
Regional District of Nanaimo

2019 Biosolids Management Summary

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TABLE OF CONTENTS

1	INTRODUCTION	1
2	2019 BIOSOLIDS MANAGEMENT SUMMARY	1
2.1	PROJECT OVERVIEW.....	1
2.2	BIOSOLIDS TRANSPORTATION.....	2
2.3	BIOSOLIDS STORAGE	2
2.4	2019 PRE-APPLICATION MEASURES	2
2.5	BIOSOLIDS LAND APPLICATION	2
2.6	BIOSOLIDS QUALITY.....	3
2.7	SOIL MONITORING	3
2.8	SURFACE WATER MONITORING	4
2.9	REGULATORY COMPLIANCE.....	4
3	SUMMARY AND INTERPRETATION OF THE EFFECTS OF BIOSOLIDS DISCHARGES ON THE RECEIVING ENVIRONMENT.....	4
4	BIOSOLIDS PROGRAM GREENHOUSE GAS MODELLING ASSESSMENT.....	5
5	CONCLUSION.....	5
	APPENDIX ONE – TABLES	6
	APPENDIX TWO – FIGURES.....	11
	APPENDIX THREE – PHOTOGRAPHS.....	14

APPENDIX ONE – TABLES

Table 1: Summary of SYLVIS 2019 deliverables as outlined in the RDN-SYLVIS 2017-2021 contract for biosolids management at the TimberWest Properties..... 6

Table 2: Regional District of Nanaimo biosolids management summary, 2019..... 7

Table 3: Regional District of Nanaimo biosolids quality summary, 2019..... 8

Table 4: TimberWest Properties soil quality summary, 2019..... 9

Table 5: Regional District of Nanaimo biosolids management program greenhouse gas emissions estimate, 2019. 10

Table 6: Historical biosolids management in the Regional District of Nanaimo's forest fertilization program and Contingency Site, 2007-2019. 10

APPENDIX TWO – FIGURES

Figure 1: Tonnage of Regional District of Nanaimo – Greater Nanaimo Pollution Control Centre (GNPCC) and French Creek Pollution Control Centre (FCPCC) dewatered biosolids delivered and applied at the TimberWest Properties by month in 2019. 11

Figure 2: Tonnage of Regional District of Nanaimo – Greater Nanaimo Pollution Control Centre (GNPCC) and French Creek Pollution Control Centre (FCPCC) dewatered biosolids delivered to Harmac by month in 2019. 12

Figure 3: TimberWest Properties application areas fertilized with Regional District of Nanaimo biosolids in 2019. 13

APPENDIX THREE – PHOTOGRAPHS

Photograph 1: RDN biosolids are stockpiled in storage areas and land-applied using specialized equipment. 14

Photograph 2: RDN biosolids are land-applied to forest stands along application trails throughout the TimberWest Properties..... 14

Photograph 3: Surface water locations were monitored at various locations within the TimberWest Properties as well as in Benson Creek, depicted here..... 14

1 INTRODUCTION

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

1. French Creek Pollution Control Centre (FCPCC) - Class A biosolids
2. Greater Nanaimo Pollution Control Centre (GNPCC) - Class B biosolids

In 2019, RDN biosolids were managed by SYLVIS Environmental (SYLVIS) 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 at this site since 2003. The objectives of biosolids forest fertilization at the TimberWest Properties are to increase soil quality and tree growth. In 2019, RDN biosolids were also managed in a soil fabrication project located at the Nanaimo Forest Products Harmac Mill in Nanaimo, BC (Harmac). Harmac serves as a contingency site for management of RDN biosolids during periods of inclement weather where management at the TimberWest Properties is not possible. 4,871 wet tonnes (wt) (87% of annual production in 2019) were delivered to the TimberWest Properties and 719 wt (13%) were delivered to Harmac.

This report summarizes biosolids management and regulatory compliance at the TimberWest Properties in 2019. It also serves as the qualified professional certification for the 2019 biosolids land application plan (LAP) for the TimberWest Properties (*2019 TimberWest Properties (Weigles Road) Forest Fertilization Land Application Plan*, authorization #109802) as required under *Organic Matter Recycling Regulation* (OMRR) section 5 (3).

No site authorization or biosolids LAP was active for the Harmac site in 2019. SYLVIS provided qualified professional services for the soil fabrication project at Harmac and a report addressing fabricated soil quality is available separately.

2 2019 BIOSOLIDS MANAGEMENT SUMMARY

This document contains a summary of the 2019 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 (Table 3), a soil quality summary (Table 4), a biosolids management program greenhouse gas 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 2019, 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 the Nanaimo Mountain Bike Club (i.e., provision of fertilization area maps for ride planning), and adherence to the conditions of site use under the RDN land-use agreement with TimberWest were completed for 2019 (Table 1).

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

2.2 BIOSOLIDS TRANSPORTATION

In 2019, 4,871 wt of RDN biosolids (1,095 wt from FCPCC; 3,776 wt from GNPCC) were transported by DBL Disposal to the TimberWest Properties (Table 2). Monthly tonnage delivered in 2019 is graphically summarized in Figure 1.

In 2019, 719 wt of RDN biosolids (161 wt from FCPCC; 558 wt from GNPCC) were transported by DBL Disposal to Harmac (Table 2). Monthly tonnage delivered in 2019 is graphically summarized in Figure 2.

Total RDN biosolids production in 2019 (5,590 wt) was above the five-year average annual production of 4,758 wt.

2.3 BIOSOLIDS STORAGE

Four storage areas 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 (Photograph 1). All four storage areas were utilized for biosolids stockpiling in 2019. Biosolids storage conformed to rainy season storage practices where biosolids are required by the OMRP to be covered from October 1st to March 31st of every year.

The biosolids storage facility at Harmac consists of an asphalt base. Harmac does not cover the stored biosolids as biosolids are typically quickly incorporated into a fabricated soil medium.

2.4 2019 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 2019 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 2019, 4,954 wt of RDN biosolids (1,113 wt from FCPCC; 3,841 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 90 hectares (ha) of forested lands at the TimberWest Properties at application rates specific to the individual fertilization units based on their history of previous biosolids land applications. Across the site, the biosolids application rate was an average of 91% of the agronomic rates. No individual application rates exceeded the application rate specified in

the LAP (25 dry tonnes / ha). At the end of 2019, 163 wt (46 wt from FCPCC; 117 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 2019 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 February and March in 2019.

Biosolids will be land-applied at the Harmac 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 2019.

2.6 BIOSOLIDS QUALITY

Biosolids quality was characterized throughout 2019 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 by SYLVIS 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 2019 met OMRR Class A and B criteria for trace elements.

A total of fourteen discrete samples were collected by SYLVIS for analysis of fecal coliforms over three sampling events (Table 3). The geometric mean for fecal coliforms in 2019 for the FCPCC was 104 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 2019 for the GNPCC was 111,400 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 2019. Average VSR was 49.4% for the FCPCC and 65.5% 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 2019. Soil samples were collected by SYLVIS and consisted of composite sample, composed of 10 sub-samples, collected from the 0-15-cm depth at random and varying distances from the roadside. On average, soil trace element concentrations remain below 75% of applicable OMRR soil criteria for this site (Table 4).

Mixed topsoil quality in the Harmac soil mixing project are discussed in a separate report.

2.8 SURFACE WATER MONITORING

Surface water at two locations was monitored by SYLVIS at the TimberWest Properties throughout 2019 and at five locations in the spring and fall of 2019 by SYLVIS (Photograph 3). Biosolids fertilization appears to have had no meaningful effect on surface water quality with the possible exception of nitrate, which is expected for a fertilized site. Details of the surface water monitoring program can be found in the SYLVIS report *Regional District of Nanaimo Biosolids Management Program - 2019 TimberWest Properties Surface Water Report* (document #1289-20).

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 LAP notified to the BC Ministry of Environment and Climate Change Strategy (ENV) on January 17th, 2019 (authorization #109802). This authorization expired on February 16th, 2020 and notification for an additional year of biosolids land applications was made to ENV and the Vancouver Island Health Authority on January 17th, 2020. All regulatory requirements of the OMRR and specifications of the 2019 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.

No site authorization or LAP is currently in place at Harmac.

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. 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.

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.

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 2019 biosolids management program at the TimberWest Properties and at Harmac. While transportation of biosolids and operation of equipment for fertilization activities generated emissions, land application of biosolids offset emissions through sequestration. In 2019, the RDN's biosolids management program accounted for -132.4 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 2019. 4,871 wt (87% of annual production in 2019) were delivered to the TimberWest Properties and 719 wt (13%) were delivered to Harmac.

All biosolids land application activities occurred as specified in the current LAP and according to management requirements under the OMRR. On average, soil quality data remain 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 42,000 wt of biosolids since 2007 (Table 6). SYLVIS looks forward to continuing this productive relationship and providing biosolids management services and support to the RDN throughout 2020 and beyond.

APPENDIX ONE – TABLES

Table 1: Summary of SYLVIS 2019 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 2019 through the collection of six full suite samples and 14 fecal coliform samples.
Biosolids Quantity	4,871 wt of RDN biosolids were transported to the TimberWest Properties by DBL Disposal in 2019. 4,954 wt of biosolids were land-applied in 2019. 163 wt remained stockpiled at the end of 2019.
	719 wt of RDN biosolids were transported to the Harmac site by DBL Disposal in 2019. 0 wt of biosolids were land-applied in 2019. 1,680 wt remained stockpiled at the end of 2019.
Biosolids Transportation and Delivery Coordination	SYLVIS coordinated biosolids deliveries to the TimberWest Properties with the biosolids transporter throughout 2019.
Access Maintenance	SYLVIS conducted road maintenance on internal roads at the TimberWest Properties in 2019.
Contingency	719 wt of RDN biosolids were sent to the Harmac contingency site in 2019.
Storage of Biosolids	Biosolids were stored in four storage facilities 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 Incidents	No environmental incidents occurred in 2019.
Site Safety	No near-miss or safety incidents occurred at the TimberWest Properties in 2019. SYLVIS maintained COR and BC Forest SAFE safety accreditations in 2019.
Public and Media Relations	SYLVIS attended and presented at an Open House at the French Creek WWTP in June 2019.
Complaints Management	There were no complaints received about the biosolids forest fertilization program at the TimberWest Properties in 2019.
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 2019. No work was completed on storage facilities in 2019.
Application Planning	SYLVIS mapped, planned, and notified all fertilized areas in 2019.

Table 1 (continued): Summary of SYLVIS 2019 deliverables as outlined in the RDN-SYLVIS 2017-2021 contract for biosolids management at the TimberWest Properties.

Task or Activity	Description
Nanaimo Mountain Bike Club Land Use Coordination	Bi-weekly application maps for use by site recreational users were produced in 2019.
Biosolids Beneficial Use	A biosolids Land Application Plan (authorization #109802) was submitted on January 17 th , 2019. 4,954 wt of biosolids were land-applied to 90 ha of forest under this authorization in 2019.
Record-Keeping	SYLVIS kept detailed records of all fertilization activities and environmental monitoring in 2019.
Environmental Monitoring	SYLVIS monitored surface water at the TimberWest Properties throughout 2019 with site-wide monitoring occurring in May 2019 and November 2019.
TimberWest Rules	SYLVIS maintained its BC Forest SAFE accreditation in 2019.
Construction	No works were constructed by SYLVIS at the TimberWest Properties in 2019.
Fires	SYLVIS followed a fire prevention protocol throughout 2019.
Hazardous Substance	No hazardous substances were introduced by SYLVIS to the TimberWest Properties in 2019.
Condition of TimberWest Lands	SYLVIS maintained the condition of the TimberWest Properties in 2019.
Equipment Storage	Except for temporary storage of heavy equipment during fertilization activities, SYLVIS did not store any equipment at the TimberWest Properties in 2019.

Table 2: Regional District of Nanaimo biosolids management summary, 2019.

Site	TimberWest Properties			Harmac			Total
	GNPCC	FCPCC	Subtotal	GNPCC	FCPCC	Subtotal	
Carry-over from 2018 (wet tonnes)	182	64	246	681	280	961^a	1,207
Delivered (wet tonnes)	3,776	1,095	4,871	558	161	719	5,590
Applied (wet tonnes)	3,841	1,113	4,954	0	0	0	4,954
Carry-over to 2020 (wet tonnes)	117	46	163	1,239	441	1,680^a	1,843

^a 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, 2019.

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	37,633	38,533	38,331	-	-	µg/g
Ammonia + Ammonium- N (available)	2,993	5,250	4,742	-	-	µg/g
Nitrate - N	8	7	7	-	-	µg/g
Phosphorus (available)	710	1,103	1,015	-	-	µg/g
Potassium (available)	774	746	752	-	-	µg/g
Organic Matter	64.3	60.3	61.2	-	-	%
Total Solids	32.5	25.4	27.0	-	-	%
pH	7.3	7.3	7.3	-	-	pH
Electrical Conductivity	6.7	4.9	5.3	-	-	dS/m
Trace Elements						
Arsenic	2.7	2.7	2.7	75	75	µg/g
Cadmium	1.5	2.7	2.4	20	20	µg/g
Chromium	37	28	30	-	1,060	µg/g
Cobalt	2.0	3.0	2.8	150	150	µg/g
Copper	660	413	469	-	2,200	µg/g
Lead	15	23	21	500	500	µg/g
Mercury	0.6	0.8	0.8	5	15	µg/g
Molybdenum	4.8	6.8	6.3	20	20	µg/g
Nickel	12	15	15	180	180	µg/g
Selenium	4.1	4.1	4.1	14	14	µg/g
Zinc	950	740	787	1,850	1,850	µg/g
Microbiological Analysis						
Fecal Coliforms	104 ^f	111,400 ^g	86,000	1,000	2,000,000	MPN/g
Vector Attraction Reduction						
Volatile Solids Reduction	49%	66%	62%	38% (minimum)	38% (minimum)	%

Note: All analyses based on dry weight.

- a French Creek Pollution Control Centre values are the average of three samples taken on April 29, July 15, and November 25, 2019 by SYLVIS and analysed by Element Laboratories in Surrey, BC.
- b Greater Nanaimo Pollution Control Centre values are the average of three samples taken on April 29, July 15, and November 25, 2019 by SYLVIS and analysed by Element Laboratories in Surrey, BC.
- c Weighted average is based on GNPCC production of 77% and FCPCC production of 23% of total biosolids production.
- d Limits as specified in Trade Memorandum T-4-93, Standards for Metals in Fertilizers and Supplements as of August 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 collected by SYLVIS on November 13, 2018 and April 29 and July 15, 2019 by SYLVIS and analyzed by ALS Laboratories in Burnaby, BC.
- g Values are the geometric mean of seven samples collected by SYLVIS on April 29, July 15, and November 25, 2019 by SYLVIS and analyzed by ALS Laboratories in Burnaby, BC.

Table 4: TimberWest Properties soil quality summary, 2019.

Parameters	Min ^{a,b}	Max ^a	Mean ^{a,b}	OMRR Soil Criteria ^c	Units
Available Nutrients, Physical Properties, Acidity					
Total Nitrogen - TKN	298	1,198	548	-	µg/g
Ammonia + Ammonium - N (dry basis)	0.4	1.2	0.7	-	µg/g
Nitrate - N	2.0	2.0	2.0	-	µg/g
Phosphorus (available)	6	11	8	-	µg/g
Potassium - available	65	88	77	-	µg/g
Organic Matter	4.0	7.2	6.1	-	%
C:N Ratio	30.1	121.9	85.0	-	-
pH	4.6	5.5	5.0	-	pH units
Electrical Conductivity	0.05	0.11	0.07	-	dS/m
Trace Elements					
Arsenic	3.0	8.6	5.3	10	µg/g
Cadmium	0.06	0.28	0.15	1	µg/g
Chromium	22	41	32	60	µg/g
Cobalt	8.0	18.0	13.8	25	µg/g
Copper	20	54	35	75	µg/g
Lead	4.1	22.0	11.4	120	µg/g
Mercury	0.039	0.130	0.072	25	µg/g
Molybdenum	0.20	0.59	0.41	60	µg/g
Nickel	15.0	35.0	22.6	90	µg/g
Selenium	0.20	0.50	0.33	1	µg/g
Zinc	45	100	76	150	µg/g

- a Values are based on a set of 18 samples collected throughout 2019 by SYLVIS and analyzed by Element 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* 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, 2019.

Process	SYLVIS	Transporter	Total
Transportation ^a	0.6	33.2	33.8
Land Application ^b	-166.2	-	-166.2
Total	-165.6	33.2	-132.4

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 2019.

Table 6: Historical biosolids management in the Regional District of Nanaimo's forest fertilization program and Contingency Site, 2007-2019.

Year	TimberWest Properties	Harmac
2007	1,150 wt	-
2008	3,350 wt	-
2009	3,000 wt	-
2010	1,560 wt	-
2011	1,350 wt	-
2012	1,280 wt	-
2013	3,930 wt	-
2014	4,812 wt	-
2015	4,383 wt	-
2016	4,263 wt	-
2017	3,662 wt	797 wt
2018	4,802 wt	164 wt
2019	4,871 wt	719 wt
Total	42,413 wt	1,680 wt

APPENDIX TWO – FIGURES

Figure 1: Tonnage of Regional District of Nanaimo – Greater Nanaimo Pollution Control Centre (GNPCC) and French Creek Pollution Control Centre (FCPCC) dewatered biosolids delivered and applied at the TimberWest Properties by month in 2019.

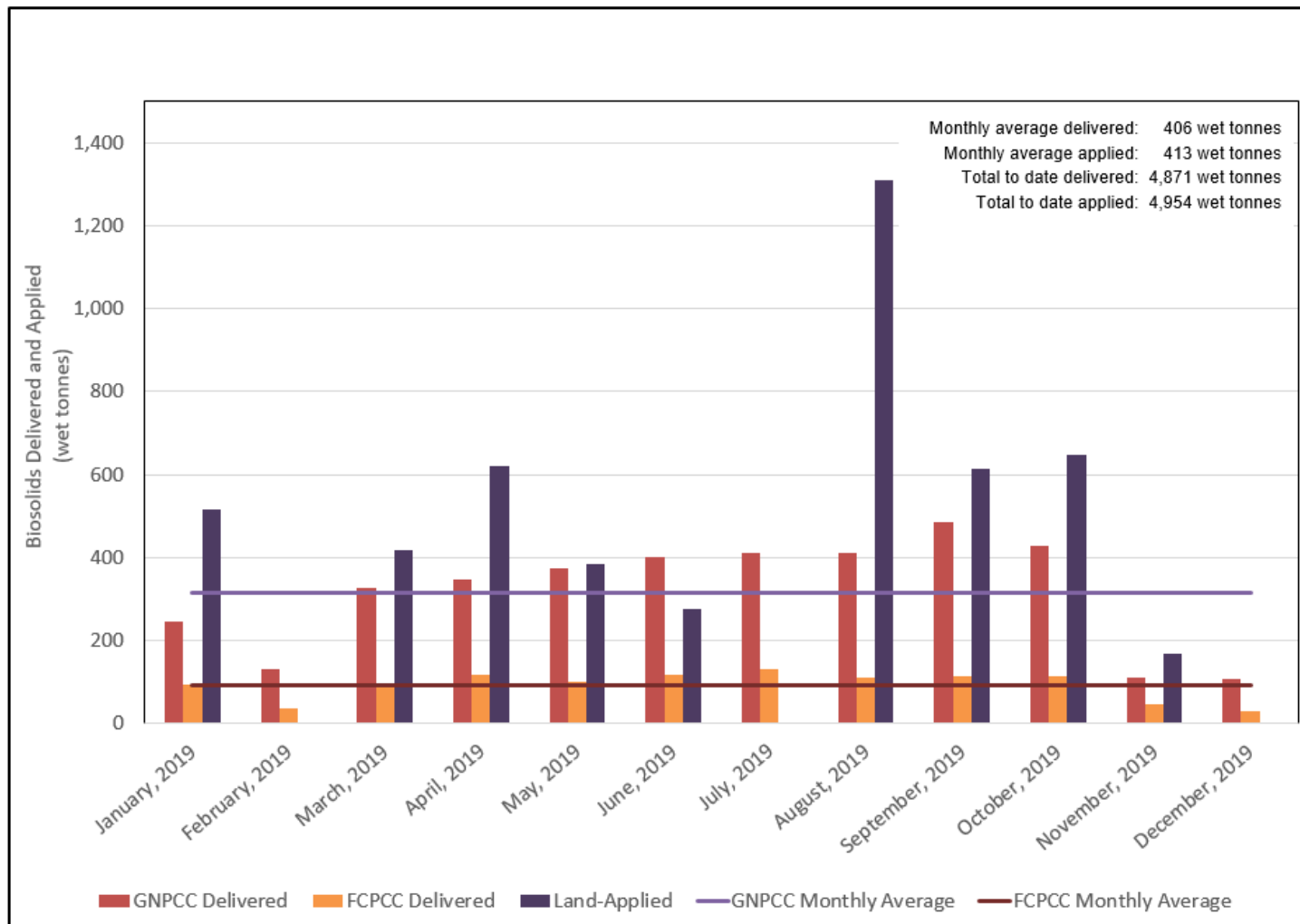


Figure 2: Tonnage of Regional District of Nanaimo – Greater Nanaimo Pollution Control Centre (GNPCC) and French Creek Pollution Control Centre (FCPCC) dewatered biosolids delivered to Harmac by month in 2019.

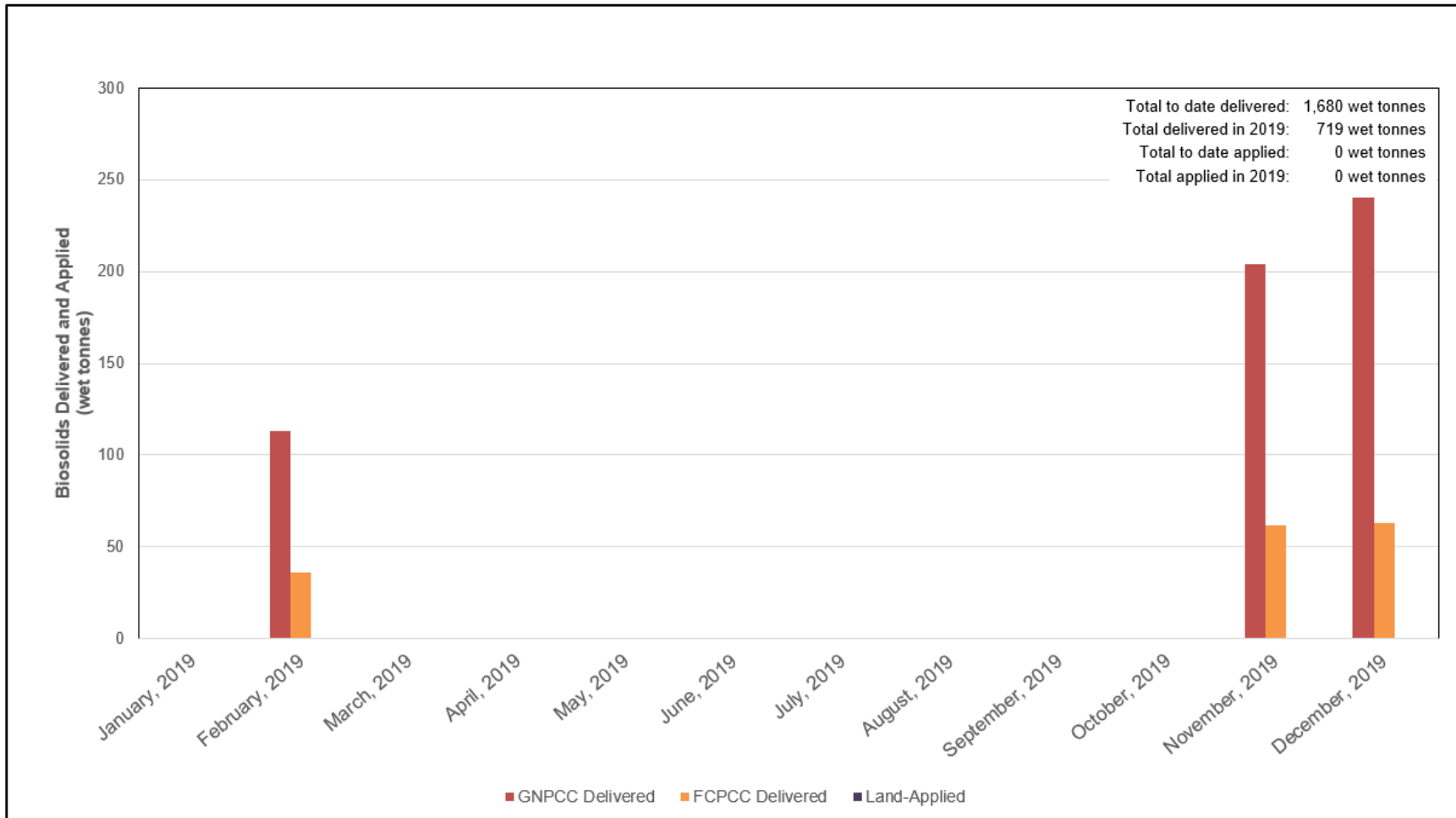
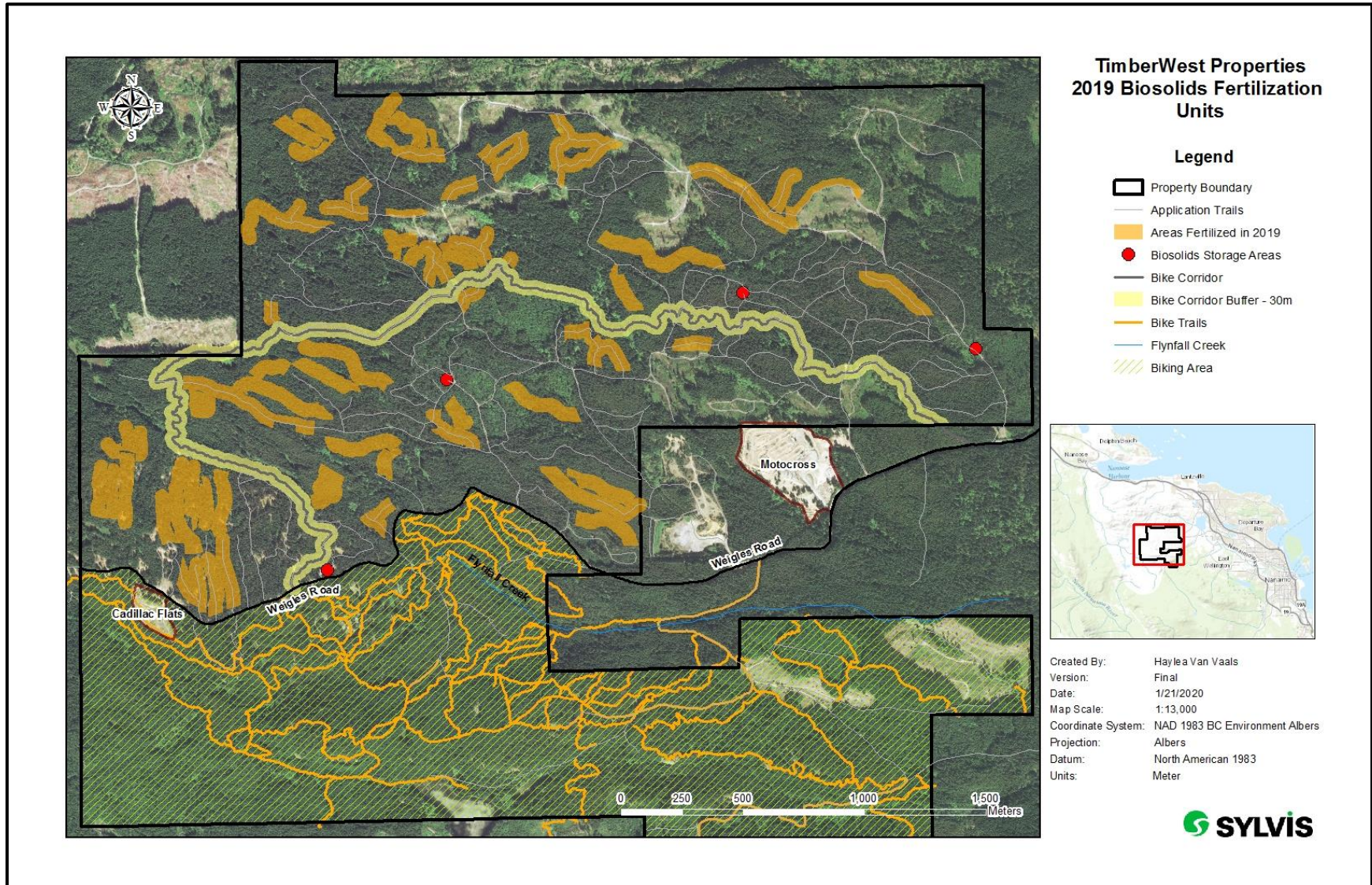


Figure 3: TimberWest Properties application areas fertilized with Regional District of Nanaimo biosolids in 2019.



APPENDIX THREE – PHOTOGRAPHS



Photograph 1: RDN biosolids are stockpiled in storage areas and land-applied using specialized equipment. (March 2019)



Photograph 2: RDN biosolids are land-applied to forest stands along application trails throughout the TimberWest Properties. (January 2019)



Photograph 3: Surface water locations were monitored at various locations within the TimberWest Properties as well as in Benson Creek, depicted here. (March 2019)