SPERLING
HANSEN
ASSOCIATES

• Landfill Engineering
• Solid Waste Planning
• Environmental Monitoring
• Landfill Fire Risk Control

October 9th 2019 PRJ18052

Matt Thomas
Director of Public Works Operations
City of Quesnel
410 Kinchant Street
Quesnel B.C. V2J 7J5

Re: Quesnel Landfill Strategic Plan Wrap-up Report

Dear Mr. Thomas,

Sperling Hansen Associates (SHA) is pleased to provide the following wrap-up report for the Landfill & Recycling Strategic Plan. The intention of this report is to summarize all of the background documents and reporting completed thus far, and provide the City & their staff with clear, concise recommendations for future solid waste needs. This report provides an overview of current and future diversion activities at the site, as well as current landfill operations and future waste disposal options.

Please do not hesitate to contact us with any questions regarding the report.

Sincerely,

Mairi Dalgleish,

SPERLING HANSEN ASSOCIATES

1. INTRODUCTION

The City of Quesnel (City) began a strategic review process for solid waste and recycling services within the City in 2018. The landfill/recycling strategic review was initiated due to the landfill was nearing the end of its capacity (with approximately 10 years remaining), the existing layout of the landfill facility needed to be updated, and the contract for recycling services was due to expire in June 2020. The City also wanted to address their Strategic Plan goals which included improving recycling and diversion, and aspiring to implement zero waste initiatives.

Sperling Hansen Associates (SHA) was the successful proponent responding to a Request for Proposals (RFP) for the aforementioned strategic review. This review has included the provision of the following documents/reports:

- Landfill Criteria Conformance Review
- Options for Future Waste Disposal
- Landfill Closure / Post-Closure Liability Update
- Recycling Contract Recommendations
- Strategic Landfill Fill Plan and Operational Plan
- Quesnel Landfill Gas Investigations

The analyses and reporting that was completed for the landfill site was based on data provided by the City and the Cariboo Regional District (CRD), site visits completed by SHA, existing background information for the site, and SHA's experience working at similar sized landfills in British Columbia (BC).

This report will provide a summary of the recommendations made throughout the strategic review including recycling and reuse services, landfill operations, and future landfill expansion options.

2. RECYCLING & REUSE SERVICES

2.1 Recycling & Reuse Background

In recent years, the recycling landscape has changed significantly. Residential recycling and diversion programs in BC communities now include several Extended Producer Responsibility (EPR) programs. EPR programs are largely run and funded by the respective producer responsibility organization. Since 2014, most communities have benefited from the Recycle BC (RBC) EPR program to divert household packaging and printed paper from the residential sector. In Quesnel, residential recycling is no longer provided under a local government service; instead RBC (through Emterra) provides curbside recycling collection of certain materials and has contracted with Northern Recycling Inc. (NRI) to provide depot services for the collection of other materials, currently located at the Quesnel Landfill. RBC also has a contract with NRI to process recyclables collected curbside and at the depot for shipment to the Lower Mainland for further processing and marketing by RBC subcontractor Green By Nature. All transportation, processing and marketing is paid by RBC. Additional recycling services that are offered at the Quesnel Landfill include commercial cardboard, select EPR products (i.e. paint

and batteries), automotive batteries, scrap metal, wood waste and yard waste. A Reuse Building is also available for residents to reuse and recycle household items and clothing.

Based on site visits and conversations with the City, SHA understands that some divertible materials have historically been landfilled. This includes crushables (i.e. concrete and rock) that have been used to construct landfill cells and wood waste which is chipped for operations.

The long-term vision for the recycling services offered at the Quesnel Landfill includes providing an "Eco-Depot" facility that supports a variety of materials diversion programs, including:

- Recycling depot for household packaging and printed paper (RecycleBC)
- Collection of current and future Extended Producer Responsibility Products with the exception of tires, medications, used beverage containers and other materials that are collected by the private sector
- Reuse Building
- Metal Recycling
- Recycling of Large Appliances
- Diversion of clean wood waste
- Composting of yard waste

2.2 Recycling & Reuse Recommendations

To achieve the City's Eco-Depot goals a series of actions are recommended:

1. **RecycleBC Depot:** The City should request the CRD to consider assuming responsibility for the RecycleBC depot and contract out the operation to the private sector. The CRD could also provide recycling opportunities for other EPR materials at this location.

2. **Reuse Building:** The City should consider contracting out the operations and maintenance of the Reuse Building (Share Shed).

3. **Commercial Cardboard:** The City should consider contracting out the management of commercial cardboard including the collection, transporting and marketing of materials. The City and CRD should lobby the provincial government to include commercial recycling under the BC Recycling Regulation.

4. **Recycling Processing Building Lease:** The City should consider establishing a formal lease agreement with NRI for the recycling processing area for as long as NRI has the contract to process RecycleBC materials.

5. **Segregate scrap metal at the landfill:** The City should establish a metal stockpile area on the crest of the landfill or the abandoned ball fields. There should be delineated areas for miscellaneous scrap metals and for appliances that require removal of ozone depleting substances (ODS). The metals and appliances following ODS removal, should be commercially serviced under a formal arrangement. The City should also register with the Major Appliance Recycling Roundtable as a collector to take advantage of their renumeration program.

6. **Compost yard and garden waste:** The City should establish a basic yard and garden waste composting system at the landfill. A small scale static pile or windrow composting system could accept chipped wood waste, grass, leaves and non-invasive weeds. The composted product could be used as a topsoil amendment to support the progressive closure of the landfill.

7. **Stockpile clean wood separately from contaminated wood:** Clean wood waste free of contaminants such as nails, glues and paint can be diverted for beneficial use at the Williams Lake cogeneration facility or composted. Contaminated wood can continue to be chipped and used onsite for daily operational cover. Landfill staff can direct customers to ensure the stockpiles are maintained appropriately and the wood is sorted correctly. The wood waste, scrap metal and yard waste stockpiles should be located in the same area to help with efficiencies for site-users and landfill staff.

8. **Separate and stockpile concrete and rock for beneficial use:** Crushable materials such as concrete and rock should be diverted from the landfill and stockpiled in an accessible area. These materials are not required for day-to-day landfill operations and take-up a significant amount of valuable landfill air space. These materials can be beneficially re-used as road base, surface water management infrastructure (i.e. as ditch armoring materials), and other landfill construction activities (such as the proposed perimeter berm discussed below).

3. LANDFILL OPERATIONS & LIFESPAN

The strategic plan has included a thorough review of landfill operations and lifespan. SHA has completed a Landfill Criteria Conformance Review and identified future landfill options including a strategic filling plan. The suggested approach has been designed to maximize landfill airspace and save costs while extending the life of the facility. SHA has also updated the landfill closure liability estimate based on the suggested landfilling concept.

3.1 Landfill Criteria Conformance Review

A Landfill Criteria Conformance Review (LCCR) was completed in 2018. The review identified areas where the landfill was not meeting the objectives of the second edition BC Landfill Criteria for Municipal Solid Waste (the Criteria). The recommended upgrades included:

- completing a supplemental landfill gas generation assessment,
- completing a landfill gas migration investigation,
- installing combustible gas monitors in buildings constructed on landfilled waste,
- completing a strategic filling plan, and
- completing progressive closure at the landfill on areas that have reached design capacity.

The City has initiated several actions identified in the LCCR to improve conformance as described in the following subsections.

3.1.1 Supplemental Landfill Gas Generation Assessment

As per the Criteria and the BC Landfill Gas Management Regulation, landfills having more than 100,000 tonnes of waste in place, or receiving more than 10,000 tonnes of waste per year, are required to submit a Landfill Gas Generation Assessment. Since it has been more than 5 years since the City's

initial assessment, a supplemental landfill gas (LFG) generation assessment was completed in early 2019 by Wood Environmental and Infrastructure Solutions (Wood).

In late summer 2019, SHA refined the LFG assessment based on information from an onsite gas investigation and the CRD's waste composition study. The SHA LFG assessment indicates the landfill is generating an estimated 852 tonnes of methane annually. Since the BC Landfill Gas Management Regulation requires LFG management plans for facilities estimated to generate 1,000 tonnes or more of methane annually, the City is not required to install an active LFG collection system.

3.1.2 Landfill gas migration investigation

An onsite investigation was completed by SHA's LFG specialist on June 17th 2019. The investigation included an assessment of explosive conditions at on-site and immediate off-site structures, a surface methane concentration scan, and soil gas methane concentration measurement using the existing soil vapour probes.

Results from the soil vapour monitoring program at the Quesnel Landfill indicate methane levels in the range of 0-60% methane have been observed in probes at the property boundary and offsite. These levels exceed the 5% lower explosive limit of methane and are considered a risk.

LFG Management Recommendations include:

1. New gas migration probes should be installed along the western property boundary and additional monitoring of these probes should be completed. Improved probe locations and increased monitoring frequency will help to better understand the migration that is occurring and aid in development of any remedial measures (if required).
2. Combustible gas monitors should be included in the Landfill scale house, reuse building and the contractor shed across the road from the scale.
3. The recycling processing fabric building should be continuously vented**.**
4. Onsite staff that may be exposed to gas should be equipped with a 4-gas safety device to continuously monitor their working environment atmosphere.

3.1.3 Strategic Fill Plan

SHA prepared a strategic fill plan for the landfill in 2019. This fill plan aims to provide a strategic landfilling approach to maximize efficiencies at the landfill. Key recommendations from the fill plan include the following:

1. Divert concrete and rock, wood waste, and yard waste from the landfill for beneficial use.
2. Divert incoming soil to an accessible stockpile at the landfill to minimize double handling.
3. Track soil usage at the landfill by bucket count or truck count.
4. Implement an alternate daily cover system to minimize cover use at the landfill and improve the waste to cover ratio.
5. Focus landfilling operations in the northern portion of the landfill and use the southern footprint for stockpiling diversion materials.
6. Dedicate a minimum of one full-time staff to landfill operations and obtain a full-time front-end loader or small dozer for landfill use.

7. Provide better organization of diverted materials such as metal, wood waste, and tires to attract stewardship agencies and improve operations.
8. Engage with NRI to clean-up the boats, car hulks and metal waste along the northern property boundary.

3.2 Landfill Development Options Considered

SHA's analysis of future landfilling options included developing conceptual final contour designs for the landfill and estimating the required operational, capital and closure costs for each option. The conceptual landfill designs have considered expansion into the old ball fields south of the current landfill footprint as well as construction of a perimeter berm around the landfill. Both of these design concepts would extend the life of the landfill beyond current estimates. Conceptual drawings and cost estimates are included in the Options for Future Landfilling Report. An amendment to the report was issued in September 2019 which revised some of the capital costs and provided more detailed landfill phasing. Figure 1 shows existing topography at the Quesnel Landfill.

The results of the analysis indicated that under current conditions, with no expansion considered and no additional diversion of materials, the landfill is expected to last until 2040 or 21 years (as shown in Figure 2). The lifespan of the current landfill design could be expanded by another 5-8 years by diverting yard and garden waste; wood waste; concrete; and, rock from the landfill.

Construction of a perimeter berm around the landfill's west and south side could further extend the lifespan of the landfill. This berm would allow the landfill to be built at steeper slopes, thereby gaining useable space for waste disposal. If the perimeter berm was constructed on the existing footprint, the landfill lifespan would be expected to extend until 2061 as outlined in the September 2019 Amendment to the Options for Future Waste Disposal Report.

If the southern lateral expansion of the landfill is completed, the overall life of the landfill will be extended until at least 2062 under base conditions with no additional diversion; figure 3 illustrates this design concept. If compostable green waste as well as concrete and rock were diverted from the landfill, the lifespan would be expected to extend an additional 13-19 years until 2075-2081 depending on the level of diversion achieved. The longest expected lifespan would be achieved by constructing a perimeter berm around the west and south portion of the landfill and by diverting compostable green waste from the landfill. This option would provide landfilling space until 2089; figure 4 illustrates this design concept.

The most cost-effective option for the City of Quesnel was found to be lateral expansion with construction of the perimeter berm - Scenario 5b. As presented in the September 2019 amendment, if concrete and rock were diverted from the landfill and simple composting of green waste were to take place, this design option would result in an overall cost per tonne of $73.37 over the life of the landfill and a breakeven tipping fee of $70.68. Final closure for would occur in 2089 under the conceptual design parameters. The estimated future capital costs for this scenario are $25,164,000 for landfill infrastructure and $9,354,000 for closure works. If approved, the City should begin planning for perimeter berm construction in 2020-2021 as the capital costs for the first phase of berm are estimated to be $1,400,000. Infrastructure grants and other funding opportunities may be available.

Extending the landfill lifespan is beneficial due to the increased challenges in siting new landfill facilities. If and when the Quesnel Landfill closes, the most likely alternative waste disposal location would be the Gibraltar Landfill near McLeese Lake. Hauling waste to Gibraltar landfill would result in increased trucking costs estimated to be $65/tonne and increased costs resulting from tipping fees paid to Gibraltar estimated to be $30/tonne. Although landfill expansion is expected to result in the highest capital costs, the long-term operating costs will be reduced with the extension of the landfill lifespan and the lack of tipping fees and/or hauling costs.

4. LONG-TERM CONSIDERATIONS

In addition to the recommendations presented above, a number of zero-waste initiatives were listed in the February 2019 Options for Future Waste Disposal report for the City's consideration including:

1. Diverting clean wood waste to Atlantic Power for cogeneration,
2. Promoting backyard composting,
3. Development of organics management infrastructure and composting waste materials,
4. Introducing variable tipping fees to incentivize waste diversion,
5. Implementing disposal bans on recyclable materials where diversion programs are in place,
6. Developing Green Procurement Policies within the City, and
7. Continuing to promote zero-waste initiatives in the community.

To achieve the goals and recommendations outlined in this report, the City and their planning teams should consider dedicating a member of staff to oversee solid waste operations. The responsibilities of this staff person could include managing recycling contracts, developing new relationships with stewardship agencies, and overseeing general landfill operations.

Ongoing planning and engineering will be required at the landfill to complete the perimeter berm construction if approved, and ongoing landfill improvements. Detailed design of the berm should be completed in the next 1-2 years. The 2019 Landfill Annual Report will provide an opportunity for the City to review improvements made over the past year at the landfill and track airspace utilization and soil usage.

5. LIMITATIONS

This report has been prepared by Sperling Hansen Associates. (SHA) on behalf of the City of Quesnel in accordance with generally accepted engineering practices to a level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions in British Columbia.

The report is based on site visits, project experience, and analysis by SHA staff of data compiled during the preparation of this report from a number of sources. Except where specifically stated to the contrary, the information on which this study is based has been obtained from external sources. This external information has not been independently verified or otherwise examined by SHA to determine its accuracy and completeness. SHA has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the reports as a result of

omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation.

The report is intended solely for the use of the City of Quesnel. Any use which other parties makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such other parties. SHA does not accept any responsibility for other uses of the material contained herein nor for damages, if any, suffered by any third party because of decisions made or actions based on this report. Copying of this intellectual property for other purposes is not permitted.

The findings and conclusions of this report are valid only as of the date of this report. The interpretations presented in this report and the conclusions and recommendations that are drawn are based on information that was made available to SHA during the course of this project. Should additional new data become available in the future, SHA should be requested to re-evaluate the findings of this report and modify the conclusions and recommendations drawn, as required.

It has been a pleasure working with the City of Quesnel on the Quesnel Landfill Strategic Fill Plan. Should you have any questions on this report or require further assistance or information, please feel free to contact the undersigned at 778-471-7088.

Kind Regards,
Sperling Hansen Associates

Report By

Mairi Dalgleish, A. Ag
Environmental Technologist

Roger Tooms, PMP
Senior Project Advisor

X:\PRJ\PRJ18\PRJ18052 - CITY OF QUESNEL LANDFILL-RECYCLING STRATEGY\06 AUTOCAD DRAWINGS\18060 QUESNEL BASEMAP_WITH PROPERTY LINES_LI.DWG 4/25/2019 2:44 PM

SPERLING HANSEN ASSOCIATES

Landfill Services Group
- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 East Keith Road
North Vancouver, B.C. V7J 1J3

Phone: (604) 986-7723
Fax: (604) 986-7734

LEGEND:

- 5m EXISTING CONTOUR
- 1m EXISTING CONTOUR
- ROAD
- PROPERTY LINE
- 50m BUFFER
- 30m BUFFER
- 15m BUFFER

CLIENT: CITY OF QUESNEL

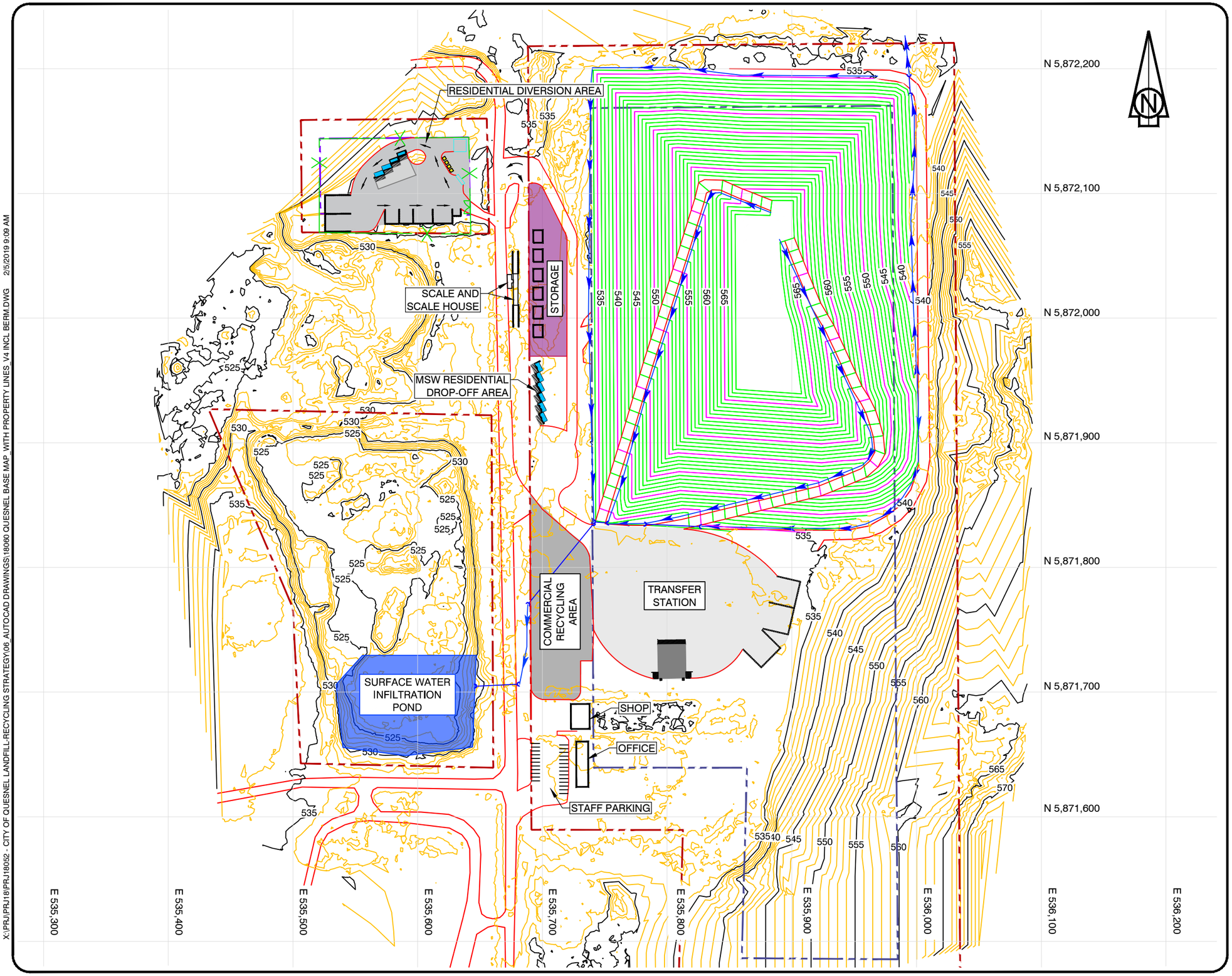
PROJECT:

QUESNEL LANDFILL
AND RECYCLING STRATEGY

TITLE:

EXISTING TOPOGRAPHY
SEPTEMBER 18, 2018

SCALE:	DATE:	PROJECT NO:
1:2000	2019/09/30 (yyyy/mm/dd)	PRJ 18052
DESIGNED	-	DRAWING NO:
DRAWN	MG	**FIGURE 1**
CHECKED	TS	



X:\PRJ\PRJ18\PRJ18052 - CITY OF QUESNEL LANDFILL-RECYCLING STRATEGY\06_AUTOCAD DRAWINGS\18060 QUESNEL BASE MAP_WITH PROPERTY LINES_V4 INCL BERM.DWG 2/5/2019 9:09 AM

SPERLING HANSEN ASSOCIATES

Landfill Services Group
- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 East Keith Road
North Vancouver, B.C. V7J 1J3

Phone: (604) 986-7723
Fax: (604) 986-7734

LEGEND:

- 5m EXISTING CONTOUR
- 1m EXISTING CONTOUR
- 5m DESIGN CONTOUR
- 1m DESIGN CONTOUR
- ROAD
- PROPERTY LINE
- 50m BUFFER
- 30m BUFFER
- 15m BUFFER

CLIENT: CITY OF QUESNEL

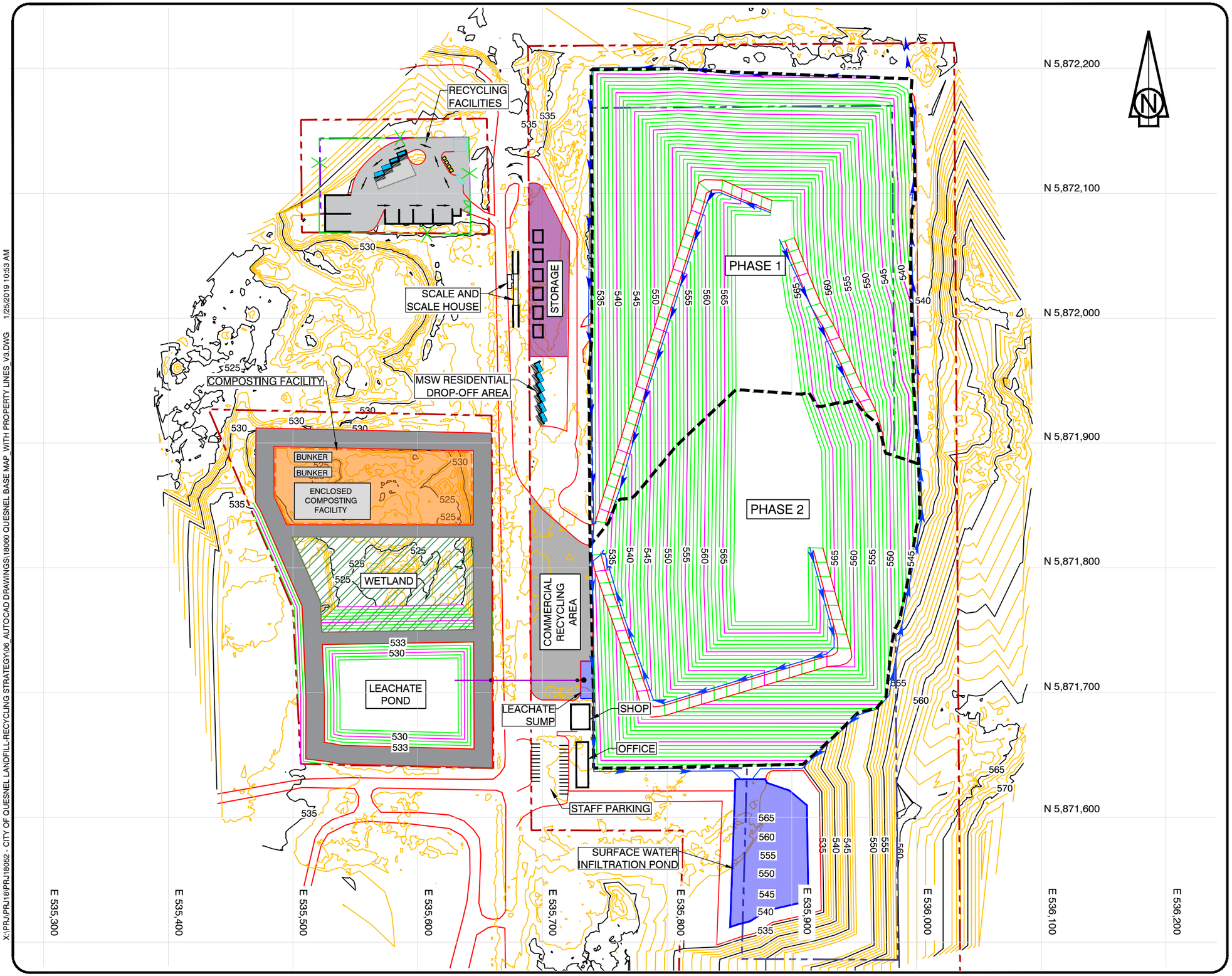
PROJECT:

QUESNEL LANDFILL
AND RECYCLING STRATEGY

TITLE:

OPTION 1 - FINAL CONTOURS OVER EXISTING LANDFILL FOOTPRINT

SCALE:	DATE:	PROJECT NO:
1:3000	2019/09/30 yyyy/mm/dd	PRJ 18052
DESIGNED	SG/TS	DRAWING NO:
DRAWN	MG	**FIGURE 2**
CHECKED	TS	



X:\PRJ\PRJ18\PRJ18052 - CITY OF QUESNEL LANDFILL-RECYCLING STRATEGY\06_AUTOCAD DRAWINGS\18060 QUESNEL BASE MAP_WITH PROPERTY LINES_V3.DWG 1/25/2019 10:53 AM

SPERLING HANSEN ASSOCIATES

Landfill Services Group
- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 East Keith Road
North Vancouver, B.C. V7J 1J3

Phone: (604) 986-7723
Fax: (604) 986-7734

LEGEND:

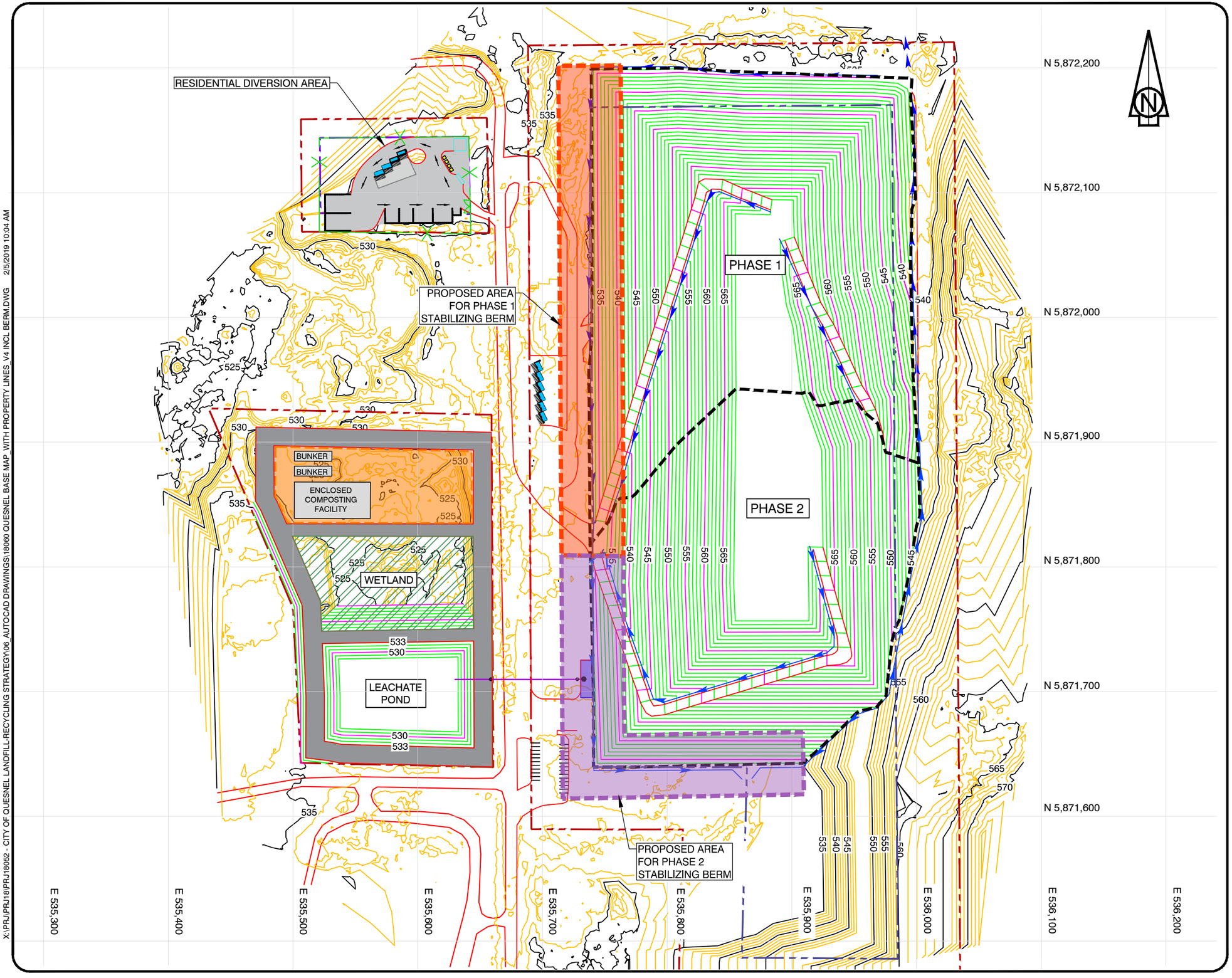
- 5m EXISTING CONTOUR
- 1m EXISTING CONTOUR
- 5m DESIGN CONTOUR
- 1m DESIGN CONTOUR
- ROAD
- PROPERTY LINE
- 50m BUFFER
- 30m BUFFER
- 15m BUFFER
- PHASE BOUNDARY

CLIENT: CITY OF QUESNEL

PROJECT: QUESNEL LANDFILL AND RECYCLING STRATEGY

TITLE: **OPTION 2 - FINAL CONTOURS INCLUDING PROPOSED PHASE 2 EXPANSION AREA**

SCALE:	DATE:	PROJECT NO:
1:3000	2019/09/30 yyyy/mm/dd	PRJ 18052
DESIGNED	SG	DRAWING NO:
DRAWN	MG	**FIGURE 3**
CHECKED	TS	



X:\PRJ\PRJ18\PRJ18052 - CITY OF QUESNEL LANDFILL-RECYCLING STRATEGY\06_AUTOCAD DRAWINGS\18060 QUESNEL BASE MAP_WITH PROPERTY LINES_V4 INCL BERM.DWG 2/5/2019 10:04 AM

SPERLING HANSEN ASSOCIATES

Landfill Services Group
- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 East Keith Road
North Vancouver, B.C. V7J 1J3

Phone: (604) 986-7723
Fax: (604) 986-7734

LEGEND:
- 5m EXISTING CONTOUR
- 1m EXISTING CONTOUR
- 5m DESIGN CONTOUR
- 1m DESIGN CONTOUR
- ROAD
- PROPERTY LINE
- 50m BUFFER
- 30m BUFFER
- 15m BUFFER
- PHASE BOUNDARY

CLIENT: CITY OF QUESNEL

PROJECT:
QUESNEL LANDFILL
AND RECYCLING STRATEGY

TITLE:
OPTION 2 - FINAL CONTOURS INCLUDING PROPOSED PHASE 2 EXPANSION AREA INCLUDING STABILIZING BERM LAYOUT

SCALE:	DATE:	PROJECT NO:
1:3000	2019/09/30 yyyy/mm/dd	PRJ 18052
DESIGNED	SG	DRAWING NO:
DRAWN	MG	**FIGURE 4**
CHECKED	TS	