 were 30 mg/kg and 20 mg/kg.

The mineralization rate of organic nitrogen from the biosolids is affected by weather, and soil moisture. According to the *BMP Guidelines*, the mineralization rate for biosolids in South-Coastal BC is between 20 and 40%. The guidelines suggest that lagoon stored biosolids have a lower mineralization rate. For the purpose of estimating soil nutrient additions, a mineralization rate of 20% has been assumed.

The mean value for Total Kjeldahl Nitrogen (TKN), in the 3 samples used, was 5.57% on a dry weight basis. Organic nitrogen content can be estimated by subtracting the ammonia/ammonium nitrogen and the nitrate nitrogen from the TKN; the estimated organic nitrogen using this method is 55,700 mg/kg or 5.57% (dry weight basis). Table 3 shows a summary of the above calculations.

Table 3. Calculation of available nitrogen and nitrogen requirements at NWEC for 2013.

Criteria	Units	Value
Biosolids Nitrogen		5.57%
Initial Ammonia/Ammonium	%	0.0076%
Initial Nitrate/Nitrite	%	0.0177%
Organic Nitrogen	%	5.56%
Solids	%	**3.01%**
Nitrogen Transformations		
Mineralization rate	%	20%
Volatilization losses	%	40%
Dentrification losses	%	10%
Nitrogen Storage/Uptake		
First crop cereal - barley	kg N/ha/yr	190
Winter cover cereal - wheat	kg N/ha/yr	160
Soil immobilization	kg N/ha/yr	200
Available N required	**kg N/ha**	**550**
Nitrogen Transformations		
Initial Ammonia/Ammonium	kg per dry tonne	0.076
Volatilization losses	kg per dry tonne	-0.03
Mineralization additions	kg per dry tonne	11.15
Total available nitrogen	kg per dry tonne	*11.20*
Denitrification losses	kg per dry tonne	-1.12
Net Available N	**kg per dry tonne**	**10.08**
Application rate	**dry t per ha**	**54.57**
Application rate	**wet t per ha**	**1810.86**
Application rate (N)	**kg per ha**	**3047.22**
Total dry tonnes - site		**592.1**

An application rate of 54.57 dry tonnes per hectare will meet the agronomic requirements for the target crops over the coming year. The effect of this application rate on soil nutrient level and soil conditions is described below. This equates to a total application of 592.1 dry tonnes on the 10.85 ha available for 2013. The City may not have this volume of biosolids in the lagoon. If not, the total volume available will be applied over the entire area with the expectation that yields may be lower than projected.

Phosphorous

Three samples were used to calculate the average plant available phosphorous in the biosolids. The mean value for phosphate was 6,000 mg/kg (dry weight basis). This means that 6.0 kg of phosphate is added to the soil from each dry tonne of biosolids. At the prescribed biosolids application rates, about 327 kg per hectare of phosphate will be added to the soils on the site. This is excess to the needs of the crops; the uptake by the crops is expected to be 40 to 45 kgs per hectare. However,

available soil phosphorous, in the pre-application samples, was only 24 ppm so an increase in overall phosphorous level is probably desirable at this point. One of the groundwater observation wells (W6), showed a slightly elevated phosphorous level, of 2.7 mg/L in the pre-application sample (April 10, 2013). The other 3 wells were at low levels – similar to past observations on the previous site. The Federal-Provincial-Territorial Committee on Drinking Water has not developed a guideline for phosphorus in drinking water, as it is not directly toxic to humans.

Potassium

The mean value for plant available potassium, in the 3 biosolids samples used, was 2,510 mg/kg (dry weight basis). This means that only 2.51 kg of potassium is added to the soil from each dry tonne of biosolids. At the prescribed biosolids application rates, 137 kg per hectare of potassium will be added to the soil.

The current soil potassium levels average 65 ppm – very low. The optimum range for soil potassium on forage grass lands in South Coastal BC is 120 to 180 ppm. Forage crops in South Coastal BC typically contain 2.0 to 4.0% potassium. An irrigated grass yield of 10.8 tonnes per ha (5 tons per acre), fairly typical to the island, would remove 330 kgs per ha of potassium. Based on this, potassium levels in the soil would be expected to decline. This did not happen with the previous application site, probably because the crop was not harvested and/or removed from the site.

Pre-application Concentrations in Soil

Two composite soil samples were collected at the site on April 10, 2013. The samples were analyzed for the eleven substances listed in Schedule 4 of the OMRR. The average concentrations are shown in Table 4. Table 4 also lists the maximum allowable soil concentrations for cobalt, molybdenum, nickel and selenium for agricultural land (from Schedule 9 of the OMRR) and the matrix soil standard for arsenic, cadmium, chromium, copper, lead, mercury and zinc for agricultural land (from Schedule 10 of the OMRR).

In the case of the matrix soil standards, the site-specific factor with the lowest allowable concentration for each element was used. The exception to this is copper. The lowest threshold for copper in the OMRR standards is 90 ppm. However, that standard is the maximum allowable concentration for “soils with a pH of less than 5.0, where groundwater flows into surface water used for aquatic life”. It is not relevant to this site because the groundwater does not flow into surface water used by aquatic life. There is a copper threshold of 150 ppm which is the maximum for “toxicity to soil plants and invertebrates” and maximum for areas where “livestock may ingest soil and fodder”. This is the most relevant standard for the application site and it is the recommended standard to be applied in planning land applications at this location.

The copper levels in the previous application site reached an average of 155 ppm after the 2011 application. Even so, there was no indication that copper is having a negative impact on crop productivity and it did not show in any of the water samples.

Table 4. Pre-Application concentrations in soil of the eleven substances listed in Schedules 9 & 10 of the OMRR compared with maximum allowable concentrations based on the most recent samples on each half of the site.

Substance	Concentration in soil average of 2 samples (µg/g dry weight)	Maximum allowable concentration (µg/g dry weight)
Arsenic	*1.6*	*15*
Cadmium	*0.09*	*1.5*
Chromium	*20.2*	*50*
Cobalt	*11.4*	*40*
Copper	*35*	***150***
Lead	*<5.0*	*100*
Mercury	*0.04*	*0.60*
Molybdenum	*<1.0*	*5*
Nickel	*12.6*	*150*
Selenium	*0.50*	*2*
Zinc	*33*	*150*

Projected concentrations in soil after land application

Predicted concentrations of the eleven substances listed in Schedule 4 of the OMRR have been calculated using the average of the two soil samples, the prescribed biosolids application rates, and the average concentrations in the biosolids of each substance, following the procedure described in the *BMP Guidelines*. To calculate the predicted concentrations, it is assumed that the soil bulk density at the site averages 1600 kg/m^3. This bulk density was used in the previous Land Application Plan and it is consistent with the soils at the site. It is also assumed that all of the trace elements in the biosolids will remain in the 0.20m plow layer of soil, and that none of the pre-application trace elements were displaced. A soil depth of 0.20m (8") is used in calculating the post application concentrations because the land preparation techniques are expected to incorporate material to at least this depth.

The calculated predicted concentrations of each substance are listed below.

Table 5. Predicted concentrations in soil of the eleven substances listed in Schedules 9 & 10 of the OMRR after application of biosolids at the prescribed rates.

Substance	Projected post-application concentration in soil (µg/g dry weight)	Maximum allowable concentration (µg/g dry weight)
Arsenic	*1.67*	*15*
Cadmium	*0.13*	*1.5*
Chromium	*20.5*	*50*
Cobalt	*11.4*	*40*
Copper	*52.7*	***150***
Lead	*6.68*	*100*
Mercury	*0.06*	*0.60*
Molybdenum	*1.15*	*5*
Nickel	*12.88*	*150*
Selenium	*0.56*	*2*
Zinc	*47.5*	*150*

All predicted post application concentrations are well below the allowable limits defined by OMRR.

Soil pH and Electrical Conductivity

The pH of the biosolids at NWEC was measured at least three times in the past year. The average pH of these samples was 6.2.

Both pre-application soil samples had a soil pH of 5.0.

Application of biosolids at the proposed rate may result in a marginal (and beneficial) increase in soil pH which will enhance the productivity of the crop. Post application soil samples will determine whether or not lime is needed in the future.

Electrical conductivity (EC) in the pre-application soil samples (April 10) ranged from 0.10 to 0.23 mS/cm – average 0.165 mS/cm. The electrical conductivity levels are not expected to impact the application or productivity of the crops.

Post application monitoring of the site

The soils within the site will be sampled and analyzed after the application, using the same sampling procedures that were used for pre-application samples.

Four groundwater observation wells were installed, around the perimeter of the site, on May 17, 2012, based on site recommendations provided by Steve Carballeira, P.Geo., of H2O Environmental Ltd. These were labeled Well 5 to Well 8 as follows:

Well 5 (W5) is in the northeast corner of the new site about 50 m north of the pivot. It is downslope from the application site and has a much higher water table than the other wells. It is considered to be the most likely well to show impact from application.

Well 6 (W6) is located about half way along the east side fence on the new site. It is also below the elevation of the application area but not believed to be in line with subsurface drainage and water

flows. The water table in this well was over 3 m below the surface in June 2012 and over 2m below the surface when samples were collected on April 10, 2013.

Well 7 (W7) is on the south perimeter fence where the old access road crossed into the lot to the south. The water table in this well has been consistently over 3 m below the surface (June 2012, November 2012 and April 10, 2013). There has not been enough water to collect a full sample in this well; it has only been tested for fecal coliform.

Well 8 (W8) is essentially the control well. It is midway along the western perimeter fence. It is outside the application area (approximately 40 m from the nearest applied biosolids) and at a higher elevation. The water table in this well is high – 0.5 m below the surface in June 2012 and about 0.3 m below the surface on April 10, 2013.

Samples were taken from each of these wells 3 times in 2012 – before, during and after application. Pre-application samples, for 2013, were collected on April 10, 2013.

Samples will be taken from each of the groundwater observation wells (if sufficient water is available) about mid-application and again post-application.

There is a drainage ditch along the northern boundary of the application site - between the new site and the old site. This was also sampled on April 10, 2013. It was not sampled in June or August of 2012 because there was no water present. If there is water available, this will be sampled mid-application and post-application. The fecal coliform count in the ditch was 150 CFU/100ml in November 2012 and 48 CFU/100ml is April 2013.

Based on past experience, on the previous biosolids application site adjacent to this site, storms that are heavy enough to create overland flows during the growing season will also be sufficient to stop application of biosolids. The intent is to use the pivot irrigation system as an irrigation system so there should be no need to apply biosolids during wet weather.

Appendix 1 – Organic Matter Recycling Regulation Schedule 7

1a) Managed Organic Matter Production Facility	Address: Norm Wood Environmental Centre 4000 N. Island Highway Campbell River, BC Legal Description Lot A District Lots 52 and 120, Sayward District, Plan EPP9665
1b) Local contact	Graham Stewart Utilities Operations Supervisor, Public Works Department City of Campbell River 4000 N. Island Hwy., Campbell River, BC V9W 8C8 Phone: (250) – 286 – 4041
1c) Land Application Plan author	Gary Rolston PAg. From the Ground Up 200E – 580 Duncan Ave., Courtenay, BC V9N 2M7 Phone: (250) – 334 – 3440
1d) Owner of Land Application Site	City of Campbell River
1e) Address and Legal Description of Land Application Site	Address: Norm Wood Environmental Centre 4000 N. Island Highway Campbell River, BC Legal Description Lot A District Lots 52 and 120, Sayward District, Plan EPP9665
1f) Location of land application site	Portion of DL 52 south of the Norm Wood Environmental Centre (as shown in Figure 1)
1g) Authorization of land application site owner	Biosolids generator is site owner. Authorization letter is attached in Appendix 4.
1h) Land Application time period	June 3 to September 15, 2013 – based on irrigation water requirement
1i) Storage and Leachate Management requirements	Described in Section 6.5.4. Biosolids will not be stored on the application site – pumped directly from the lagoon through the irrigation application system.
1j) Managed Organic Matter to be land applied:	Class B biosolids originating from the Norm Wood Environmental Centre, City of Campbell River.

2a) Fecal coliform density in the managed organic matter	Biosolids have been sampled at least 3 times in the past 12 months. The average of the samples is 843,333 MPN/100 gm. The highest count was 2,200,000 MPN/100 gm (January 31). The others were 170,000 MPN/100 gm (March 4), and 160,000 MPN/100 gm (March 15).
2b) Vector Attraction Reduction process or management method	Aerobic digestion
2c) Total solids content of the managed organic matter:	Samples were analyzed daily during the 2012 application. The average solids content was 2.3%. The solids content of the applied material may require dilution to effectively pass through the irrigation equipment.
2d) Total Kjehldahl Nitrogen (TKN) concentration in the managed organic matter	TKN was measured 3 times in the past year. The average of these samples was 5.57% - slightly higher than previous years.
2e) Ammonia and nitrate content of the managed organic matter.	Ammonia/ammonium nitrogen – average of 3 samples was 76 mg/kg. – much lower than previous years. Nitrate & nitrite – average of 3 samples was 177 mg/kg
2f) Available phosphorus and potassium in the managed organic matter	Available P - 6,000 mg/kg Available K – 2,510 mg/kg
2g) Land Application nutrient goals	To provide 550 kgs per hectare of net available N. 190 kgs for uptake by a summer cereal (barley) crop. 160 kg/ha for uptake by a winter cereal (likely wheat) 200 kgs immobilization in soil.
2h) Trace element concentrations in soil pre-application:	See Table 3a) below
2i) pH and electrical conductivity of soil pre-application	pH - 5.0 EC – 0.10 to 0.23 dS/m
2j) Trace element concentrations in managed organic matter post application	See Table 3a) below
2k) pH and Electrical conductivity of managed organic matter	pH – 6.2 (average of 3 samples) EC – 3.4 dS/m (average of 3 samples)

3a) Projected post-application soil trace element concentrations:

Substance	Concentration in biosolids (µg/g dry weight)	Concentration in soil (site average - 2 samples) (µg/g dry weight)	Projected post application concentration (µg/g dry weight)
Arsenic	3.87	1.60	1.67
Cadmium	2.73	0.09	0.13
Chromium	20.7	20.2	20.55
Cobalt	3.33	11.35	11.41
Copper	1069	34.5	52.73
Lead	99	5.0	6.68
Mercury	0.90	0.04	0.06
Molybdenum	8.7	<1.0	1.15
Nickel	16.5	12.6	12.88
Selenium	6.53	0.45	0.56
Zinc	853	33	47.54

3b) Post application soil sampling method:	Two composite soil samples consisting of at least 10 sub-samples will be collected. Samples will be collected in the fall of 2013 after application and prior to any subsequent applications.
3c) Site specific management methods:	The site was fenced, in May 2013, with 2m woven wire fence. Internal surface runoff is contained within the site. Buffer areas seeded to grass to control runoff and erosion and trap nutrients. No public access. Buffers and setbacks in accordance with OMRR as described in Section 6.2.
3d) Management methods for Class B biosolids with fecal coliform densities >1000 MPN/100 gms	Buffer setbacks in accordance with OMRR. Containment of runoff within site. Restricted public access – 2 m fence around site. Surface application of biosolids only during periods when there is a measured soil water deficit – i.e. when irrigation is required.
3e) Management methods for Class B biosolids not achieving vector attraction reduction requirements.	Not applicable
3f) Management methods for Class B compost not achieving maturity requirements.	Not applicable
3g) Application rate	Maximum of 54.57 dry tonnes per hectare. The rate and timing of application will be determined by soil moisture deficit – the requirement for irrigation of the crop.

3h) Post-application monitoring plan	Post application soil analysis – nutrient and trace elements. Surface water monitoring – sampling of surface water within the internal drainage system (if surface water is present) pre-application, during and post-application (3 times per year, minimum) Groundwater monitoring – sampling pre, during and post-application (3 times per year, minimum)

Appendix 2 – OMRR Schedule 13 Requirements

a) Name and address of discharger	City of Campbell River 301 St. Ann's Road Campbell River, BC V9W 4C7
b) Local contact for discharger	Graham Stewart Utilities Operations Supervisor Public Works Department City of Campbell River 4000 N. Island Hwy., Campbell River, BC V9W 8C8
c) Location of Land Application Site	Norm Wood Environmental Centre 4000 Island Highway Campbell River, BC
Legal Description	Lot A District Lots 52 and 120, Sayward District, Plan EPP9665
d) Owner of Land Application Site	City of Campbell River 301 St. Ann's Road Campbell River, BC V9W 4C7

e) Land application site is in the ALR

f) Site will be used to produce a summer crop (barley) and winter crop (wheat) of cereal that will be cultivated back into the soil to condition the soil for future crops. The first year crops will not be harvested/removed from the site.

g) Previous Waste Management # - not applicable

h) Type of managed organic matter	Class B Biosolids
i) Land Application Schedule	June 3 to September 15, 2013 – during dry weather only
j) Application Rate	Maximum of 54.57 dry tonnes per hectare

k) Maximum cumulative trace element addition for 2013

Arsenic	0.21	kgs/ha	Mercury	0.05	kgs/ha
Cadmium	0.15	kgs/ha	Molybdenum	0.47	kgs/ha
Chromium	1.13	kgs/ha	Nickel	0.90	kgs/ha
Cobalt	0.18	kgs/ha	Selenium	0.36	kgs/ha
Copper	58.35	kgs/ha	Zinc	46.53	kgs/ha
Lead	5.38	kgs/ha			

l) Pre-approved soil standards — Not Applicable

m) Attached map: — Refer to site location map – Figure 1

n) Authorization of Land Owner — Refer to Appendix 4

Appendix 3 – Pre application Soil Sample Results - 2013

Sample name		*Pre-Application 2013 - S1 NW*	*Pre-Application 2013 - S2 SW*	***Average***	*OMRR Limits Soil*	*% of OMRR limit*
Date		10-Apr-13	10-Apr-13			
NO3 & NO2-N	*mg/kg*	<3.0	<9.0	***<6.0***	n/a	
Ammonium N	*mg/kg*	0.5	1.1	***0.8***	n/a	
Total Nitrogen	*%*	0.45	0.63	***0.54***	n/a	
Available Phosphorus	*mg/kg*	7	40	***24***	n/a	
Available Potassium	*mg/kg*	58	71	***65***	n/a	
Total Solids	*%*	71.0	73.2	***72.1***	n/a	
Volatile Solids	*%*	6.0	7.2	***6.60***	n/a	
pH		5.0	5.0	***5.0***	n/a	
EC	*ms/cm*	0.10	0.23	***0.17***	n/a	
Fecal Coliforms	*CFU/100ml*	200	500	***350***	n/a	
Organic Matter	*%*	6.82	7.06	***6.94***		
C:N Ratio		7.5	5.6	***6.6***		
Arsenic	*mg/kg*	1.5	1.7	***1.6***	15	11%
Cadmium	*mg/kg*	0.07	0.10	***0.09***	2	4%
Chromium	*mg/kg*	20.6	19.8	***20.2***	50	40%
Cobalt	*mg/kg*	11.6	11.1	***11.4***	40	28%
Copper	*mg/kg*	34	35	***35***	100	35%
Lead	*mg/kg*	<5	<5	***<5.0***	100	5%
Mercury	*mg/kg*	0.03	0.05	***0.04***	15	0%
Molybdenum	*mg/kg*	<1.0	<1.0	***<1.0***	5	20%
Nickel	*mg/kg*	12.6	12.6	***12.6***	150	8%
Selenium	*mg/kg*	0.5	0.4	***0.5***	2	23%
Zinc	*mg/kg*	26	40	***33***	150	22%

Appendix 4 – Landowner and Agent Authorization

Attachments:

- Agent Authorization for Land Application Plan – letter from Graham Stewart dated April 18, 2012
- Authorization for the Application of Managed Organic Matter under the BC Organic Matter Recycling Regulation – letter from Graham Stewart dated April 18, 2012
- Current Land Title Certificate for application site
- Copy of notices sent to Agricultural Land Commission and Medical Health Officer