
Regional District of Nanaimo

2018 Biosolids Management Summary

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1 INTRODUCTION

The Regional District of Nanaimo (RDN) operates two wastewater treatment plants that produce municipal biosolids:

1. French Creek Pollution Control Centre (FCPCC)
 - a. Average annual production: 1,250 wet tonnes (wt) of Class A biosolids
 - b. Authorization # 4200
2. Greater Nanaimo Pollution Control Centre (GNPCC)
 - a. Average annual production: 3,300 wt of Class B biosolids
 - b. Authorization #5989

In 2018, RDN biosolids were managed by SYLVIS Environmental in a forest fertilization program on private forest lands owned by TimberWest on Weigles Road in Nanaimo, BC (the TimberWest Properties). RDN biosolids have been managed on an annual basis at this site since 2003. The objectives of biosolids forest fertilization at the TimberWest Properties are to increase soil quality and tree growth. In 2018, RDN biosolids were also managed in a soil fabrication project located at the Nanaimo Forest Products Harmac Mill in Nanaimo, BC (Harmac). 4,802 wet tonnes (wt) (97% of annual production in 2018) were delivered to the TimberWest Properties and 164 wt (3%) were delivered to Harmac.

This report summarizes biosolids management and regulatory compliance at the TimberWest Properties and at Harmac in 2018. It also serves as the qualified professional certification for the 2018 biosolids land application plan for the TimberWest Properties (2018 Weigles Road Woodlot Forest Fertilization Land Application Plan, authorization #109265) as required under *Organic Matter Recycling Regulation* (OMRR) section 5 (3). No land application plan is active for the Harmac site as no land application of biosolids has occurred or is forecast to occur in the near future. SYLVIS provided qualified professional services for the soil fabrication project at Harmac and a report addressing fabricated soil quality is available separately.

2 2018 BIOSOLIDS MANAGEMENT SUMMARY

This document contains a summary of the 2018 RDN biosolids management program including a summary of contractual requirements for the forest fertilization program (Table 1), a biosolids management summary (Table 2, Figure 1 and Figure 2), a biosolids quality summary data (Table 3), a soil quality summary (Table 4), a biosolids management program carbon emissions estimate (Table 5), a summary of historical management (Table 6), a map of application areas at the TimberWest Properties, (Figure 3), and photographs from the management program (Photographs 1 to 3).

2.1 PROJECT OVERVIEW

In 2018, RDN biosolids were managed at the TimberWest Properties on Weigles Road in Nanaimo, BC. All contractual tasks relating to biosolids quality monitoring, biosolids delivery coordination, biosolids beneficial use, site safety, environmental monitoring, public engagement,

reporting, coordination with site stakeholders, and adherence to the conditions of site use under the RDN land-use agreement with TimberWest were completed for 2018 (Table 1).

RDN biosolids delivered to Harmac were managed under contract by Harmac with SYLVIS providing qualified professional oversight.

2.2 BIOSOLIDS TRANSPORTATION

In 2018, 4,802 wt of RDN biosolids (1,252 wt from FCPC; 3,550 wt from GNPCC) were transported by DBL Disposal to the TimberWest Properties (Table 2). Monthly tonnage delivered in 2018 is graphically summarized in Figure 1.

In 2018, 164 wt of RDN biosolids (44 wt from FCPC; 120 wt from GNPCC) were transported by DBL Disposal to Harmac (Table 2). Monthly tonnage delivered in 2018 is graphically summarized in Figure 2.

Total RDN biosolids production in 2018 (4,966 wt) was above the five-year average annual production of 4,600 wt.

2.3 BIOSOLIDS STORAGE

Four storage facilities exist at the TimberWest Properties (A, B, C, and D), each consisting of an asphalt base with lock blocks delineating three sides of the facility. Three of the facilities (A, B, and C) were utilized for biosolids stockpiling in 2018. Biosolids storage conformed to rainy season storage practices where biosolids are required by the OMRR to be covered from October 1st to March 31st of every year (Photograph 1).

The biosolids storage facility at the Harmac Mill consists of an asphalt base. Harmac does not cover the stored biosolids as this storage facility is located in an area of leachate collection.

2.4 2018 PRE-APPLICATION MEASURES

At the TimberWest Properties, a site inspection was carried out by a SYLVIS Qualified Professional or designate prior to biosolids fertilization. During the site inspection, water features were identified, mapped, and 30-metre (m) setback distances were determined. Pre-application soil samples were collected in order to determine an appropriate agronomic rate of biosolids application. Groundwater depth was measured using a soil auger or confirmed visually in road cuts and was confirmed to be in excess of 1 m prior to commencing biosolids applications.

At Harmac, a site inspection was carried out prior to initiating soil fabrication operations to confirm the suitability of the storage facility, the mixing methodology, and the soil storage area. All fabricated soil incorporating RDN biosolids in 2018 was stockpiled for future use; no fabricated soil was land-applied. As such, no pre-application assessments were undertaken.

2.5 BIOSOLIDS LAND APPLICATION

In 2018, 4,705 wt of RDN biosolids (1,226 wt from FCPC; 3,479 wt from GNPCC) were applied as a fertilizer and soil amendment to the TimberWest Properties (Table 2 and Photograph 2). Biosolids were land-applied to 64 hectares (ha) of forested lands at the TimberWest Properties for a site-wide average application rate of 73.1 wt/ha (18.5 dry tonnes or dt/ha), 97% of the

agronomic application rate of 19.0 dt/ha specified in the LAP. At the end of 2018, 246 wt (64 wt from FCPCC; 182 wt from GNPCC) remained in storage facilities at the TimberWest Properties (Table 2).

Biosolids were land-applied using a side-discharge spreader equipped with a hydraulic fan which propels the biosolids up to 30 m into forest stands. All biosolids applications adhered to a 30-m setback distance from permanent water features and identified ephemeral water features. Biosolids applications were completed bi-weekly throughout 2018 except during periods of extreme weather (i.e., snowfall, heavy rainfall) or when ground was snow-covered: land application operations were suspended during these times. Extreme weather, including snowfall or snow cover, occurred in late January/early February and late February/early March in 2018.

Biosolids will be land-applied at the Harmac Mill's landfill as a topsoil cover during landfill closure operations. To date, no such closure operations have occurred and the fabricated topsoil is stockpiled adjacent to the landfill. No RDN biosolids were land-applied at the Harmac landfill in 2018.

2.6 BIOSOLIDS QUALITY

Biosolids quality was characterized throughout 2018 to ensure that it met quality requirements for trace element concentrations and pathogen reduction set forth in the OMRR. A total of six composite samples, each composed of eight equal-volume subsamples, were collected from the FCPCC and the GNPCC. The biosolids were analyzed for physical parameters, nutrients, and trace elements (Table 3). All RDN biosolids samples collected in 2018 met OMRR Class A and B criteria for trace elements.

A total of fifteen discrete samples were collected for analysis of fecal coliforms over three sampling events (Table 3). The geometric mean for fecal coliforms in 2018 for the FCPCC was 14 most probable number per gram (MPN/g) which is below the OMRR limit of 1,000 for Class A biosolids; in addition, as required by the OMRR, each individual sample was below this Class A criterion. The geometric mean for fecal coliform in 2018 for the GNPCC was 55,400 most probable number per gram (MPN/g) which is below the OMRR limit of 2,000,000 for Class B biosolids. As deliveries of FCPCC and GNPCC biosolids co-occur in the same storage area at the TimberWest Properties and the biosolids are mixed prior to land application, both are managed as a Class B product.

The RDN performed analysis of volatile solids reduction (VSR) throughout 2018. Average VSR was 43% for the FCPCC and 67% for the GNPCC; both were above the minimum VSR of 38% specified in the OMRR (Table 3).

2.7 SOIL MONITORING

Ongoing soil monitoring was carried out at the TimberWest Properties throughout 2018. Soil quality data remain at or below 75% of applicable OMRR soil criteria for this site (Table 4).

Mixed topsoil quality in the Harmac soil mixing project conformed to applicable OMRR soil criteria as detailed in a separate report.

2.8 SURFACE WATER MONITORING

Surface water was monitored at the TimberWest Properties in spring and fall 2018 by SYLVIS (Photograph 3). Biosolids fertilization has had no discernable effect on surface water quality with the possible exception of nitrate, which at a site-wide average of 1.3 mg/L, is still within the range of reference values for ambient surface concentration (0.3 – 2 mg/L) and below the BC Approved Water Quality Guideline for protection of freshwater aquatic life (30-day mean of 3 mg/L). Details of the surface water monitoring program can be found in the SYLVIS report *Regional District of Nanaimo Biosolids Management Program - 2017-2018 Surface Water Report* (document # 1211-19).

No surface water monitoring occurs at the Harmac site.

2.9 REGULATORY COMPLIANCE

Biosolids land application activities at the TimberWest Properties were carried out in compliance with the Land Application Plan (LAP) notified to the BC Ministry of Environment and Climate Change Strategy (ENV) on January 25th, 2018 (authorization #109265). This authorization expired on January 29th, 2019 and notification for an additional year of biosolids land applications was made to ENV and the Vancouver Island Health Authority on January 17th, 2019. All regulatory requirements of the OMRR and specifications of the 2018 LAP were met including the requirements for rainy season storage, agronomic application rate, groundwater level during application, water feature buffers biosolids quality, pre-application and predicted post-application soil concentration limits, signage, and storage.

An LAP (authorization #108801) was produced in February 2017 for authorization of land application of RDN biosolids as part of the fabricated topsoil in landfill closure activities at the Harmac landfill. Ultimately, no biosolids were land-applied under this authorization and it expired on February 28th, 2018. No landfill closure activities using the fabricated topsoil/biosolids have been undertaken to date and no future plans are currently in place. An LAP is required specifically for the land application of biosolids and thus the authorization has not been renewed. Therefore, biosolids stockpiling, topsoil fabrication, and topsoil stockpiling activities will continue at Harmac without an active LAP. A new notification will be made to ENV prior to any land application of the fabricated topsoil containing biosolids.

3 SUMMARY AND INTERPRETATION OF THE EFFECTS OF BIOSOLIDS DISCHARGES ON THE RECEIVING ENVIRONMENT

The objectives of biosolids forest fertilization at the TimberWest Properties are to increase soil quality and tree growth while remaining compliant with the OMRR. Biosolids fertilization has generally increased surface horizon organic matter content and available nutrients (e.g., phosphorus). These enriched soils enable accelerated tree growth, which has been documented at this site and other biosolids forest fertilization sites. Trace element concentrations in the soil have increased as a result of additions from biosolids. Areas where soil trace element concentrations achieve 75% of their respective OMRR limit are retired and no longer used. No effects on surface water quality have been observed with the possible exception of nitrate, which

is expected for a fertilized site. A detailed assessment of surface water quality at this site is provided in a separate report.

It has been observed¹ at this site that deer browse of trees is increased in biosolids-fertilized areas, underlining a finding from many biosolids sites that increases in vegetation biomass can lead to increases in animal populations that consume or inhabit the vegetation.

4 BIOSOLIDS PROGRAM GREENHOUSE GAS MODELLING ASSESSMENT

Greenhouse gas (GHG) emission accounting is a requirement for every local government which has signed on to the BC Climate Action Charter, including the RDN. In 2010, SYLVIS produced the Biosolids Emissions Assessment Model (BEAM) for the Canadian Council of Ministers of the Environment. While the BEAM focusses largely on emissions from biosolids production at the wastewater treatment plant, it also addresses the transport and land application of biosolids. Based on the latter aspects of the BEAM, SYLVIS has produced an estimate of GHG emissions from the RDN's 2018 biosolids management program at the TimberWest Properties and at Harmac. While transportation of biosolids and operation of equipment for fertilization activities generated emissions, soil amendment and incremental biomass production offset emissions through sequestration. In 2018, the RDN's biosolids management program accounted for -151.1 tonnes of carbon dioxide equivalents (CO₂eq) (Table 5).

It should be noted that this emissions estimate is not a validated estimate and cannot be used to claim credits on carbon markets.

5 CONCLUSION

RDN biosolids were managed at the Weigles Road TimberWest Properties and at the Harmac Mill in 2018. 4,802 wet tonnes (wt) (97% of annual production in 2018) were delivered to the TimberWest Properties and 164 wt (3%) were delivered to Harmac.

All biosolids land application activities occurred as specific in the current LAP and according to management requirements under the OMRR. Soil quality data remain at or below 75% of applicable OMRR soil criteria for this site. Surface water quality remains similar to background ambient levels or within expected norms.

The TimberWest Properties have accepted over 37,000 wt of biosolids since 2007 (Table 6, Appendix One). SYLVIS looks forward to continuing this productive relationship and providing biosolids management services and support to the RDN throughout 2019 and beyond.

¹ Danjou, B. 2014. Effect of Biosolid on Vegetation Development Within Two Douglas-fir Plantations: Third Year Progress Report - DRAFT. Vancouver Island University, Nanaimo, B.C.

APPENDIX ONE – TABLES

Table 1: Summary of SYLVIS 2018 deliverables as outlined in the RDN-SYLVIS 2017-2021 contract for biosolids management at the TimberWest Properties.

Task or Activity	Description
Biosolids Quality	RDN biosolids quality was monitored throughout 2018 through the collection of six full suite samples and 14 fecal coliform samples.
Biosolids Quantity	4,802 tonnes of RDN biosolids were transported to the TimberWest Properties by DBL Disposal in 2018. 4,705 tonnes of biosolids were land-applied in 2018. 246 tonnes remained stockpiled at the end of 2018. 164 tonnes of RDN biosolids were transported to Harmac by DBL Disposal in 2018. 0 tonnes of biosolids were land-applied at Harmac in 2018. 961 tonnes remained stockpiled at Harmac as a component of stockpiled fabricated topsoil at the end of 2018.
Biosolids Transportation and Delivery Coordination	SYLVIS coordinated biosolids deliveries to the TimberWest Properties with the biosolids transporter throughout 2018.
Access Maintenance	A new internal road was constructed by TimberWest in late 2018; SYLVIS coordinated with TimberWest to confirm concurrent upgrades to stockpile access roads. Limited road maintenance was performed throughout the year by SYLVIS using a front loader. No significant road maintenance was conducted in 2018 on stockpile access roads. No snow plowing of access roads was completed in 2018.
Contingency	164 tonnes of RDN biosolids were sent to the Harmac contingency site in 2018.
Storage of Biosolids	Biosolids were stored in three storage facilities (A, B, and C) at the TimberWest Properties and covered with tarps from October 1 st to March 31 st as per OMRR requirements.
Invoicing	Biosolids were invoiced on a monthly basis.
Environmental Monitoring and Incidents	No environmental incidents occurred in 2018.
Site Safety	No near-miss or safety incidents occurred at the TimberWest Properties in 2018. SYLVIS maintained COR and BC Forest SAFE safety accreditations in 2018.
Public and Media Relations	SYLVIS attended and presented at an Open House in April 2018 at the TimberWest Properties along with the RDN, TimberWest, and the NMBC; this event was held in conjunction with a site cleanup. SYLVIS attended and presented at an Open House at the French Creek WWTP in June 2018.
Public Concern Management	SYLVIS addressed the concerns of a resident by phone in May 2018. The RDN addressed the concerns of a resident in October 2018.
Annual Reporting	This summary report fulfills the regulatory requirement for written certification under OMRR Section 5(3).
Storage Facility Management	SYLVIS managed storage facilities throughout 2018. No work was completed on storage facilities in 2018.
Application Planning	SYLVIS mapped, planned, and notified all fertilized areas in 2018.
Nanaimo Mountain Bike Club Land Use Coordination	Bi-weekly application maps for use by site recreational users were produced in 2018.
Biosolids Beneficial Use	A biosolids Land Application Plan (authorization #109265) was submitted on January 25 th , 2018. 4,705 tonnes of biosolids were land-applied to 64 ha of forest under this authorization in 2018.
Record-Keeping	SYLVIS kept detailed records of all fertilization activities and environmental monitoring in 2018.
Environmental Monitoring	SYLVIS monitored surface water at the TimberWest Properties in May and November 2018.
TimberWest Rules	SYLVIS maintained its BC Forest SAFE accreditation in 2018.
Construction	No works were constructed by SYLVIS at the TimberWest Properties in 2018.
Fires	SYLVIS followed a fire prevention protocol throughout 2018.
Hazardous Substance	No hazardous substances were introduced by SYLVIS to the TimberWest Properties in 2018.
Condition of TimberWest Lands	SYLVIS maintained the condition of the TimberWest Properties in 2018.
Equipment Storage	Except for temporary storage of heavy equipment during fertilization activities, SYLVIS did not store any equipment at the TimberWest Properties in 2018.

Table 2: Regional District of Nanaimo biosolids – management summary, 2018.

Site WWTP	RDN Woodlot			Harmac ^a			Total
	GNPCC	FCPCC	Subtotal	GNPCC	FCPCC	Subtotal	
Carry-over from 2017 (wet tonnes)	111	39	150	561	236	797^b	946
Delivered in 2018 (wet tonnes)	3,550	1,252	4,802	120	44	164	4,966
Applied in 2018 (wet tonnes)	3,479	1,226	4,705	0	0	0	4,705
Carry-over to 2019 (wet tonnes)	182	64	246	681	280	961^b	1,207

a Biosolids managed at the Nanaimo Forest Products Harmac Mill are incorporated into a fabricated soil totalling approximately six times the volume of the biosolids.

b Biosolids delivered to the Harmac site have been incorporated into a fabricated topsoil but not land-applied. Carry-over amounts at Harmac refer to biosolids which have been incorporated into the fabricated soil but which have not yet been land-applied.

Table 3: Regional District of Nanaimo biosolids quality summary, 2018.

Parameter	FCPCC ^a	GNPCC ^b	Weighted Average ^c	Regulatory Limits		Units
	Class A	Class B		Class A ^d	Class B ^e	
Available Nutrients, Physical Properties, Acidity						
Total Nitrogen - TKN	53,600	47,000	48,722	-	-	µg/g
Ammonia - N (available)	4,547	5,447	5,212	-	-	µg/g
Nitrate - N	10	10	10	-	-	µg/g
Phosphorus (available)	1,967	2,033	2,016	-	-	µg/g
Potassium (available)	847	782	799	-	-	µg/g
Organic Matter	63.9	59.3	60.5	-	-	%
Total Solids	33.7	25.1	27.3	-	-	%
pH	7.3	7.2	7.1	-	-	pH
Electrical Conductivity	6.4	3.3	4.1	-	-	dS/m
Trace Elements						
Arsenic	2.3	2.7	2.6	75	75	µg/g
Cadmium	1.4	1.5	1.5	20	20	µg/g
Chromium	29	30	30	-	1,060	µg/g
Cobalt	1.8	3.1	2.8	150	150	µg/g
Copper	670	477	527	-	2,200	µg/g
Lead	17	24	22	500	500	µg/g
Mercury	0.7	1.2	1.1	5	15	µg/g
Molybdenum	4.5	6.6	6.0	20	20	µg/g
Nickel	11	17	15	180	180	µg/g
Selenium	4.0	4.2	4.1	14	14	µg/g
Zinc	897	903	902	1,850	1,850	µg/g
Microbiological Analysis						
Fecal Coliforms	14 ^f	55,400 ^g	41,000	1,000	2,000,000	MPN/g Dry
Vector Attraction Reduction						
Volatile Solids Reduction	43%	67%	61%	38% (minimum)	38% (minimum)	%

Note: All analyses based on dry weight.

- a Greater Nanaimo Pollution Control Centre values are the average of three samples taken on January 11, April 17, and August 13, 2018 by SYLVIS and analysed by Exova Laboratories in Surrey, BC.
- b French Creek Pollution Control Centre values are the average of three samples taken on April 17, August 13, and November 13, 2018 by SYLVIS and analysed by Exova Laboratories in Surrey, BC.
- c Weighted average is based on GNPCC production of 74% and FCPCC production of 26% of total annual biosolids production.
- d Limits from Trade Memorandum T-4-93, Standards for Metals in Fertilizers and Supplements as of 2017.
- e Limits specified in the BC *Organic Matter Recycling Regulation* for Class B biosolids, Schedule 4, Column 3.
- f Values are the geometric mean of seven samples taken by SYLVIS on April 17, August 13, and November 13, 2018 and analyzed by ALS Laboratories in Burnaby, BC.
- g Values are the geometric mean of eight samples taken by SYLVIS on January 11, April 17, and August 13, 2018 and analyzed by ALS Laboratories in Burnaby, BC.

Table 4: TimberWest Properties soil quality summary, 2018.

Parameters	Min ^{a,b}	Max ^a	Mean ^{a,b}	OMRR Soil Criteria ^c	Units
Available Nutrients, Physical Properties, Acidity					
Total Nitrogen - TKN	941	3,160	1,681	-	µg/g
Ammonium - N (dry basis)	0.3	14.1	2.0	-	µg/g
Nitrate - N	2.0	20.0	4.1	-	µg/g
Phosphorus - available	7	500	56	-	µg/g
Potassium - available	91	219	141	-	µg/g
Organic Matter	6.5	16.8	9.6	-	%
C:N Ratio	0.4	39.1	28.4	-	-
pH	4.7	5.6	5.1	-	pH units
Electrical Conductivity	0.08	0.41	0.16	-	dS/m
Trace Elements					
Arsenic	2.7	7.4	4.9	10	µg/g
Cadmium	0.02	0.20	0.12	1	µg/g
Chromium	21	42	31	60	µg/g
Cobalt	9.0	18.0	13.5	25	µg/g
Copper	16	54	34	75	µg/g
Lead	5.9	21.0	10.7	120	µg/g
Mercury	0.034	0.180	0.080	10	µg/g
Molybdenum	0.20	0.68	0.40	80	µg/g
Nickel	18.0	32.0	24.4	100	µg/g
Selenium	0.20	0.60	0.41	1	µg/g
Zinc	38	100	73	150	µg/g

- a Values are based on a set of 29 composite samples collected throughout 2018 by SYLVIS and analyzed by EXOVA Laboratories in Surrey, BC.
- b Where the value was below detection limit, the detection limit was included in the determination of the minimum and mean.
- c BC Organic Matter Recycling Regulation (OMRR) soil quality criteria, based on site-specific factors "intake of contaminated soil", "toxicity to soil invertebrates and plants", "groundwater flow to surface water used by freshwater aquatic life", and "major microbial functional impairment".

Table 5: Regional District of Nanaimo biosolids management program greenhouse gas emissions estimate, 2018.

Process	SYLVIS	Transporter	Total
Transportation ^a	0.4	28.3	28.7
Land Application ^b	-150.4	-	-150.4
Biomass ^c	-29.4	-	-29.4
Total	-179.4	28.3	-151.1

Note: All values in tonnes of carbon dioxide equivalents (CO₂eq). Estimated emissions are not validated and cannot be used to claim credits on carbon markets.

Note: Emissions from soil fabrication and storage at Harmac are not included in this estimate.

- a Includes transportation to the TimberWest Properties and Harmac.
- b Includes land application of biosolids at the RDN TimberWest Properties; land application of biosolids did not occur at Harmac in 2018.
- c Based on broad assumptions, this represents the sequestration value of the incremental increase in carbon storage in trees due to fertilization.

Table 6: Historical management of Regional District of Nanaimo biosolids by SYLVIS, 2007-2018.

Year	Total (wet tonnes)
2007	1,150
2008	3,350
2009	3,000
2010	1,560
2011	1,350
2012	1,280
2013	3,930
2014	4,812
2015	4,383
2016	4,263
2017	3,662
2018	4,966
Total	37,706

APPENDIX TWO – FIGURES

Figure 1: Tonnage of Regional District of Nanaimo – Hammond Bay (GNPCC) and French Creek (FCPCC) dewatered biosolids delivered and applied at the TimberWest Properties by month in 2018.

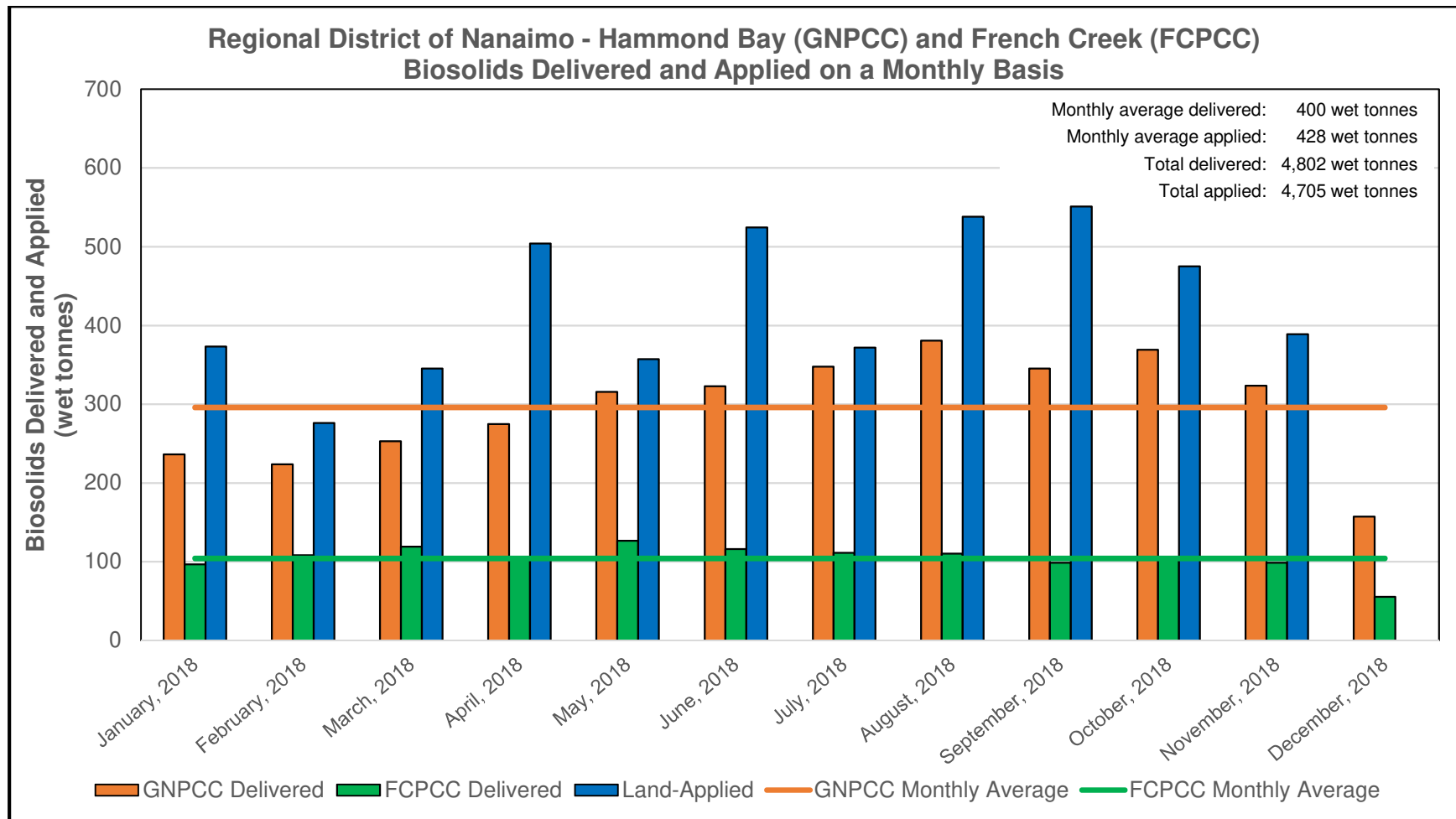


Figure 2: Tonnage of Regional District of Nanaimo – Hammond Bay (GNPCC) and French Creek (FCPCC) dewatered biosolids delivered to the Harmac Mill by month in 2018.

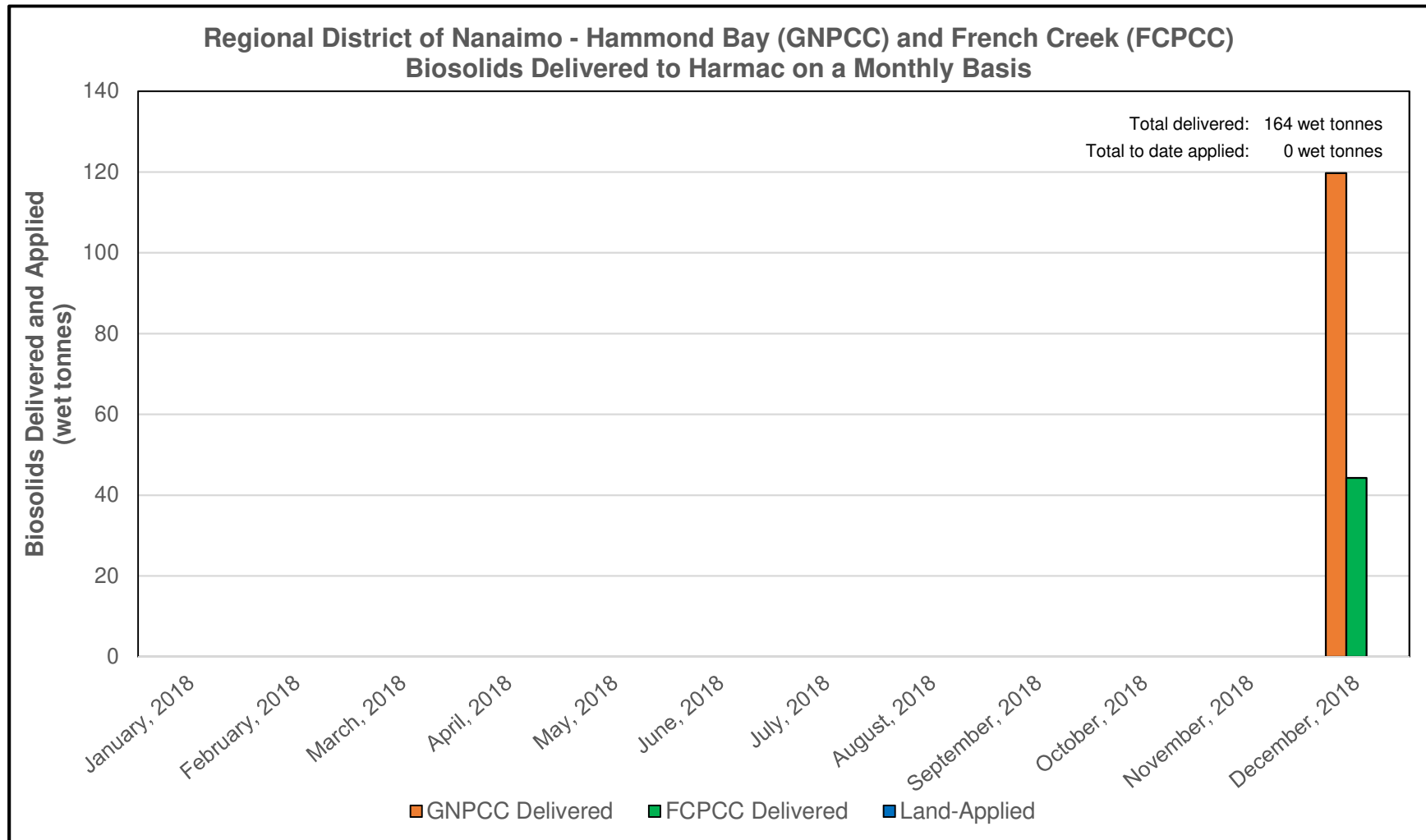
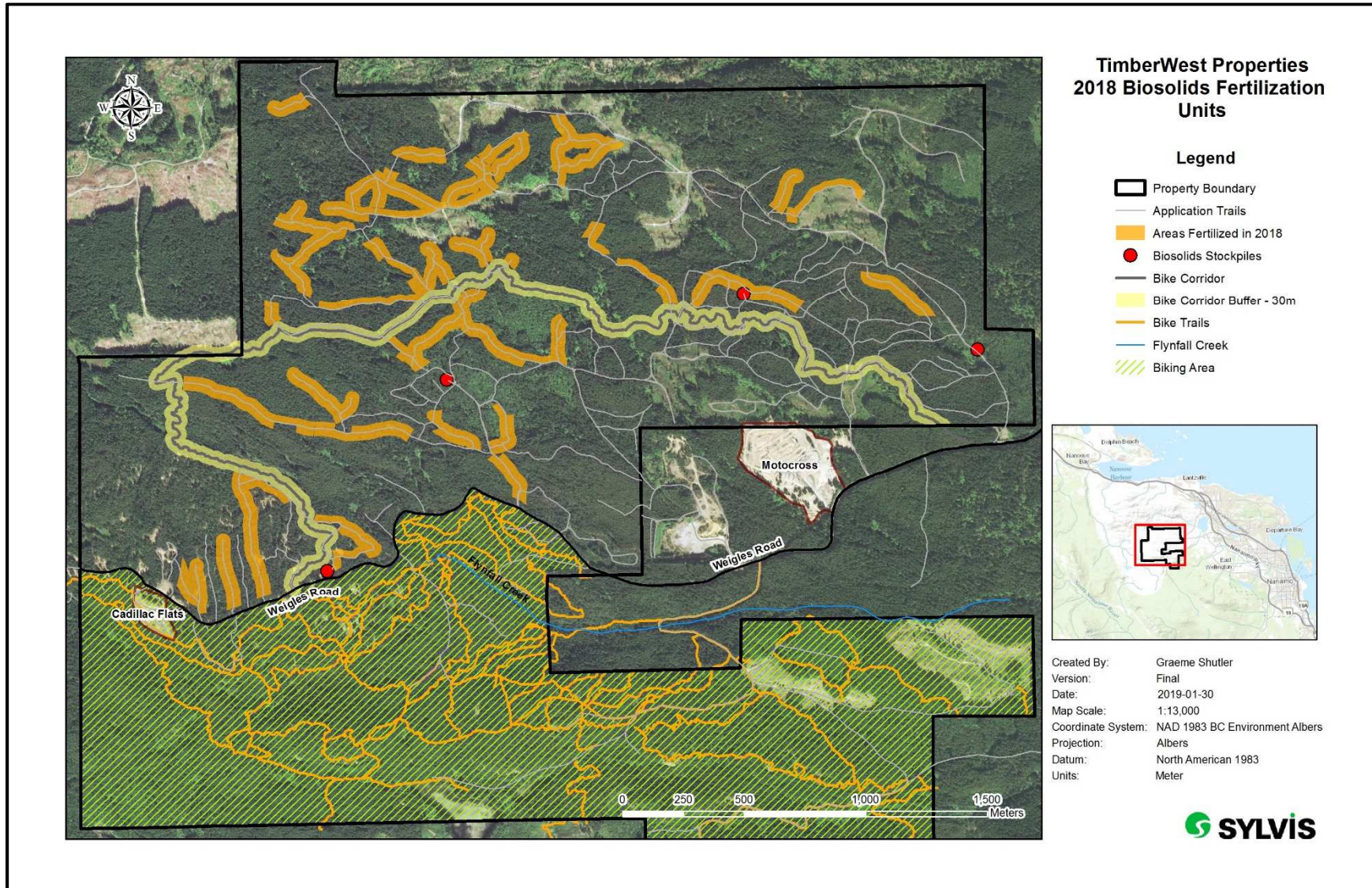


Figure 3: TimberWest Properties application areas fertilized with Regional District of Nanaimo biosolids in 2018.



APPENDIX THREE – PHOTOGRAPHS



Photograph 1: RDN biosolids are stored and tarped from October to March at the TimberWest Properties as required by the OMRR.
(January, 2018)



Photograph 2: RDN biosolids were land-applied to forest stands at the TimberWest Properties throughout 2018.
(March, 2018)



Photograph 3: Surface water locations were monitored at the TimberWest Properties in spring and fall 2018.
(May, 2018)