Regional District of Nanaimo

2024 Biosolids Management Summary Report

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1 PROGRAM OVERVIEW

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

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

This report provides a summary management of GNPCC biosolids. In 2024, GNPCC biosolids were managed at one site in the Nanaimo area: private forest lands off Nanaimo River Road (Blackjack) managed by Mosaic Forest Management (Mosaic).

At Blackjack, Class B GNPCC biosolids were used by SYLVIS in a forest fertilization program. The objectives of biosolids forest fertilization were to increase soil quality and tree growth. Since the GNPCC biosolids management program was transitioned to Blackjack in 2021, over 16,700 wet tonnes (wt) have been managed at this site through forest fertilization and reclamation.

A total of 5,727 wt of biosolids were produced from the GNPCC in 2024, all of which were delivered to Blackjack (Table 1, Appendix One). Total GNPCC biosolids production in 2024 was consistent with the five-year average annual production, since the implementation of secondary treatment operations at the GNPCC has stabilized (Table 1, Appendix One).

2 REGULATORY AUTHORIZATION

RDN biosolids were managed at Blackjack under the *2023 Blackjack – Forest Fertilization & Restoration Land Application Plan* (SYLVIS document #1602-23) associated with Authorization #111628 valid April 23, 2023 to April 22, 2024 and under the *2024 Blackjack – Forest Fertilization & Reclamation Land Application Plan* (SYLVIS document #1701-24) associated with Authorization #112120 valid April 22, 2024 to April 21, 2025.

3 2024 BIOSOLIDS MANAGEMENT

3.1 BIOSOLIDS MANAGEMENT SUMMARY

In 2024, all GNPCC biosolids were managed at Blackjack on Nanaimo River Road in Nanaimo, British Columbia (BC). Contractual tasks under the 2021-2026 contract relating to biosolids quality monitoring, biosolids delivery coordination, site safety, environmental monitoring, public engagement, First Nations communications, sustainability activities, and reporting were completed in 2024 are summarized in Table 3 (Appendix One).

3.2 BIOSOLIDS TRANSPORTATION

Biosolids produced at GNPCC are scaled at the plant and tonnages are provided by the RDN. In 2024, all biosolids produced at the GNPCC (5,727 wt) were transported by DBL Disposal to Blackjack (Table 1 and Table 2, Appendix One). Monthly tonnage delivered to this site in 2024 is shown in Figure 1 (Appendix One).

3.3 BIOSOLIDS STORAGE

Two storage sites were used at Blackjack in 2024. The majority of biosolids were stored at the main stockpile, consisting of an asphalt base with lock blocks delineating the three sides of the stockpile (Photograph 1, Appendix Three). All other biosolids delivered to Blackjack in 2024 were stored at the Old Jump Main stockpile, in the new application area south of Nanaimo Lakes. Biosolids storage conformed to OMRR requirements for Vancouver Island where biosolids are required to be covered from October 1 to March 31 of every year. At the end of 2024, 120 wt remained in storage site at Blackjack in preparation for fertilization in 2025 (Table 2, Appendix One).

3.4 2024 PRE-APPLICATION MEASURES

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

3.5 BIOSOLIDS LAND APPLICATION

Biosolids (5,807 wt) were land-applied to 61.2 hectares (ha) of forested lands for forest fertilization (Figure 2 and Figure 3, Appendix Two). Biosolids were land-applied in forested areas using a side-discharge spreader equipped with a hydraulic fan which propels the biosolids up to 30 m into forest stands (Photograph 1, Appendix Three). Forest fertilization biosolids applications occurred throughout 2024 except during periods of extreme weather (i.e., snowfall, heavy rainfall, heat waves), during bud break in the late spring, or when the ground was snow-covered. All biosolids applications adhered to a 30-m setback distance from permanent water features and identified ephemeral water features.

Forest fertilization application rates were specific to the individual fertilization units based on pre-application soil sampling and nutrient requirements of the trees, understory vegetation, and soils. The biosolids application rate for forested land averaged 18.6 dry tonnes per ha (dt/ha) which does not exceed the lower of the maximum agronomic application rates specified in the LAPs for forest fertilization (32 dry tonnes per ha).

3.6 BIOSOLIDS QUALITY

The OMRR requires that a set of seven discrete samples be collected for fecal coliform analysis and one sample for trace elements annually or for every 1,000 dry tonnes of biosolids applied, whichever comes first. Biosolids quality was characterized throughout 2024 to ensure biosolids met quality requirements for trace element concentrations, foreign matter, and pathogen reduction set forth in the OMRR.

In 2024, 1,138 dt of biosolids were produced by the GNPCC. Three composite samples, each composed of eight equal-volume subsamples, were collected by SYLVIS at the GNPCC. Composite samples were analyzed for physical parameters, nutrients, and trace elements (Table

4, Appendix One). All RDN biosolids samples collected in 2024 met the OMRR Class B criteria for trace elements concentrations.

SYLVIS collected 14 fecal samples from the GNPCC, the geometric mean of the sampling sets was 13,300 MPN/g (Table 4), meeting OMRR Class B criterion of 2,000,000 MPN/g.

3.7 SOIL MONITORING

Soil monitoring was conducted prior to applications in forest fertilization areas at Blackjack in 2024. Soil samples, each comprised of 15 sub-samples, were collected from the top 15 cm of soil by SYLVIS (Photograph 3, Appendix Three). Soil trace element concentrations were below applicable OMRR soil criteria for this site. Further details on soil sampling and nutrient concentrations can be found in the LAP.

3.8 REGULATORY COMPLIANCE

A Qualified Professional Certification was provided to Mosaic for biosolids applied at Blackjack under Authorization #111628. Authorization #112120 remains active until April 21, 2025; a Qualified Professional Certification will be authored upon completion of the Authorization term.

3.9 CARBON ACCOUNTING RELATED TO BIOSOLIDS MANAGEMENT

The management of 5,727 wt GNPCC biosolids at Blackjack in 2024 resulted in -1,390 t/CO2e of net emissions (emissions and emissions removals), of which transport represents +58 t CO2e GHG emissions.

This carbon emissions estimate considers biosolids transport, biosolids storage, land application, soil carbon sequestration, and soil nitrous oxide emissions. Carbon sequestration related to tree growth is accounted for separately by Mosaic and vehicle (i.e., pickup truck) emissions related to project operations are accounted for externally by SYLVIS.

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

The objectives of biosolids forest fertilization at Blackjack are to increase soil quality and tree growth while remaining compliant with the OMRR. Biosolids fertilization has increased organic matter content and available nutrients in the surface horizon. These enriched soils store more carbon and enable accelerated tree growth, which has been documented at this site and other biosolids forest fertilization sites. It has been observed[1] at the previous TimberWest Properties site on Doumont Road that deer browsing of trees is increased in biosolids-fertilized areas. Other biosolids fertilization sites in BC have documented similar results with improved wildlife habitat from biosolids applications on grasslands[2].

[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.
[2] Meineke, J., Doyle, F. I., Oukil, L., & Hodges, K. E. (2023). Small mammal responses to biosolids on grazed rangelands in British Columbia. *Restoration Ecology*, e14063.

Water sampling upstream and downstream of biosolids applications were completed by SYLVIS in April and November 2024. No adverse impacts from biosolids were seen; data can be provided upon request.

5 CONCLUSION

RDN's GNPCC biosolids were managed at Blackjack in 2024; 5,727 wt were delivered and 5,807 wt were applied onsite (Table 2). All biosolids land application activities at Blackjack occurred as specified in the applicable LAPs and according to management requirements included in the OMRR. Since transitioning the biosolids management program to Blackjack in 2021, over 16,700 wt of GNPCC biosolids have been managed onsite while being set up to become a successful long-term management site.

SYLVIS looks forward to continuing this productive relationship and providing biosolids management services and support to the RDN throughout 2025.

APPENDIX ONE – TABLES

Table 1: Historical management of Regional District of Nanaimo's Greater Nanaimo Pollution Control Centre biosolids at the TimberWest Properties and Blackjack from 2014 to 2024.

Year	TimberWest Properties	Blackjack	Total Production
2014	3,506 wt	-	3,506 wt
2015	3,087 wt	-	3,087 wt
2016	3,074 wt	-	3,074 wt
2017	2,686 wt	-	2,686 wt
2018	3,550 wt	-	3,550 wt
2019	3,776 wt	-	3,776 wt
2020	3,653 wt	-	3,653 wt
2021	5,060 wt	317 wt	5,377 wt
2022	802 wt	5,095 wt	5,897 wt
2023	-	5,717 wt	5,717 wt
2024	-	5,727 wt	5,727 wt
Total	**29,195 wt**	**16,856 wt**	**46,051 wt**

Table 2: Regional District of Nanaimo's Greater Nanaimo Pollution Control Centre Class B biosolids management summary - 2024.

Site	**Blackjack** (wt)
Storage from 2023	200
Delivered	5,727
Land Applied	5,807
Storage to 2025	120

Table 3: Summary of SYLVIS 2024 deliverables as outlined in the RDN-SYLVIS 2021-2026 Agreement for GNPCC biosolids management.

Task or Activity	Description
Biosolids Quality	RDN biosolids quality was monitored throughout 2024 through the collection of three full suite samples and 14 fecal coliform samples.
Biosolids Quantity	5,727 tonnes of RDN biosolids were transported to the Blackjack site by DBL Disposal in 2024. 5,807 tonnes of biosolids were land-applied in 2024. 120 tonnes remained stored at Blackjack at the end of 2024.
Biosolids Transportation & Delivery Coordination	The RDN coordinated biosolids deliveries with DBL and SYLVIS throughout 2024.
Contingency Plan & Management	A Contingency Plan was written for the 2021-2026 biosolids management contract and the following contingency sites were available for use in 2024: TimberWest Properties, Harmac, Hamm Road, 155-A Pit, and Haslam Pit. No contingency management was required in 2024.
Storage of Biosolids	Biosolids were stored at the Central Sort and Old Jump Main storage sites at Blackjack and covered with tarps from October 1 to March 31 as per OMRR requirements.
Invoicing	Biosolids deliveries were invoiced on a monthly basis.
Environmental Incidents	No environmental incidents occurred in 2024.
Site Safety	No safety incidents occurred at Blackjack in 2024. SYLVIS maintained COR and BC Forest SAFE safety accreditations in 2024.
Complaints Management	There were no complaints received about the biosolids forest fertilization program in 2024.
Odour Management Plan	The program Odour Management Plan was adhered to in 2024.
Communications Plan & Engagement	The program Communications Plan was adhered to in 2024. Two inquiries were received regarding potential impacts to wild game and plant foraging. SYLVIS held one phone discussion and in-person meeting to address questions. First Nations engagement was carried out with the Snuneymuxw First Nation for the Blackjack site through Mosaic during 2024. A meeting was held with a Snuneymuxw First Nation staff member and Mosaic in May 2024 to provide and overview of the project and discuss potential impacts to wild game and plant harvesting (included in the two inquires above).
Annual Reporting	Qualified Professional Certification of Compliance report, fulfilling the regulatory requirement for written certification under OMRR Section 5(3), were provided to the RDN and Mosaic for land applications at Blackjack under Authorization #111628.
Biosolids Beneficial Use	Two biosolids Land Application Plans for Authorizations #111628 and #112120 were submitted to the Ministry of Environment and Climate Change on April 28, 2023 and May 5, 2024 respectively, for Blackjack. 5,807 tonnes of biosolids were land-applied to 61.2 ha of forest.
Review of Biosolids Technology & Management Advancements	A review was completed of emerging biosolids treatment technologies and management strategies across BC and Canada. A summary is provided in Appendix Four.

Table 4: Regional District of Nanaimo – Greater Nanaimo Pollution Control Centre biosolids quality summary - 2024.

Parameter	GNPCC	Regulatory Criteria[a]	Units
Available Nutrients, Physical Properties, Acidity			
Total Nitrogen - TKN	61,292	-	µg/g
Ammonia + Ammonium- N (available)	7,863	-	µg/g
Nitrate - N	7	-	µg/g
Phosphorus (available)	1,433	-	µg/g
Potassium (available)	723	-	µg/g
Organic Matter	70.5	-	%
Total Solids	18.7	-	%
pH	6.8	-	pH
Electrical Conductivity	6.0	-	dS/m
Trace Elements			
Arsenic	2.3	75	µg/g
Cadmium	1.3	20	µg/g
Chromium	26.5	1,060	µg/g
Cobalt	2.8	150	µg/g
Copper	579	2,200	µg/g
Lead	22	500	µg/g
Mercury	0.54	15	µg/g
Molybdenum	7.3	20	µg/g
Nickel	13.8	180	µg/g
Selenium	6.1	14	µg/g
Zinc	885	1,850	µg/g
Microbiological Analysis - Fecal Coliforms			
Fecal Coliforms	13,300[b]	2,000,000	MPN/g

Note: Values are the mean of three composite samples, each composed of eight equal-volume subsamples collected during 2024 by SYLVIS Environmental and analyzed by Element Laboratories. All analyses based on dry weight.

a Class B trace element criteria specified in Schedule 4 and microbiological criteria in Schedule 3 of the BC *Organic Matter Recycling Regulation*.

b Value is the geometric mean of 14 samples collected by SYLVIS throughout 2024.

APPENDIX TWO – FIGURES

Figure 1: Tonnage of Regional District of Nanaimo – Greater Nanaimo Pollution Control Centre (GNPCC) dewatered biosolids delivered and applied at Blackjack by month in 2024.

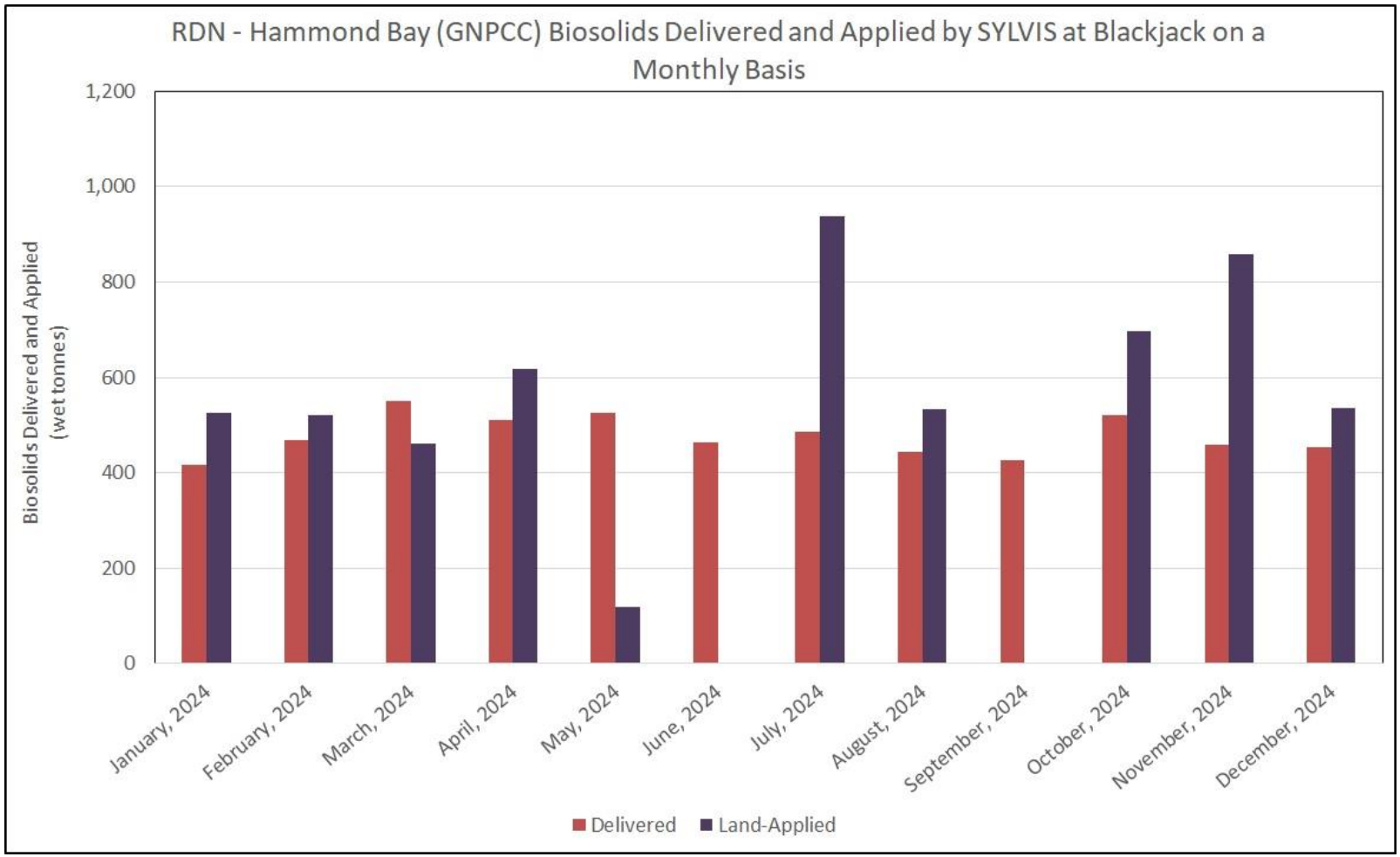


Figure 2: Blackjack application areas north of the lake fertilized with Regional District of Nanaimo biosolids in 2024.

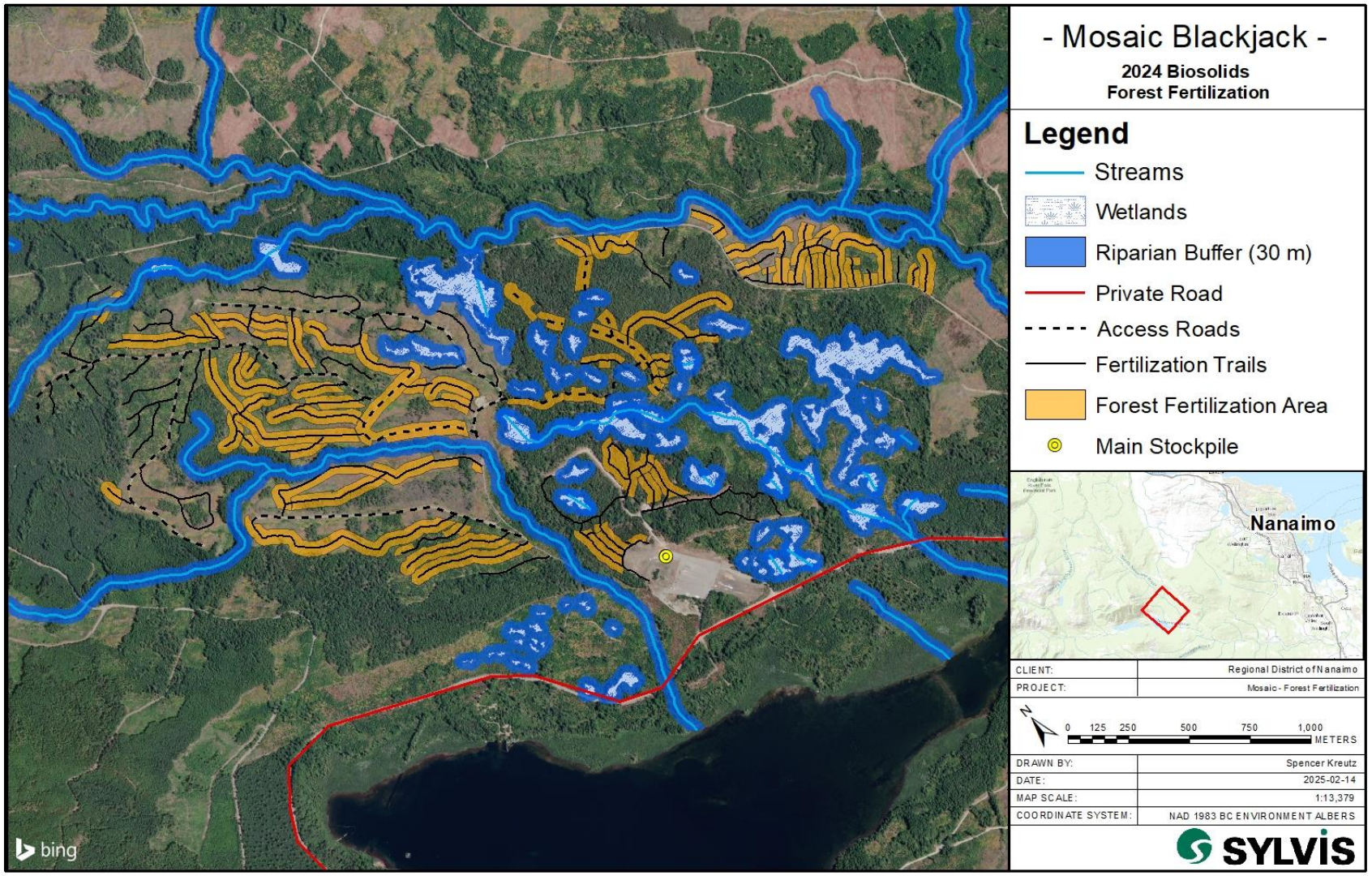
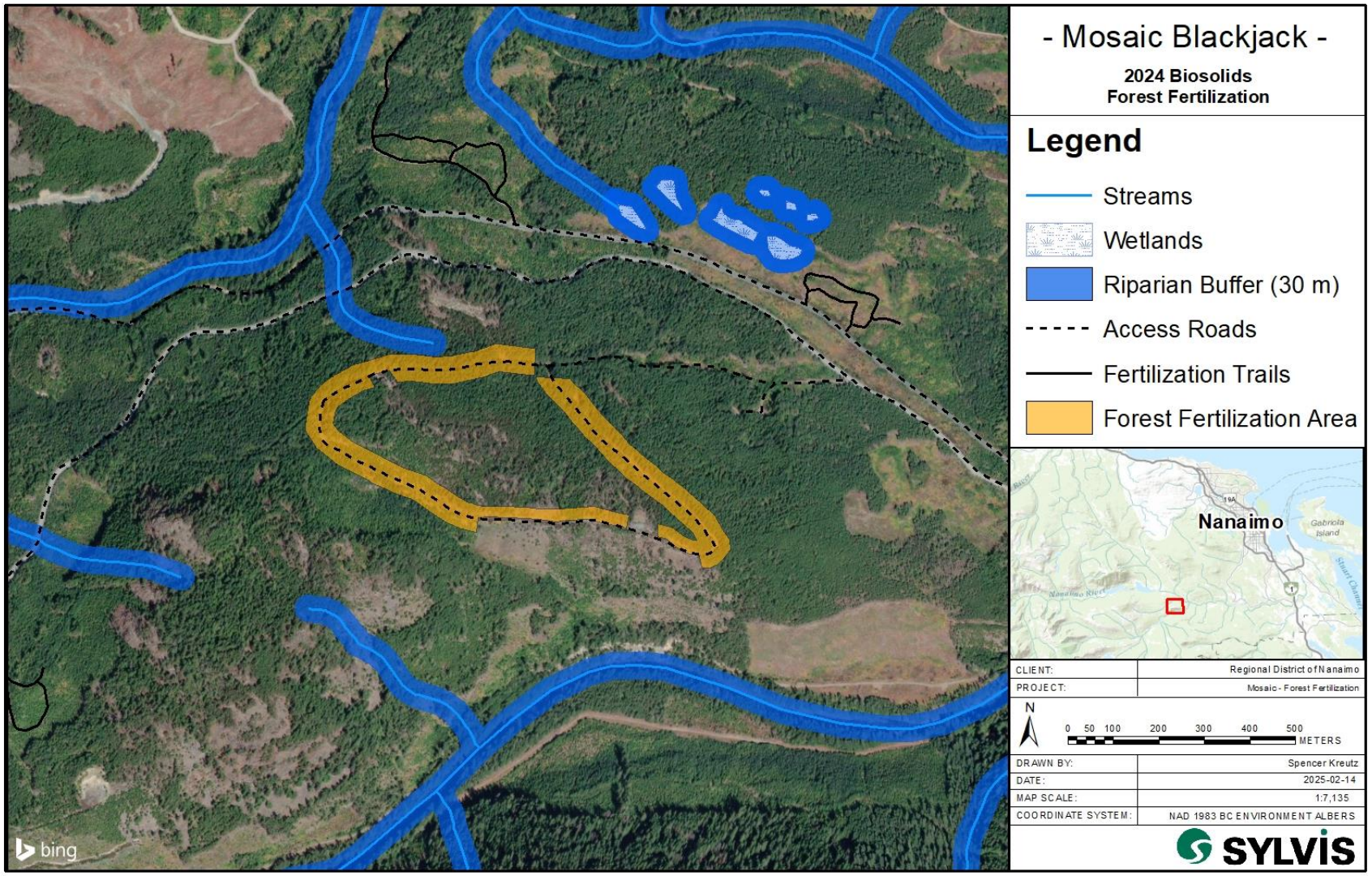


Figure 3: Blackjack application areas south of the lake fertilized with Regional District of Nanaimo biosolids in 2024.



APPENDIX THREE – PHOTOGRAPHS

Photograph 1: Biosolids main storage site at the Blackjack. (July 2024)

Photograph 2: Forest fertilization using biosolids onto a juvenile forest block. (August 2023)

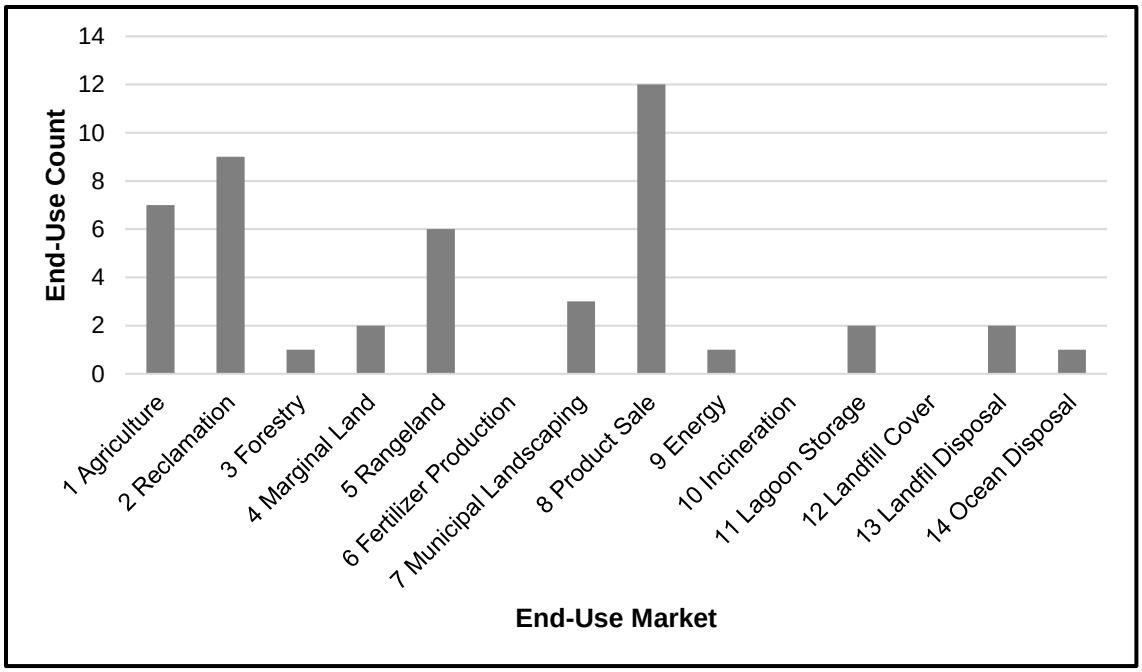
Photograph 3: Soil sampling in mature stand. (June 2024)

APPENDIX FOUR – REVIEW OF BIOSOLIDS TECHNOLOGY IMPROVEMENTS & MANAGEMENT ADVANCEMENTS

The RDN is interested in understanding how biosolids are managed in other jurisdictions across Canada and in keeping up-to-date on emerging treatment technologies. A high-level review of improvements in biosolids processing technologies and management programs across Canada was conducted and is summarized below.

Fourteen biosolids management methods and uses were found across BC and Canada. Biosolids management by 38 municipalities in British Columbia are presented in Figure B 1. Reported values are counts of municipalities and are not based on the tonnage of biosolids managed; if a municipality manages biosolids through multiple methods then each method is presented as an individual result.

Figure B 1: Biosolids products and markets in British Columbia.

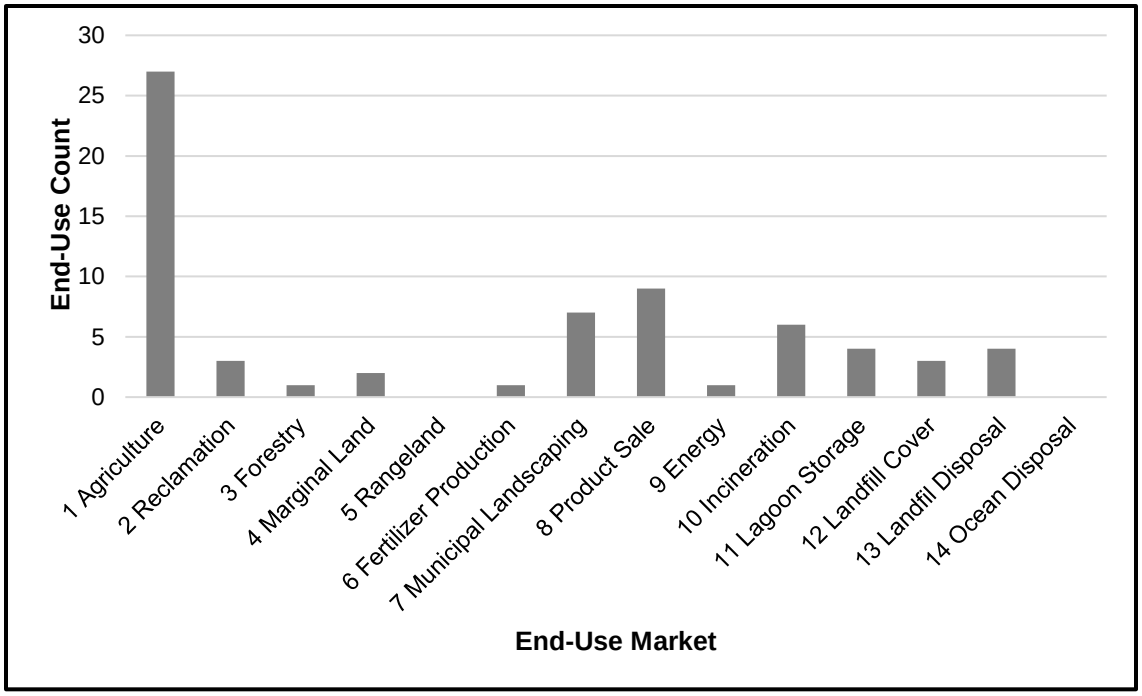


Most BC municipalities are managing biosolids and biosolids-derived products in land application markets (end-use markets 1-8). Numerous small biosolids generators are managed in large composting facilities which produce compost for sale or for use in mine reclamation. The RDN's current management programs using biosolids in forest fertilization is similar to land application processes in other BC jurisdictions, and the distribution of soils fabricated using biosolids (biosolids growing medium, BGM) aligns with many other BC municipalities.

SYLVIS conducted a high-level review and update of biosolids management across the rest of Canada. Basic management information for the most populous city or cities in each province or territory was gathered using information readily available through internet research. Biosolids management by 69 Canadian municipalities outside of BC are presented in Figure B 2. Similar to

the figure above, counts represent municipalities and are not based on tonnage produced; if a municipality manages biosolids through multiple methods then each method has been included as an individual result.

Figure B 2: Biosolids products and markets in Canada outside of British Columbia.



Similar to BC, most municipalities are managing biosolids and biosolids-derived products in land application markets (markets 1-8). According to the limited data gathered, the RDN's forest fertilization project continues to be one of two forest fertilization projects in the country, while the BGM project is one of three similar projects.

Currently there are numerous innovative wastewater solids treatment technologies under development in the world. Many of these technologies can replace digestion at a wastewater treatment plant but can also accept digested biosolids. A selection of these technologies is presented in the following table.

Table A 1: Example innovative wastewater processing technologies.

Technology	Acronym	Product & Value
heat drying	-	dried Class A biosolids
pyrolysis	-	biochar
gasification	-	renewable natural gas (RNG)
hydrothermal liquefaction	HTL	biocrude, hydrochar
super critical water oxidation	SCWO	CO_2, inert ash
thermal hydrolysis	-	Class A biosolids
Advanced Oxidation Processes	AOPs	Biosolids, degradation of organic pollutants and odors

Artificial Intelligence/ Machine Learning	AI	Increased plant efficiency and decreased downtime
Ultraviolet light-emitting diode reactors	UV LED	Disinfection process during treatment process

Some of these technologies have been implemented in Canada, but others have not. A non-exhaustive list of innovative technologies implemented and planned at Canadian sites is presented in the following table.

Table A 2: Canadian examples of innovative wastewater solids processing technologies.

Technology	Location	Feedstock	End-Use Market	Stage
Lystek - thermal hydrolysis	Ontario, Saskatchewan, Manitoba	digested biosolids	agriculture	commissioned & under construction
N-Viro alkaline stabilization	Alberta, Nova Scotia, Prince Edward Island, Ontario	biosolids	agriculture, fertilizer	commissioned
heat drying	Metro Vancouver	biosolids	agriculture, fertilizer	-
hydrothermal liquefaction (HTL)	Metro Vancouver	biosolids	unknown	design
pyrolysis	Ontario, Quebec, CRD	biosolids	syngas, biochar	under development, under consideration
gasification	CRD	biosolids	unknown	potential future option

The Lystek thermal hydrolysis process produces a number of products including a liquid Class A biosolids which is appropriate for use in agricultural regions but is less suited to Vancouver Island. The N-Viro alkaline stabilization process uses a considerable amount of lime to stabilize wastewater solids. Heat drying can reduce the mass of wet biosolids by 90% or more, reducing transport costs, but is expensive to implement and operate. Other thermal conditioning and treatment technologies for biosolids (pyrolysis, gasification, HTL) are less mature and are not currently implemented, even at pilot scale, in Canada though some pilots are planned.

The RDN's current approach of anaerobic digestion and centrifuge-dewatering, while not innovative, is reliable and predictable. RDN's forest fertilization program is relatively uncommon at the national scale and represents an innovative end-use of the RDN's biosolids. RDN's BGM production aligns with the second most common biosolids management use across Canada. The findings of this section are based on limited research and investigation; should the RDN wish to understand more about how its program compares to other biosolids management programs, both in Canada and elsewhere, SYLVIS would be pleased to carry this out under a separate scope of work.