Organic Management Consultant Task 2 – Feasibility Assessment



PRESENTED TO

Regional District of Okanagan-Similkameen

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EXECUTIVE SUMMARY

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by the Regional District of Okanagan-Similkameen (RDOS) to assess the feasibility of developing organics processing facilities at eight (8) publicly owned properties.

The RDOS is exploring options to enhance its organics collection and processing capabilities. This includes embarking on a multi-year project to develop an ‘apples to apples’ comparison between publically and privately owned composting facilities.

This report builds on *Organic Management Consultant Task 1 – Site Assessment* which involved a review and compilation of information about each site, amount of organics each site could receive from its service area and proximity to sensitive receptors. The objective of this report is to examine organic processing technologies, and present conceptual designs and cost estimates for each of the eight (8) sites based on the amount of organics that could come from their respective service area and from multiple service areas (i.e. regional organics processing facilities).

An organics processing technology review was conducted to select technologies to consider for each site. Four options were selected: 1) aerated static pile, 2) membrane covered aerated static pile, 3) in-vessel composting, and 4) anaerobic digestion. Conceptual designs based on these technologies were prepared for each site, using design capacity estimates based on projected quantities of organics feedstock over a 20 year period. Conceptual layouts were presented to show how the components of the various technologies could fit at each site. For two sites, windrow composting was also considered and the feasibility assessment was adapted to identify important considerations in the event residential food waste was processed using their current approach.

For each design scenario, capital and operating cost estimates were calculated and presented as a unit processing cost (cost per tonne). The cost per tonne ranged from $52 to $320. Although the conceptual designs show that it would be possible to develop organics processing facilities at each site, the unit processing cost was determined to be more ecomonical for facilities with higher processing capacities.

The unit processing costs were compared with the processing rate from the respective design scenario. As shown in the following figure, regional or centralized organics processing facilities that process feedstock from multiple service areas have economies of scale that make their processing cost more feasible. Adapting smaller windrow composting operations to receive food waste can also be a viable option for sites such as Osoyoos and Oliver where compost demand is high but run a risk of greater potential for odour impacts.

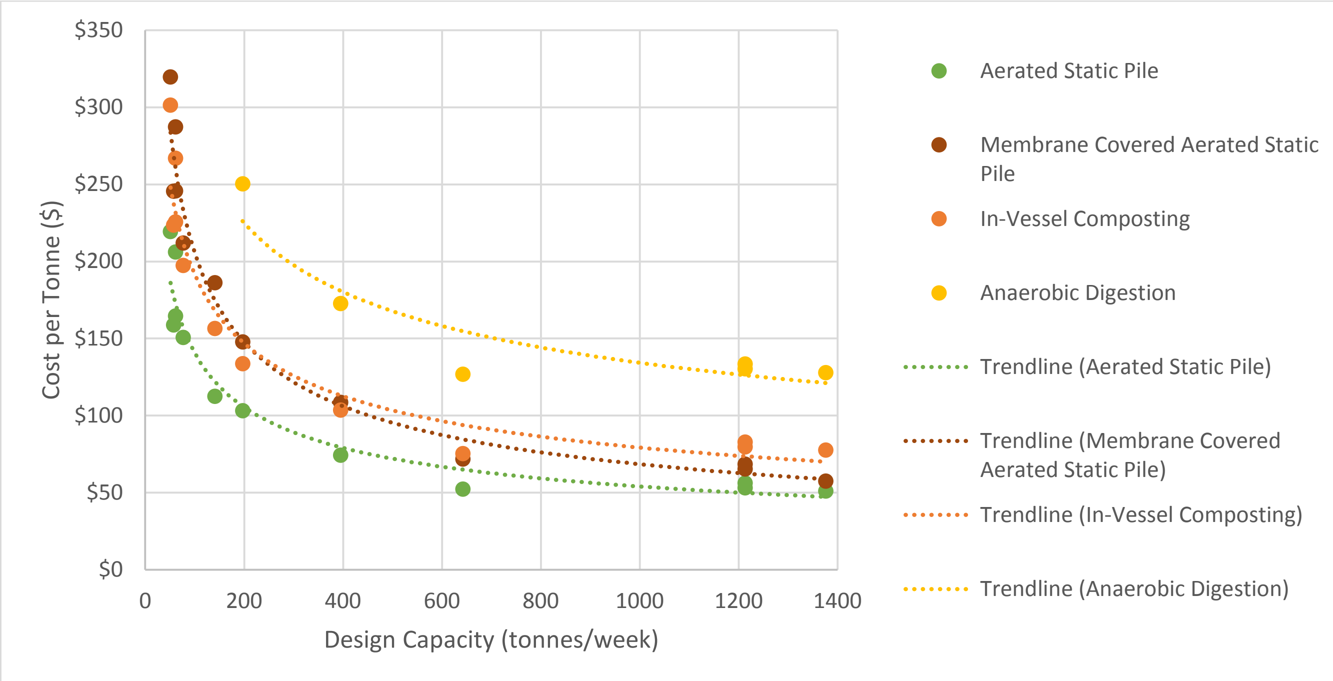


Figure A: Cost per Tonne versus Design Capacity

TABLE OF CONTENTS

LIST OF TABLES IN TEXT

LIST OF FIGURES IN TEXT

LIST OF PHOTOS IN TEXT

APPENDIX SECTIONS

APPENDICES

KEY TERMS, ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
BC	British Columbia
Green Waste	Leaf and Yard Waste
Ha	Hectare
MSW	Municipal Solid Waste
RDOS	Regional District of Okanagan-Similkameen
SWM	Solid Waste Management
Tetra Tech EBA	Tetra Tech EBA Inc.

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Regional District of Okanagan – Similkameen and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Regional District of Okanagan – Similkameen, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

The preparation of this feasibility study was carried out with assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

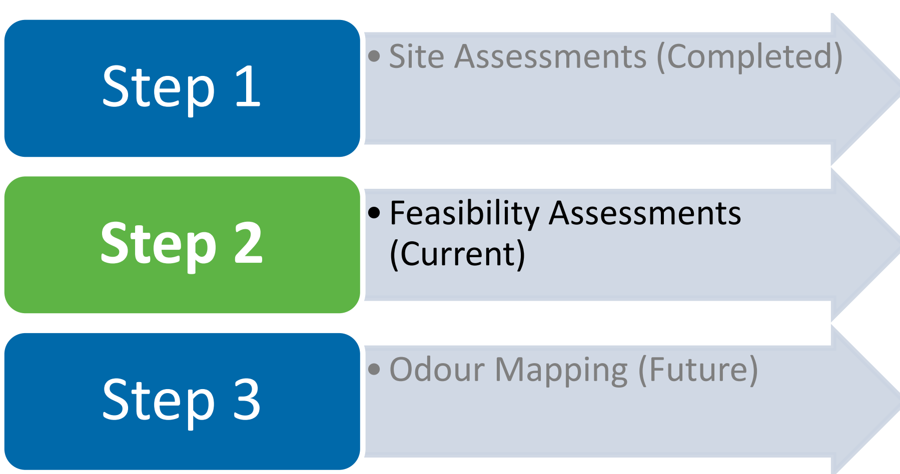
1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by the Regional District of Okanagan-Similkameen (RDOS) to assess the feasibility of locating organic management facilities at eight (8) publicly owned properties. Tetra Tech EBA has prepared this report with input from Impact Bioenergy.

The RDOS is exploring options to enhance its organics management capabilities. Organic waste refers to the biodegradable materials in the waste stream that are easy to break down by microorganisms. Organic waste generally includes food waste, leaf and yard waste (green waste), white wood, compostable paper, biosolids, agricultural waste, and slaughterhouse waste.

In 2010, the RDOS completed a Regional Organics Waste Management Strategy which looked at potential organics management options and their associated costs. In the same year, the RDOS began updating its Solid Waste Management (SWM) Plan which included calls for upgrading biosolids and yard waste composting practices and considering banning organic waste (including food waste) from landfill disposal. The RDOS embarked on a multi-year project to develop an 'apples to apples' comparison between publically and privately operated compost facilities.

The feasibility study is being undertaken as a three (3) step process. Step 1 consisted of site assessments for nine (9) publically owned sites. During Step 1, Site Assessments – relevant information was collected, reviewed, and on each of the sites to help the RDOS with selecting sites that would be considered for Step 2 – Feasibility Assessments. Eight (8) sites were selected for feasibility assessments. The scope of the feasibility assessments included conceptual designs and comparisons of capital and operating costs between the types of organics processing technology options. The results from Step 2 will be used for Step 3 – Odour Mapping.



2.0 SELECTED SITES

Eight (8) of the nine (9) sites from the site assessment phase were selected for feasibility assessments. Rationale for site selection is presented in the following table. Additional information about each site can be found in the report *Organic Management Consultant Task 1 – Site Assessment*.

Table 1: Rationale for Sites

Site	Feasibility Assessment	Rationale
Campbell Mountain Landfill	Yes	▪ Currently has an aerated static pile biosolids composting facility ▪ Central location
Summerland Landfill	Yes	▪ Large amount of undeveloped land ▪ Central location
Okanagan Falls Landfill	Yes	▪ Large amount of wood waste that can be composted
Oliver Landfill	Yes	▪ Has undeveloped land within landfill property ▪ Good market for compost sales
Osoyoos Landfill	Yes	▪ Area for current composting facility has space for expansion ▪ Good market for compost sales
Princeton Landfill	Yes	▪ Has undeveloped land adjacent to the north owned by RDOS ▪ Source of clean wood waste from nearby mill
Princeton Hayfield Site	Yes	▪ Large amount of undeveloped land ▪ Close proximity to electricity and road ▪ Source of clean wood waste from nearby mill
Keremeos Transfer Station	Yes	▪ Some land available on closed landfill ▪ Good market for compost sales
Keremeos Greenfield Site	No	▪ Long distance from population centres ▪ Environmentally sensitive habitat ▪ Within Agricultural Land Reserve and Watercourse Development Permit Areas ▪ May have slope stability concerns

3.0 CONCEPTUAL DESIGN

General information about conceptual design of organics processing facilities is presented below. Conceptual designs for each site, layouts, and site-specific considerations are included as part of each site's feasibility assessment in Appendix B.

3.1 Feedstock and Design Capacity

The following is a summary of the feedstock and design capacity for each site and regional facility scenario. The regional facility scenarios are defined as follows:

- Campbell Mountain: Accepting organics from the Campbell Mountain, Summerland, Oliver, and Osoyoos service areas
- Summerland: Accepting organics from the Campbell Mountain, Summerland, Oliver, and Osoyoos service areas
- Summerland with RDCO Biosolids: Accepting organics from the Campbell Mountain, Summerland, Oliver, and Osoyoos service areas as well as biosolids from the Regional District of Central-Okanagan (RDCO)
- Oliver: Accepting organics from the Oliver and Osoyoos service areas as well as manure and wood chips from an adjacent feedlot
- Osoyoos Windrow: Accepting curbside residential food waste in addition to currently composted organics at the site

Feedstock quantities were based on 2013 or 2014 scale tonnages (where available), otherwise estimates were made based on material volumes or the *Regional Organic Waste Management Strategy*. A 20-year forecast was then applied to account for population growth, which was assumed to be 1.1% per year (BC Stats, 2011). The design capacity was calculated based on the peak month percentage of municipal solid waste (MSW) at each facility for all sites except for Okanagan Falls and Princeton (e.g., at Campbell Mountain the peak month was July, which accounted for 10% of the annual MSW). This was based on the assumption that each facility would be designed for peak food waste quantities, as that is the most putrescible stream of organics and is currently in the MSW stream. For Princeton, which did not have scale data, the peak month percentage was assumed to be the same as Keremeos. For Okanagan Falls, since food waste is not accepted, the peak organics percentage was assumed.

Table 2: Feedstock and Design Capacity by Site

Site	Design Capacity (tonnes/ week)[1]	% of Total			Quantity (tonnes/yr)			Total (tonnes/ yr)[2]
		Green and Wood Waste	Biosolids /Manure	Food Waste and Compostable Paper	Green and Wood Waste	Biosolids/ Manure	Food Waste and Compostable Paper	
Individual Sites								
Campbell Mountain Landfill	642	51	23	26	14,551	6,501	7,596	28,648
Summerland Landfill	197	63	18	19	4,853	1,386	1,480	7,719
Okanagan Falls Landfill	51	93	7	0	1,463	112	0	1,575
Oliver Landfill	141	50	0	50	2,486	0	2,473	4,959
Osoyoos Landfill	77	52	0	48	1,409	0	1,324	2,733
Princeton Landfill/ Princeton Hayfield	61	60	0	40	1,263	0	852	2,114
Keremeos Transfer Station	57	50	6	44	997	112	884	1,993
Regional Facilities								
Campbell Mountain	1,213	55	17	28	25,635	7,887	12,873	46,395
Summerland	1,213	55	17	28	25,635	7,887	12,873	46,395
Summerland with RDCO Biosolids	1,376	49	27	24	25,635	14,110	12,873	52,618
Oliver	395	50	23	27	7,006	3,111	3,797	13,915
Osoyoos Windrow	34	78	0	22	1,036	0	291	1,327

[1] Based on 20 year peak month tonnages.
[2] Estimated annual tonnage in 20 years.

3.2 Receiving Area

The receiving area is where source separated organics are dropped off, ground to a uniform size (if needed), and mixed in the appropriate ratio for processing. This area was sized assuming a feedstock density of 350 kg/m^3 and pile height of 3 m, so there would be capacity to store up to a week's worth of feedstock during peak periods (in 20 years). However, the best management practice would be to clear materials from the receiving area each day to minimize potential for odour. The base of the receiving area is a concrete pad with 2% grade (to direct leachate run-off to a sump).

For Campbell Mountain, Summerland, Oliver, and Osoyoos, it was assumed that the area is covered by a dome-shaped fabric building on top of concrete blocks to provide weather protection and snow shedding in the winter as well as odour control. One end wall is constructed with concrete blocks to allow for piles of materials to be pushed against it. The other end is a concrete block wall with an opening for a roll-up fabric door. This would be where trucks would drop-off materials. The building is equipped with a ventilation system connected to a biofilter for odour control.

For Okanagan Falls, Princeton (Landfill and Hayfield), and Keremeos, it was assumed that the receiving area is uncovered.

For the Osoyoos Windrow scenario, it was assumed that the receiving area has a partially enclosed structure with bunkers for mixing the feedstock.

3.3 Organics Processing

Five (5) organics processing technologies were considered for feasibility assessments. Descriptions of each option are presented below. The first three options were included in the feasibility assessments of all sites. The fourth option (anaerobic digestion) was only considered for Campbell Mountain and Summerland as they are the two sites with the largest quantity of feedstock. The feedstock quantity at other sites was considered to be too low to consider anaerobic digestion as an option. The fifth option (windrow composting) was only considered for Osoyoos for the scenario where residential curbside food waste is added to the current composting operation. A brief discussion about the feasibility of windrow composting in Oliver was also included in the Oliver Regional Facility report.

3.3.1 Organics Processing Option 1: Aerated Static Pile

Photo 3.1: Aerated Static Pile

The composting area is built on a concrete pad with a 2% grade to allow for leachate collection. The residence time for this type of system is 35 days. Each pile is equipped with a trench style concrete aeration floor, connected to a blower and control system. Each trench consists of a perforated stainless steel cover and HDPE pipe installed below-grade. The control system tracks operating conditions to determine aeration rates (including whether it should be positive or negative air flow). Condensate and leachate are collected in the trench. Odour is managed with a simple biofilter with a wood chip based medium.

3.3.2 Organics Processing Option 2: Membrane Covered Aerated Static Pile

Photo 3.2: Membrane Covered Aerated Static Pile

The composting area is built on a concrete pad with a 2% grade to allow for leachate collection. The residence time for this type of system is 56 days. The design of the aeration system is similar to that of Option 1, using a trench style concrete aeration floor. However, the system only operates with positive aeration. The piles are covered with a breathable membrane, sealed along the edges to create a fully-enclosed system. This membrane allows for the management and retention of moisture, temperature, and odour. The control system measures oxygen in addition to temperature to control the rate of aeration. The composting process consists of three phases, including curing, so this system does not require a separate curing area.

- **Phase 1**: A heap is built and covered with a membrane for 28 days of high rate active composting
- **Phase 2**: The heap is moved from the Phase 1 to Phase 2 area, then covered again with a membrane for two weeks of maturation curing composting
- **Phase 3**: The heap is moved from the Phase 2 to Phase 3 area, then left uncovered and aerated for two weeks of finishing

3.3.3 Organics Processing Option 3: In-Vessel Composting

Photo 3.3: In-Vessel Composting

The in-vessel composting process is similar to an aerated static pile in the fact that the piles are aerated continuously with a combination of positive and negative air flow. The difference is that these piles are contained in rigid structures. The vessels are made of concrete, with gasketed and insulated stainless steel doors. The residence time for this type of system is 28 days. The vessel is equipped with an aeration floor and condensate/leachate collection system. The control system tracks operating conditions to determine aeration rates. Odour is managed with a biofilter (with a wood chip based medium) or wet scrubber and biofilter.

3.3.4 Organics Processing Option 4: Anaerobic Digestion

Photo 3.4: Anaerobic Digestion

This system uses dry (high-solids) anaerobic digestion for the initial processing of organics, followed by in-vessel composting. The anaerobic digestion phase has a residence time of 21-28 days. The tunnels are made of concrete with a separate or sub-grade percolate tank and in-floor blower system. The anaerobic digestion process is as follows:

- **Aeration**: Air is supplied into the tunnel to bring material to process temperatures under aerobic conditions before anaerobic conditions are created, typically in 12 hours
- **Percolate Cycle**: After conditions become anaerobic, percolate (conditioned process water with micro-organisms) is sprayed onto the material, allowing the material to decompose and produce biogas for 20-28 days; the percolate is treated and recycled in a closed-loop system
- **Biogas System**: Biogas is collected and used for a combined heat and power (CHP) system to provide electricity and heat to the anaerobic digestion system; excess electricity can be sold to the grid. Another option is to convert the unused biogas to compressed natural gas (CNG) which could be used to fuel vehicles
- **Exhaust Air**: The percolate cycle is stopped and air is circulated in the tunnel; exhaust gas is collected, combusted, and put through a biofilter

Following anaerobic digestion, the digestate is composted in aerated static piles, as described in Section 3.3.

3.3.5 Organics Processing Option 5: Windrow Composting

Photo 3.5: Windrow

Windrow composting consists of placing the mixture of raw materials into long narrow piles, or windrows, which are agitated or turned on a regular basis. Typically, these windrows are one metre high for dense or tightly packed materials like manures, and three to five metres high for porous or less dense materials like leaves and branches. In cold weather conditions, windrows should have a wider cross-section area and taller height to reduce heat loss. The equipment used for turning these windrows determines the size, shape, and spacing of the windrows. Front-end bucket loaders or telescopic handlers with a long reach can build high windrows, while turning machines tend to produce low and wide windrows.

Windrows aerate primarily by natural or passive air movement (convection and gaseous diffusion). The rate of air exchange depends on the porosity of the windrow. Turning the rows mixes the materials, rebuilds the porosity of the windrow, and releases trapped heat, water vapour and gases. This type of compost technology is best suited to composting clean yard, garden and green waste in combination with wood waste. Most of the landfills in the RDOS currently employ this form of composting.

3.4 Curing

For static curing, the area is built on a geomembrane-lined pad with a 2% grade to allow for drainage. It was assumed that between the composting and curing stages, there would be 25% volume reduction for aerated static pile, in-vessel composting, anaerobic digestion (to primary curing).

For membrane covered aerated static pile, the curing process is incorporated into the composting process, so a separate curing area is not required. For anaerobic digestion, aerated static pile composting is used for primary curing adjacent to the digesters. Secondary curing takes place by the screening/storage area. Between primary and secondary curing for anaerobic digestion, a 20% volume reduction was assumed.

3.5 Storage/Screening Area

Adjacent to the curing area is space for a screener to screen the finished compost product and storage of finished compost. Like the curing area, the area is built on a geomembrane-lined pad with a 2% grade to allow for drainage. Overs (organic material that has not decomposed completely and gets screen out) is returned to the receiving area.

4.0 COST ESTIMATES

General information about capital and operating costs of organics processing facilities is presented below. Cost estimates for each site and site-specific considerations are included as part of each site's feasibility assessment in Appendix B. Cost estimate assumptions and unit rates are included in Appendix C.

Capital, annual operating, and cost per tonne for each site are presented in the following tables for the organics processing technologies considered. Note that a full cost analysis was not conducted for the windrow composting scenarios, but the average industry cost per tonne range for a windrow facility with food waste composting is included as a comparison.

Capital costs were generally lower for aerated static pile composting. Membrane covered aerated static pile and in-vessel composting capital costs were relatively close in price, with in-vessel composting being slightly lower for all sites except for Campbell Mountain Landfill and the larger regional facility scenarios. Anaerobic digestion has the highest capital cost. Operating costs across the different technologies followed a similar trend to capital costs. However, the difference in operating costs was generally not as large.

Note that the regional facilities at Campbell Mountain and Summerland have the same design capacities, but vary in capital and operating costs. Campbell Mountain has higher capital costs due to the need to relocate Spiller Road such that land that is currently outside of the landfill footprint can be used for a facility. Summerland has higher operating costs because it was assumed that the facility would have its own entrance separate from the landfill entrance and would therefore require additional staff to attend the scale.

Table 3: Capital Costs

Site	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Individual Sites				
Campbell Mountain Landfill	$7,825,406	$11,010,088	$12,813,371	$24,610,159
Summerland Landfill	$3,626,111	$5,832,470	$5,441,690	$12,422,622
Okanagan Falls Landfill	$1,635,554	$2,618,685	$2,590,573	N/A
Oliver Landfill	$2,237,613	$4,250,507	$3,415,136	N/A
Osoyoos Landfill	$1,871,890	$2,871,683	$2,810,337	N/A
Princeton Landfill	$1,612,558	$2,693,267	$2,561,266	N/A
Princeton Hayfield	$1,612,626	$2,693,334	$2,561,334	N/A
Keremeos Transfer Station	$1,500,857	$2,585,658	$2,451,991	N/A
Regional Facilities				
Campbell Mountain	$16,499,867	$19,038,968	$25,859,664	$44,855,148
Summerland	$13,410,322	$15,949,423	$22,770,119	$41,765,603
Summerland with RDCO Biosolids	$14,716,750	$15,484,793	$25,343,651	$46,679,751
Oliver	$5,808,609	$8,766,140	$8,905,491	$16,560,129

Table 4: Annual Operating Costs

Site	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Individual Sites				
Campbell Mountain Landfill	$814,185	$1,095,732	$1,039,171	$1,486,058
Summerland Landfill	$479,965	$632,356	$558,167	$848,349
Okanagan Falls Landfill	$202,769	$275,064	$248,916	N/A
Oliver Landfill	$362,504	$552,697	$478,538	N/A
Osoyoos Landfill	$248,247	$328,737	$294,395	N/A
Princeton Landfill	$207,415	$284,832	$253,563	N/A
Princeton Hayfield	$294,775	$372,192	$340,923	N/A
Keremeos Transfer Station	$185,706	$263,925	$231,854	N/A
Regional Facilities				
Campbell Mountain	$1,170,296	$1,517,263	$1,591,249	$2,286,537
Summerland	$1,293,767	$1,640,734	$1,714,719	$2,410,007
Summerland with RDCO Biosolids	$1,400,938	$1,683,365	$1,878,457	$2,657,959
Oliver	$526,781	$747,892	$665,865	$960,788

The cost per tonne of material processed was calculated by amortizing the capital cost over 20 years and adding the operating cost, then dividing the total by the annual feedstock tonnage. The general trend across the different processing technologies for cost per tonne is similar to that of capital and operating costs (i.e., lowest for aerated static pile, highest for anaerobic digestion). The average industry cost per tonne range for windrow facilities that compost food waste is included for comparison.

At the Summerland Landfill, the option of using the landfill scale instead of building a separate scale at the Princeton-Summerland Road was considered for potential cost savings. The cost for the scale house ($50,000) can be removed from capital costs and the avoided operational costs for a scale attendant is approximately $110,000 per year. This reduction in costs by using the existing scale is equivalent to an $18/tonne savings for the Summerland individual site and $2/tonne for the regional sites. This model assumed that trucks would check in at the Summerland Landfill scale, then drive on the paved Summerland/Princeton Road to the compost facility entrance.

Table 5: Cost per Tonne

Site	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion	Windrow Composting
Individual Sites					
Campbell Mountain Landfill	$52	$72	$75	$127	N/A
Summerland Landfill	$103	$148	$134	$250	N/A
Okanagan Falls Landfill	$219	$320	$301	N/A	N/A
Oliver Landfill	$112	$186	$157	N/A	N/A
Osoyoos Landfill	$151	$212	$197	N/A	N/A
Princeton Landfill	$165	$246	$226	N/A	N/A
Princeton Hayfield	$206	$287	$267	N/A	N/A
Keremeos Transfer Station	$159	$246	$224	N/A	N/A
Regional Facilities					
Campbell Mountain	$56	$68	$83	$134	N/A
Summerland	$53	$65	$80	$130	N/A
Summerland with RDCO Biosolids	$51	$58	$78	$128	N/A
Oliver	$74	$109	$104	$173	N/A
Osoyoos Windrow	N/A	N/A	N/A	N/A	$33 to $59

* Calculated based on annualized capital cost plus operating cost divided by annual feedstock tonnage in 20 years except for windrow composting. The windrow composting cost per tonne is a range of the industry average.

The following figure shows a comparison of the cost per tonne for each processing technology with design capacity for each site. The cost per tonne decreases with increasing size of a facility and generally follows a decreasing exponential trend. This means that the larger the facility, the more cost savings there would be due to economy of scale. It is worthwhile to consider regional organics processing facilities that can combine the feedstock from multiple sites. However, when a facility reaches a size greater than approximately 650 tonnes/week, the cost per tonne does not drop as dramatically and in some cases, increases with a larger size of facility. This is generally due to increased capital costs for construction, as once a facility reaches a certain size, pre-fabricated units are no longer sufficient in size. On-site assembly and construction is required, which generally costs more than transporting and installing pre-fabricated units. At a certain point, there is also a need for additional mobile equipment (e.g. another loader), which also increases capital and operating costs for maintenance.

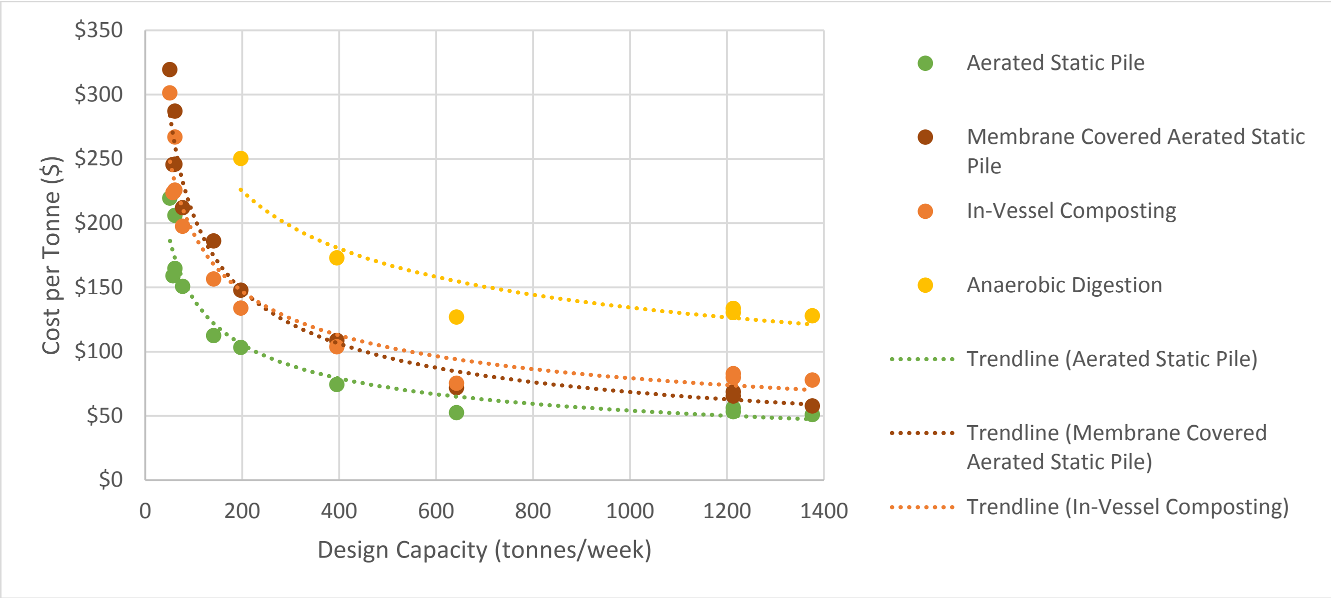


Figure 1: Cost per Tonne versus Design Capacity

5.0 CONCLUSION

Feasibility assessments were conducted for eight (8) sites identified by the RDOS for potential expansion of organics processing facilities for each service area as well as regional facilities. A review of organics processing technologies was conducted to select technologies to consider for each site. Design capacity estimates, conceptual designs, layouts, and cost estimates were made for each site.

Although it would be possible to develop organics processing facilities at each site, the cost per tonne is more favourable for facilities with a higher design capacity. Regional organics processing facilities that can combine the feedstock from multiple sites should be considered to take advantage of the efficiency and cost savings from a larger facility.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
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APPENDIX A

TETRA TECH EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEO-ENVIRONMENTAL REPORT

This report incorporates and is subject to these "General Conditions".

1.1 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of TETRA TECH's client. TETRA TECH does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than TETRA TECH's Client unless otherwise authorized in writing by TETRA TECH. Any unauthorized use of the report is at the sole risk of the user.

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1.3 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

1.4 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of the report, TETRA TECH may rely on information provided by persons other than the Client. While TETRA TECH endeavours to verify the accuracy of such information when instructed to do so by the Client, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B
FEASIBILITY ASSESSMENT REPORTS

Report 1	Campbell Mountain Landfill
Report 2	Summerland Landfill
Report 3	Okanagan Falls Landfill
Report 4	Oliver Landfill
Report 5	Osoyoos Landfill
Report 6	Princeton Landfill
Report 7	Princeton Hayfield
Report 8	Keremeos Transfer Station
Report 9	Campbell Mountain Regional
Report 10	Summerland Regional
Report 11	Summerland RDCO Biosolids
Report 12	Oliver Regional
Report 13	Osoyoos Windrow with SSO

CAMPBELL MOUNTAIN LANDFILL

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Campbell Mountain Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 5 km northeast of the City of Penticton, BC. It is an active landfill operated by the Regional District of Okanagan-Similkameen (RDOS) and biosolids composting facility operated by the City of Penticton.

2.1 Service Area

The Site's service area includes:

- City of Penticton
- Village of Keremeos
- Penticton Indian Band
- Lower Similkameen Indian Band
- Upper Similkameen Indian Band
- Electoral Area B, D, E, and G (including Cawston, Okanagan Falls, Kaleden, Apex Mountain, Naramata, Hedley, Olalla, and Rural Keremeos)
- Parts of Electoral Area F (including West Bench and Sage Mesa)

The total service population is 47,414, with 5,103 of this population within the Keremeos Transfer Station service area.

2.2 Accepted Materials at the Landfill

The Site accepts the following materials:

- Municipal solid waste (MSW)
- Construction and demolition (C&D) waste (diverted by preferential tipping fees to Okanagan Falls Landfill)
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- White wood (painted wood and dimensional lumber)
- Biosolids

Currently, the City of Penticton composts biosolids mixed with chipped green waste and white wood in aerated static piles (ASP) on the east side of the Site (Figure 1). This biosolids composting facility does not currently have capacity to process additional materials such as food waste and may have odour concerns at certain times of the year. There are plans to move this facility to the southern end of the property between the scale house/entrance and Spiller Road. The RDOS also composts green waste in static piles. Quantities of organics that are currently received and processed are summarized in Table 1.

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

Table 1: Organic Waste Processed at Campbell Mountain Landfill (2013)

Organic Material	Quantity (tonnes/yr)
Green Waste	6,473
Biosolids	5,224
White Wood	1,400 (7,000 m^3)[1]
Total Currently Processed	**13,096**

[1]Approximately 7,000 m^3 used for biosolids composting; the remainder is used on site for mud control or taken offsite.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area. It was assumed that the organics processing facility would share the landfill scale and office.

3.2 Proposed Location

The location of the organics processing facility is the proposed location for the new City of Penticton biosolids composting facility in the southern end of the property between the scale entrance and Spiller Road (Figure 3.1). Currently, this area is used for commercial wood waste storage. There is approximately 2.5 ha of available land in this area. It was assumed that this area would only be used for composting and curing as space is limited. Additional curing, screening of finished compost, and storage would take place at the current storage location where the RDOS compost to the west (Figure 1).

[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

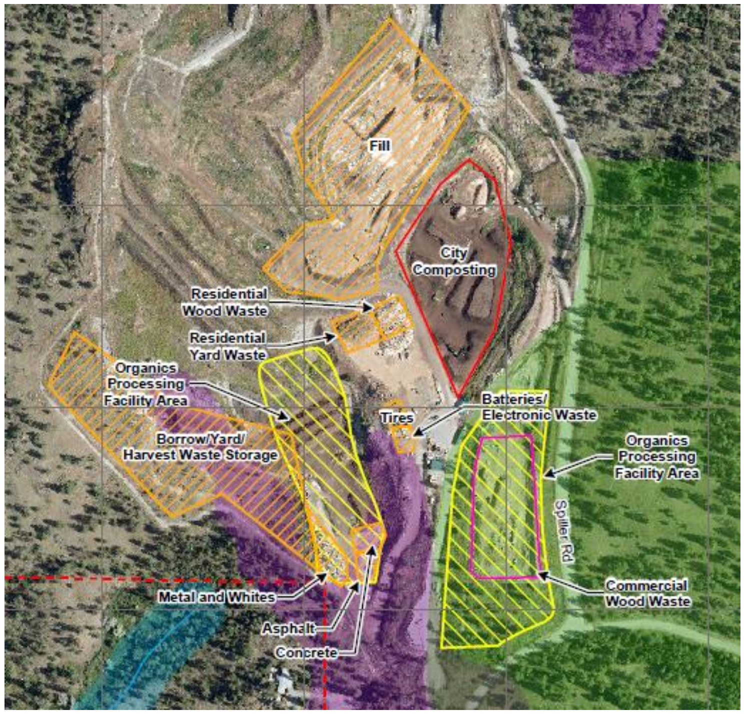


Figure 3.1: Proposed Location of Organics Processing Facility

Although there is undeveloped land within the property boundary to the east of Spiller Road (Figure 1), it is within direct line of site from passing residents, within the Agricultural Land Reserve (ALR), contains areas with steep slopes, and has potential environmentally sensitive habitats. Due to these barriers, this land was not considered for the feasibility study as the capital cost of developing the land and potentially relocating Spiller Road would be cost prohibitive.

3.2.1 On-Site Infrastructure and Mobile Equipment

The following infrastructure and mobile equipment are available on site and assumed could be used for the organics processing facility.

- Scale
- Loader
- Grinder
- Trommel screen

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[2]. The total amount of organics feedstock is 23,019 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of biosolids, green waste, and white wood, and projected quantities of food waste and compostable paper. Assuming a growth rate of 1.1%[3] over the next 20 years, the annual quantity of feedstock is calculated to be 28,648 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, the peak months were July and August. During each of those months, the waste collected accounts for approximately 10% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 642 tonnes/week.

The assumed feedstock composition is presented in Table 2 below. Generally the ratio of food waste/biosolids to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 2: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	14,551	51%
Biosolids	6,501	23%
Food Waste and Compostable Paper	7,596[2]	26%
Total	**28,648**	**100%**
Design Capacity (tonnes/week)	**642**	

[2] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

3.3.1 Compost Market Considerations

As biosolids are approximately one-quarter of the feedstock, it can be processed separately in its own piles or vessels. This would increase the marketability of the finished compost product, as biosolids-free compost would be more attractive to a wider range of customers, especially in the agriculture sector. Compost containing biosolids can be used for non-agricultural purposes, such as landfill cover, construction projects, turf for golf courses, and landscaping.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial

[2] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf
[3] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas of the RDOS that do not have infrastructure for processing food waste.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 5 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area is a dome-shaped fabric building on top of concrete blocks. The building is approximately 22 m by 48 m.

3.4.2 Organics Processing Technologies and Area

Table 3 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 3: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Currently used at City of Penticton biosolids composting facility ▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Technology is more suitable for larger facilities, and this site has potential to be a centralized facility for the RDOS
Anaerobic Digestion	▪ Improves odour and moisture control ▪ Opportunity for energy recovery ▪ Biosolids from City of Penticton are not currently digested, and may be digested with this technology ▪ Technology is more suitable for larger facilities, and this site has potential to be a centralized facility for the RDOS

Table 4 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 4: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Residence Time (days)	35	42	28	21
Number of Piles/Vessels	12	9	12	6
Pile/Vessel Dimensions	35.2 m x 8.0 m x 3.0 m	40.0 m x 8.0 m x 3.5 m	25.0 m x 9.0 m x 3.0 m	32.0 m x 5.5 m x 2.6 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 5 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 5: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting	Anaerobic Digestion (Primary)	Anaerobic Digestion (Secondary)
Residence Time (days)	35	14	42	28	21
Number of Piles	12	3	18	9	3
Pile Dimensions	27.2 m x 8.0 m x 3.0 m	40.0 m x 8.0 m x 3.5 m	25.0 m x 6.8 m x 3.0 m	31.8 m x 8.0 m x 3.0 m	28.6 m x 16.0 m x 3.0 m

[1]Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 6: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
General Site Grading and Preparation	$740,580	$687,593	$730,903	$718,310
Scale House	$0	$0	$0	$0
Leachate and Surface Water Management	$179,148	$177,819	$179,291	$177,899
Receiving Building	$493,636	$493,636	$493,636	$493,636
Organics Processing	$3,640,412	$6,165,204	$7,327,624	$16,148,763
Screening, Curing, and Storage	$576,154	$464,702	$593,265	$524,473
Equipment (Mobile)	$225,000	$225,000	$225,000	$225,000
Subtotal Capital (without mobile equipment)	$5,629,930	$7,988,954	$9,324,719	$18,063,081
Subtotal Capital (with mobile equipment)	$5,854,930	$8,213,954	$9,549,719	$18,288,081
Engineering (10% of non-mobile equipment capital)	$562,993	$798,895	$932,472	$1,806,308
Contingency (25% of non-mobile equipment capital)	$1,407,483	$1,997,239	$2,331,180	$4,515,770
Total Capital	**$7,825,406**	**$11,010,088**	**$12,813,371**	**$24,610,159**

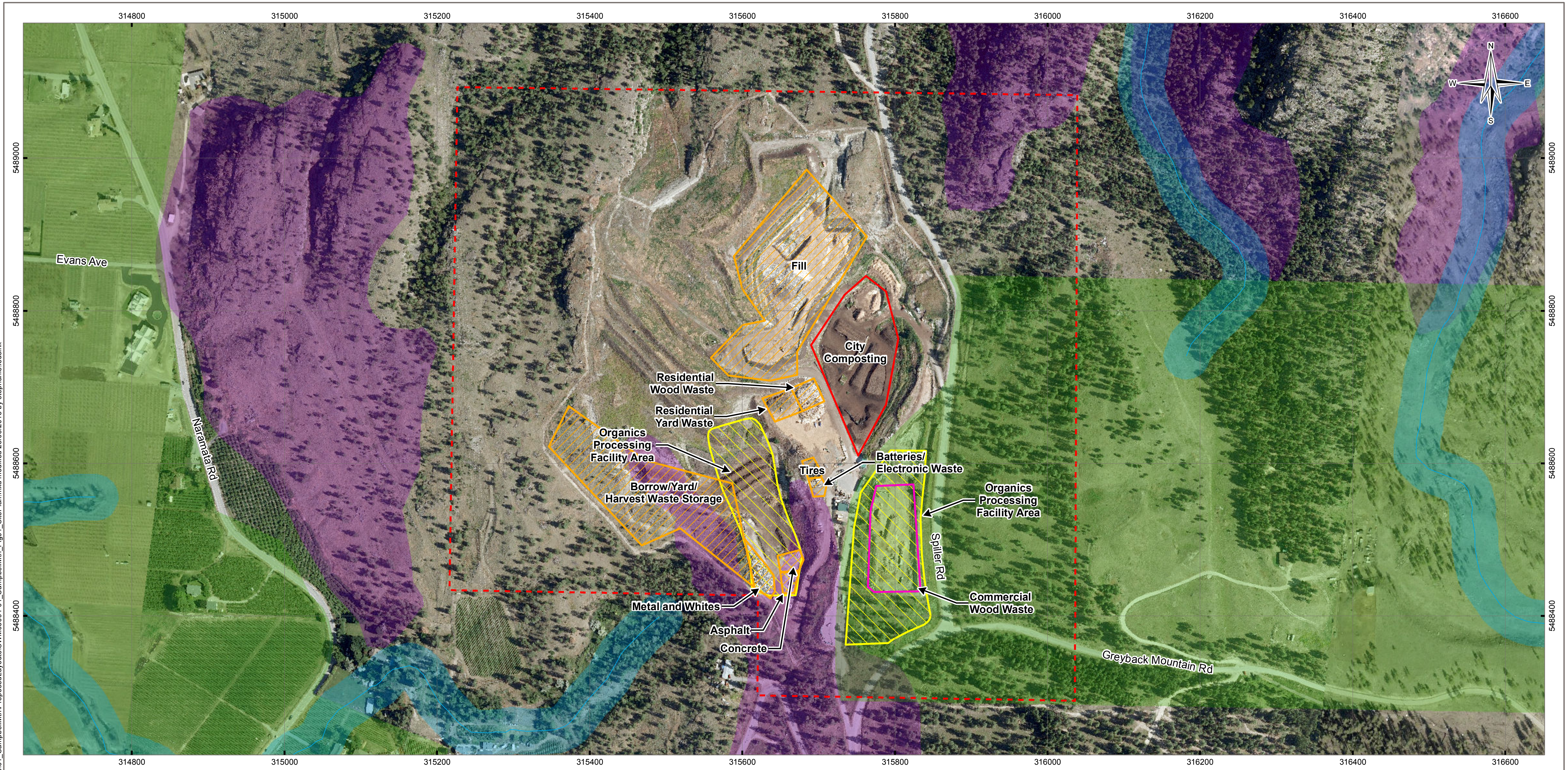
Table 7: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Electricity	$37,290	$26,647	$37,290	$32,856
Water	$1,471	$736	$736	$1,471
Diesel	$247,404	$268,576	$247,404	$280,071
Labour	$205,509	$216,856	$205,509	$223,018
Equipment Maintenance and Use	$236,343	$449,090	$423,831	$867,916
Bi-Product Revenue	-$48,059	-$48,059	-$48,059	-$165,479
Subtotal	**$679,958**	**$913,846**	**$866,711**	**$1,239,853**
Contingency (20%)	$135,992	$182,769	$173,342	$247,971
Total Operating	**$815,950**	**$1,096,615**	**$1,040,054**	**$1,487,824**

Table 8: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Annualized Capital (20 years)	$682,255	$959,910	$1,117,128	$2,145,626
Annual Operating	$815,950	$1,096,615	$1,040,054	$1,487,824
Annualized Total	$1,498,205	$2,056,525	$2,157,182	$3,633,450
Cost per Tonne	**$52**	**$72**	**$75**	**$127**

Attachments:
Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout
Figure 5: Anaerobic Digestion Site Layout



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LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Proposed Relocation of City of Penticton Composting
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR, Environmentally Sensitive Habitat and Watercourses provided by RDOS.
Imagery provided by RDOS (2014);
Google Earth Pro; City of Penticton (2004).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:5,000
100 50 0 100
Metres

FILE NO.
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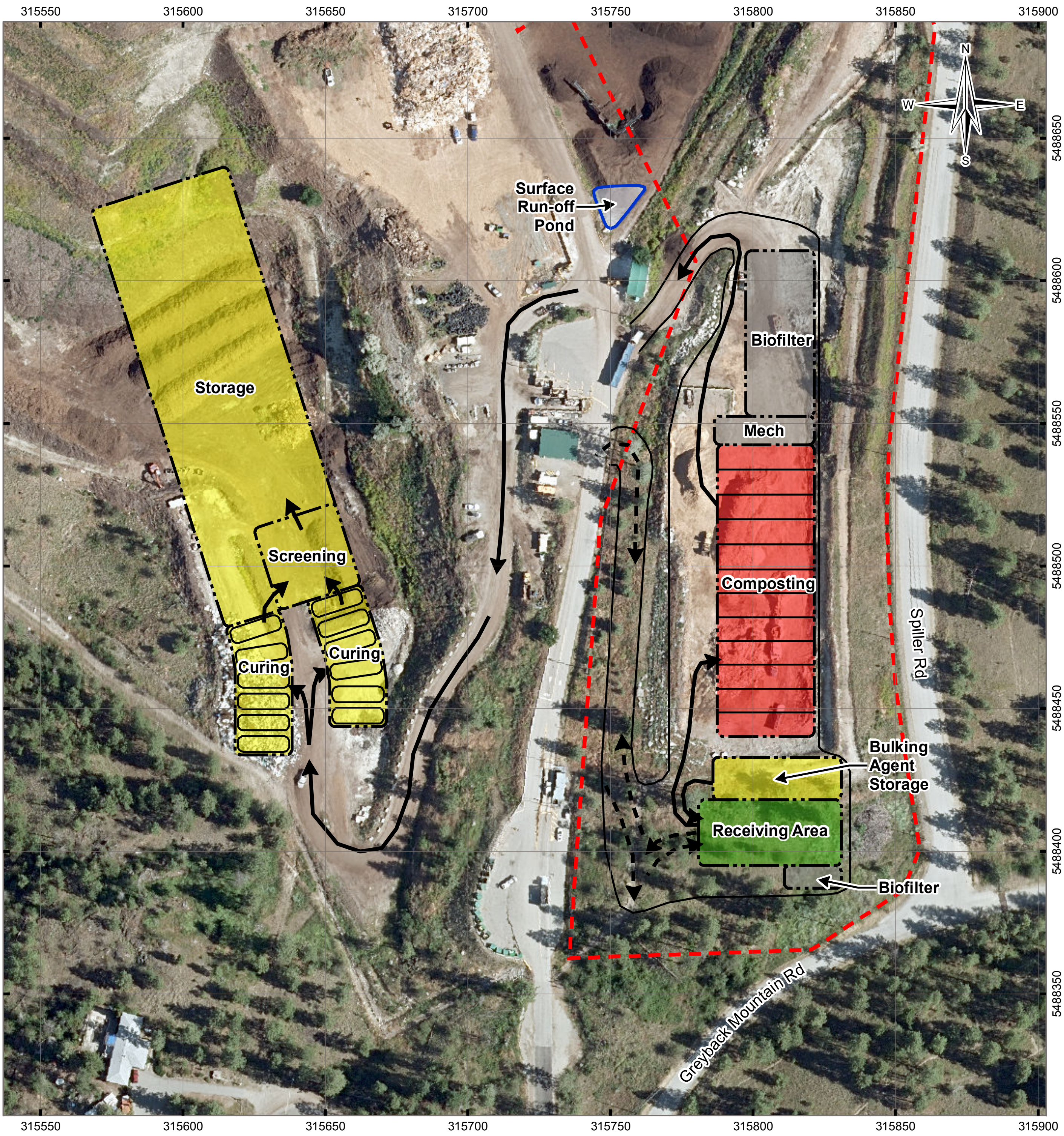
TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 28, 2015

Figure 1



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Surface Run-off Pond
- Composting Limit (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

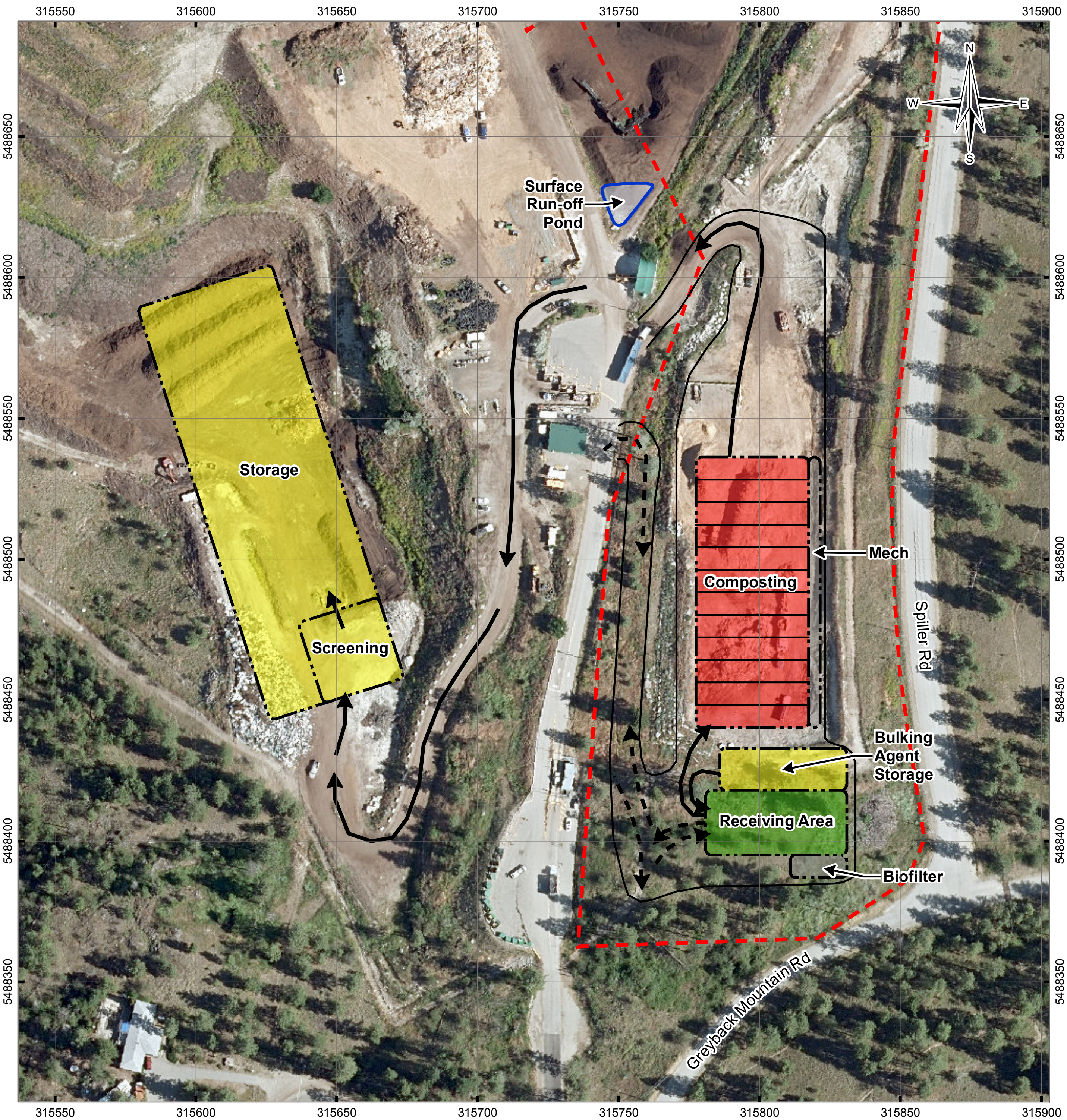
TETRA TECH EBA

FILE NO.
SWM03094-01_CampbellMtn_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 28, 2015

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Surface Run-off Pond
- Composting Limit (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

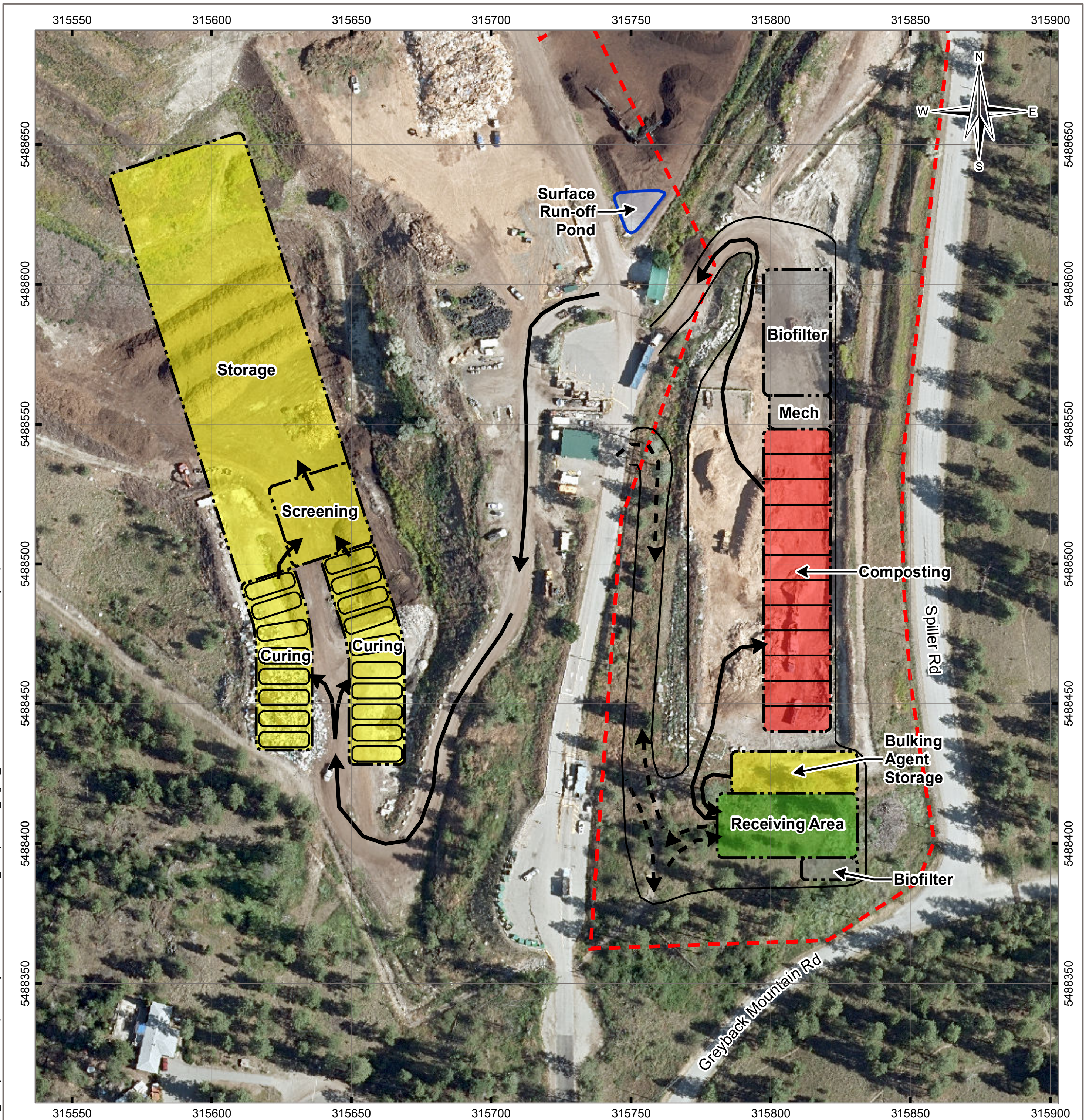
TETRA TECH EBA

FILE NO.
SWM03094-01_CampbellMtn_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 28, 2015

Figure 3



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Surface Run-off Pond
- Composting Limit (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

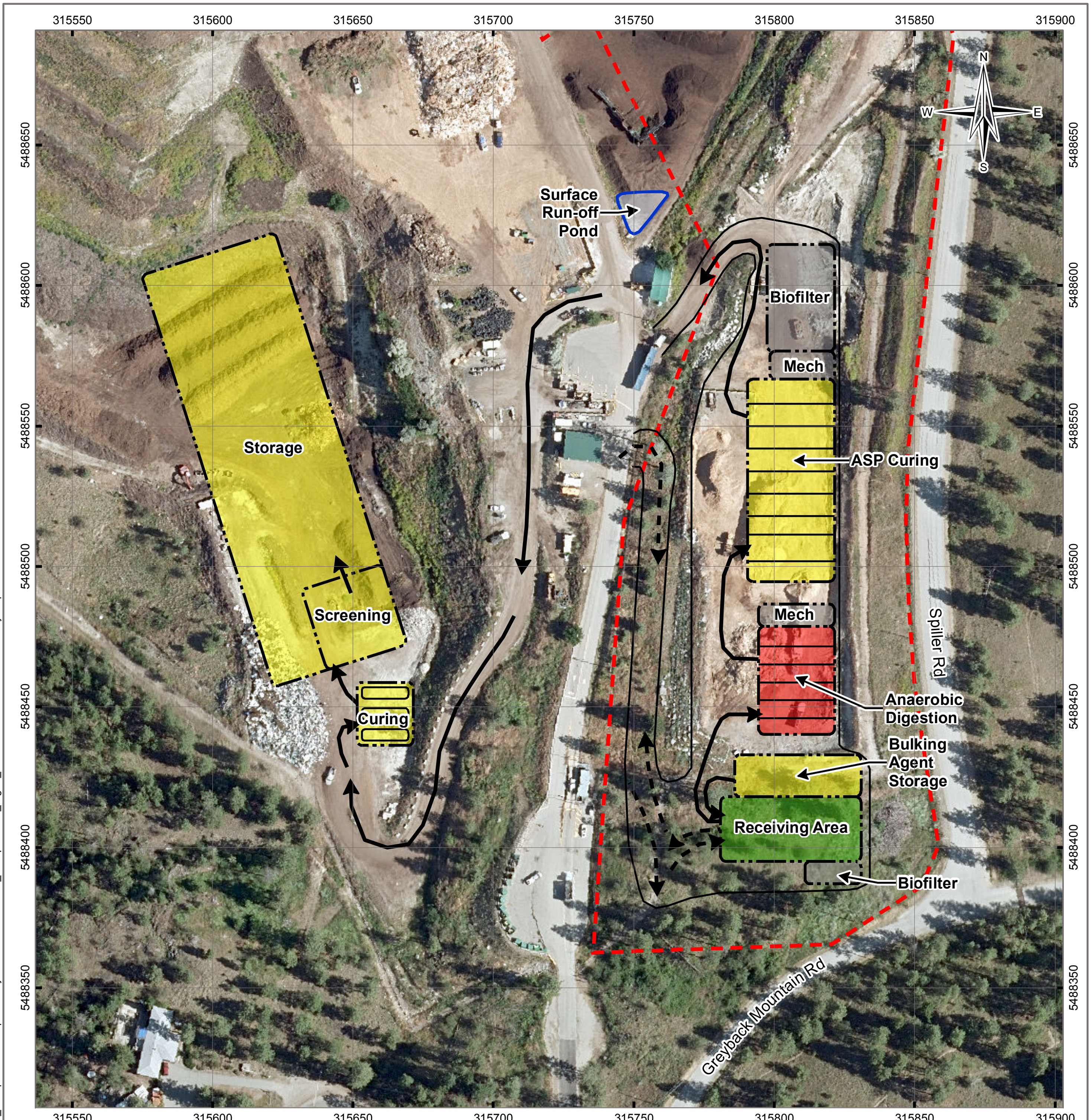
FILE NO.
SWM03094-01_CampbellMtn_Fig04_InVessel.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 28, 2015

Figure 4



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LEGEND

- Loader Movement
- Truck Movement
- Anaerobic Digestion
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Surface Run-off Pond
- Composting Limit (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Anaerobic Digestion Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_CampbellMtn_Fig05_AD.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 28, 2015

Figure 5

SUMMERLAND LANDFILL

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Summerland Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 4 km southwest of the Town of Summerland, BC. It is an active landfill operated by the District of Summerland.

2.1 Service Area

The Site's service area includes:

- District of Summerland
- Areas immediately to the west and north in Electoral Area F

The total service population is 12,579.

2.2 Accepted Materials at the Landfill

The Site accepts the following materials:

- Municipal solid waste (MSW)
- Construction and demolition (C&D) waste
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- White wood (painted wood and dimensional lumber)
- Biosolids

Currently, windrow composting is used to co-compost biosolids with green waste on the eastern side of the site, north of the scale house (Figure 1). This facility does not have capacity to process additional materials such as food waste using the current method of composting. Quantities of organics currently processed are summarized below in Table 1.

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

Table 1: Organic Waste Processed at Summerland Landfill (2013)

Organic Material	Quantity (tonnes/yr)
Green Waste	3,899
Biosolids	1,114
Total Currently Processed	**5,013**

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the proposed organics processing facility is northwest of the current landfill, south of the Princeton-Summerland Road (Figure 3.1). Currently, this is an undeveloped area owned by the District of Summerland. An organics processing facility would need approximately one hectare of land. It was assumed for the feasibility assessment that the organics processing facility would have its own entrance off Princeton-Summerland Road, and therefore its own scale. An alternative would be to share the scale with the landfill and construct a road between the landfill and organics processing facility.

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.1 On-Site Infrastructure and Mobile Equipment

As the land for the proposed organics processing facility is currently undeveloped, there is no infrastructure available at the Site. However, there is mobile equipment currently used for the windrow composting facility. The following mobile equipment are available on site and assumed could be used for the organics processing facility.

- Loader
- Trommel screen

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[2]. The total amount of organics feedstock is 6,202 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of biosolids and green waste, and projected quantities of food waste and compostable paper. Assuming a growth rate of 1.1%[3] over the next 20 years, the annual quantity of feedstock is calculated to be 7,719 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics could be received. Through reviewing monthly data for residential MSW collected in 2013, the peak months were July and August. During each of those months, the waste collected accounts for approximately 11% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 197 tonnes/week.

The assumed feedstock composition is presented in the table below. Generally the ratio of food waste/biosolids to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 2: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	4,853	63%
Biosolids	1,386	18%
Food Waste and Compostable Paper	1,480[1]	19%
Total	**7,719**	**100%**
Design Capacity (tonnes/week)	**197**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

[2] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[3] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

3.3.1 Compost Market Considerations

As biosolids are close to one-quarter of the feedstock, it can be processed separately in its own piles or vessels. This would increase the marketability of the finished compost product, as biosolids-free compost would be more attractive to a wider range of customers, especially in the agriculture sector. Compost containing biosolids can be used for non-agricultural purposes, such as landfill cover, construction projects, turf for golf courses, and landscaping.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas of the RDOS that do not have infrastructure for processing food waste.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 5 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area is a dome-shaped fabric building on top of concrete blocks. The building is approximately 20 m by 22 m.

3.4.2 Organics Processing Technologies and Area

Table 3 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 3: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Technology is more suitable for larger facilities, and this site has potential to be a centralized facility for the RDOS
Anaerobic Digestion	▪ Improves odour and moisture control ▪ Opportunity for energy recovery ▪ Biosolids from District of Summerland are not currently digested, and may be digested with this technology ▪ Technology is more suitable for larger facilities, and this site has potential to be a centralized facility for the RDOS

Table 4 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 4: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Residence Time (days)	35	42	28	21
Number of Piles/Vessels	6	6	4	8
Pile/Vessel Dimensions	21.6 m x 8.0 m x 3.0 m	25.0 m x 8.0 m x 3.5 m	23.0 m x 9.0 m x 3.0 m	15.0 m x 3.7 m x 2.6 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 5 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 5: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting	Anaerobic Digestion (Primary)	Anaerobic Digestion (Secondary)
Residence Time (days)	35	14	42	28	21
Number of Piles	6	2	6	3	1
Pile Dimensions	21.9 m x 6.3 m x 3.0 m	25.0 m x 8.0 m x 3.5 m	23.0 m x 6.8 m x 3.0 m	28.2 m x 8.0 m x 3.0 m	25.4 m x 16.0 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

If the Summerland Landfill scale is used instead of building a separate scale at the entrance on the Princeton-Summerland Road to the Site, the cost for the scale house ($50,000) can be removed from capital costs. By using the existing scale, the avoided operational costs for a scale attendant is approximately $110,000 per year. This reduction in costs by using the existing scale is equivalent to an $18/tonne savings. This model assumed that trucks would check in at the Summerland Landfill scale, then drive on the paved Summerland/Princeton Road to the compost facility entrance.

Table 6: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
General Site Grading and Preparation	$365,918	$331,585	$362,001	$359,301
Scale House	$50,000	$50,000	$50,000	$50,000
Leachate and Surface Water Management	$136,100	$136,178	$135,638	$137,084
Receiving Building	$285,099	$286,049	$286,049	$286,049
Organics Processing	$1,361,402	$3,064,762	$2,705,115	$7,899,086
Screening, Curing, and Storage	$172,675	$136,959	$177,265	$155,608
Equipment (Mobile)	$425,000	$425,000	$425,000	$425,000
Subtotal Capital (without mobile equipment)	$2,371,194	$4,005,533	$3,716,066	$8,887,128
Subtotal Capital (with mobile equipment)	$2,796,194	$4,430,533	$4,141,066	$9,312,128

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Engineering (10% of non-mobile equipment capital)	$237,119	$400,553	$371,607	$888,713
Contingency (25% of non-mobile equipment capital)	$592,798	$1,001,383	$929,017	$2,221,782
Total Capital	**$3,626,111**	**$5,832,470**	**$5,441,690**	**$12,422,622**

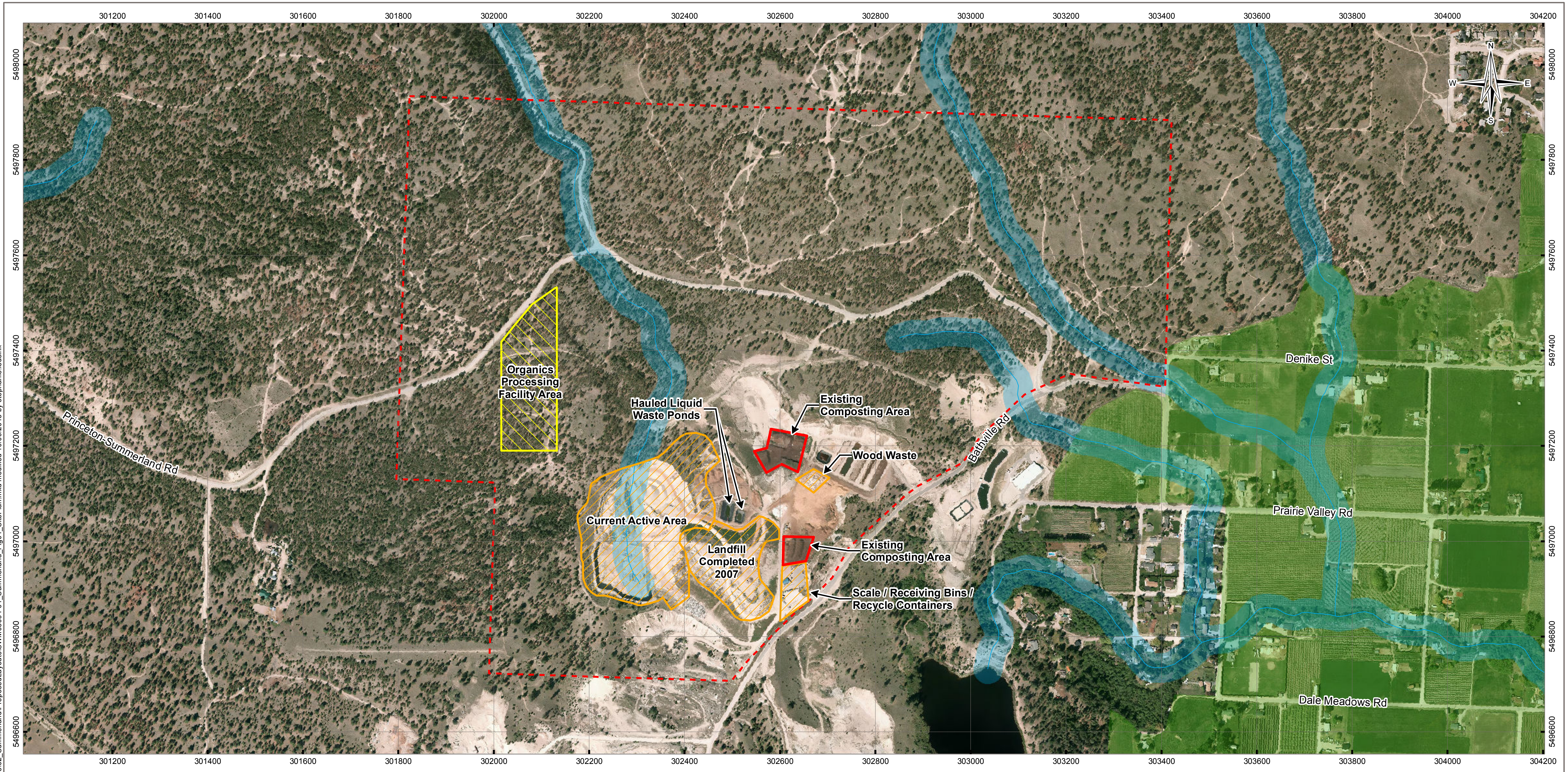
Table 7: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Electricity	$27,920	$23,781	$24,964	$23,486
Water	$874	$437	$437	$874
Diesel	$58,542	$65,383	$58,542	$68,110
Labour	$194,213	$197,880	$194,213	$199,341
Equipment Maintenance and Use	$135,580	$256,205	$203,705	$464,205
Bi-Product Revenue	-$16,726	-$16,726	-$16,726	-$48,625
Subtotal	**$400,404**	**$526,960**	**$465,136**	**$707,391**
Contingency (20%)	$80,081	$105,392	$93,027	$141,478
Total Operating	**$480,485**	**$632,352**	**$558,163**	**$848,869**

Table 8: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Annualized Capital (20 years)	$316,141	$508,501	$474,431	$1,083,061
Annual Operating	$480,485	$632,352	$558,163	$848,869
Annualized Total	$796,626	$1,140,853	$1,032,594	$1,931,930
Cost per Tonne	**$103**	**$148**	**$134**	**$250**

Attachments:
Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout
Figure 5: Anaerobic Digestion Site Layout



LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve

NOTES
Base data source:
ALR and Watercourses provided by RDOS.
Imagery provided by RDOS (2012).

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Site Plan

PROJECTION: UTM Zone 11	DATUM: NAD83	CLIENT: Regional District of Okanagan-Similkameen
Scale: 1:8,000 (100 50 0 100 Metres)		TETRA TECH EBA
FILE NO.: SWM03094-01_Summerland_Fig01_SitePlan.mxd		
PROJECT NO.: ENVSWM03094-01	DWN: SL · CKD: MEZ · APVD: BL · REV: 0	Figure 1
OFFICE: Tt EBA-VANC	DATE: June 10, 2015	

STATUS
ISSUED FOR REVIEW

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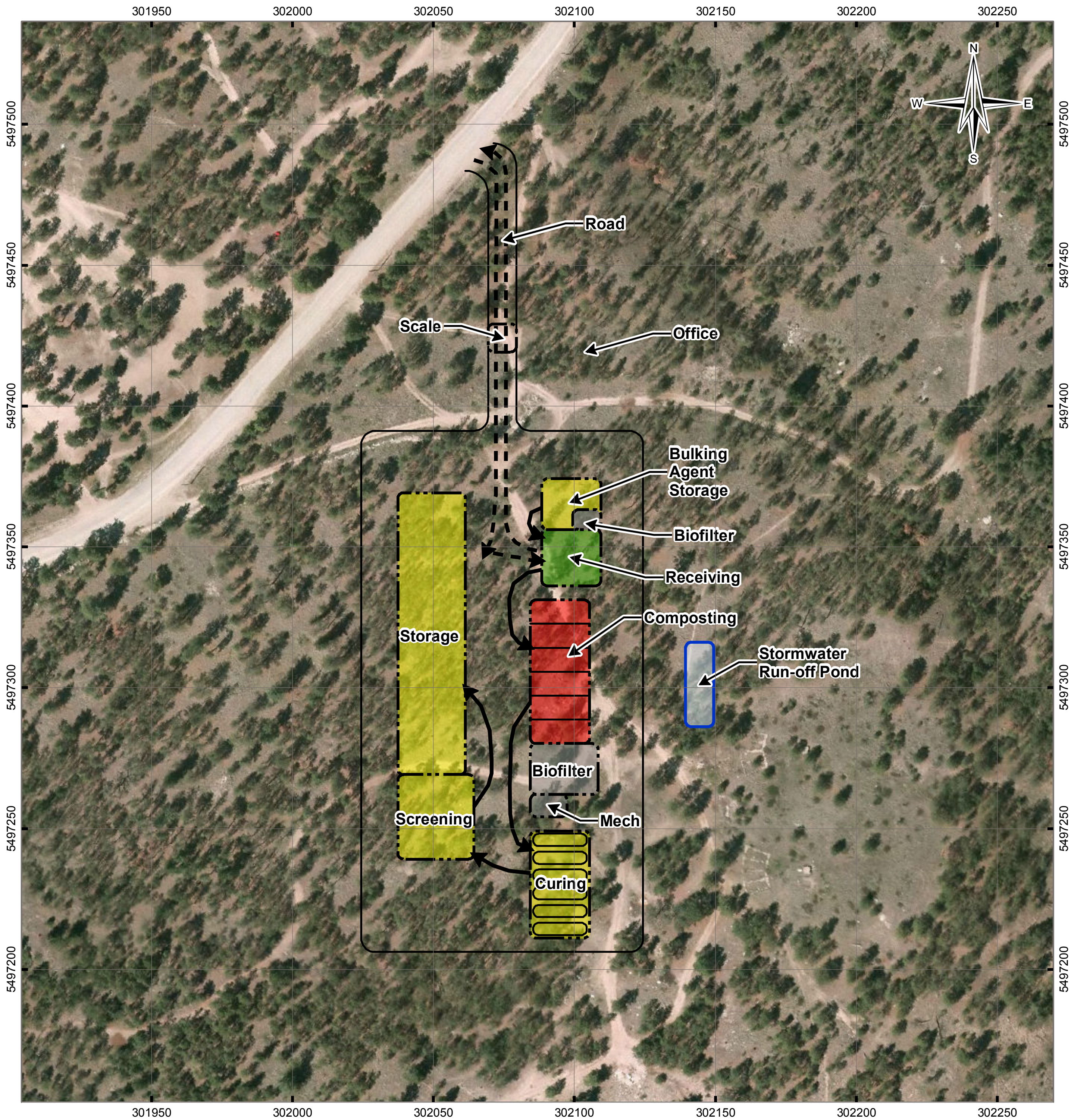


LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

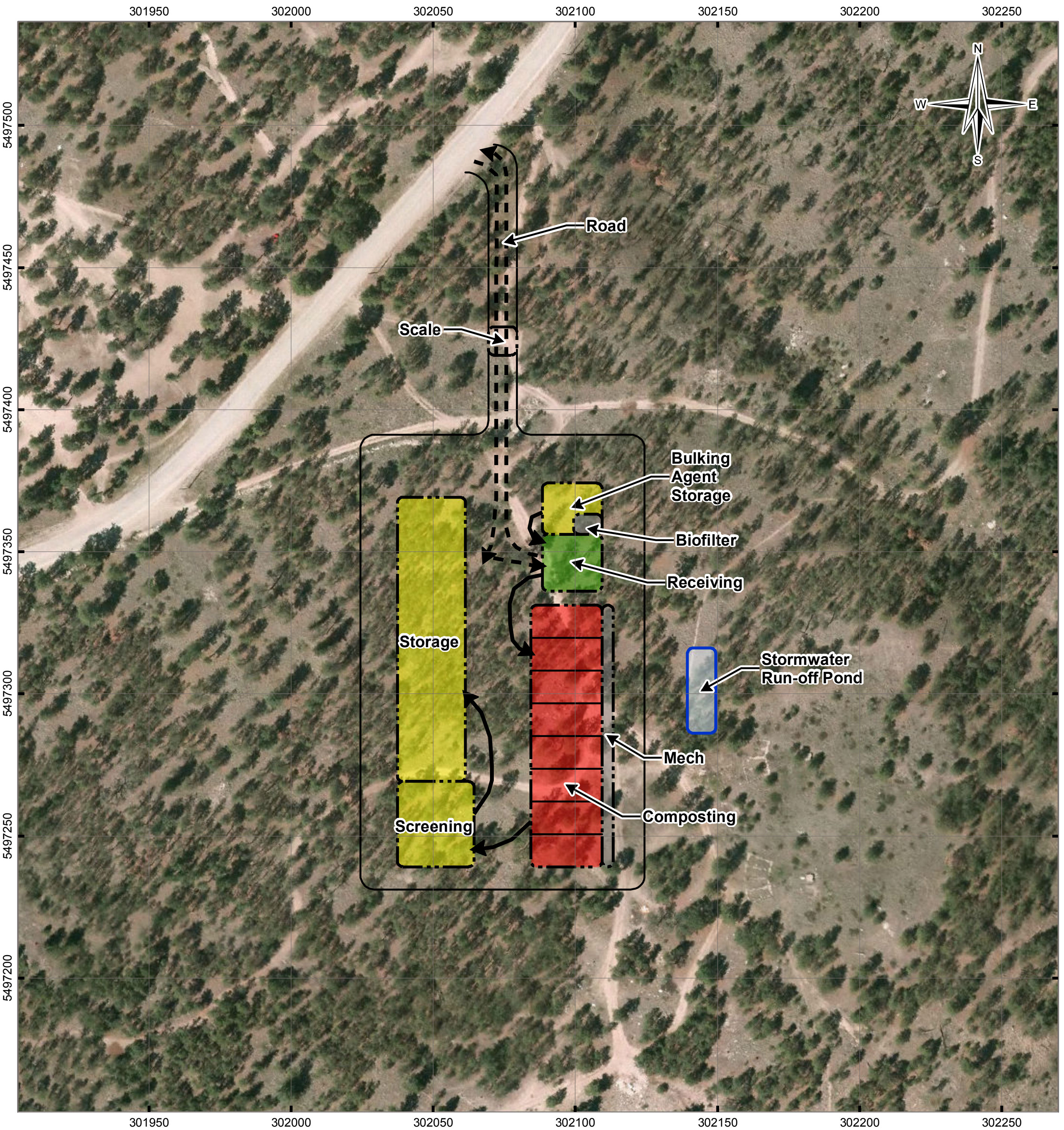
TETRA TECH EBA

FILE NO.
SWM03094-01_Summerland_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT SUMMERLAND LANDFILL, SUMMERLAND, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000

40 20 0 40

Metres

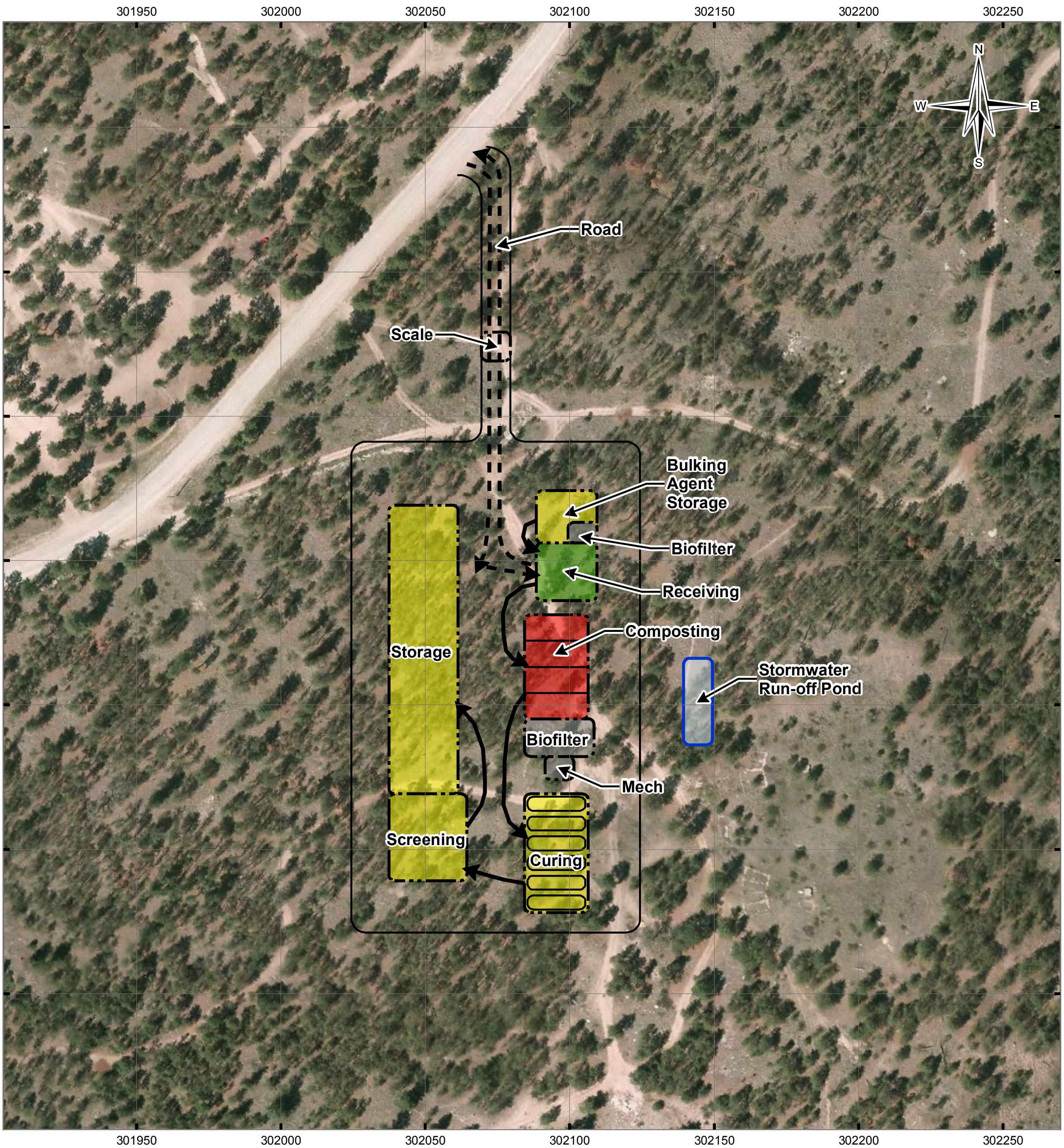
TETRA TECH EBA

FILE NO.
SWM03094-01_Summerland_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 3



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT SUMMERLAND LANDFILL, SUMMERLAND, BC

In-Vessel Composting Site Layout

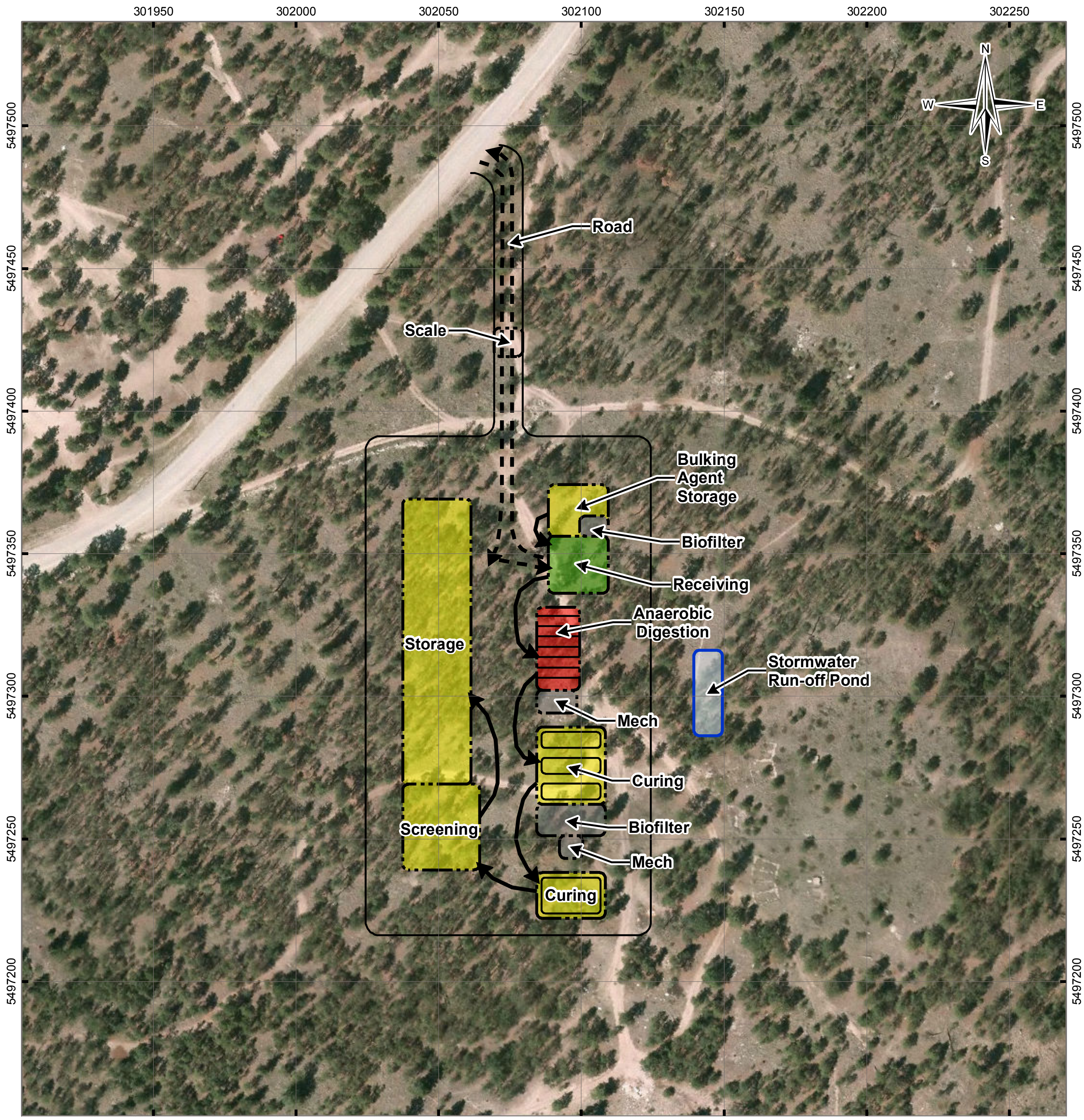
PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_Summerland_Fig04_InVessel.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	May 19, 2015			

Figure 4



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LEGEND

- Loader Movement
- Truck Movement
- Anaerobic Digestion
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Anaerobic Digestion Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 5

OKANAGAN FALLS LANDFILL

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Okanagan Falls Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 4 km east of Okanagan Falls, BC. It is an active landfill operated by the Regional District of Okanagan-Similkameen (RDOS) for Demolition, Land Clearing, and Construction (DLC) waste through a contractor, B&B Wood Grinding.

2.1 Service Area

The Site's service area is the same as the Campbell Mountain Landfill and includes:

- City of Penticton
- Village of Keremeos
- Penticton Indian Band
- Lower Similkameen Indian Band
- Upper Similkameen Indian Band
- Electoral Area B, D, E, and G (including Cawston, Okanagan Falls, Kaleden, Apex Mountain, Naramata, Hedley, Olalla, and Rural Keremeos)
- Parts of Electoral Area F (including West Bench and Sage Mesa)

The total service population is 47,414, with 5,103 of this population within the Keremeos Transfer Station service area.

2.2 Accepted Materials at the Landfill

The Site accepts the following materials:

- Construction and demolition (C&D) waste
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- White wood (painted wood and dimensional lumber)
- Biosolids

Currently, windrow composting is used to co-compost biosolids with green waste at the site. Piles are created in various parts of the site, where land is available. Quantities of organics currently processed are summarized in Table 1.

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

Table 1: Organic Waste Processed at Okanagan Falls Landfill (2013)

Organic Material	Quantity (tonnes/yr)
Green Waste	1,176
Biosolids	90
Total Currently Processed	**1,266**

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is by the entrance of the landfill, on the northeast corner of the Site (Figure 3.1). Currently, this is an undeveloped area. There is approximately 0.25 ha of available land in this area.

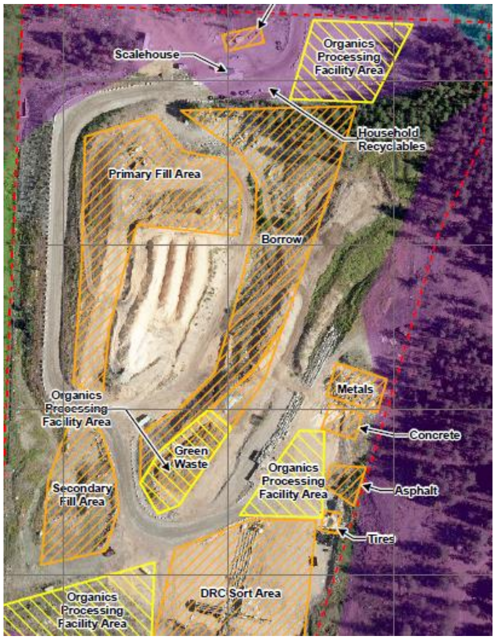


Figure 3.1: Proposed Location of Organics Processing Facility

[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

3.2.1 On-Site Infrastructure and Mobile Equipment

The following infrastructure and mobile equipment are available on site and assumed could be used for the organics processing facility, especially considering the relatively small quantity of feedstock. Note that mobile equipment is owned by the contractor.

- Scale
- Loader

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013. The total amount of organics feedstock is 1,266 tonnes/year. Assuming a growth rate of 1.1%[2] over the next 20 years, the annual quantity of feedstock is calculated to be 1,575 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for organics received in 2013, the peak month was May. During this month, the organics collected accounted for approximately 14% of all organics throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 51 tonnes/week. Note that the RDOS does not plan to accept food waste at this facility, as it is a DLC landfill.

The assumed feedstock composition is presented in the table below. Generally the ratio of biosolids to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 2: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	1,463	93%
Biosolids	112	7%
Total	**1,575**	**100%**
Design Capacity (tonnes/week)	**51**	

3.3.1 Compost Market Considerations

As this would be a biosolids processing facility, it was assumed that compost produced would be used on site (e.g., as landfill cover) and not sold to the public.

3.3.2 Other Design Considerations

Due to the small quantity of biosolids feedstock at the Site, one consideration would be to size a facility based on the peak biosolids quantity instead of total organics. This would reduce the facility size, and likely the capital cost as well. Green and wood waste can be stockpiled and added as needed. However, this would result in a very small

[2] BC Stats Census Total Population Results, 2011.
http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

facility, which may not be worth the capital investment. An alternative would be to transport organics to another facility for processing.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 4 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, it was assumed that green and wood waste would be received and stockpiled at the landfill, chipped, and brought to the organics processing area as needed. Therefore, only a small concrete pad is needed at the receiving area, which can also be used for mixing biosolids with bulking agent.

3.4.2 Organics Processing Technologies and Area

Table 3 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 3: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ More difficult for animals to access

Table 4 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 4: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Residence Time (days)	35	42	28
Number of Piles/Vessels	2	4.5	4
Pile/Vessel Dimensions	16.8 m x 8.0 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	13.5 m x 6.0 m x 3.0 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 5 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 5: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting
Residence Time (days)	35	14	42
Number of Piles	2	1.5	3
Pile Dimensions	19.0 m x 6.3 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	15.0 m x 6.0 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 6: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
General Site Grading and Preparation	$337,794	$259,410	$337,929
Scale House	$0	$0	$0
Leachate and Surface Water Management	$86,644	$87,358	$86,703
Receiving Building	$12,823	$12,896	$12,896
Organics Processing	$704,816	$1,521,798	$1,412,098
Screening, Curing, and Storage	$69,444	$58,304	$69,317
Equipment (Mobile)	$0	$0	$0
Subtotal Capital (without mobile equipment)	$1,211,522	$1,939,766	$1,918,943
Subtotal Capital (with mobile equipment)	$1,211,522	$1,939,766	$1,918,943
Engineering (10% of non-mobile equipment capital)	$121,152	$193,977	$191,894
Contingency (25% of non-mobile equipment capital)	$302,880	$484,942	$479,736
Total Capital	**$1,635,554**	**$2,618,685**	**$2,590,573**

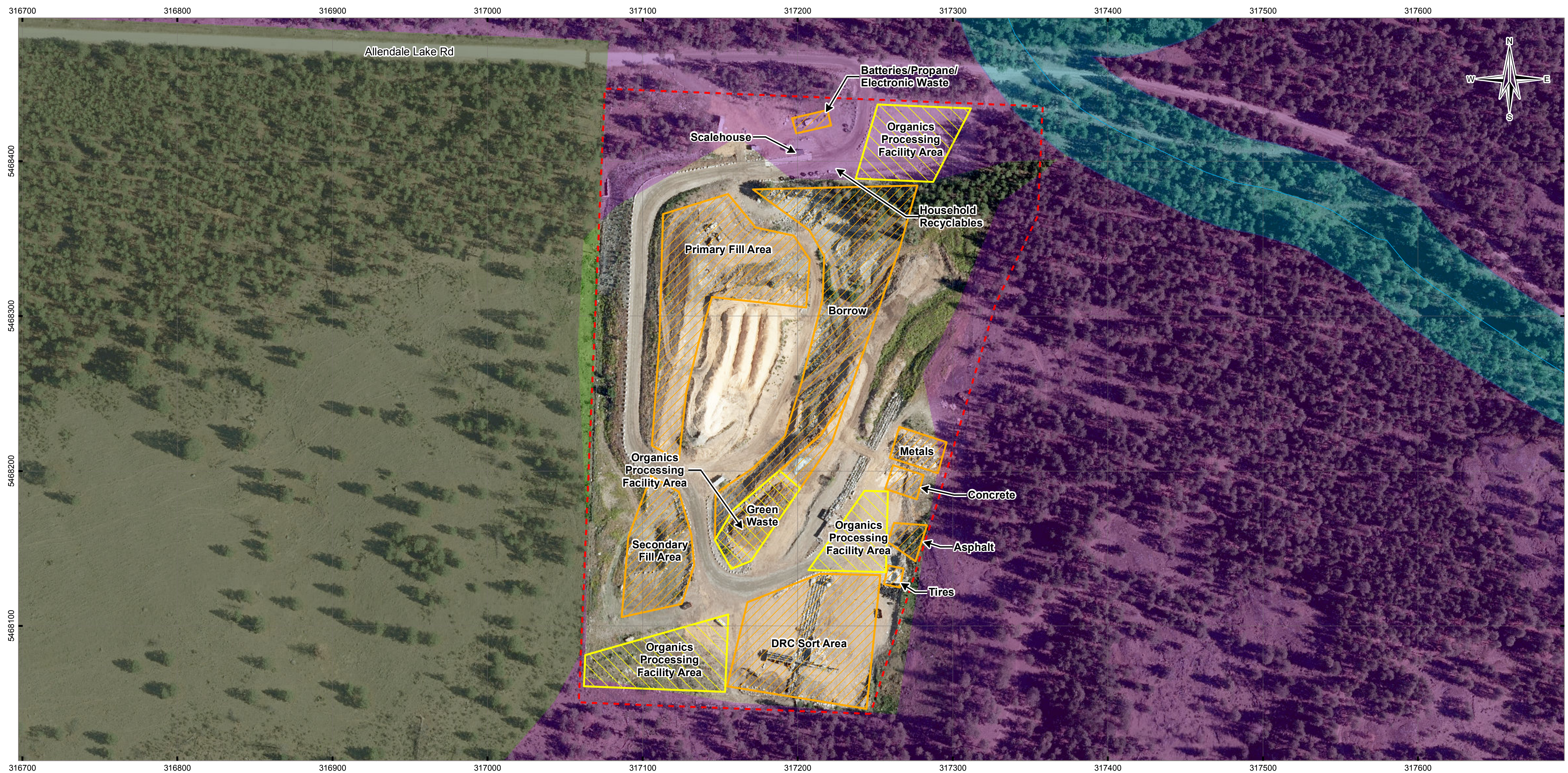
Table 7: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Electricity	$6,958	$7,549	$9,914
Water	$337	$169	$169
Diesel	$0	$0	$0
Labour	$25,454	$25,023	$25,454
Equipment Maintenance and Use	$136,341	$196,428	$171,841
Bi-Product Revenue	$0	$0	$0
Subtotal	**$169,091**	**$229,168**	**$207,379**
Contingency (20%)	$33,818	$45,834	$41,476
Total Operating	**$202,909**	**$275,002**	**$248,854**

Table 8: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Annualized Capital (20 years)	$142,595	$228,309	$225,858
Annual Operating	$202,909	$275,002	$248,854
Annualized Total	$345,504	$503,311	$474,712
Cost per Tonne	**$219**	**$320**	**$301**

Attachments: Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout



LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR, Environmentally Sensitive Habitat and Watercourses provided by RDOS.
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR USE

ORGANIC MANAGEMENT CONSULTANT OKANAGAN FALLS LANDFILL OKANAGAN FALLS, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_OKFalls_Fig01_SitePlan.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 7, 2015

Figure 1

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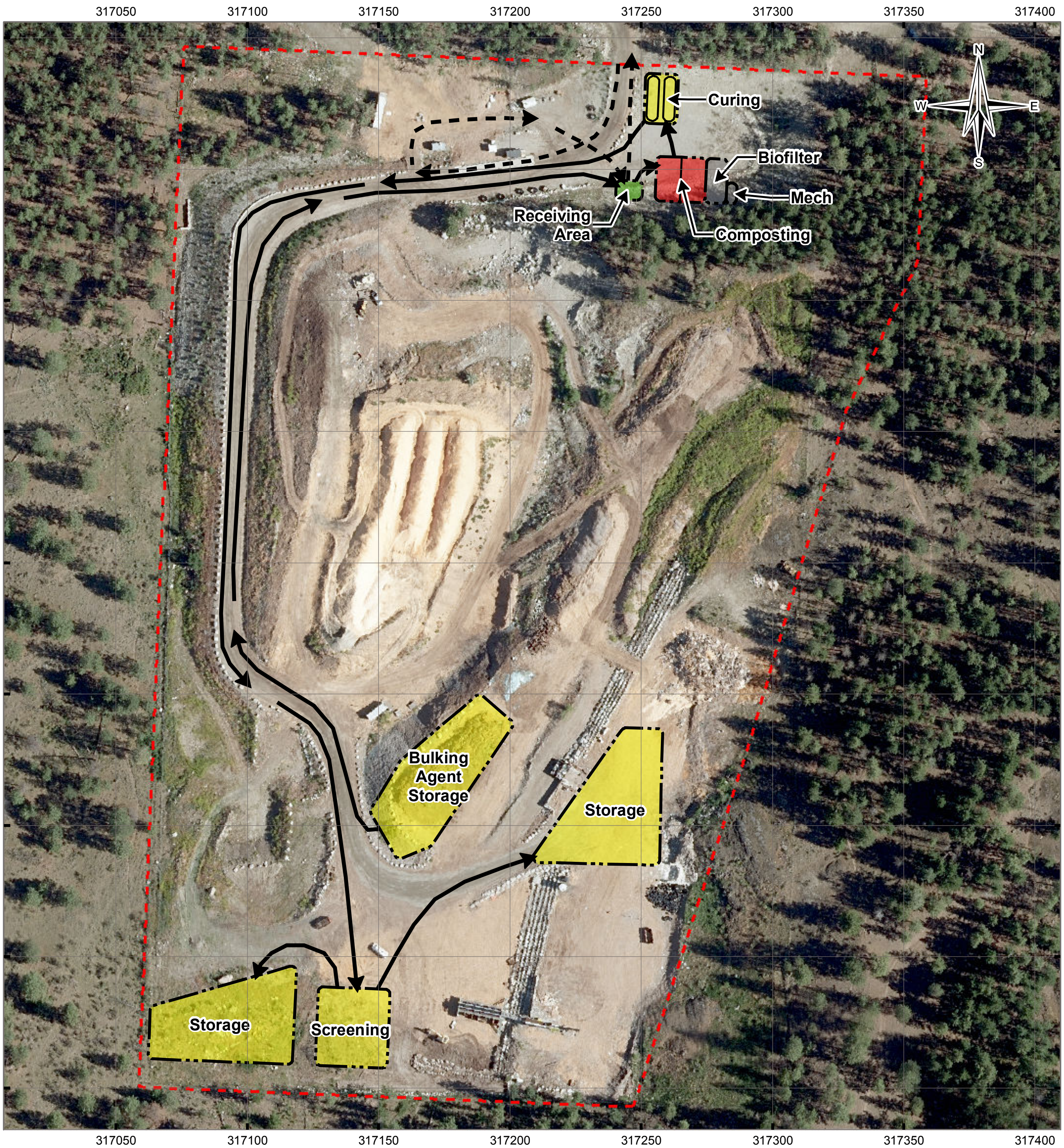


LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OKANAGAN FALLS LANDFILL
OKANAGAN FALLS, BC

Aerated Static Pile Site Layout

PROJECTION
UTM Zone 11

DATUM
NAD83

CLIENT
Regional District of Okanagan-Similkameen

Scale: 1:2,200
40 20 0 40
Metres

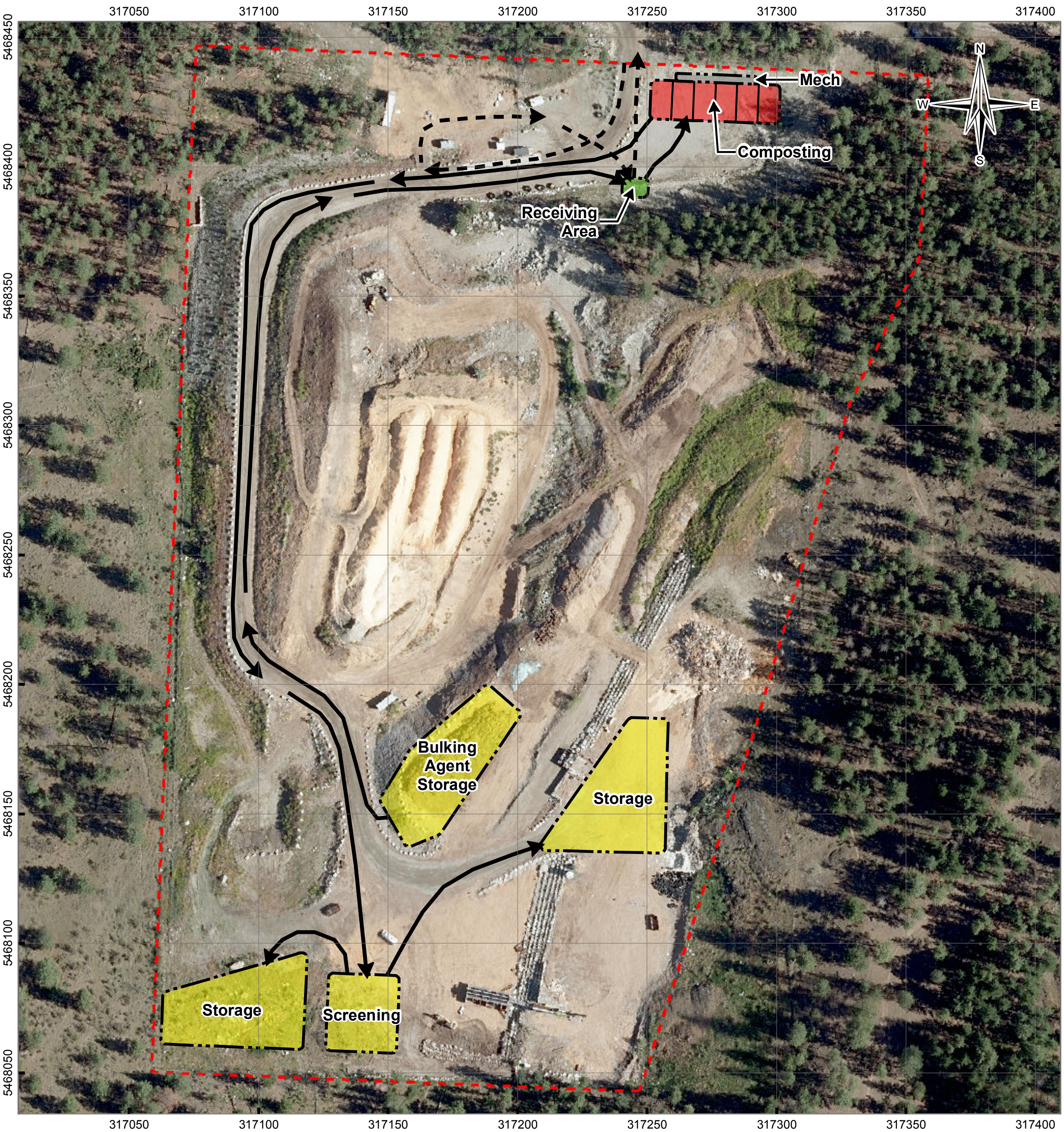
TETRA TECH EBA

FILE NO.
SWM03094-01_OKFalls_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 26, 2015

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OKANAGAN FALLS LANDFILL OKANAGAN FALLS, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,200
40 20 0 40
Metres

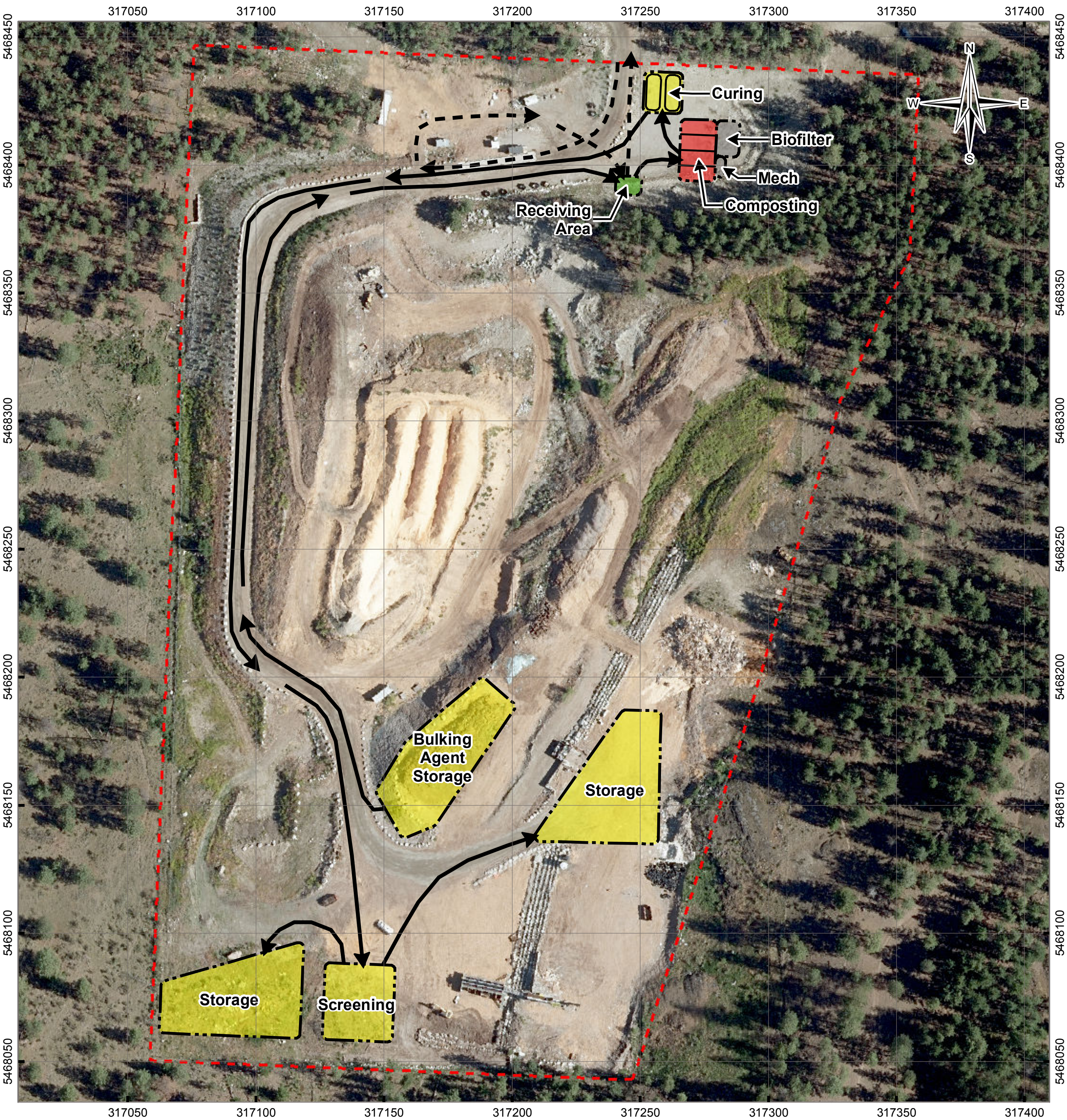
TETRA TECH EBA

FILE NO.
SWM03094-01_OKFalls_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 26, 2015

Figure 3



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OKANAGAN FALLS LANDFILL OKANAGAN FALLS, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,200
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_OKFalls_Fig04_InVessel.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	DATE			
Tt EBA-VANC	May 26, 2015			

Figure 4

OLIVER LANDFILL

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Oliver Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 6 km south of the Town of Oliver, BC. It is an active landfill operated by the Regional District of Okanagan-Similkameen (RDOS) through a contractor, B&B Wood Grinding.

2.1 Service Area

The Site's service area includes:

- Town of Oliver
- Electoral Area C

The total service population is 8,925.

2.2 Accepted Materials at the Landfill

The Site accepts the following materials:

- Municipal solid waste (MSW)
- Construction and demolition (C&D) waste
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- Harvest (fruit) waste
- White wood (painted wood and dimensional lumber)

Currently, windrow composting is used to compost green waste and harvest waste in the middle of the Site, north of the receiving area (Figure 1). This facility does not have capacity to process additional materials such as food waste using the current method of composting. Quantities of organics that are currently processed are summarized in Table 1.

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

Table 1: Organic Waste Processed at Oliver Landfill (2013)

Organic Material	Quantity (tonnes/yr)
Green Waste	1,997
Harvest Waste	674
Total Currently Processed	**2,671**

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is the current footprint of the Site's composting operations, plus the land to the southwest up to the scale entrance (Figure 3.1). There is approximately one hectare of available land in this area.

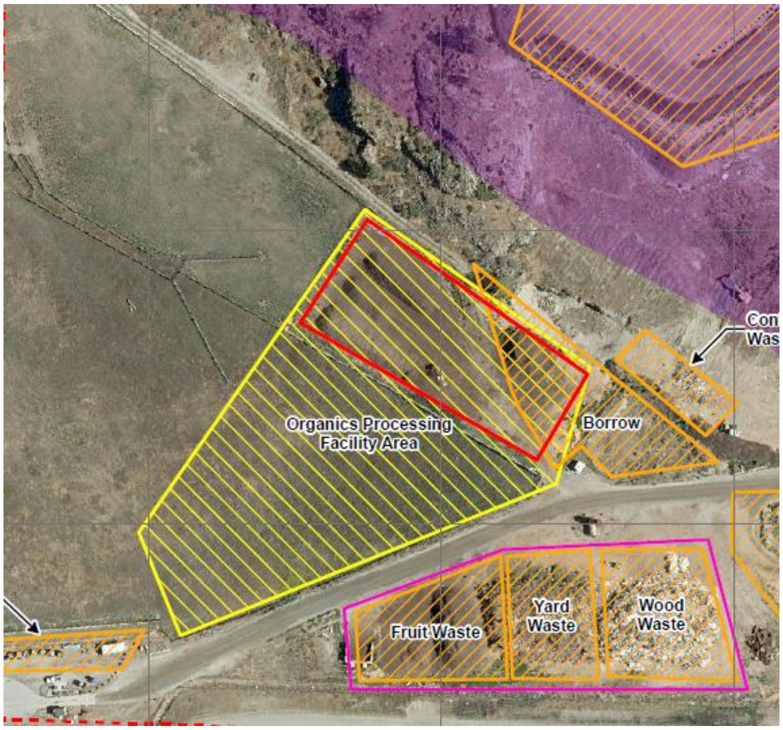


Figure 3.1: Proposed Location of Organics Processing Facility

3.2.2 On-Site Infrastructure and Mobile Equipment

As the proposed location is within the landfill property boundary and easily accessible from the road, it was assumed that the following infrastructure and mobile equipment can be shared with the organics processing facility. Note that mobile equipment is owned by the contractor.

- Scale
- Loader
- Trommel screen (part-time, shared with Osoyoos)

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[2]. The total amount of organics feedstock is 3,984 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of green and harvest waste, and projected quantities of food waste and compostable paper. Assuming a growth rate of 1.1%[3] over the next 20 years, the annual quantity of feedstock is calculated to be 4,959 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, the peak month was May. During this month, the waste collected accounted for approximately 12% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 141 tonnes/week.

The assumed feedstock composition is presented in the table below. Generally the ratio of food waste/harvest waste to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 2: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	2,486	50%
Food Waste and Compostable Paper (Including Harvest Waste)	2,473[1]	50%
Total	**4,959**	**100%**
Design Capacity (tonnes/week)	**141**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. Also includes harvest waste.

[2] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[3] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

3.3.1 Compost Market Considerations

There is a high demand for compost in the area around the Oliver Landfill. Since this compost is primarily used for agriculture, it may be worthwhile to pursue higher compost quality to increase its marketability.

Compost made from biosolids and white wood is undesirable to potential customers. In Canada and the United States, organic food regulations prohibit the use of sewage sludge for growing food[4],[5]. Agricultural operations seeking an organic certification will stay away from using compost that would affect the marketability of their crop.

To further increase the marketability of the finished compost product, certification through an independent reviewer such as Organic Materials Review Institute (OMRI) may be considered.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas of the RDOS that do not have infrastructure for processing food waste.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 4 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area is a dome-shaped fabric building on top of concrete blocks. The building is approximately 13 m by 22 m.

3.4.2 Organics Processing Technologies and Area

Table 3 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 3: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint

[4] Organic Product Systems Permitted Substances Lists, 2011. https://www.cog.ca/uploads/PSL.pdf
[5] USDA National Organic Program, 2015. http://www.ams.usda.gov/AMSv1.0/NOPOrganicStandards

Table 4 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 4: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Residence Time (days)	35	42	28
Number of Piles/Vessels	4	9	4
Pile/Vessel Dimensions	23.2 m x 8.0 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	24.7 m x 6.0 m x 3.0 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 5 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 5: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting
Residence Time (days)	35	14	42
Number of Piles	4	3	6
Pile Dimensions	24.2 m x 6.3 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	24.7 m x 4.5 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 6: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
General Site Grading and Preparation	$300,555	$274,692	$297,073
Scale House	$0	$0	$0
Leachate and Surface Water Management	$121,088	$120,814	$120,575
Receiving Building	$211,753	$212,367	$212,367
Organics Processing	$899,098	$2,442,606	$1,772,183
Screening, Curing, and Storage	$124,996	$98,045	$127,532
Equipment (Mobile)	$0	$0	$0
Subtotal Capital (without mobile equipment)	$1,657,491	$3,148,524	$2,529,730
Subtotal Capital (with mobile equipment)	$1,657,491	$3,148,524	$2,529,730
Engineering (10% of non-mobile equipment capital)	$165,749	$314,852	$252,973
Contingency (25% of non-mobile equipment capital)	$414,373	$787,131	$632,433
Total Capital	**$2,237,613**	**$4,250,507**	**$3,415,136**

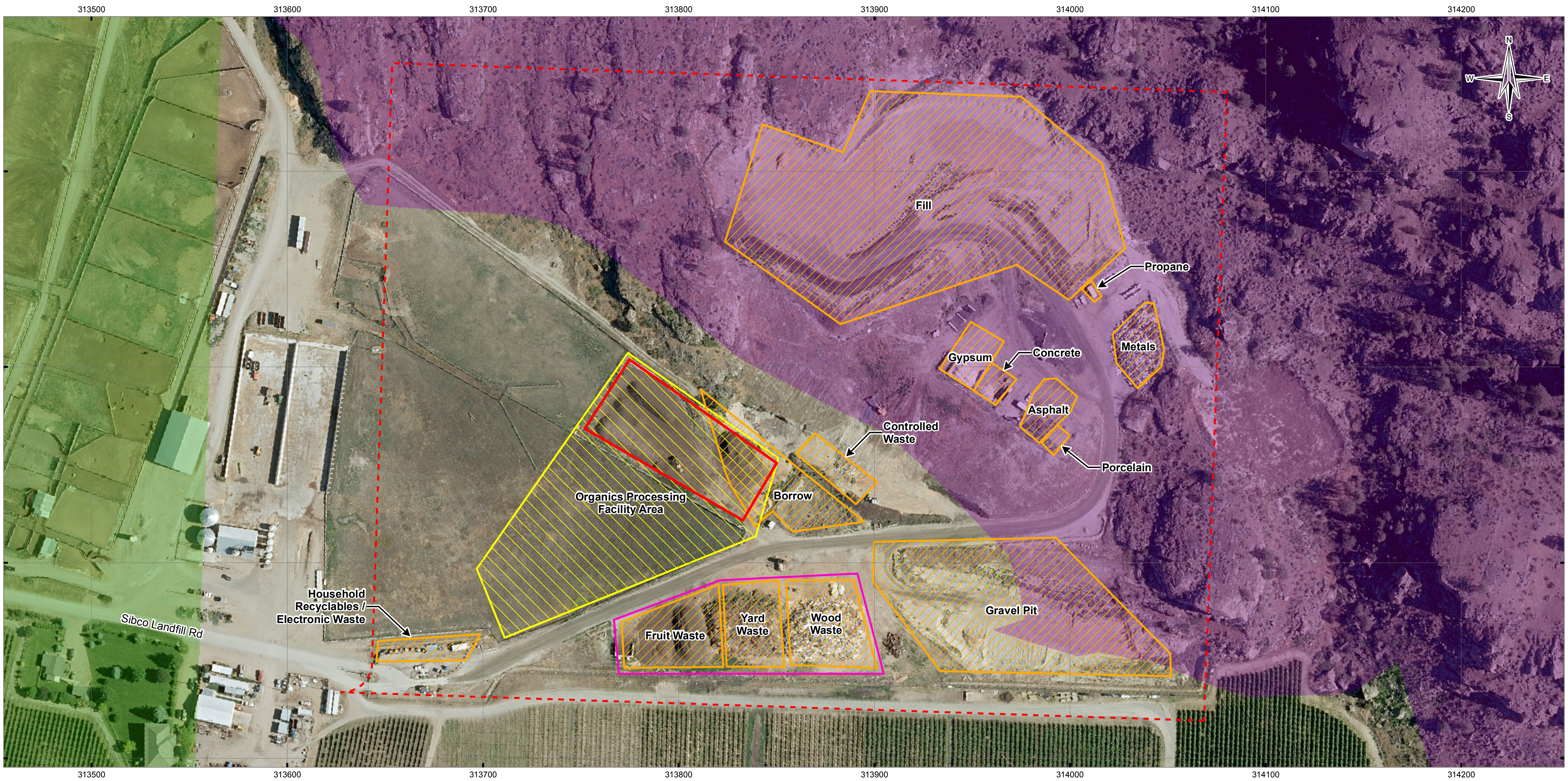
Table 7: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Electricity	$24,857	$26,040	$24,857
Water	$323	$162	$162
Diesel	$0	$0	$0
Labour	$48,933	$58,064	$59,738
Equipment Maintenance and Use	$243,071	$391,414	$329,123
Bi-Product Revenue	-$15,098	-$15,098	-$15,098
Subtotal	$302,086	$460,581	$398,781
Contingency (20%)	$60,417	$92,116	$79,756
Total Operating	**$362,504**	**$552,697**	**$478,538**

Table 8: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Annualized Capital (20 years)	$195,085	$370,579	$297,747
Annual Operating	$362,504	$552,697	$478,538
Annualized Total	$557,589	$923,276	$776,285
Cost per Tonne	**$112**	**$186**	**$157**

Attachments: Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout



LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Compost Area
- Recieving and Composting Area
- Other Facility Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR and Environmentally Sensitive Habitat provided by RDOS.
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OLIVER LANDFILL, OLIVER, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE: Tt EBA-VANC
DATE: May 25, 2015

Figure 1

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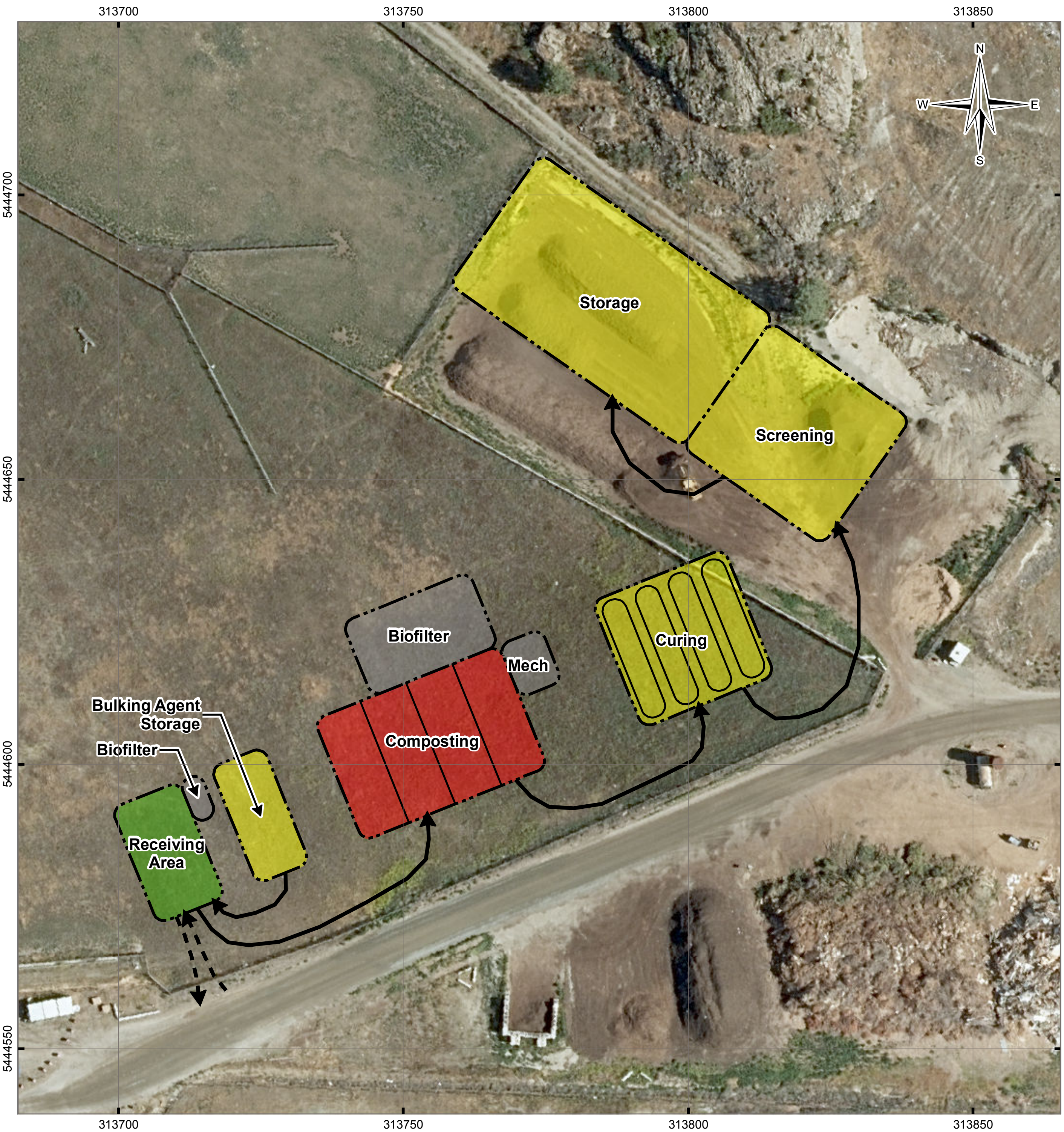

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OLIVER LANDFILL, OLIVER, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

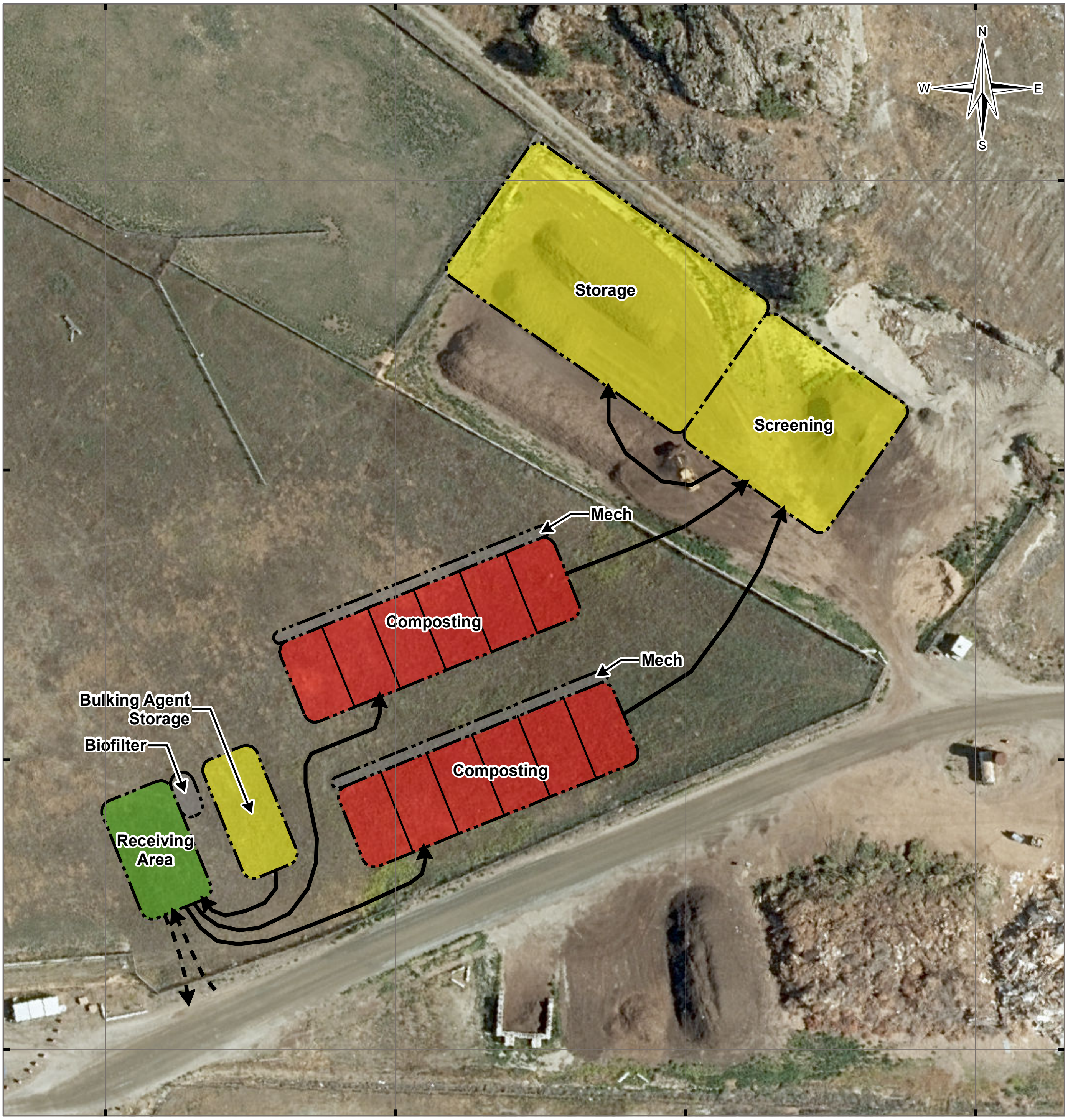
FILE NO.
SWM03094-01_Oliver_Fig02_ASP.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OLIVER LANDFILL, OLIVER, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

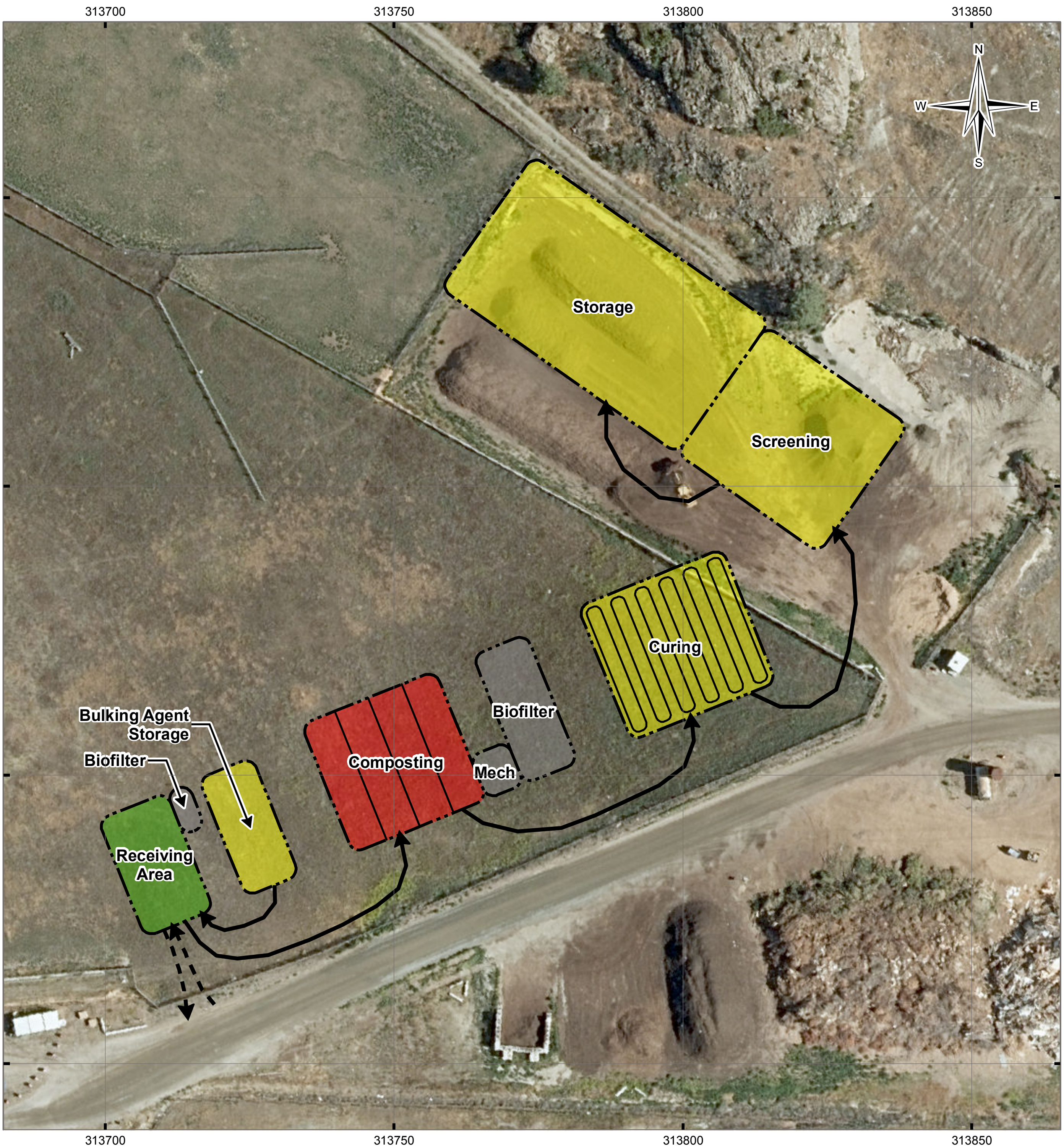
FILE NO.
SWM03094-01_Oliver_Fig03_Mem.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 3



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OLIVER LANDFILL, OLIVER, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_Oliver_Fig04_InVessel.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	May 19, 2015			

Figure 4

OSOYOOS LANDFILL

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Osoyoos Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 5 km northwest of the Town of Osoyoos, BC. It is an active landfill operated by the Town of Osoyoos through a contractor, B&B Wood Grinding.

2.1 Service Area

The Site's service area includes:

- Town of Osoyoos
- Electoral Area A

The total service population is 6,737.

2.2 Accepted Materials at the Landfill

The Site accepts the following materials:

- Municipal solid waste (MSW)
- Construction and demolition (C&D) waste
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- Harvest (fruit) waste
- White wood (painted wood and dimensional lumber)

Currently, windrow composting is used to compost green waste and harvest waste on the northeast corner of the Site (Figure 1). This facility does not have capacity to process additional materials such as food waste using the current method of composting. Quantities of organics that are currently processed are summarized in Table 1.

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

Table 1: Organic Waste Processed at Osoyoos Landfill (2013)

Organic Material	Quantity (tonnes/yr)
Green Waste	832
Harvest Waste	3[1]
Total Currently Processed	**835**

[1] Most harvest waste arrives mixed with green waste and therefore was counted as green waste.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is the current footprint of the Site's composting operations on the northeast corner of the Site (Figure 3.1). There is approximately 0.5 ha of available land in this area.

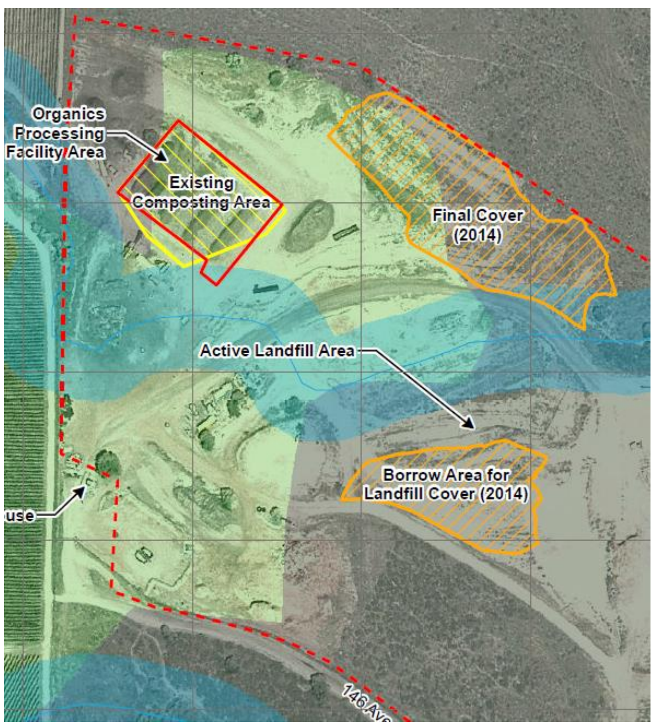

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.2 On-Site Infrastructure and Mobile Equipment

As the proposed location is within the landfill property boundary and easily accessible from the road, it was assumed that the following infrastructure and mobile equipment can be shared with the organics processing facility. Note that mobile equipment is owned by the contractor.

- Scale
- Loader
- Trommel screen (part-time, shared with Oliver)
- Grinder

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[2]. The total amount of organics feedstock is 1,896 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of green and harvest waste, and projected quantities of food waste and compostable paper. However, as the amount of available bulking agent (green waste) is not enough for the projected amount of food waste and compostable paper, 300 tonnes was added to the total as additional bulking agent to bring the total to 2,196 tonnes/year. This bulking agent can be brought in from other nearby sites with excess wood waste, such as Okanagan Falls. Assuming a growth rate of 1.1%[3] over the next 20 years, the annual quantity of feedstock is calculated to be 2,733 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, the peak month was August. During this month, the waste collected accounted for approximately 12% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 77 tonnes/week.

The assumed feedstock composition is presented in Table 2 below.

Table 2: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	1,409	52%
Food Waste and Compostable Paper (Including Harvest Waste)	1,324[1]	48%
Total	**2,733**	**100%**
Design Capacity (tonnes/week)	**77**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. Also includes harvest waste.

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[2] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[3] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

3.3.1 Compost Market Considerations

There is a high demand for compost in the area around the Osoyoos Landfill. Since this compost is primarily used for agriculture, it may be worthwhile to pursue higher compost quality to increase its marketability.

Compost made from biosolids and white wood is undesirable to potential customers. In Canada and the United States, organic food regulations prohibit the use of sewage sludge for growing food[4],[5]. Agricultural operations seeking an organic certification will stay away from using compost that would affect the marketability of their crop.

To further increase the marketability of the finished compost product, certification through an independent reviewer such as Organic Materials Review Institute (OMRI) may be considered.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas of the RDOS that do not have infrastructure for processing food waste.

Due to the relatively small amount of organics received at this site compared to other facilities nearby (e.g., Oliver Landfill), an alternative would be to transport some or all food waste and compostable paper to another facility for processing.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 4 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area is a dome-shaped fabric building on top of concrete blocks. The building is approximately 13 m by 18 m.

4 Organic Product Systems Permitted Substances Lists, 2011. https://www.cog.ca/uploads/PSL.pdf
5 USDA National Organic Program, 2015. http://www.ams.usda.gov/AMSv1.0/NOPOrganicStandards

3.4.2 Organics Processing Technologies and Area

Table 3 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 3: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint

Table 4 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 4: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Residence Time (days)	35	42	28
Number of Piles/Vessels	2	4.5	4
Pile/Vessel Dimensions	25.3 m x 8.0 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	13.5 m x 6.0 m x 3.0 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 5 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 5: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting
Residence Time (days)	35	14	42
Number of Piles	2	1.5	6
Pile Dimensions	28.6 m x 6.3 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	13.5 m x 4.5 m x 3.0 m

[1]Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 6: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
General Site Grading and Preparation	$302,018	$250,881	$299,005
Scale House	$0	$0	$0
Leachate and Surface Water Management	$103,359	$102,505	$102,539
Receiving Building	$194,365	$194,794	$194,794
Organics Processing	$712,554	$1,521,798	$1,412,105
Screening, Curing, and Storage	$74,289	$57,195	$73,288
Equipment (Mobile)	$0	$0	$0
Subtotal Capital (without mobile equipment)	$1,386,585	$2,127,173	$2,081,731
Subtotal Capital (with mobile equipment)	$1,386,585	$2,127,173	$2,081,731
Engineering (10% of non-mobile equipment capital)	$138,659	$212,717	$208,173
Contingency (25% of non-mobile equipment capital)	$346,646	$531,793	$520,433
Total Capital	**$1,871,890**	**$2,871,683**	**$2,810,337**

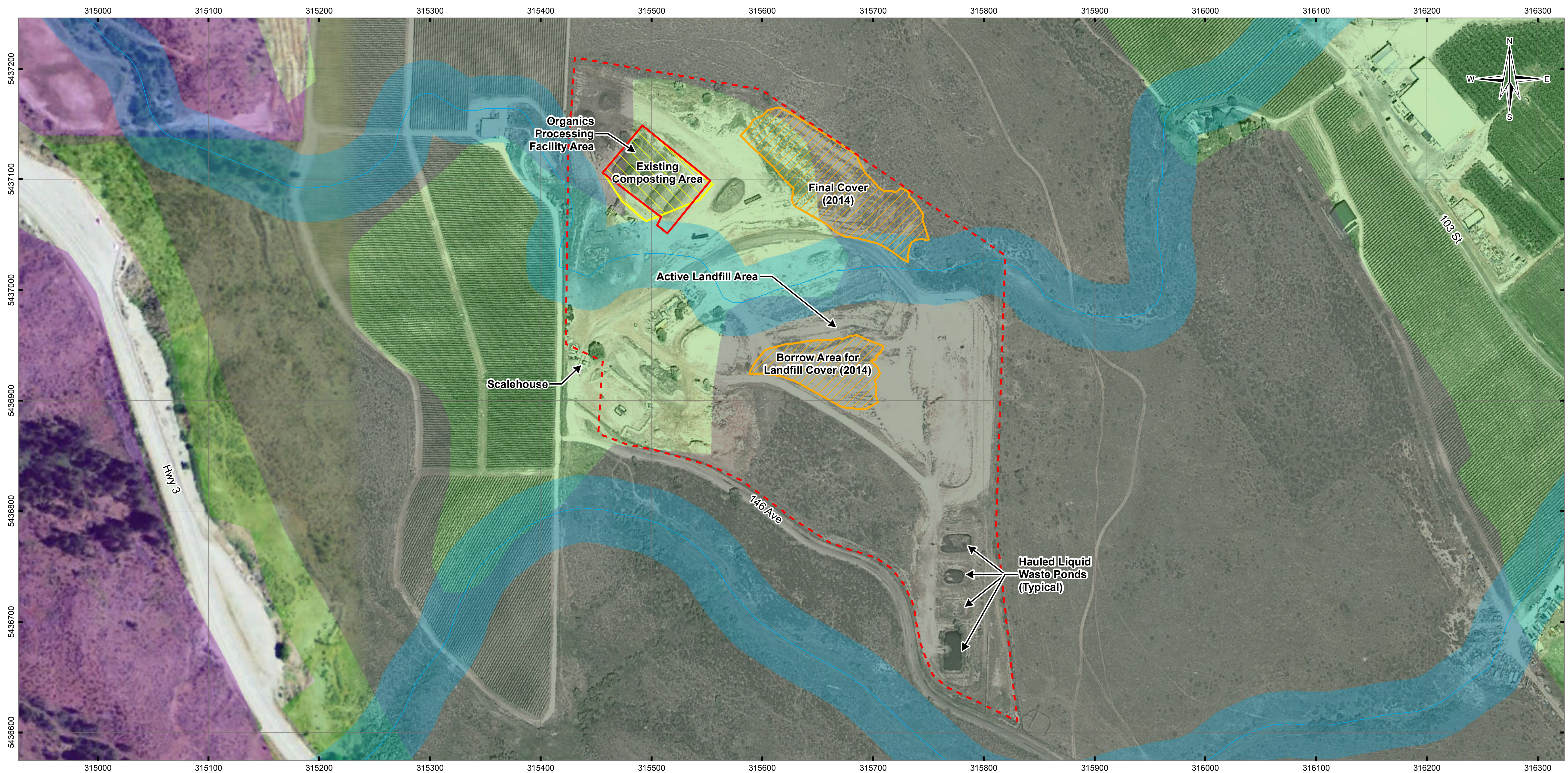
Table 7: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Electricity	$21,826	$22,418	$24,783
Water	$176	$88	$88
Diesel	$0	$0	$0
Labour	$41,249	$42,223	$41,249
Equipment Maintenance and Use	$151,902	$217,410	$187,402
Bi-Product Revenue	-$8,104	-$8,104	-$8,104
Subtotal	**$207,049**	**$274,035**	**$245,418**
Contingency (20%)	$41,410	$54,807	$49,084
Total Operating	**$248,459**	**$328,843**	**$294,501**

Table 8: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Annualized Capital (20 years)	$163,200	$250,366	$245,018
Annual Operating	$248,459	$328,843	$294,501
Annualized Total	$411,659	$579,209	$539,519
Cost per Tonne	**$151**	**$212**	**$197**

Attachments: Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout



LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR, Environmentally Sensitive Habitat and Watercourses provided by RDOS.
Imagery from Google Earth Pro; Digital Globe (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OSOYOOS LANDFILL, OSOYOOS, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,500
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_Osoyoos_Fig01_SitePlan.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	May 20, 2015			

Figure 1

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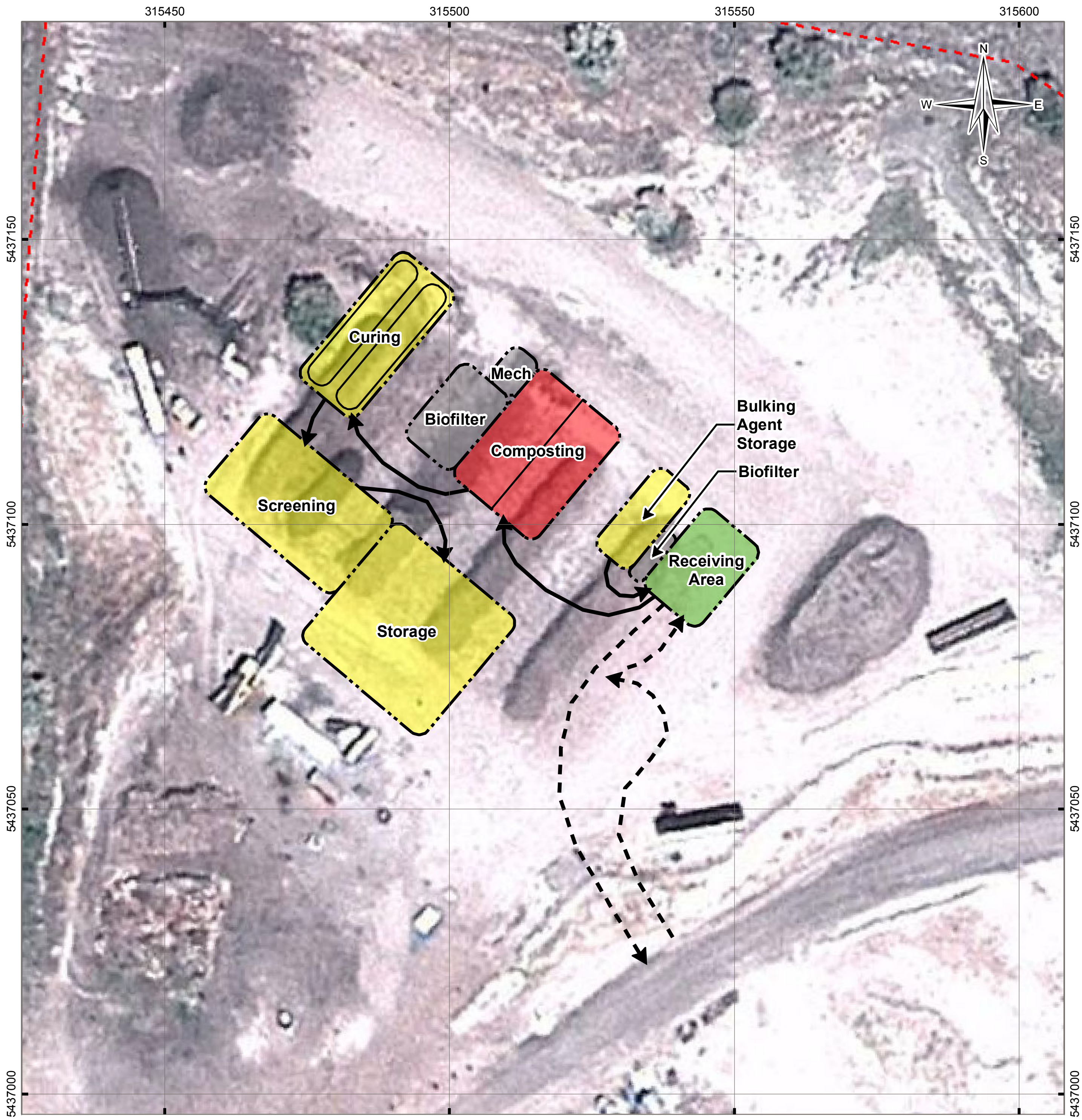

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery from Google Earth Pro;
Digital Globe (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OSOYOOS LANDFILL, OSOYOOS, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
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Metres

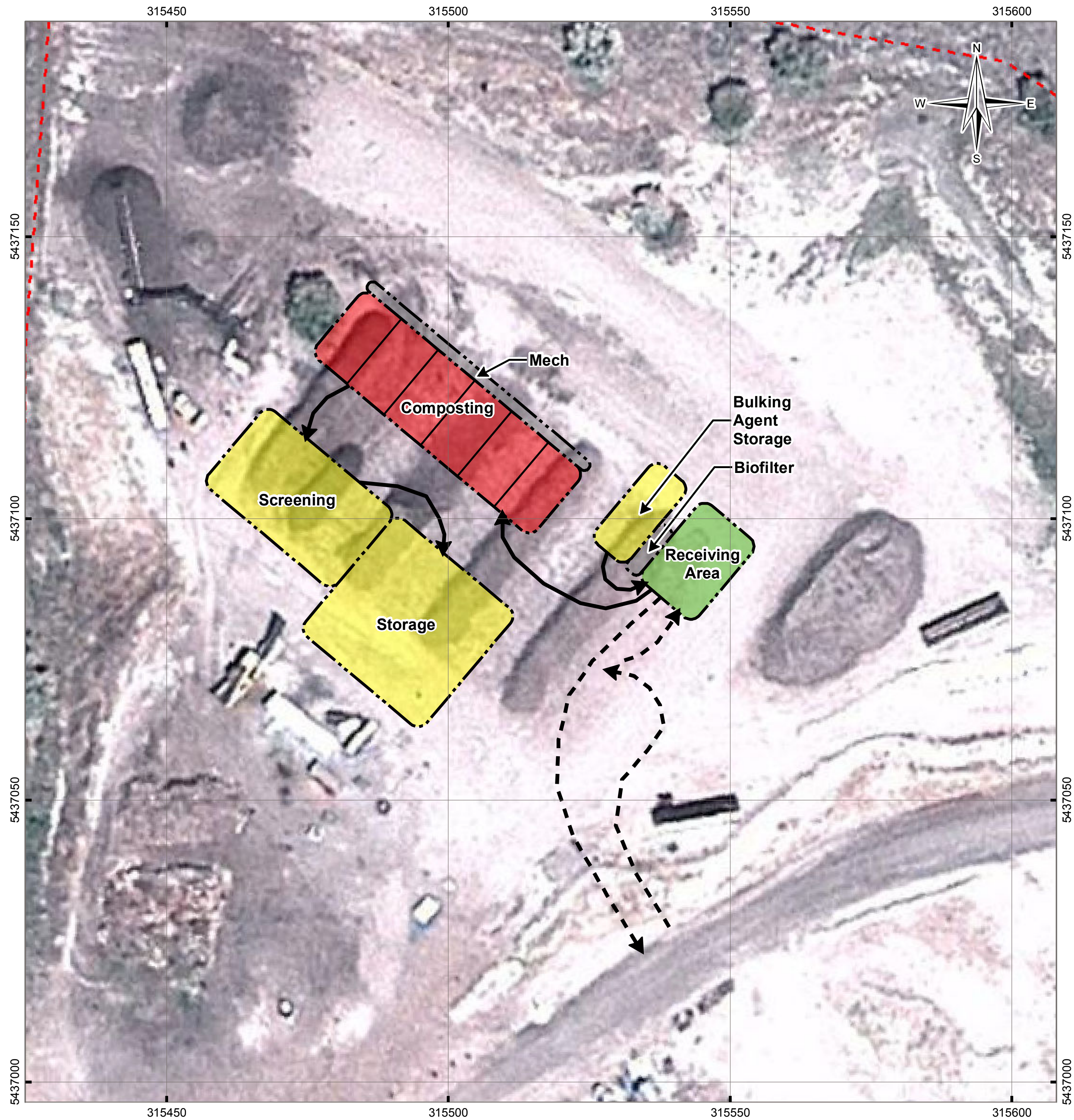
TETRA TECH EBA

FILE NO.
SWM03094-01_Osoyoos_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 2



LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery from Google Earth Pro;
Digital Globe (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OSOYOOS LANDFILL, OSOYOOS, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 3

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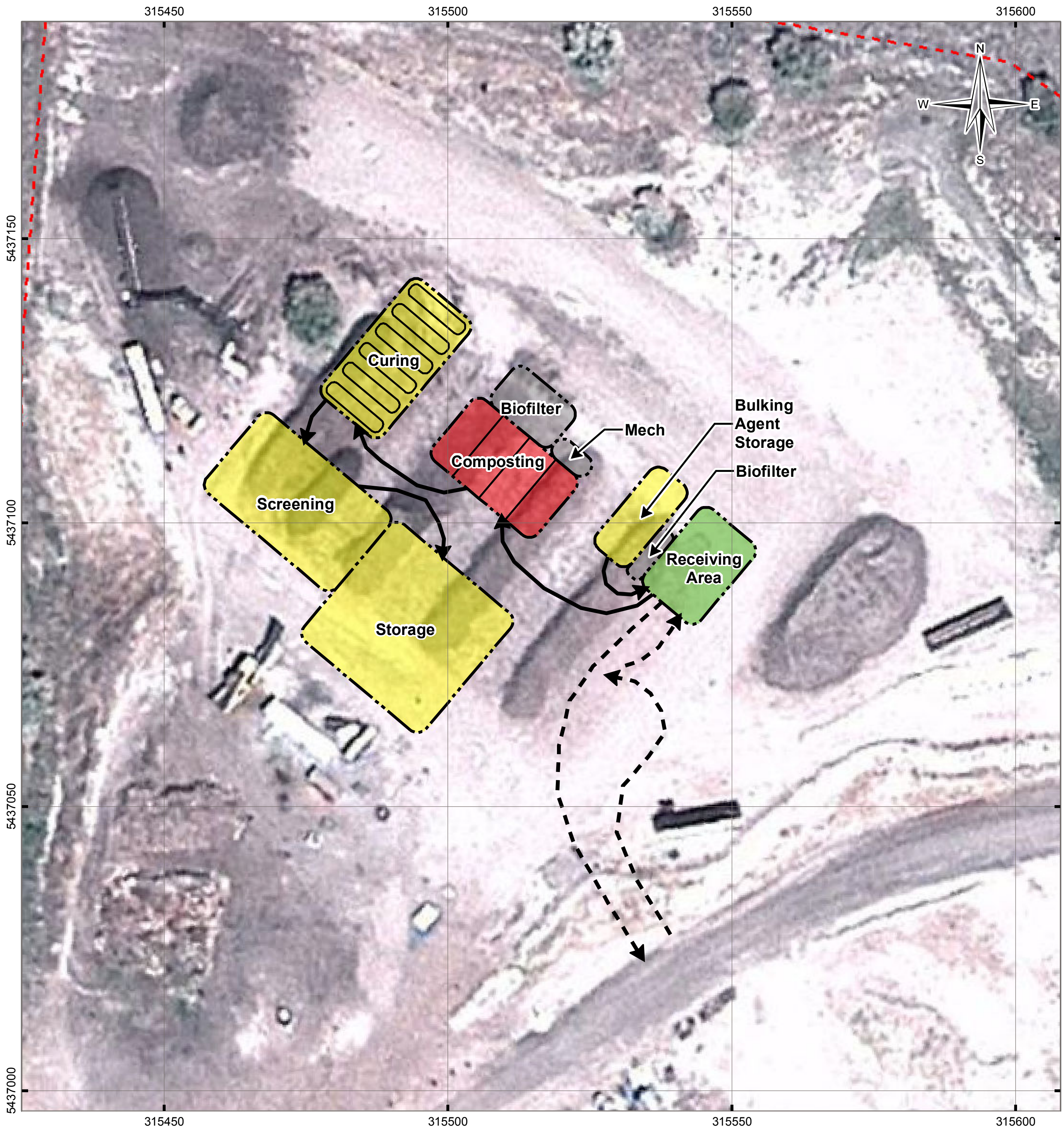

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery from Google Earth Pro;
Digital Globe (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OSOYOOS LANDFILL, OSOYOOS, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_Osoyoos_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 19, 2015

Figure 4

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PRINCETON LANDFILL

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Princeton Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 1.5 km northeast of the Town of Princeton, BC. It is an active landfill operated by the Town of Princeton.

2.1 Service Area

The Site's service area includes:

- Town of Princeton
- Electoral Area H

The total service population is 4,492.

2.2 Accepted Materials at the Landfill

The Site accepts the following materials:

- Municipal solid waste (MSW)
- Construction and demolition (C&D) waste
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- White wood (painted wood and dimensional lumber)

Currently, organics are stored in piles and chipped periodically for use at the Site (Figure 1). This facility does not compost organics. As there was no scale data available, the estimated amount of green waste received in 2013 was 415 tonnes based on the Regional Organic Waste Management Strategy[1].

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[2].

[1] http://www.rdosmaps.bc.ca/min_bylaws/contract_reports/CorpBd/2010/19Nov18/Environment/CH2MHill_Regional_Organic_Waste_Strategy_REVISED_Final_DRAFT.pdf

[2] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is adjacent to the northeast corner of the Site (Figure 3.1). There is approximately one hectare of available land in this area. This is undeveloped land owned by the Town of Princeton and would require an access road to be built from the landfill, or a separate entrance from Princeton-Summerland Road.

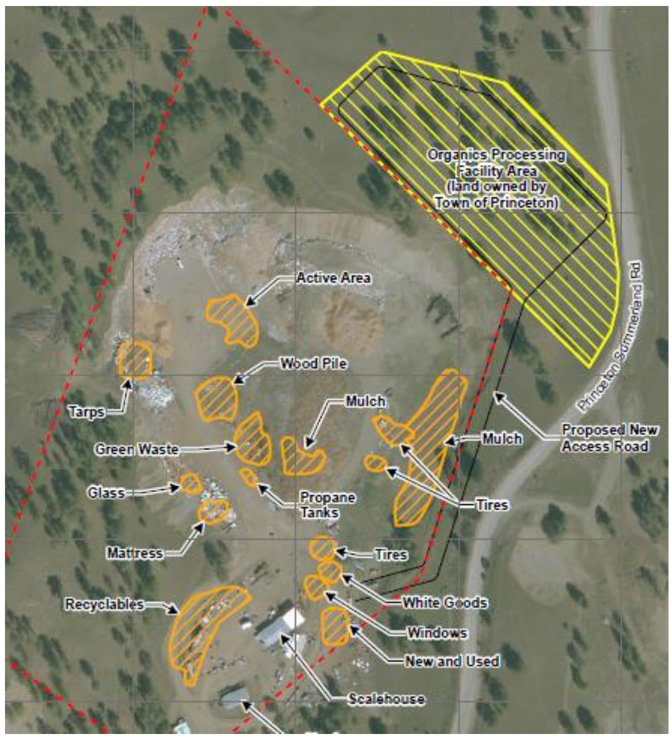

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.2 On-Site Infrastructure and Mobile Equipment

As the proposed location is adjacent to the landfill, it was assumed that the following infrastructure and mobile equipment can be shared with the organics processing facility.

- Scale
- Loader
- Grinder (available when needed)

3.3 Feedstock and Design Capacity

Feedstock estimates were developed based on green waste estimates from the Regional Organic Waste Management Strategy, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[3]. Since scale data was not available for MSW, the average per capita MSW generation from Oliver and Osoyoos was used to make a population-based estimate for Princeton.

The assumed feedstock composition is based on estimated quantities of green waste and projected quantities of food waste and compostable paper. The total amount of organics feedstock is 1,099 tonnes/year. This is inclusive of materials from residential, commercial, and self-haul waste to the facility. As the amount of available bulking agent (green waste) is not enough for the projected amount of food waste and compostable paper, 600 tonnes was added to the total as additional bulking agent to bring the total to 1,699 tonnes/year. This bulking agent can be brought in as hog fuel from a nearby mill operated by Weyerhaeuser. Assuming a growth rate of 1.1%[4] over the next 20 years, annual quantity of feedstock is calculated to be 2,114 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. As scale data was not available, the peak month and percentage was assumed to the same as Keremeos. During this month, the organics accounted for approximately 12% of all organics throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 61 tonnes/week.

The assumed feedstock composition is presented in the table below.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	1,263	60%
Food Waste and Compostable Paper	852[1]	40%
Total	**2,114**	**100%**
Design Capacity (tonnes/week)	**61**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

[3] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[4] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

3.3.1 Compost Market Considerations

There is generally low agricultural demand for compost in the area around Princeton. However, the landfill will need top soil for final cover, so that is one potential use for the compost. The Town of Princeton, Ministry of Transportation, and private businesses can also use the compost for projects such as road construction, turf for golf courses, and landscaping.

3.3.2 Other Design Considerations

The design capacity was estimated for peak material quantities in 20 years and is approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years. One option to reduce the initial capital cost is to do construction in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Due to the relatively small amount of organics received at the Site compared to other facilities in the RDOS, an alternative would be to transport some or all food waste and compostable paper to another facility for processing. However, due to the long distance between Princeton and other facilities, a small on-site organics processor (e.g., dewatering, dehydrating, or composting unit) that is sized just for putrescible organics may be more cost-effective.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 4 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, it was assumed that green and wood waste would be received and stockpiled at the landfill, chipped, and brought to the organics processing area as needed. Therefore, only a small concrete pad is needed at the receiving area.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Residence Time (days)	35	42	28
Number of Piles/Vessels	2	4.5	4
Pile/Vessel Dimensions	20.1 m x 8.0 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	13.5 m x 6.0 m x 3.0 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting
Residence Time (days)	35	14	42
Number of Piles	2	1.5	3
Pile Dimensions	22.7 m x 6.3 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	15.0 m x 6 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
General Site Grading and Preparation	$314,849	$314,636	$313,771
Scale House	$0	$0	$0
Leachate and Surface Water Management	$89,797	$89,750	$89,559
Receiving Building	$15,337	$15,424	$15,424
Organics Processing	$707,727	$1,521,798	$1,412,098
Screening, Curing, and Storage	$66,778	$53,403	$66,382
Equipment (Mobile)	$0	$0	$0
Subtotal Capital (without mobile equipment)	$1,194,488	$1,995,012	$1,897,234
Subtotal Capital (with mobile equipment)	$1,194,488	$1,995,012	$1,897,234
Engineering (10% of non-mobile equipment capital)	$119,449	$199,501	$189,723
Contingency (25% of non-mobile equipment capital)	$298,622	$498,753	$474,309
Total Capital	**$1,612,558**	**$2,693,267**	**$2,561,266**

Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Electricity	$7,036	$7,627	$9,992
Water	$195	$97	$97
Diesel	$0	$0	$0
Labour	$41,926	$42,373	$41,926
Equipment Maintenance and Use	$125,787	$189,262	$161,287
Bi-Product Revenue	-$1,958	-$1,958	-$1,958
Subtotal	**$172,986**	**$237,402**	**$211,345**
Contingency (20%)	$34,597	$47,480	$42,269
Total Operating	**$207,583**	**$284,883**	**$253,613**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Annualized Capital (20 years)	$140,590	$234,811	$223,303
Annual Operating	$207,583	$284,883	$253,613
Annualized Total	$348,173	$519,694	$476,916
Cost per Tonne	**$165**	**$246**	**$226**

Attachments: Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout

LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Facility Area
- Agricultural Land Reserve

NOTES
Base data source:
ALR provided by RDOS.
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
PRINCETON LANDFILL
TOWN OF PRINCETON, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,000
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

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Tt EBA-VANC	May 20, 2015

Figure 1

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT PRINCETON LANDFILL TOWN OF PRINCETON, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,500
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_PrincetonLF_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 20, 2015

Figure 2

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT PRINCETON LANDFILL TOWN OF PRINCETON, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,500
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_PrincetonLF_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

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Figure 3

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
PRINCETON LANDFILL
TOWN OF PRINCETON, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,500
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_PrincetonLF_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 20, 2015

Figure 4

PRINCETON HAYFIELD

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Princeton Hayfield (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 1.6 km east of the Town of Princeton, BC. It is undeveloped land that is uphill from a lagoon treatment system operated by the Princeton Wastewater Department. Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

2.1 Service Area

The Site's service area would be the same as that of Princeton Landfill:

- Town of Princeton
- Electoral Area H

The total service population is 4,492.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is southwest of the wastewater treatment lagoons on the undeveloped hayfield (Figure 3.1). The facility would need less than one hectare of land. This is undeveloped land owned by the Town of Princeton.

[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

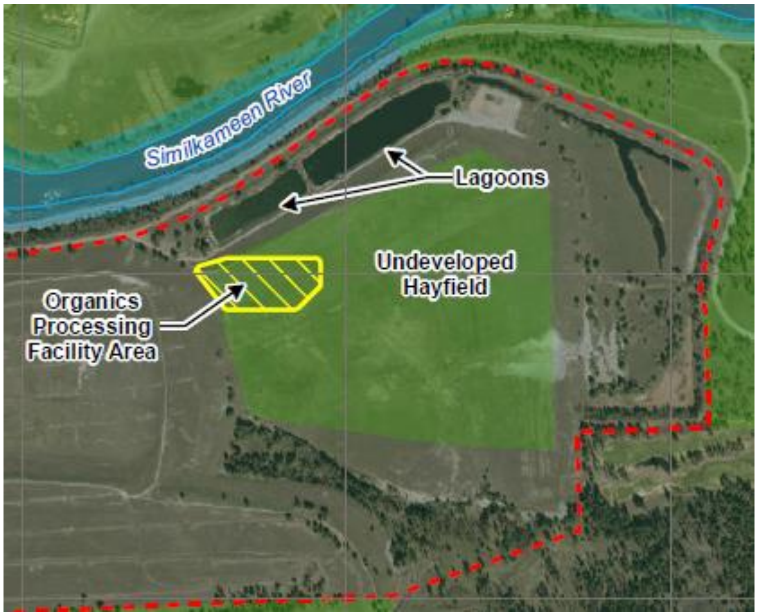

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.1 Infrastructure and Mobile Equipment

As the land is currently undeveloped, there is no infrastructure available at the Site. A scale would need to be installed. Due to the relatively small amount of organics that would be processed at the Site, it was assumed that mobile equipment would be owned by the contractor.

3.3 Feedstock and Design Capacity

Feedstock estimates were developed based on green waste estimates from the Regional Organic Waste Management Strategy, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current municipal solid waste (MSW) consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[2]. Since scale data was not available for MSW, the average per capita MSW generation from Oliver and Osoyoos was used to make a population-based estimate for Princeton. The assumed feedstock composition is based on estimated quantities of green waste and projected quantities of food waste and compostable paper. The total amount of organics feedstock is 1,099 tonnes/year. This is inclusive of materials from residential, commercial, and self-haul waste to the facility. As the amount of available bulking agent (green waste) is not enough for the projected amount of food waste and compostable paper, 600 tonnes would need to be added to the total as additional bulking agent to bring the total quantity to 1,699 tonnes/year. This bulking agent can be brought in as hog fuel from a nearby mill operated by Weyerhaeuser. Assuming a growth rate of 1.1%[3] over the next 20 years, the annual quantity of feedstock is calculated to be 2,114 tonnes/year.

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[2] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.
http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[3] BC Stats Census Total Population Results, 2011.
http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. As scale data was not available, the peak month and percentage was assumed to be the same as Keremeos. During this month, the organics accounted for approximately 12% of all organics throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 61 tonnes/week.

The assumed feedstock composition is presented in Table 1 below.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	1,263	60%
Food Waste and Compostable Paper	852[1]	40%
Total	**2,114**	**100%**
Design Capacity (tonnes/week)	**61**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

3.3.1 Compost Market Considerations

There is generally low agricultural demand for compost in the area around Princeton. However, the landfill will need top soil for final cover, so that is one potential use for the compost. The Town of Princeton, Ministry of Transportation, and private businesses can also use the compost for projects such as road construction, turf for golf courses, and landscaping.

3.3.2 Other Design Considerations

The design capacity was estimated for peak material quantities in 20 years and is approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years. One option to reduce the initial capital cost is to do construction in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Due to the relatively small amount of organics received at the Site compared to other facilities in the RDOS, an alternative would be to transport some or all food waste and compostable paper to another facility for processing. However, due to the long distance between Princeton and other facilities, a small on-site organics processor (e.g., dewatering, dehydrating, or composting unit) that is sized just for putrescible organics may be more cost-effective. Other considerations are that designated staff would be needed for the Site (e.g., scale operator) since it is not adjacent to a landfill, which increases operating costs.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 4 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, it was assumed that green and wood waste would be received and stockpiled at the bulking agent storage area. Therefore, only a small concrete pad is needed at the receiving area.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Residence Time (days)	35	42	28
Number of Piles/Vessels	2	4.5	4
Pile/Vessel Dimensions	20.1 m x 8.0 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	13.5 m x 6.0 m x 3.0 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting
Residence Time (days)	35	14	42
Number of Piles	2	1.5	3
Pile Dimensions	22.7 m x 6.3 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	15.0 m x 6 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
General Site Grading and Preparation	$264,899	$264,686	$263,821
Scale House	$50,000	$50,000	$50,000
Leachate and Surface Water Management	$89,797	$89,750	$89,559
Receiving Building	$15,337	$15,424	$15,424
Organics Processing	$707,727	$1,521,798	$1,412,098
Screening, Curing, and Storage	$66,778	$53,403	$66,382
Equipment (Mobile)	$0	$0	$0
Subtotal Capital (without mobile equipment)	$1,194,538	$1,995,062	$1,897,284
Subtotal Capital (with mobile equipment)	$1,194,538	$1,995,062	$1,897,284
Engineering (10% of non-mobile equipment capital)	$119,454	$199,506	$189,728
Contingency (25% of non-mobile equipment capital)	$298,634	$498,766	$474,321
Total Capital	**$1,612,626**	**$2,693,334**	**$2,561,334**

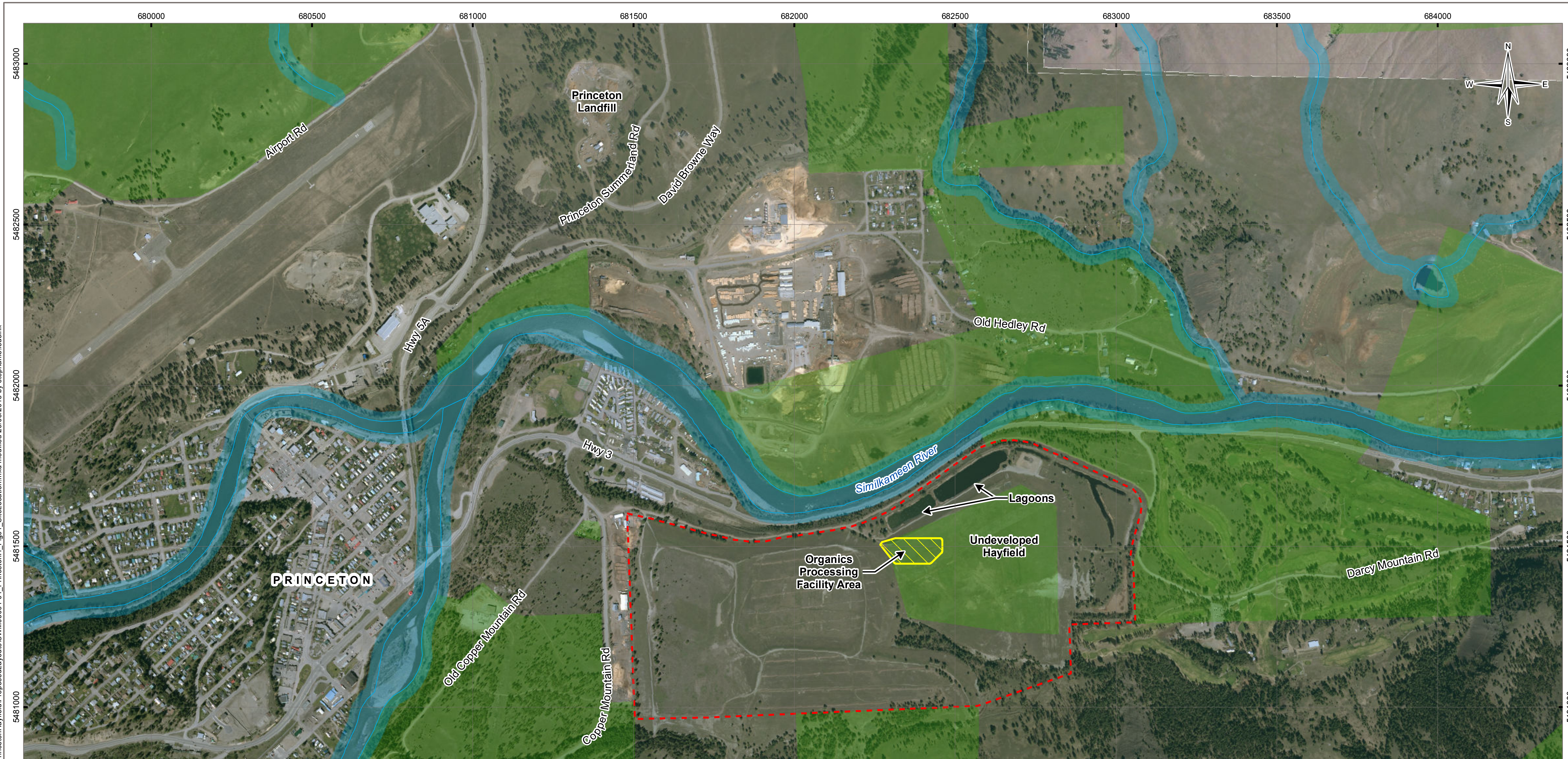
Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Electricity	$7,036	$7,627	$9,992
Water	$195	$97	$97
Diesel	$0	$0	$0
Labour	$114,726	$115,173	$114,726
Equipment Maintenance and Use	$125,787	$189,262	$161,287
Bi-Product Revenue	-$1,958	-$1,958	-$1,958
Subtotal	**$245,786**	**$310,202**	**$284,145**
Contingency (20%)	$49,157	$62,040	$56,829
Total Operating	**$294,943**	**$372,243**	**$340,973**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Annualized Capital (20 years)	$140,596	$234,817	$223,309
Annual Operating	$294,943	$372,243	$340,973
Annualized Total	$435,539	$607,060	$564,282
Cost per Tonne	**$206**	**$287**	**$267**

Attachments: Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout



NOTES
Base data source:
ALR and Watercourses provided by RDOS.
Imagery provided by RDOS (2013);
Google Earth Pro; Province of BC (2003).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
PRINCETON HAYFIELD SITE
TOWN OF PRINCETON, BC

Site Location

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:12,000 (200 100 0 200 Metres)

TETRA TECH EBA

FILE NO.				
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	DATE			
Tt EBA-VANC	May 20, 2015			

Figure 1

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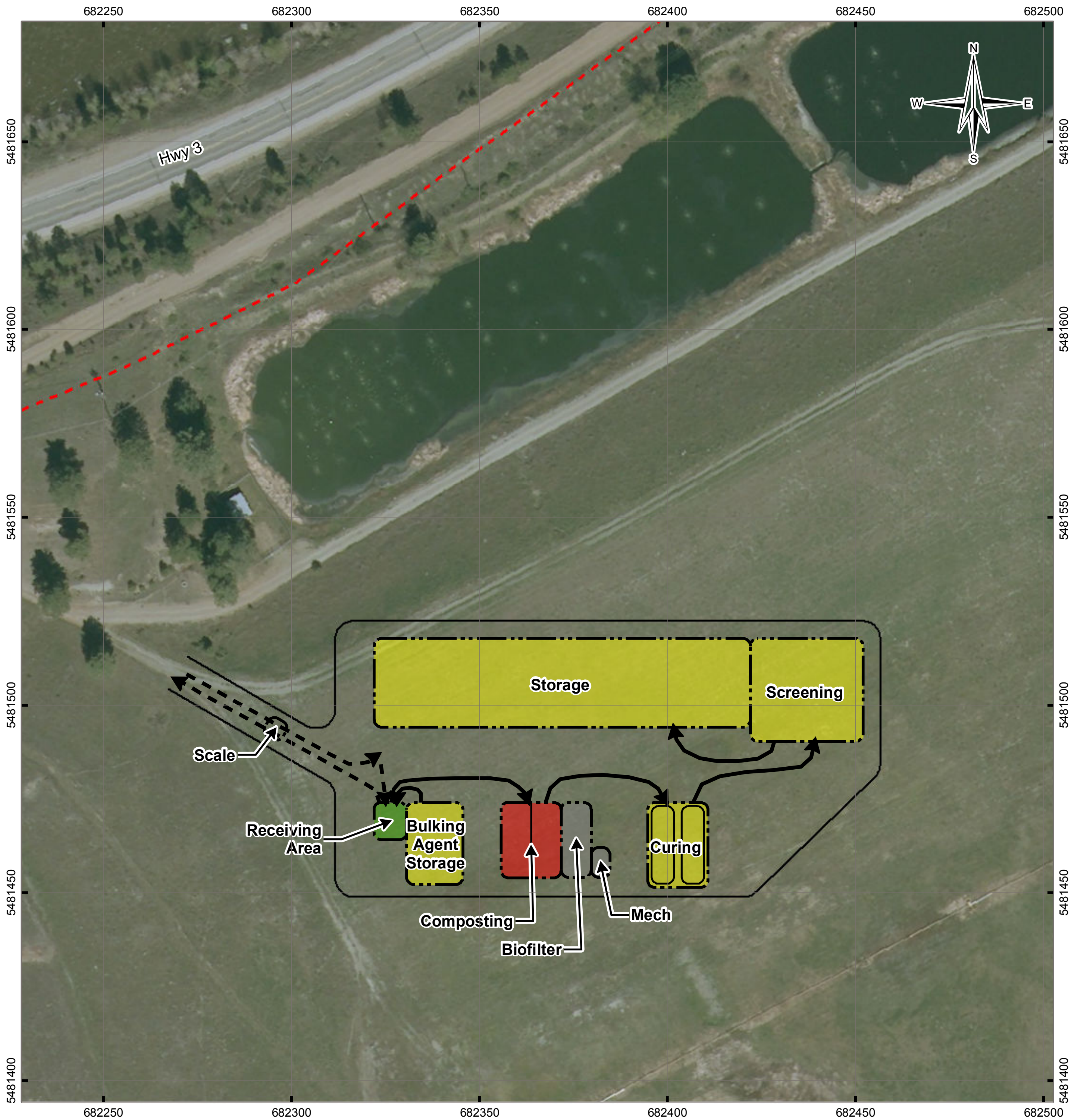

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT PRINCETON HAYFIELD SITE TOWN OF PRINCETON, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,500
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 20, 2015

Figure 2

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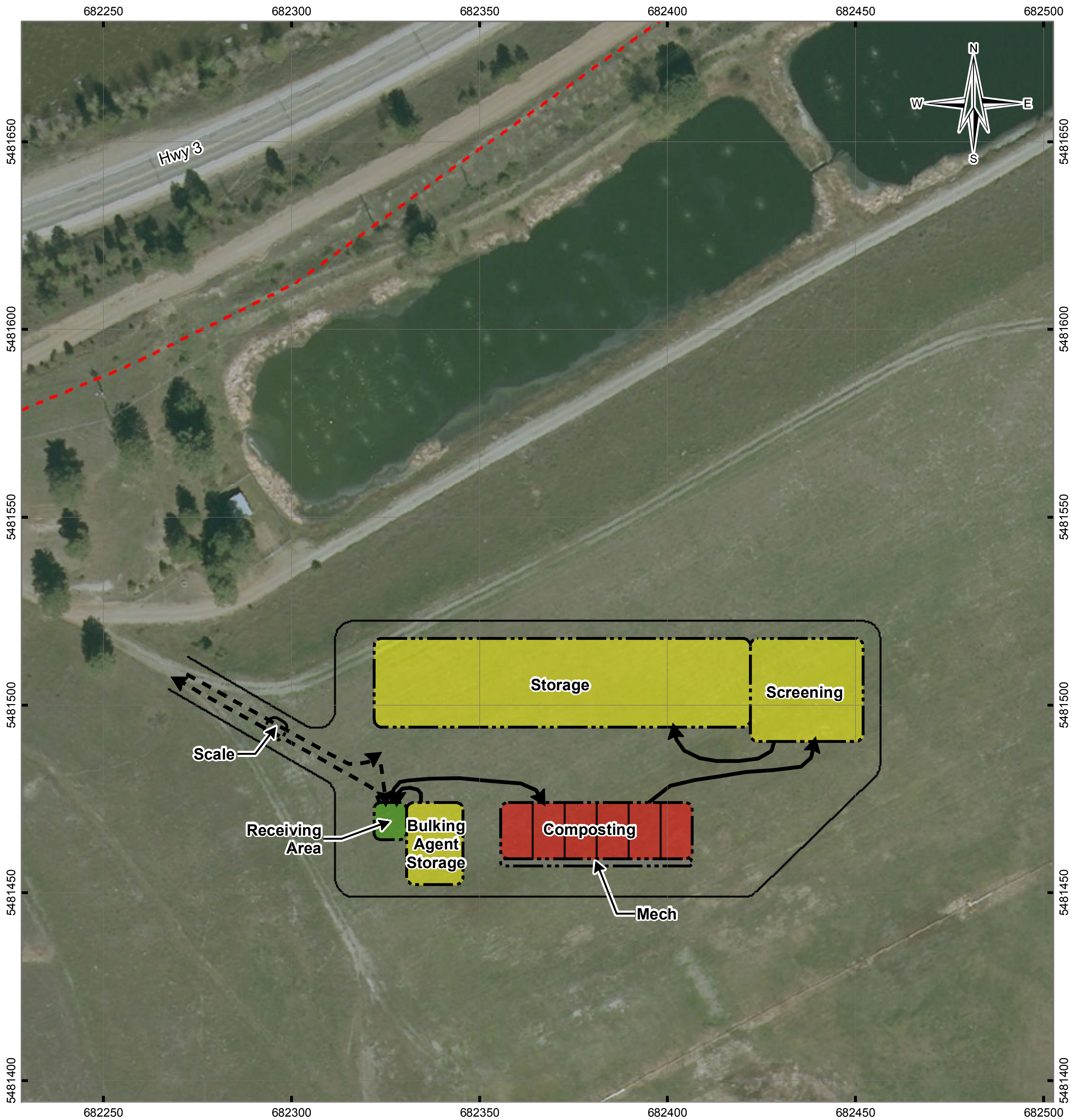

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
PRINCETON HAYFIELD SITE
TOWN OF PRINCETON, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,500
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 20, 2015

Figure 3

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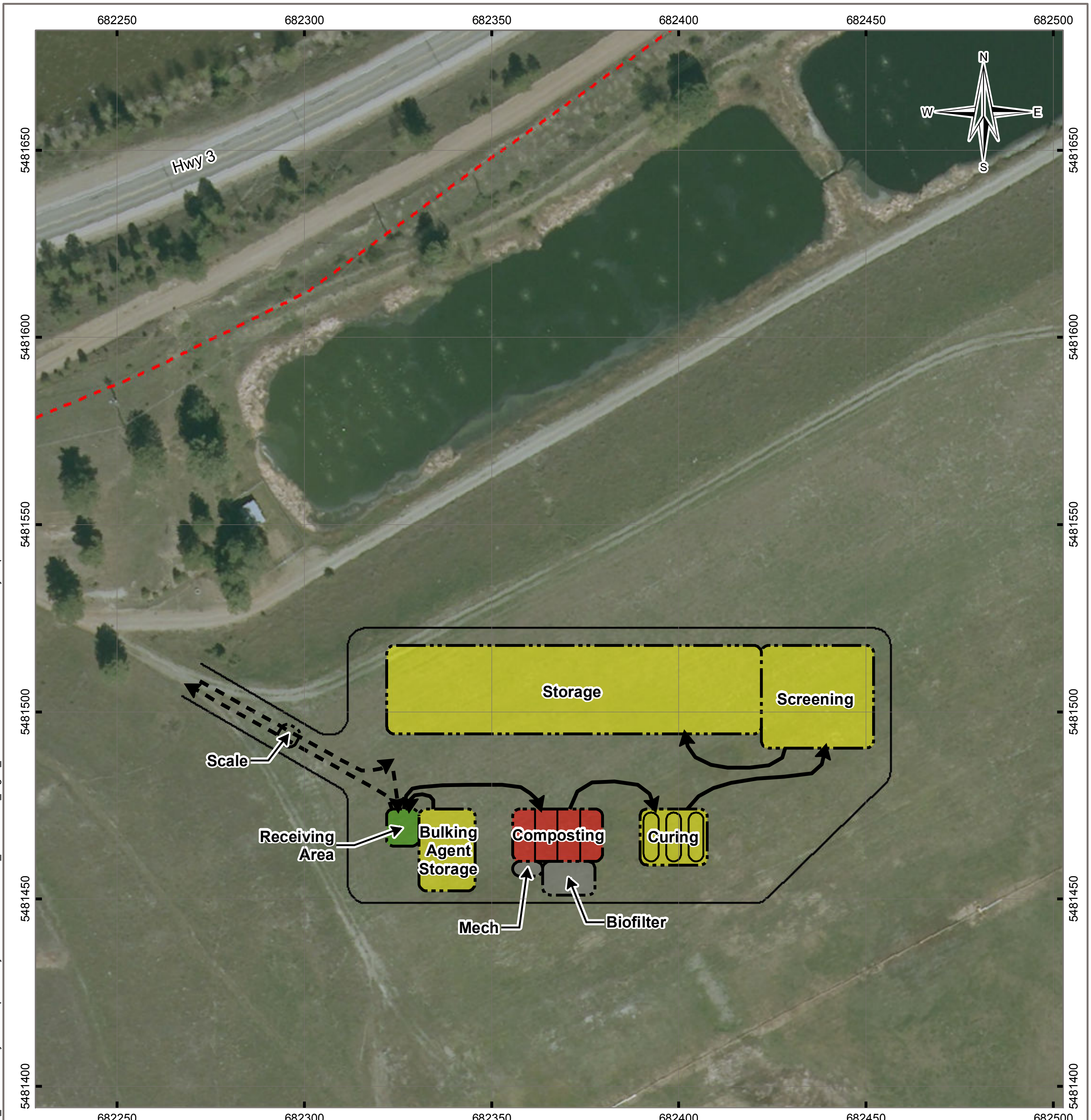

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT PRINCETON HAYFIELD SITE TOWN OF PRINCETON, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,500
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_PrincetonH_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 20, 2015

Figure 4

KEREMEOS TRANSFER STATION

1.0 INTRODUCTION

The following is a feasibility assessment for locating an organics management facility at Keremeos Transfer Station (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 2 km north of the Village of Keremeos, BC. It is a closed landfill that has converted to a transfer station, operated by the Regional District of Okanagan-Similkameen (RDOS).

2.1 Service Area

The Site's service area includes:

- Village of Keremeos
- Adjacent areas, including Cawston, Olalla, and Hedley

The total service population is 5,103.

2.2 Accepted Materials at the Transfer Station

The Site accepts the following materials:

- Municipal solid waste (MSW)
- Construction and demolition (C&D) waste
- Organics (more details below)
- Recyclable materials

2.3 Organics Currently Accepted

Organics received at the Site is separated from refuse and currently consist of:

- Leaf and yard waste (green waste)
- White wood (painted wood and dimensional lumber)

Currently, organics are stored in piles and chipped periodically for use at the Site (Figure 1). This facility does not compost organics. A scale was not installed at the Site until end of year 2013. Therefore, it was estimated that 501 tonnes of the green waste was received at the Site using available 2014 scale data.

Further information about the Site can be found in Organic Management Consultant Task 1 – Site Assessment[1].

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[1] Organic Management Consultant Task 1 – Site Assessment, 2014. http://www.rdos.bc.ca/departments/public-works/solid-waste/organic-management-facilities/

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is on top of the closed landfill towards the middle of the Site (Figure 3.1). Note that this is not an ideal location for an organics processing facility due to the steep slopes on either side, differential settlement from the landfilled waste, and potential for landfill gas seepage if the cap is disturbed. There is approximately 0.25 ha of available land in this area.

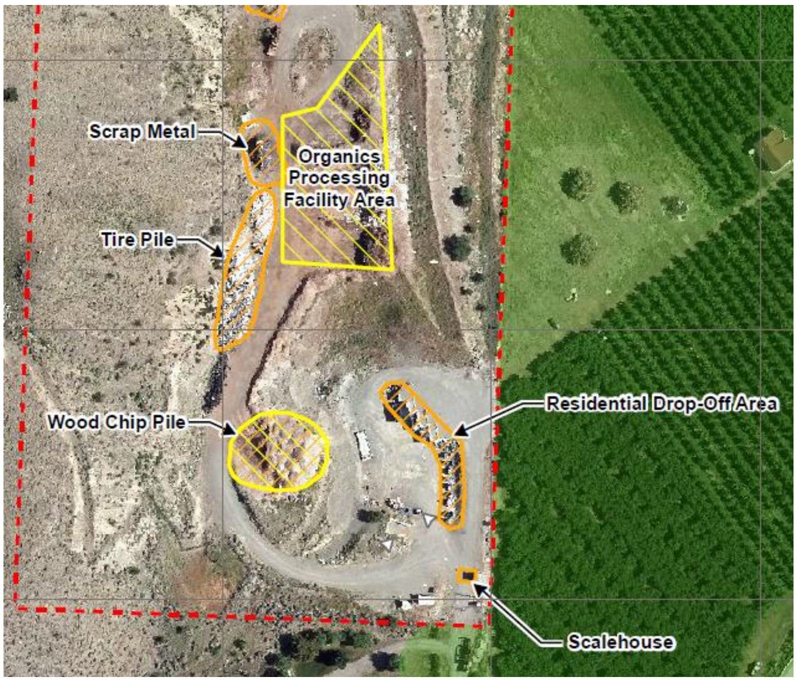

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.2 On-Site Infrastructure and Mobile Equipment

As the proposed location is within the closed landfill, it was assumed that the scale can be shared with the organics processing facility. No equipment is kept at the Site because it is only in operation for limited hours. Equipment such as a loader and grinder would need to be brought to the Site by the contractor.

3.3 Feedstock and Design Capacity

Feedstock quantities were calculated based on scale estimates for green waste, biosolids and proportion of food waste and compostable paper in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[2].

Since MSW is currently transferred the Campbell Mountain Landfill without any disposal records, an estimate of the MSW generated in Keremeos was calculated based on the average MSW per capita disposal rate of 535 kg/year (from other sites with data). Biosolids from Keremeos, which is currently taken to Okanagan Falls Landfill, was also added to the overall total. The total amount of organics feedstock is calculated to be 1,301 tonnes/year. This is inclusive of materials from residential, commercial, and self-haul waste to the facility. As the amount of available bulking agent (green waste) is not enough for the projected amount of biosolids, food waste and compostable paper, 300 tonnes was added to the total as additional bulking agent to bring the total feedstock quantity to 1,601 tonnes/year. This bulking agent can be brought in from another site with excess wood waste. Assuming a growth rate of 1.1%[3] over the next 20 years, the annual feedstock quantity is calculated to be 1,993 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. For Keremeos, the peak month was May. During this month, the organics accounted for approximately 12% of all organics throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 57 tonnes/week.

The assumed feedstock composition is presented in Table 1 below.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	997	50%
Biosolids	112	6%
Food Waste and Compostable Paper	884[1]	44%
Total	**1,993**	**100%**
Design Capacity (tonnes/week)	**57**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

[2] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.
http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[3] BC Stats Census Total Population Results, 2011.
http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

3.3.1 Compost Market Considerations

There is a high demand for compost in the area around Keremeos due to the large number of fruit orchards. Since this compost is primarily used for agriculture, it may be worthwhile to pursue higher compost quality to increase its marketability.

Compost made from biosolids and white wood is undesirable to potential customers. In Canada and the United States, organic food regulations prohibit the use of sewage sludge for growing food[4],[5]. Agricultural operations seeking an organic certification will stay away from using compost that would affect the marketability of their crop.

To further increase the marketability of the finished compost product, certification through an independent reviewer such as Organic Materials Review Institute (OMRI) may be considered.

3.3.2 Other Design Considerations

Due to the relatively small amount of organics received at the Site compared to other facilities in the RDOS, an alternative would be to transport some or all food waste and compostable paper to another facility for processing. Since MSW is already being transported to Campbell Mountain Landfill, the same can be done for organics. However, due to the long distance between Keremeos and other facilities, a small on-site organics processor (e.g., dewatering, dehydrating, or composting unit) that is sized just for putrescible organics may be more cost-effective.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 4 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, it was assumed that green and wood waste would be received and stockpiled at the Site, chipped, and brought to the organics processing area as needed. Therefore, only a small concrete pad is needed at the receiving area.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint

[4] Organic Product Systems Permitted Substances Lists, 2011. https://www.cog.ca/uploads/PSL.pdf
[5] USDA National Organic Program, 2015. http://www.ams.usda.gov/AMSv1.0/NOPOrganicStandards

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Residence Time (days)	35	42	28
Number of Piles/Vessels	2	4.5	4
Pile/Vessel Dimensions	18.8 m x 8.0 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	13.5 m x 6.0 m x 3.0 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting
Residence Time (days)	35	14	42
Number of Piles	2	1.5	3
Pile Dimensions	21.2 m x 6.3 m x 3.0 m	15.0 m x 6.0 m x 2.5 m	15.0 m x 6 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
General Site Grading and Preparation	$245,365	$245,885	$244,773
Scale House	$0	$0	$0
Leachate and Surface Water Management	$85,625	$85,809	$85,416
Receiving Building	$14,331	$14,413	$14,413
Organics Processing	$706,553	$1,521,798	$1,412,098
Screening, Curing, and Storage	$59,871	$47,398	$59,590
Equipment (Mobile)	$0	$0	$0
Subtotal Capital (without mobile equipment)	$1,111,746	$1,915,302	$1,816,290
Subtotal Capital (with mobile equipment)	$1,111,746	$1,915,302	$1,816,290
Engineering (10% of non-mobile equipment capital)	$111,175	$191,530	$181,629
Contingency (25% of non-mobile equipment capital)	$277,936	$478,826	$454,072
Total Capital	**$1,500,857**	**$2,585,658**	**$2,451,991**

Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Electricity	$7,018	$7,609	$9,974
Water	$131	$65	$65
Diesel	$0	$0	$0
Labour	$39,250	$39,835	$39,250
Equipment Maintenance and Use	$112,252	$176,258	$147,752
Bi-Product Revenue	-$3,765	-$3,765	-$3,765
Subtotal	**$154,886**	**$220,003**	**$193,277**
Contingency (20%)	$30,977	$44,001	$38,655
Total Operating	**$185,863**	**$264,003**	**$231,932**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting
Annualized Capital (20 years)	$130,852	$225,429	$213,776
Annual Operating	$185,863	$264,003	$231,932
Annualized Total	$316,714	$489,433	$445,708
Cost per Tonne	**$159**	**$246**	**$224**

Attachments: Figure 1. Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout

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LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Facility Area
- Agricultural Land Reserve

NOTES
Base data source:
ALR provided by RDOS.
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT KEREMEOS TRANSFER STATION, VILLAGE OF KEREMEOS, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500

50 25 0 50

Metres

TETRA TECH EBA

FILE NO.
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PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 26, 2015

Figure 1

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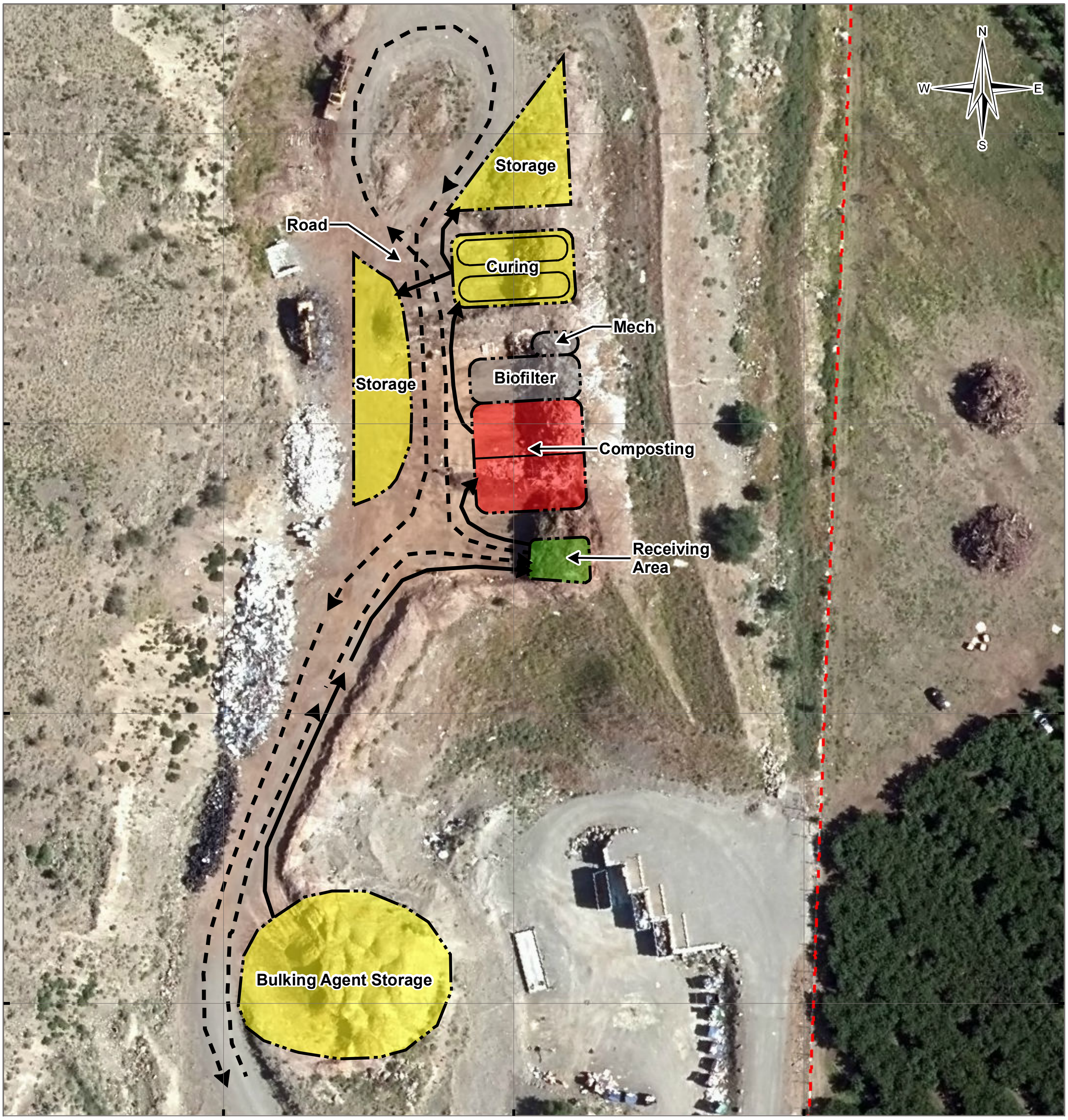

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT KEREMEOS TRANSFER STATION, VILLAGE OF KEREMEOS, BC

Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
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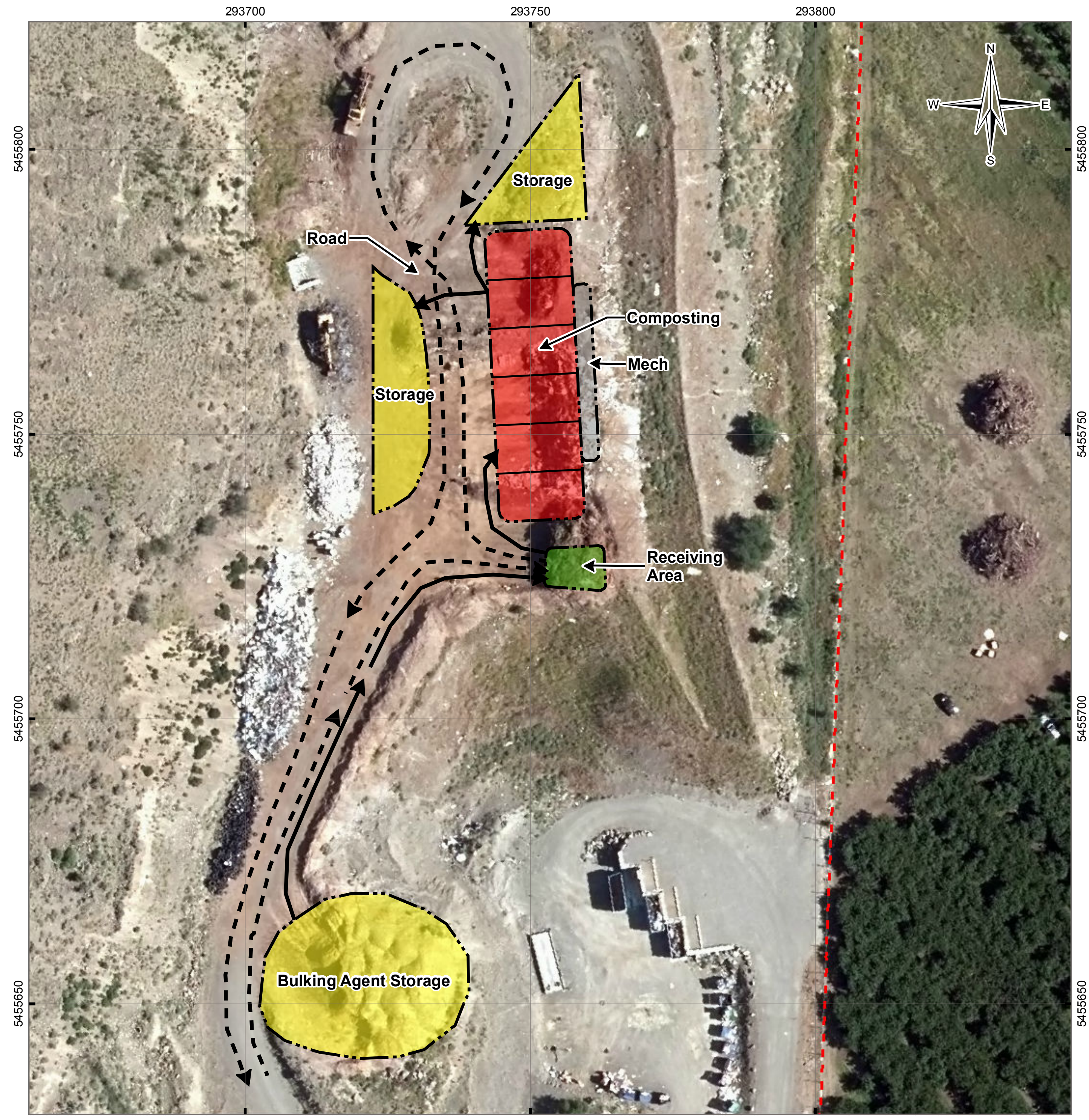
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	June 8, 2015

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Storage
- Receiving Area
- Mech
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT KEREMEOS TRANSFER STATION, VILLAGE OF KEREMEOS, BC

Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

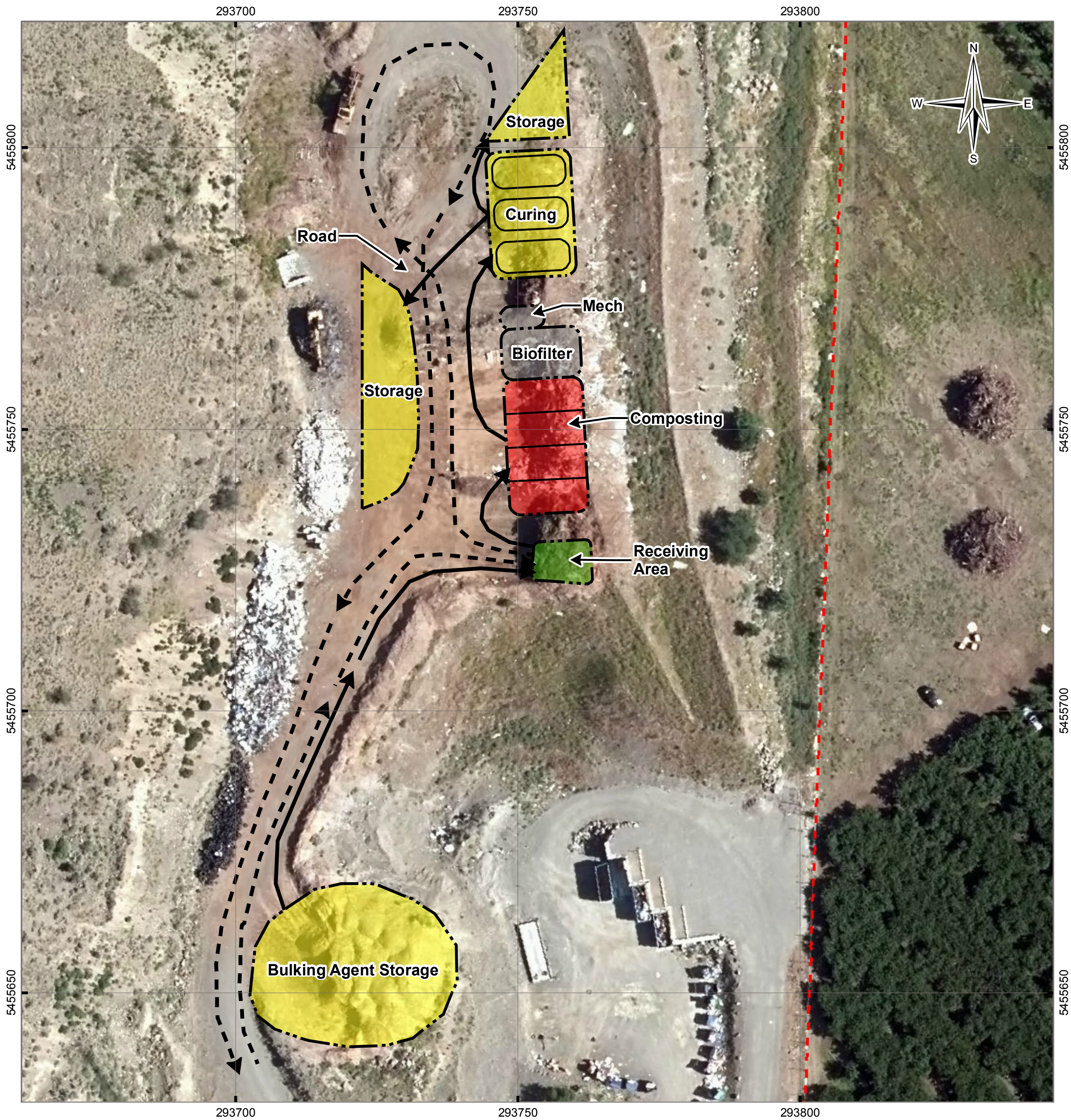
TETRA TECH EBA

FILE NO.
SWM03094-01_KeremeosTS_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	May 26, 2015

Figure 3



Q:\Vancouver\GIS\ENVIRONMENTAL\SWM\SWM03094-01_RDOS\Maps\06_KeremeosTransfer\ProposedLayouts\SWM03094-01_KeremeosTS_Fig04_InVessel.mxd modified 08/06/2015 by stephanie.leusink

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2013).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT KEREMEOS TRANSFER STATION, VILLAGE OF KEREMEOS, BC

In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_KeremeosTS_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	June 8, 2015

Figure 4

CAMPBELL MOUNTAIN REGIONAL

1.0 INTRODUCTION

The following is a feasibility assessment for locating a regional organics management facility at Campbell Mountain Landfill (hereafter referred to as the “Site”).

2.0 SITE INFORMATION

The Site is 5 km northeast of the City of Penticton, British Columbia. It is an active landfill operated by the Regional District of Okanagan-Similkameen (RDOS) and biosolids composting facility operated by the City of Penticton. Additional information about the Site can be found in the *Campbell Mountain Landfill Feasibility Assessment*.

2.1 Service Area Assumptions

For this assessment, the Site’s service area includes organics from the Campbell Mountain, Summerland, Oliver, and Osoyoos service areas. This includes:

- City of Penticton;
- Village of Keremeos;
- Penticton Indian Band;
- Lower Similkameen Indian Band;
- Upper Similkameen Indian Band;
- District of Summerland;
- Town of Oliver;
- Town of Osoyoos; and
- Electoral Areas A, B, C, D, E, F, and G (including West Bench, Sage Mesa, Cawston, Okanagan Falls, Kaleden, Apex Mountain, Naramata, Hedley, Olalla, and Rural Keremeos).

The total service population is assumed to be 75,655, of which 5,103 is from the Keremeos Transfer Station service area.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

For a regional facility, which will receive approximately double the amount of feedstock, the proposed location used in the *Campbell Mountain Landfill Feasibility Assessment* is no longer adequate. Approximately 4 ha is required for a regional facility and the available land within the landfill footprint is only 2.5 ha. Therefore, the proposed location of the regional organics processing facility was moved to the parcel of land to the east of Spiller Road (Figure 3.1). Currently, this is undeveloped land. There is approximately 12 ha of available land in this area. It was assumed that this area would be used for composting, curing, screening, and a limited amount of storage. Additional storage would take place across Greyback Mountain Road south of the Site.

Note that the Site is within direct line of site from passing residents, within the Agricultural Land Reserve (ALR), contains areas with steep slopes, and has potential environmentally sensitive habitats. Furthermore, to develop the Site, Spiller Road would need to be relocated to the east, resulting in additional capital costs. A high-level estimate of the road construction cost is included in this assessment. However, as this is a conceptual-level study, it was not within the scope of work to conduct a more detailed assessment of the Site to quantify the costs associated with potential geotechnical challenges and additional environmental assessments.

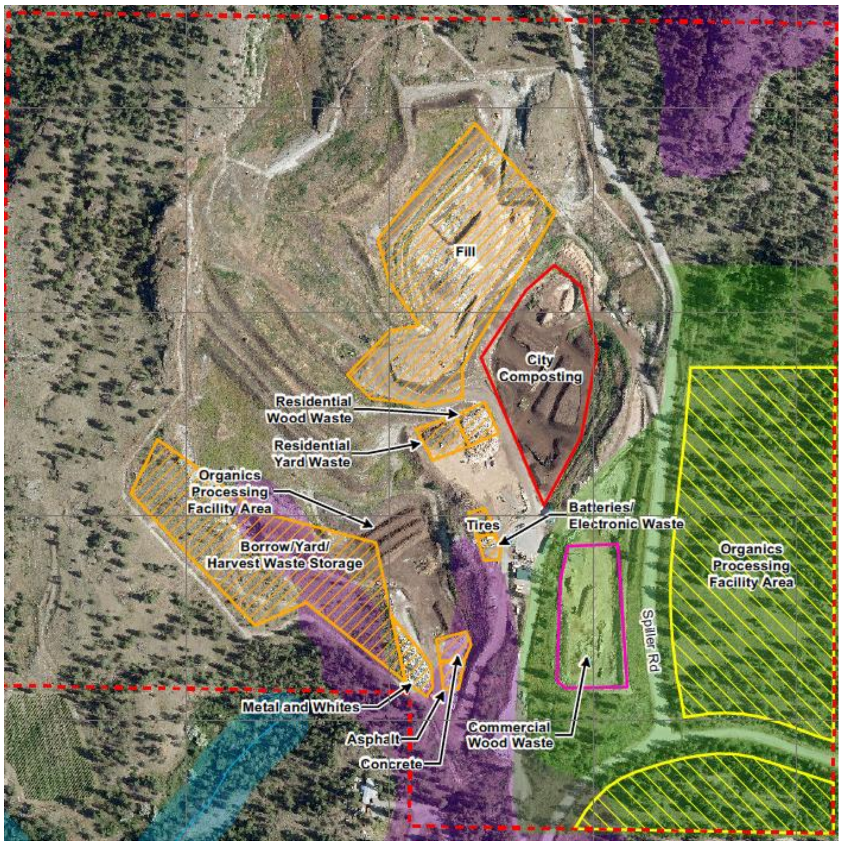


Figure 3.1: Proposed Location of Organics Processing Facility

3.2.1 On-Site Infrastructure and Mobile Equipment

The following infrastructure and mobile equipment are available on site and assumed could be used for the organics processing facility. As there is only one loader available, additional loaders would need to be purchased.

- Scale;
- Loader;
- Grinder; and
- Trommel screen.

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013 for Campbell Mountain, Summerland, Oliver, and Osoyoos, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[1]. The total amount of available organics feedstock is calculated to be 37,278 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of biosolids, green waste, and white wood, and projected quantities of food waste and compostable paper. Assuming a growth rate of 1.1%[2] over the next 20 years, the projected quantity of feedstock is calculated to be 46,395 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, a weighted average of the peak months from Campbell Mountain, Summerland, Oliver, and Osoyoos was calculated. During the peak month, the waste collected accounts for approximately 11% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 1,213 tonnes/week.

The assumed feedstock composition is presented in Table 1 below. Generally the ratio of food waste/biosolids to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	25,635	55%
Biosolids	7,887	17%
Food Waste and Compostable Paper	12,873[1]	28%
Total	**46,395**	**100%**
Design Capacity (tonnes/week)	**1,213**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

3.3.1 Compost Market Considerations

As biosolids is close to 20% of the feedstock, it can be processed separately in its own piles or vessels. This would increase the marketability of the finished compost product, as biosolids-free compost would be more attractive to a wider range of customers, especially in the agriculture sector. Compost containing biosolids can be used for non-agricultural purposes, such as landfill cover, construction projects, turf for golf courses, and landscaping. Furthermore, due to the large amount of white wood waste, biosolids can be composted with white wood so that green waste can be reserved for composting with food waste.

[1] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf.

[2] British Columbia Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas, such as a neighbouring regional district.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 5 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area consists of two dome-shaped fabric buildings on top of concrete blocks. Each building is approximately 22 m by 48 m. One building is for food waste and the other is for biosolids to keep these materials segregated.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Currently used at City of Penticton biosolids composting facility ▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Technology is more suitable for larger facilities
Anaerobic Digestion	▪ Improves odour and moisture control ▪ Opportunity for energy recovery ▪ Biosolids are not currently digested, and may be digested with this technology ▪ Potential to add biosolids from the Regional District of Central Okanagan ▪ Technology is more suitable for larger facilities

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Residence Time (days)	35	42	28	21
Number of Piles/Vessels	16	13.5	16	12
Pile/Vessel Dimensions	49.9 m x 8.0 m x 3.0 m	50.0 m x 8.0 m x 3.5 m	35.5 m x 9.0 m x 3.0 m	29.0 m x 5.5 m x 2.6 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting	Anaerobic Digestion (Primary)	Anaerobic Digestion (Secondary)
Residence Time (days)	35	14	42	28	21
Number of Piles	16	4.5	24	12	4
Pile Dimensions	38.3 m x 8.0 m x 3.0 m	50.0 m x 8.0 m x 3.5 m	35.5 m x 6.8 m x 3.0 m	45.1 m x 8.0 m x 3.0 m	40.6 m x 16.0 m x 3.0 m

[1]Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
General Site Grading and Preparation	$3,168,870	$3,090,760	$3,152,044	$3,126,923
Scale House	$0	$0	$0	$0
Leachate and Surface Water Management	$243,029	$236,877	$239,784	$237,006
Receiving Building	$987,272	$987,272	$987,272	$987,272
Organics Processing	$6,582,265	$8,762,892	$13,501,405	$27,733,219
Screening, Curing, and Storage	$925,873	$710,323	$959,988	$826,801
Equipment (Mobile)	$425,000	$425,000	$425,000	$425,000
Subtotal Capital (without mobile equipment)	**$11,907,309**	**$13,788,124**	**$18,840,492**	**$32,911,220**
Subtotal Capital (with mobile equipment)	**$12,332,309**	**$14,213,124**	**$19,265,492**	**$33,336,220**
Engineering (10% of non-mobile equipment capital)	$1,190,731	$1,378,812	$1,884,049	$3,291,122
Contingency (25% of non-mobile equipment capital)	$2,976,827	$3,447,031	$4,710,123	$8,227,805
Total Capital	**$16,499,867**	**$19,038,968**	**$25,859,664**	**$44,855,148**

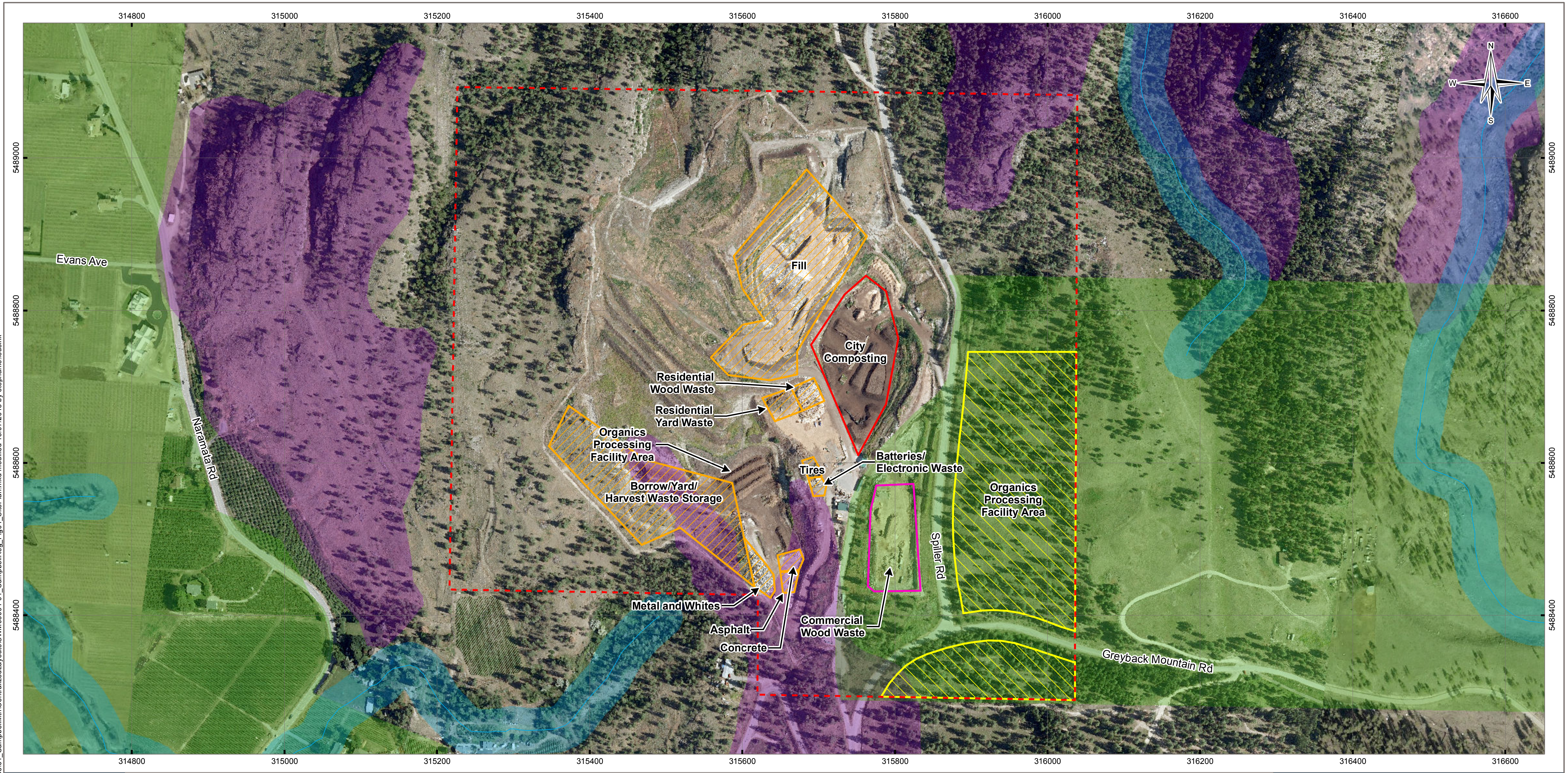
Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Electricity	$58,523	$45,514	$58,523	$52,610
Water	$2,780	$1,390	$1,390	$2,780
Diesel	$326,911	$365,323	$326,911	$388,633
Labour	$238,294	$258,883	$238,294	$271,376
Equipment Maintenance and Use	$430,388	$674,925	$782,572	$1,500,446
Bi-Product Revenue	-$81,649	-$81,649	-$81,649	-$310,397
Subtotal	**$975,247**	**$1,264,386**	**$1,326,041**	**$1,905,447**
Contingency (20%)	$195,049	$252,877	$265,208	$381,089
Total Operating	**$1,170,296**	**$1,517,263**	**$1,591,249**	**$2,286,537**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Annualized Capital (20 years)	$1,438,534	$1,659,904	$2,254,563	$3,910,676
Annual Operating	$1,170,296	$1,517,263	$1,591,249	$2,286,537
Annualized Total	$2,608,830	$3,177,167	$3,845,812	$6,197,213
Cost per Tonne	**$56**	**$68**	**$83**	**$134**

Attachments: Figure 1: Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout
Figure 5: Anaerobic Digestion Site Layout



LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Proposed Relocation of City of Penticton Composting
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR, Environmentally Sensitive Habitat and Watercourses provided by RDOS.
Imagery provided by RDOS (2014); Google Earth Pro; City of Penticton (2004).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Campbell Mountain Regional Facility Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:5,000
100 50 0 100
Metres

FILE NO.
SWM03094-01_CampbellReg_Fig01_SitePlan.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 14, 2015

TETRA TECH EBA

Figure 1

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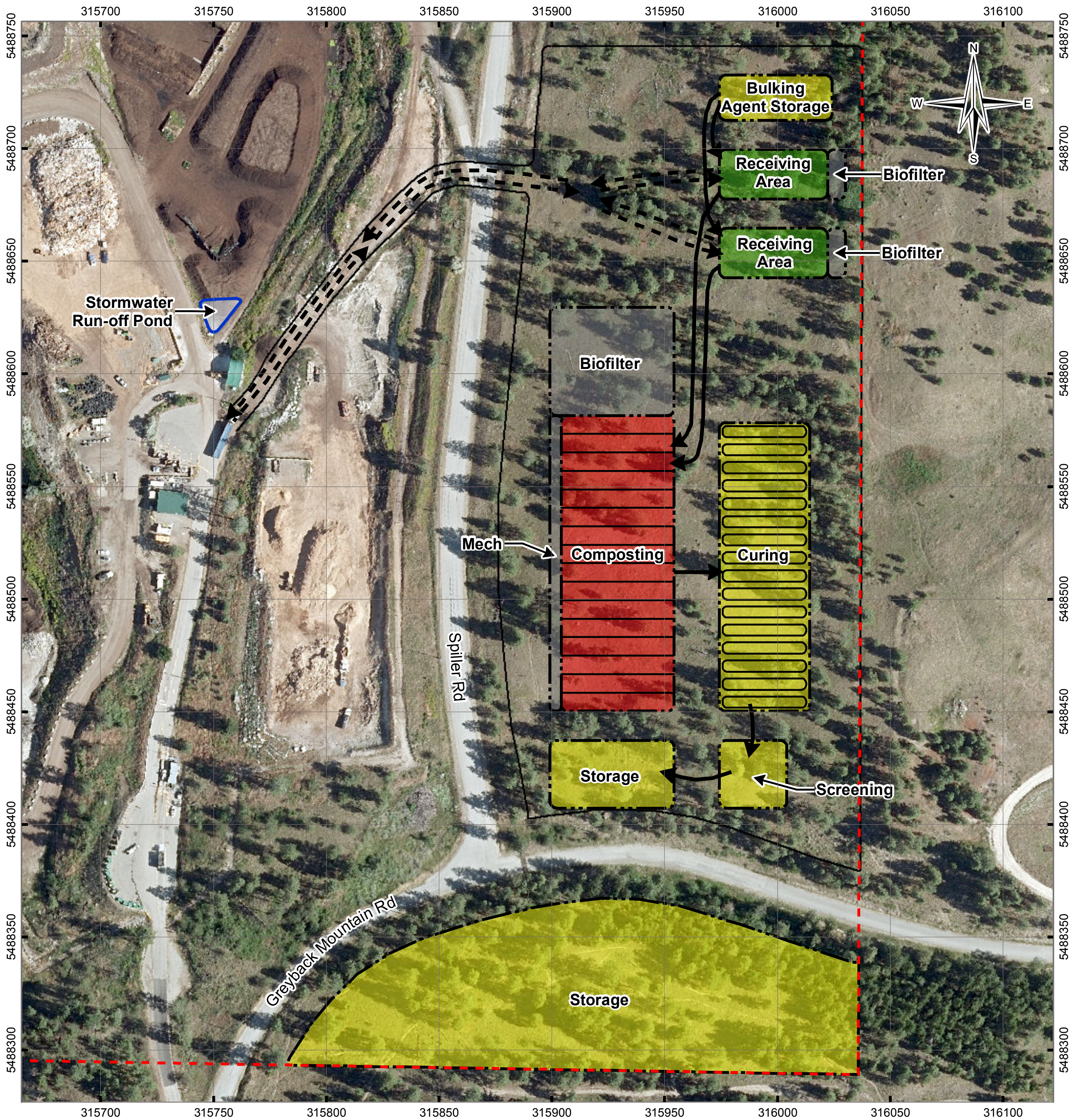


LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Campbell Mountain Regional Facility Aerated Static Pile Site Layout

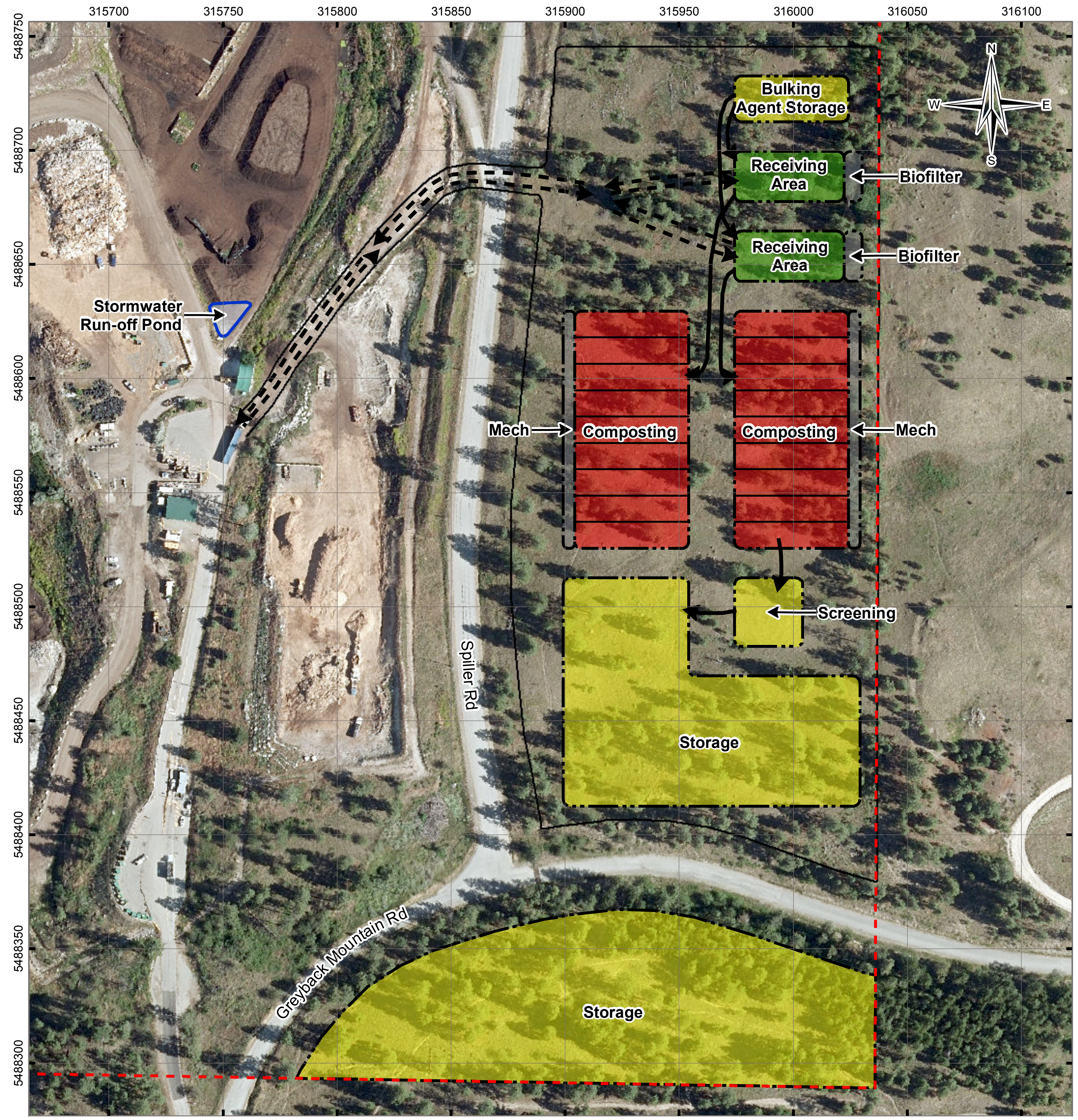
PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_CampbellReg_Fig02_ASP.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	July 15, 2015			

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
CAMPBELL MOUNTAIN LANDFILL
PENTICTON, BC

Campbell Mountain Regional Facility Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500
40 20 0 40
Metres

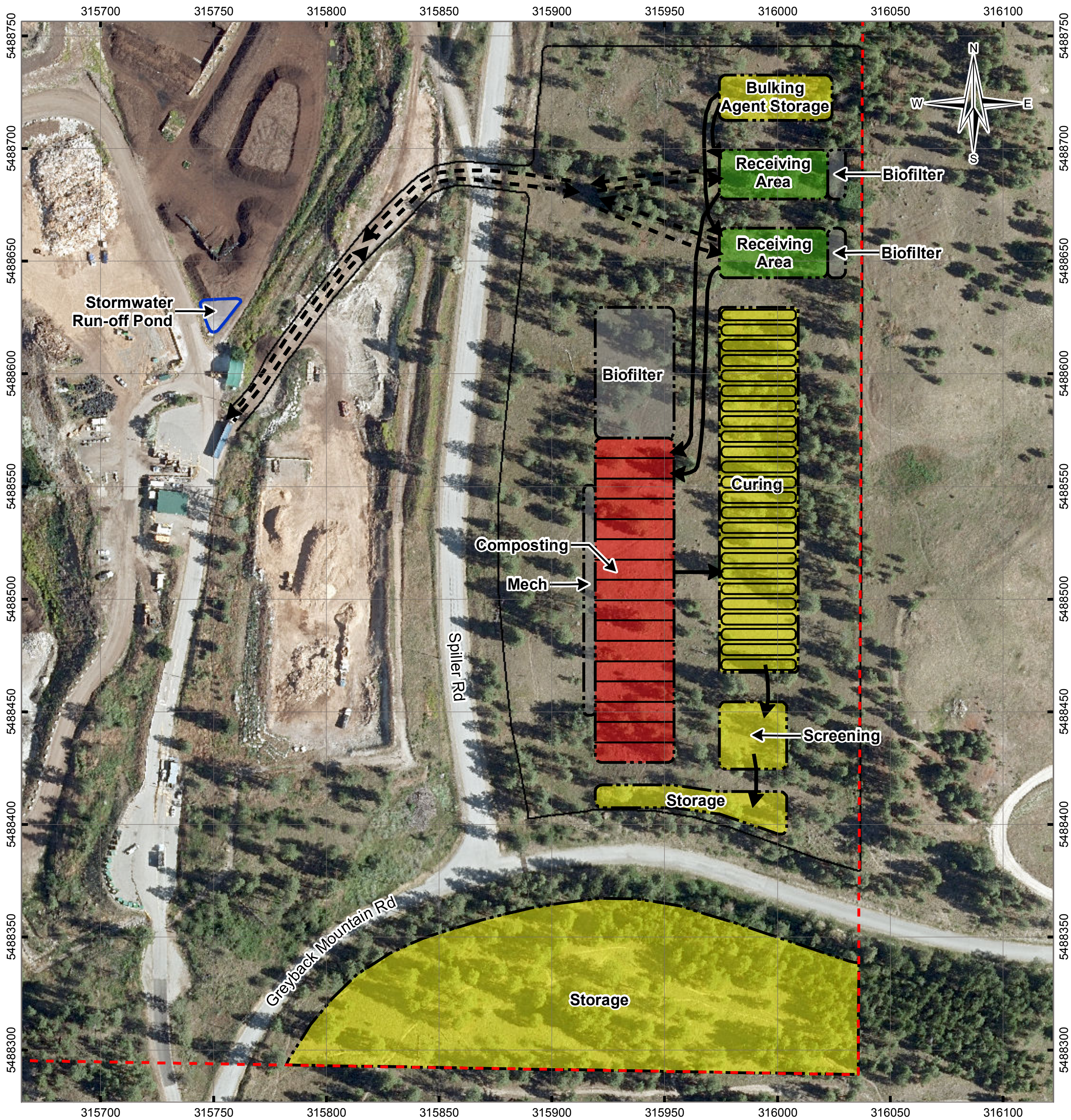
TETRA TECH EBA

FILE NO.
SWM03094-01_CampbellReg_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 15, 2015

Figure 3



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT CAMPBELL MOUNTAIN LANDFILL PENTICTON, BC

Campbell Mountain Regional Facility In-Vessel Composting Site Layout

PROJECTION UTM Zone 11
DATUM NAD83
CLIENT Regional District of Okanagan-Similkameen

Scale: 1:2,500
40 20 0 40
Metres

TETRA TECH EBA

FILE NO. SWM03094-01_CampbellReg_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE Tt EBA-VANC
DATE July 15, 2015

Figure 4

LEGEND

- Loader Movement
- Truck Movement
- Anaerobic Digestion
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
CAMPBELL MOUNTAIN LANDFILL
PENTICTON, BC

Campbell Mountain Regional Facility
Anaerobic Digestion
Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500
40 20 0 40
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_CampbellReg_Fig05_AD.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 15, 2015

Figure 5

SUMMERLAND REGIONAL

1.0 INTRODUCTION

The following is a feasibility assessment for locating a regional organics management facility at Summerland Landfill (hereafter referred to as the "Site").

2.0 SITE INFORMATION

The Site is 4 km southwest of the Town of Summerland, British Columbia. It is an active landfill operated by the District of Summerland. Additional information about the Site can be found in the *Summerland Landfill Feasibility Assessment*.

2.1 Service Area Assumptions

For this assessment, the Site's service area includes organics from the Campbell Mountain, Summerland, Oliver, and Osoyoos service areas. This includes:

- City of Penticton;
- Village of Keremeos;
- Penticton Indian Band;
- Lower Similkameen Indian Band;
- Upper Similkameen Indian Band;
- District of Summerland;
- Town of Oliver;
- Town of Osoyoos; and
- Electoral Areas A, B, C, D, E, F, and G (including West Bench, Sage Mesa, Cawston, Okanagan Falls, Kaleden, Apex Mountain, Naramata, Hedley, Olalla, and Rural Keremeos).

The total service population is assumed to be 75,655, of which 5,103 is from the Keremeos Transfer Station service area.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the proposed organics processing facility is northwest of the current landfill, south of the Princeton-Summerland Road (Figure 3.1). Currently, this is an undeveloped area owned by the District of Summerland. It was assumed for the feasibility assessment that the organics processing facility would have its own entrance off Princeton-Summerland Road, and therefore, its own scale. An alternative would be to share the scale with the landfill and construct a road between the landfill and organics processing facility.

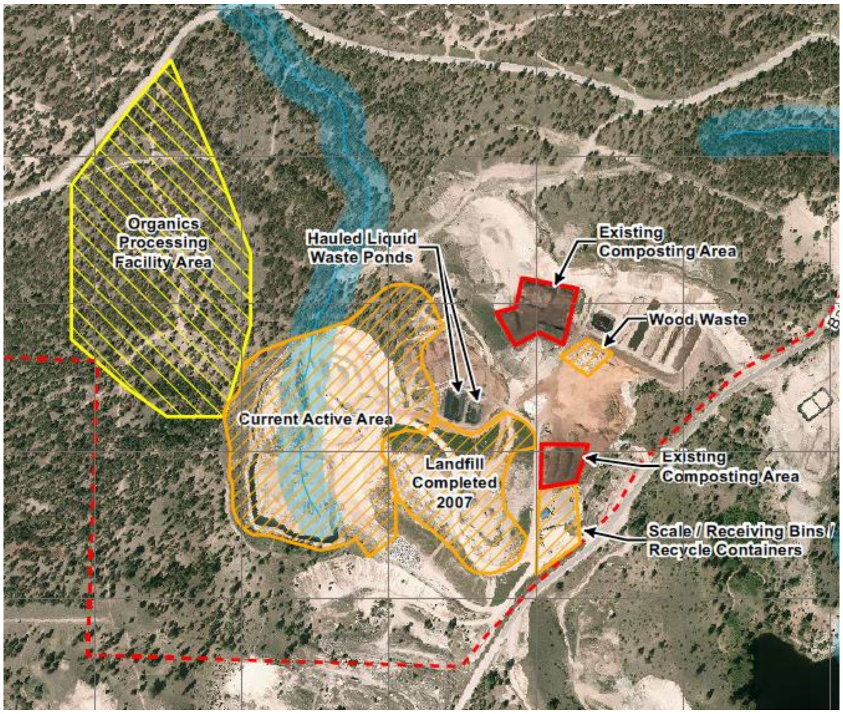

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.1 On-Site Infrastructure and Mobile Equipment

The following infrastructure and mobile equipment are available on site and assumed could be used for the organics processing facility. As there is only one loader available, additional loaders and mobile equipment would need to be purchased.

- Loader; and
- Trommel screen.

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013 for Campbell Mountain, Summerland, Oliver, and Osoyoos, with the addition of food waste and compostable paper currently in the waste disposal stream. It was assumed that 40% of current MSW consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[1]. The total amount of available organics feedstock is calculated to be 37,278 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of biosolids, green waste, and white wood, and projected quantities of food waste and compostable paper. Assuming a growth rate of 1.1%[2] over the next 20 years, the projected quantity of feedstock is calculated to be 46,395 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, a weighted average of the peak months from Campbell Mountain, Summerland, Oliver, and Osoyoos was calculated. During the peak month, the waste collected accounts for approximately 11% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 1,213 tonnes/week.

The assumed feedstock composition is presented in Table 1 below. Generally the ratio of food waste/biosolids to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	25,635	55%
Biosolids	7,887	17%
Food Waste and Compostable Paper	12,873[1]	28%
Total	**46,395**	**100%**
Design Capacity (tonnes/week)	**1,213**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

3.3.1 Compost Market Considerations

As biosolids is close to 20% of the feedstock, it can be processed separately in its own piles or vessels. This would increase the marketability of the finished compost product, as biosolids-free compost would be more attractive to a wider range of customers, especially in the agriculture sector. Compost containing biosolids can be used for non-agricultural purposes, such as landfill cover, construction projects, turf for golf courses, and landscaping. Furthermore, due to the large amount of white wood waste, biosolids can be composted with white wood so that green waste can be reserved for composting with food waste.

[1] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf.

[2] British Columbia Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas, such as a neighbouring regional district.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 5 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area consists of two dome-shaped fabric buildings on top of concrete blocks. Each building is approximately 22 m by 48 m. One building is for food waste and the other is for biosolids to keep these materials segregated.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Technology is more suitable for larger facilities
Anaerobic Digestion	▪ Improves odour and moisture control ▪ Opportunity for energy recovery ▪ Biosolids are not currently digested, and may be digested with this technology ▪ Potential to add biosolids from the Regional District of Central Okanagan ▪ Technology is more suitable for larger facilities

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Residence Time (days)	35	42	28	21
Number of Piles/Vessels	16	13.5	16	12
Pile/Vessel Dimensions	49.9 m x 8.0 m x 3.0 m	50.0 m x 8.0 m x 3.5 m	35.5 m x 9.0 m x 3.0 m	29.0 m x 5.5 m x 2.6 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting	Anaerobic Digestion (Primary)	Anaerobic Digestion (Secondary)
Residence Time (days)	35	14	42	28	21
Number of Piles	16	4.5	24	12	4
Pile Dimensions	38.3 m x 8.0 m x 3.0 m	50.0 m x 8.0 m x 3.5 m	35.5 m x 6.8 m x 3.0 m	45.1 m x 8.0 m x 3.0 m	40.6 m x 16.0 m x 3.0 m

[1]Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

If the Summerland Landfill scale is used instead of building a separate scale at the entrance on the Princeton-Summerland Road to the Site, the cost for the scale house ($50,000) can be removed from capital costs. By using the existing scale, the avoided operational costs for a scale attendant is approximately $110,000 per year. This reduction in costs by using the existing scale is equivalent to a $2/tonne savings. This model assumed that trucks would check in at the Summerland Landfill scale, then drive on the paved Summerland/Princeton Road to the compost facility entrance.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
General Site Grading and Preparation	$682,170	$604,060	$665,344	$640,223
Scale House	$50,000	$50,000	$50,000	$50,000
Leachate and Surface Water Management	$243,029	$236,877	$239,784	$237,006
Receiving Building	$987,272	$987,272	$987,272	$987,272
Organics Processing	$6,582,265	$8,762,892	$13,501,405	$27,733,219
Screening, Curing, and Storage	$925,873	$710,323	$959,988	$826,801
Equipment (Mobile)	$625,000	$625,000	$625,000	$625,000
Subtotal Capital (without mobile equipment)	**$9,470,609**	**$11,351,424**	**$16,403,792**	**$30,474,520**
Subtotal Capital (with mobile equipment)	**$10,095,609**	**$11,976,424**	**$17,028,792**	**$31,099,520**
Engineering (10% of non-mobile equipment capital)	$947,061	$1,135,142	$1,640,379	$3,047,452
Contingency (25% of non-mobile equipment capital)	$2,367,652	$2,837,856	$4,100,948	$7,618,630
Total Capital	**$13,410,322**	**$15,949,423**	**$22,770,119**	**$41,765,603**

Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Electricity	$58,523	$45,514	$58,523	$52,610
Water	$2,780	$1,390	$1,390	$2,780
Diesel	$326,911	$365,323	$326,911	$388,633
Labour	$321,186	$341,775	$321,186	$354,269
Equipment Maintenance and Use	$450,388	$694,925	$802,572	$1,520,446
Bi-Product Revenue	-$81,649	-$81,649	-$81,649	-$310,397
Subtotal	**$1,078,139**	**$1,367,278**	**$1,428,933**	**$2,008,339**
Contingency (20%)	$215,628	$273,456	$285,787	$401,668
Total Operating	**$1,293,767**	**$1,640,734**	**$1,714,719**	**$2,410,007**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Annualized Capital (20 years)	$1,169,173	$1,390,543	$1,985,203	$3,641,316
Annual Operating	$1,293,767	$1,640,734	$1,714,719	$2,410,007
Annualized Total	$2,462,940	$3,031,277	$3,699,922	$6,051,323
Cost per Tonne	**$53**	**$65**	**$80**	**$130**

Attachments:
Figure 1: Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout
Figure 5: Anaerobic Digestion Site Layout

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LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve

NOTES
Base data source:
ALR and Watercourses provided by RDOS.
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:8,000
100 50 0 100
Metres

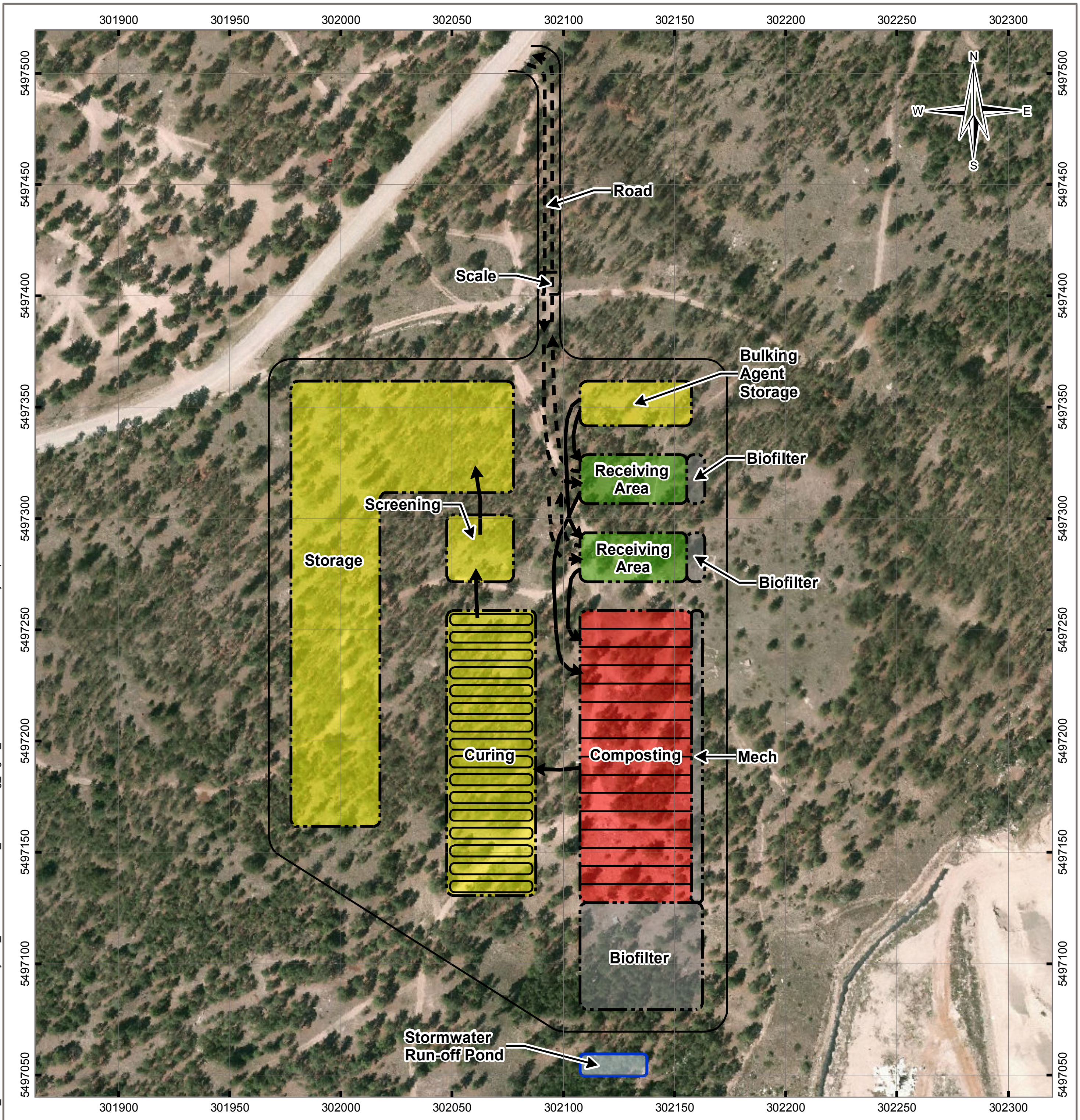
TETRA TECH EBA

FILE NO.
SWM03094-01_SummerReg_Fig01_SitePlan.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 2, 2015

Figure 1



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility
Aerated Static Pile
Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500
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Metres

TETRA TECH EBA

FILE NO.				
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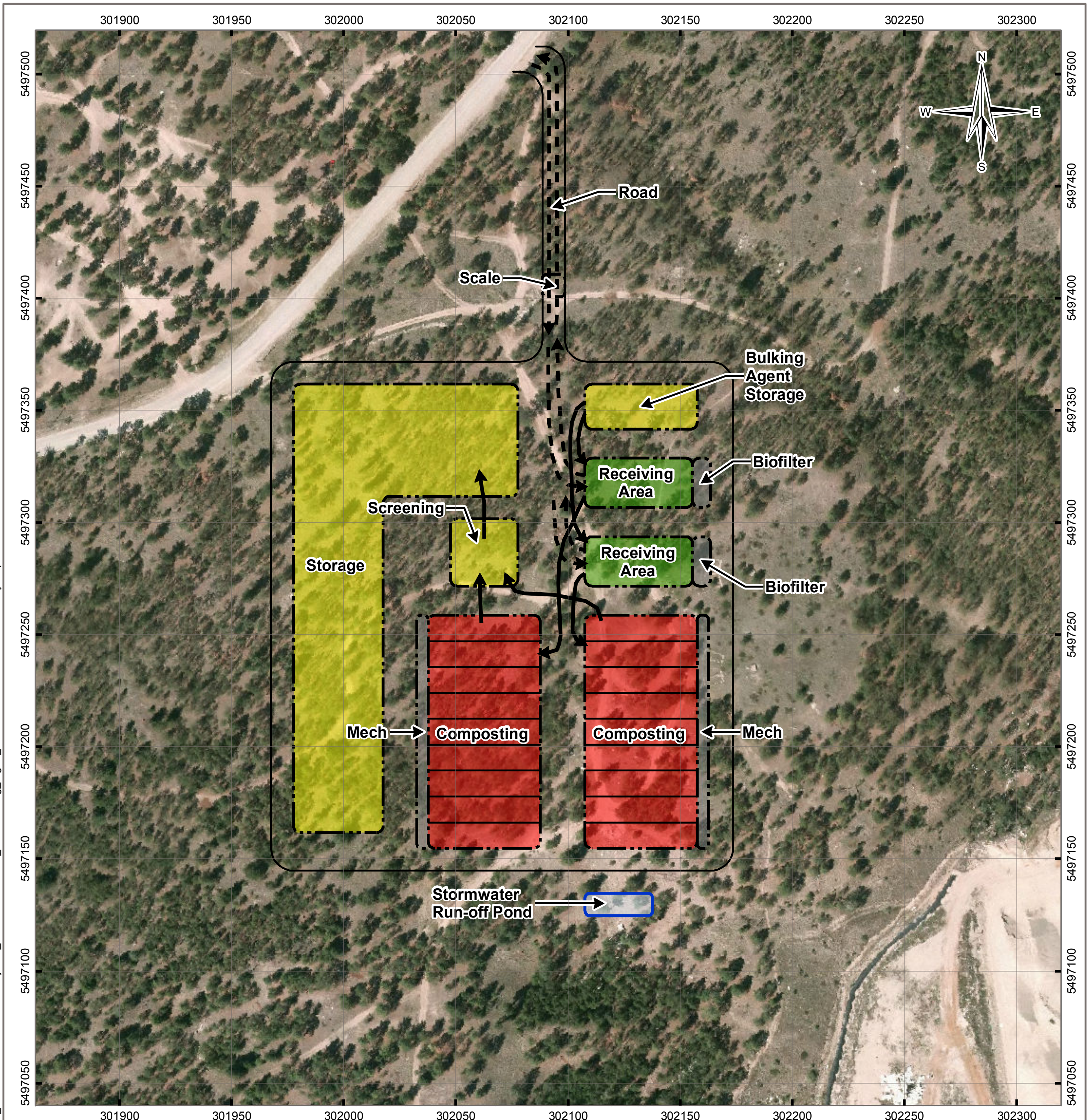
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	July 15, 2015			

Figure 2



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

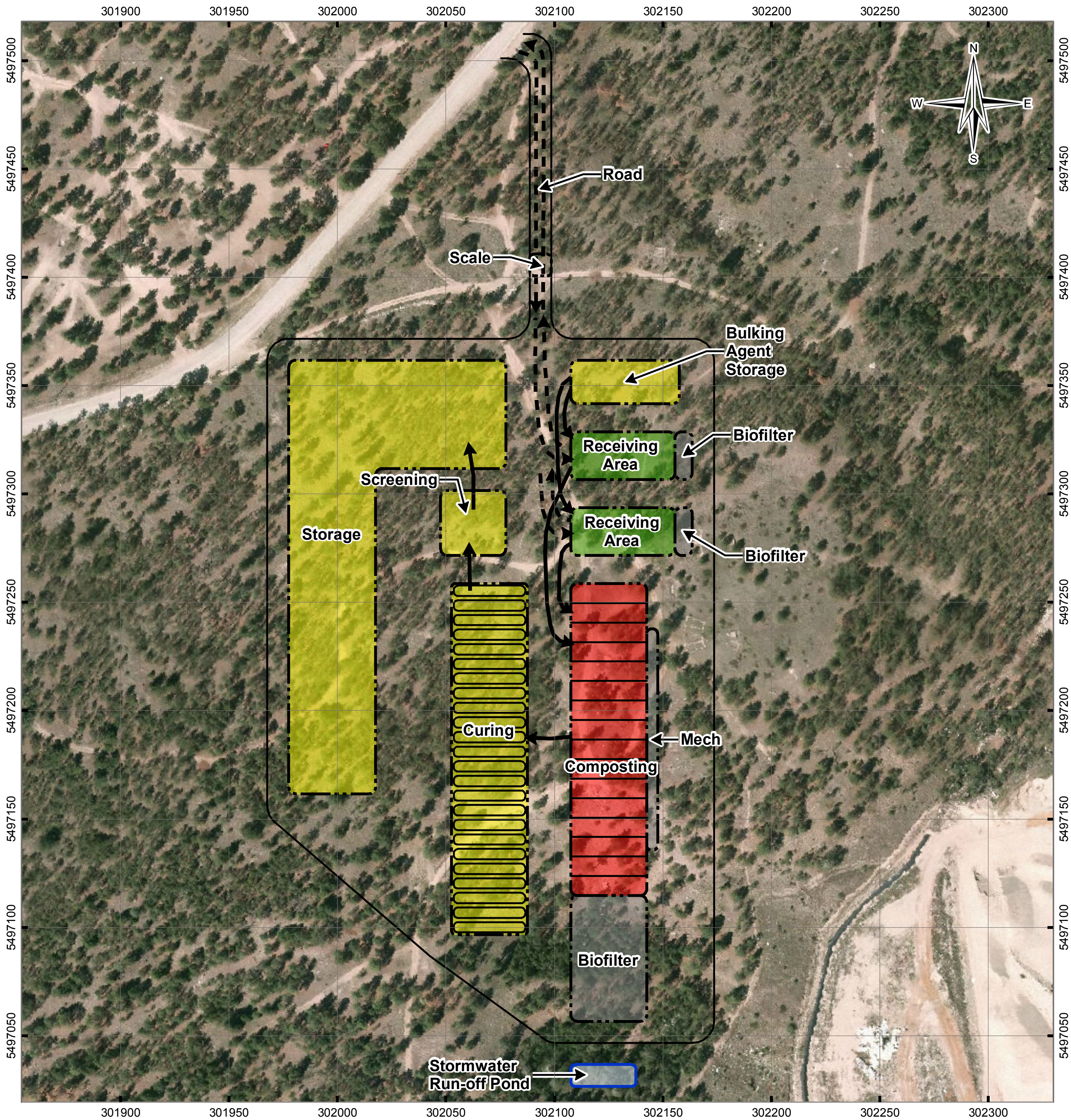
NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility Membrane Covered Aerated Static Pile Site Layout

PROJECTION		DATUM		CLIENT
UTM Zone 11		NAD83		Regional District of Okanagan-Similkameen
Scale: 1:2,500 50 25 0 50 Metres				TETRA TECH EBA
FILE NO. SWM03094-01_SummerReg_Fig03_Mem.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	DATE			Figure 3
Tt EBA-VANC	July 15, 2015			



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,600
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.				
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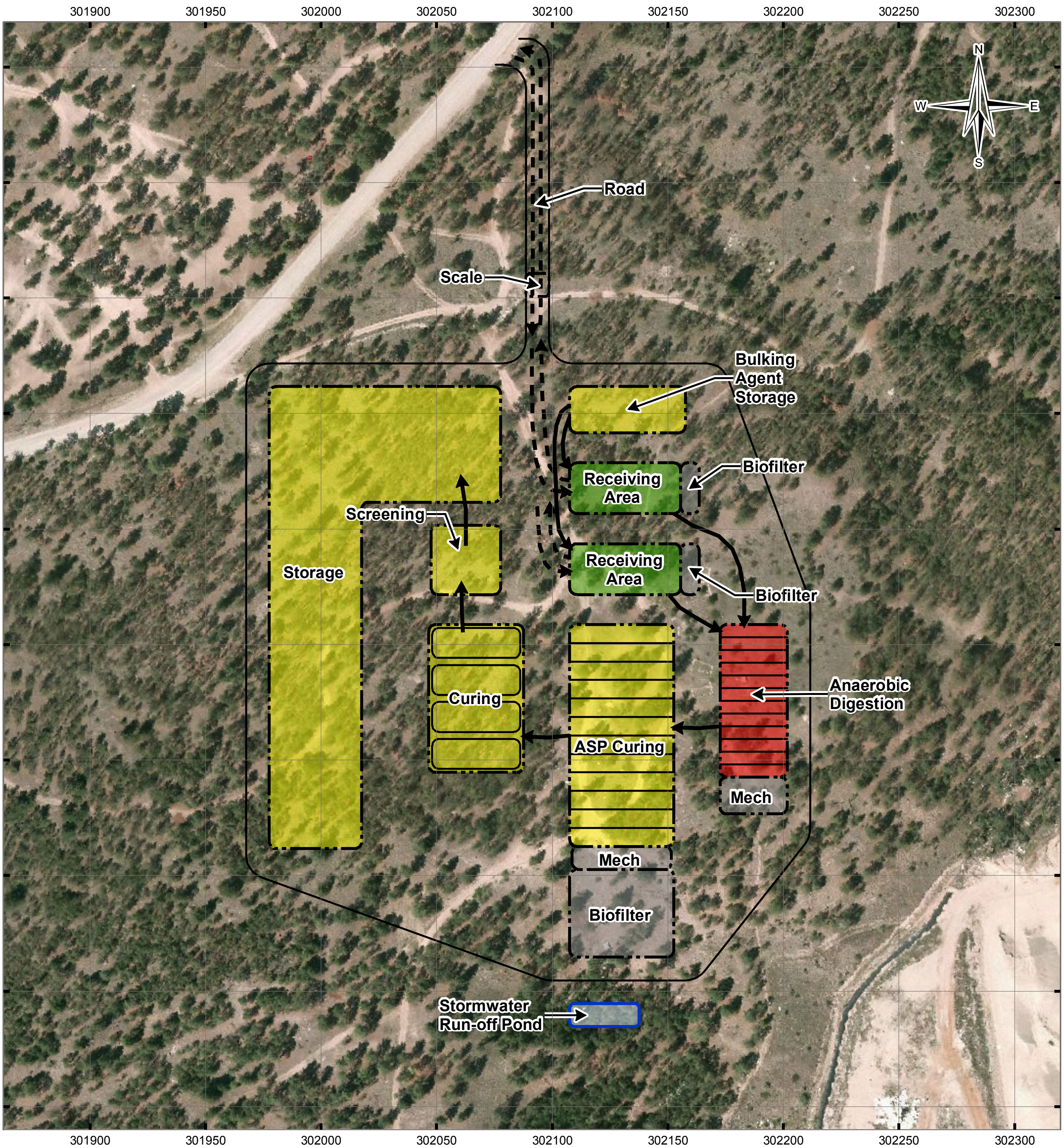
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	July 15, 2015			

Figure 4



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LEGEND

- Loader Movement
- Truck Movement
- Anaerobic Digestion
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility Anaerobic Digestion Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,500
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Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_SummerReg_Fig05_AD.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	July 15, 2015			

Figure 5

SUMMERLAND RDCO BIOSOLIDS

1.0 INTRODUCTION

The following is a feasibility assessment for locating a regional organics management facility at Summerland Landfill (hereafter referred to as the "Site") with the addition of 5,000 tonnes of biosolids from the Regional District of Central Okanagan (RDCO).

2.0 SITE INFORMATION

The Site is 4 km southwest of the Town of Summerland, British Columbia. It is an active landfill operated by the District of Summerland. Additional information about the Site can be found in the *Summerland Landfill Feasibility Assessment* and the *Summerland Regional Facility Feasibility Assessment*. This feasibility assessment builds on the design of the Summerland Regional Facility.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the proposed organics processing facility is northwest of the current landfill, south of the Princeton-Summerland Road (Figure 3.1). Currently, this is an undeveloped area owned by the District of Summerland. It was assumed for the feasibility assessment that the organics processing facility would have its own entrance off Princeton-Summerland Road, and therefore its own scale. An alternative would be to share the scale with the landfill and construct a road between the landfill and organics processing facility.

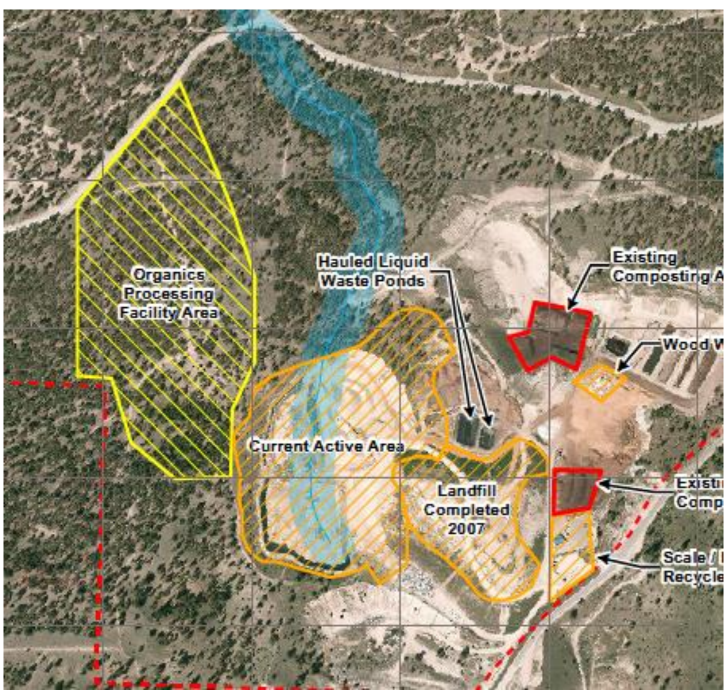

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.1 On-Site Infrastructure and Mobile Equipment

The following infrastructure and mobile equipment are available on site and assumed could be used for the organics processing facility. As there is only one loader available, additional loaders and mobile equipment would need to be purchased.

- Loader; and
- Trommel screen.

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on the same assumptions as the *Summerland Regional Facility Feasibility Assessment* with the addition of 5,000 tonnes of biosolids from the RDCO. The total amount of available organics feedstock is calculated to be 42,278 tonnes/year. Assuming a growth rate of 1.1%[1] over the next 20 years, the projected quantity of feedstock is calculated to be 52,618 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. The peak month was assumed to be the same as the *Summerland Regional Facility Feasibility Assessment,* which amounts to 11% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 1,376 tonnes/week.

The assumed feedstock composition is presented in Table 1 below. Generally the ratio of food waste/biosolids to green/wood waste should be 1:1 for organics processing. The available green and wood waste is slightly lower than 50% of the feedstock, so a small amount of additional bulking agent should be sourced, though is not necessarily required.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste	25,635	49%
Biosolids (RDCO)	6,223	12%
Biosolids (RDOS)	7,887	15%
Food Waste and Compostable Paper	12,873[2]	24%
Total	**52,618**	**100%**
Design Capacity (tonnes/week)	**1,376**	

[2] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011.

3.3.1 Compost Market Considerations

As biosolids is close to 30% of the feedstock, it can be processed separately in its own piles or vessels. This would increase the marketability of the finished compost product, as biosolids-free compost would be more attractive to a wider range of customers, especially in the agriculture sector. Compost containing biosolids can be used for non-agricultural purposes, such as landfill cover, construction projects, turf for golf courses, and landscaping.

[1] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx.

Furthermore, due to the large amount of white wood waste, biosolids can be composted with white wood so that green waste can be reserved for composting with food waste.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to build the facility for the 20 year peak capacity and use the extra capacity in the first few years to process organics from other areas, such as a neighbouring regional district.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 5 provides layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this site, the receiving area consists of two dome-shaped fabric buildings on top of concrete blocks. Each building is approximately 22 m by 48 m. One building is for food waste and the other is for biosolids to keep these materials segregated.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Technology is more suitable for larger facilities
Anaerobic Digestion	▪ Improves odour and moisture control ▪ Opportunity for energy recovery ▪ Large amount of biosolids, which not currently digested, and may be digested with this technology ▪ Technology is more suitable for larger facilities

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Residence Time (days)	35	42	28	21
Number of Piles/Vessels	20	15	20	14
Pile/Vessel Dimensions	45.3 m x 8.0 m x 3.0 m	50.0 m x 8.0 m x 3.5 m	32.2 m x 9.0 m x 3.0 m	29.0 m x 5.5 m x 2.6 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting	Anaerobic Digestion (Primary)	Anaerobic Digestion (Secondary)
Residence Time (days)	35	14	42	28	21
Number of Piles	20	5	30	16	6
Pile Dimensions	34.6 m x 8.0 m x 3.0 m	50.0 m x 8.0 m x 3.5 m	32.2 m x 6.8 m x 3.0 m	38.3 m x 8.0 m x 3.0 m	30.7 m x 16.0 m x 3.0 m

[1]Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

If the Summerland Landfill scale is used instead of building a separate scale at the entrance on the Princeton-Summerland Road to the Site, the cost for the scale house ($50,000) can be removed from capital costs. By using the existing scale, the avoided operational costs for a scale attendant is approximately $110,000 per year. This reduction in costs by using the existing scale is equivalent to a $2/tonne savings. This model assumed that trucks would check in at the Summerland Landfill scale, then drive on the paved Summerland/Princeton Road to the compost facility entrance.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
General Site Grading and Preparation	$712,168	$625,815	$694,074	$666,580
Scale House	$50,000	$50,000	$50,000	$50,000
Leachate and Surface Water Management	$246,820	$239,283	$242,961	$239,920
Receiving Building	$987,272	$987,272	$987,272	$987,272
Organics Processing	$7,458,618	$8,361,180	$15,312,458	$31,300,317
Screening, Curing, and Storage	$983,455	$743,705	$1,023,348	$870,542
Equipment (Mobile)	$625,000	$625,000	$625,000	$625,000
Subtotal Capital (without mobile equipment)	**$10,438,333**	**$11,007,254**	**$18,310,112**	**$34,114,631**
Subtotal Capital (with mobile equipment)	**$11,063,333**	**$11,632,254**	**$18,935,112**	**$34,739,631**
Engineering (10% of non-mobile equipment capital)	$1,043,833	$1,100,725	$1,831,011	$3,411,463
Contingency (25% of non-mobile equipment capital)	$2,609,583	$2,751,814	$4,577,528	$8,528,658
Total Capital	**$14,716,750**	**$15,484,793**	**$25,343,651**	**$46,679,751**

Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Electricity	$64,482	$46,743	$64,482	$58,569
Water	$3,153	$1,577	$1,577	$3,153
Diesel	$358,131	$400,301	$358,131	$428,147
Labour	$333,694	$356,297	$333,694	$371,221
Equipment Maintenance and Use	$492,527	$682,425	$892,036	$1,698,314
Bi-Product Revenue	-$84,538	-$84,538	-$84,538	-$344,438
Subtotal	**$1,167,448**	**$1,402,804**	**$1,565,381**	**$2,214,966**
Contingency (20%)	$233,490	$280,561	$313,076	$442,993
Total Operating	**$1,400,938**	**$1,683,365**	**$1,878,457**	**$2,657,959**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Annualized Capital (20 years)	$1,283,073	$1,350,035	$2,209,575	$4,069,753
Annual Operating	$1,400,938	$1,683,365	$1,878,457	$2,657,959
Annualized Total	$2,684,012	$3,033,400	$4,088,032	$6,727,713
Cost per Tonne	**$51**	**$58**	**$78**	**$128**

Attachments:
Figure 1: Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout
Figure 5: Anaerobic Digestion Site Layout

LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve

NOTES
Base data source:
ALR and Watercourses provided by RDOS.
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility with RDCO Biosolids Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:8,000
100 50 0 100
Metres

FILE NO.
SWM03094-01_SummerRDCO_Fig01_SitePlan.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 21, 2015

Figure 1

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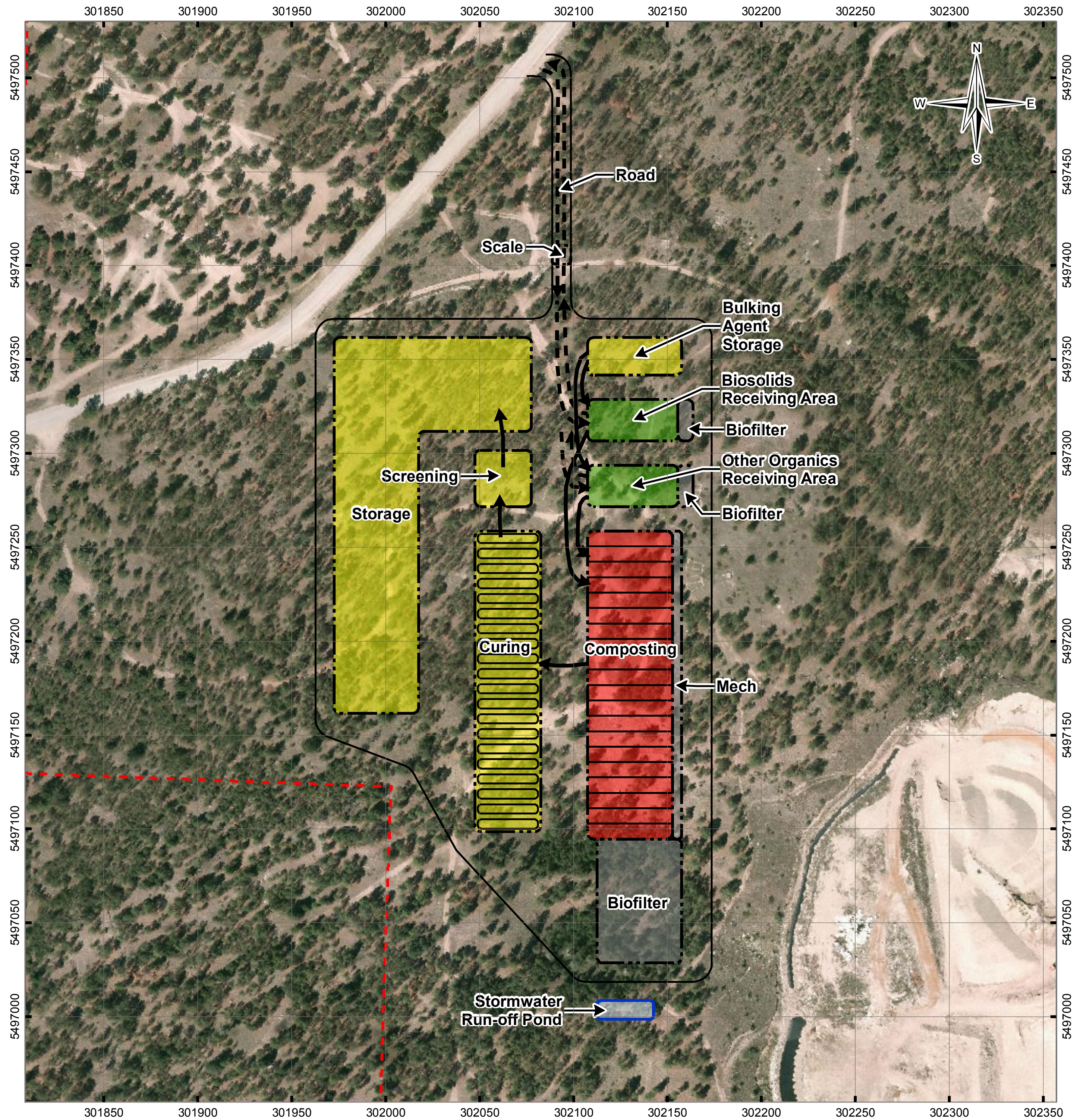

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility with RDCO Biosolids Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,000
50 25 0 50
Metres

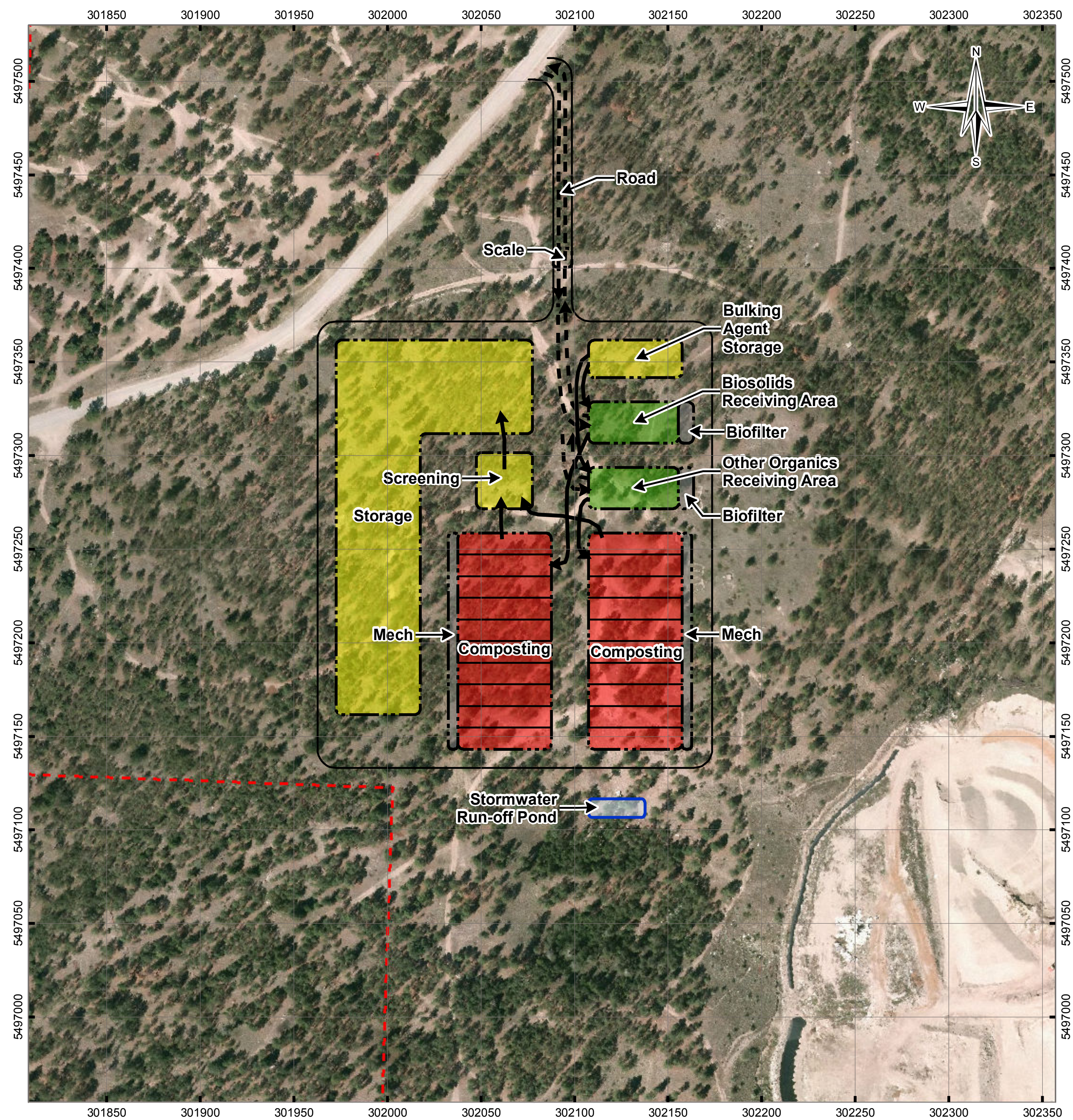
TETRA TECH EBA

FILE NO.
SWM03094-01_SummerRDCO_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 21, 2015

Figure 2



LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility with RDCO Biosolids Membrane Covered Aerated Static Pile Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,000
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_SummerRDCO_Fig03_Mem.mxd				
PROJECT NO.	**DWN**	**CKD**	**APVD**	**REV**
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	**DATE**			
Tt EBA-VANC	July 21, 2015			

Figure 3

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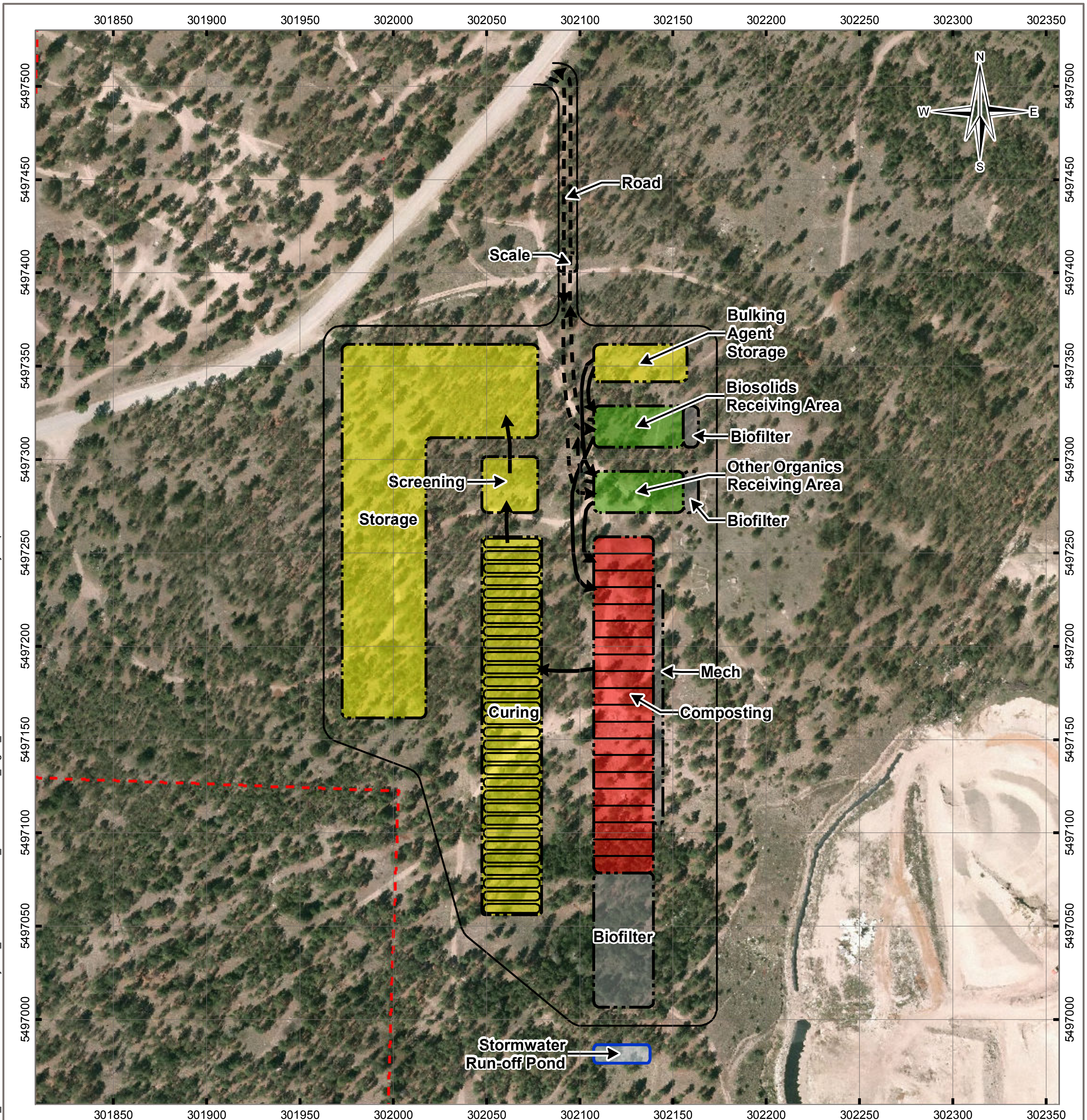

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility with RDCO Biosolids In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,000
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_SummerRDCO_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 21, 2015

Figure 4

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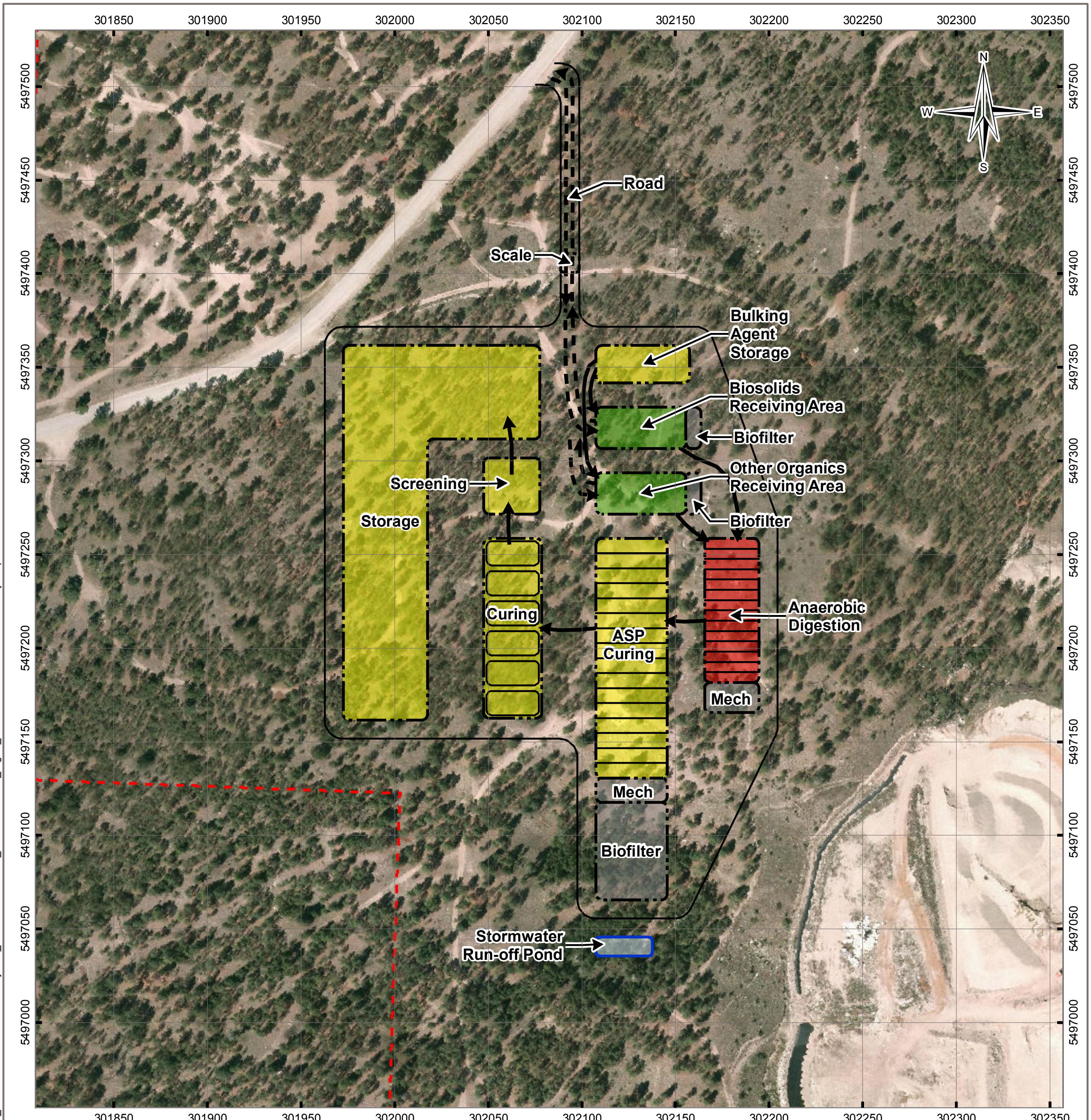

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LEGEND

- Loader Movement
- Truck Movement
- Anaerobic Digestion
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Stormwater Run-off Pond
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
SUMMERLAND LANDFILL, SUMMERLAND, BC

Summerland Regional Facility with RDCO Biosolids Anaerobic Digestion Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,000
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_SummerRDCO_Fig05_AD.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 21, 2015

Figure 5

OLIVER REGIONAL

1.0 INTRODUCTION

The following is a feasibility assessment for locating a regional organics management facility at Oliver Landfill (hereafter referred to as the “Site”).

2.0 SITE INFORMATION

The Site is 6 km south of the Town of Oliver, British Columbia. It is an active landfill operated by the Regional District of Okanagan-Similkameen (RDOS) through a contractor, B&B Wood Grinding. Additional information about the Site can be found in the *Oliver Landfill Feasibility Assessment*.

2.1 Service Area Assumptions

For this assessment, the Site’s service area includes organics from the Oliver and Osoyoos services areas. This includes:

- Town of Oliver;
- Town of Osoyoos; and
- Electoral Areas A and C.

The total service population is 9,132.

3.0 CONCEPTUAL DESIGN

3.1 Scope

The scope of the design approach includes the receiving area, organics processing area, and curing area.

3.2 Proposed Location

The location of the organics processing facility is the current footprint of the Site’s composting operations, plus the land to the southwest up to the scale entrance (Figure 3.1). There is approximately two hectares of available land in this area.

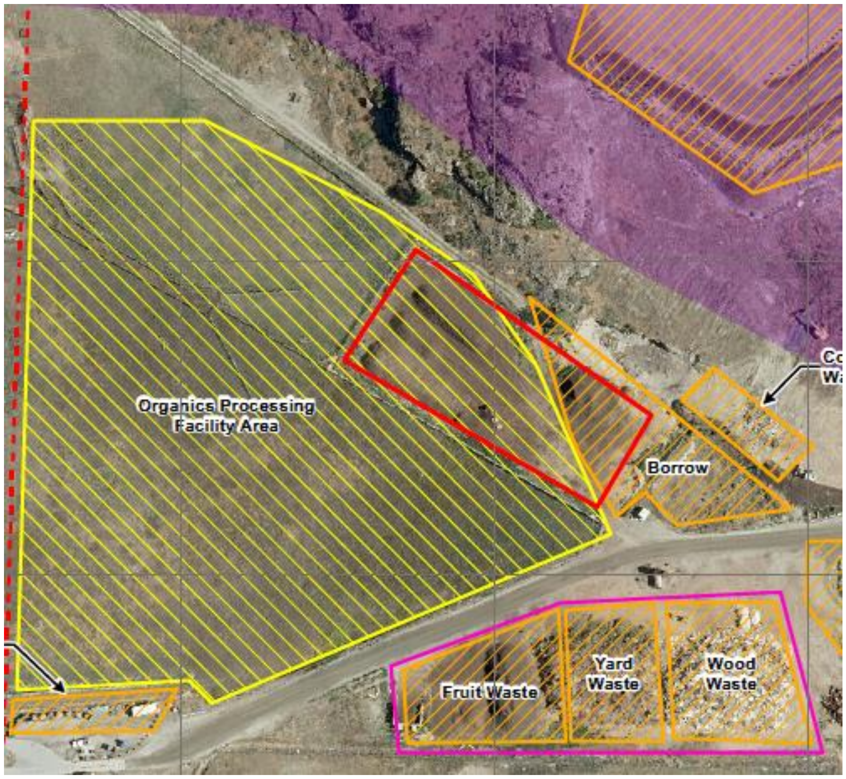

Figure 3.1: Proposed Location of Organics Processing Facility

3.2.1 On-Site Infrastructure and Mobile Equipment

As the proposed location is within the landfill property boundary and easily accessible from the road, it was assumed that the landfill scale can be shared with the organics processing facility. Mobile equipment is available on site, however is owned by the contractor. Due to the scale of this regional facility, it would be more cost effective for the RDOS to purchase the equipment and have the contractor operate it. This increases capital costs, but decreases operating costs. Note that the option of using contractor-owned equipment was assessed, and was approximately 10 to 30% more on a cost per tonne basis than if the RDOS owned the equipment.

3.3 Feedstock and Design Capacity

Feedstock estimates were calculated based on data from 2013 for Oliver and Osoyoos, with the addition of food waste and compostable paper currently in the waste disposal stream and organics from the adjacent feed lot (manure and wood chips). It was assumed that 40% of current municipal solid waste (MSW) consists of food waste and soiled paper, of which 65% is divertible through organics collection programs and drop-off[1]. The total amount of available organics feedstock is calculated to be 11,180 tonnes/year. This is inclusive of materials from residential curbside, commercial, and self-haul waste to the facility. The assumed feedstock composition is based on current quantities of green and harvest waste, and projected quantities of food waste and compostable paper. Assuming a

[1] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf.

growth rate of 1.1%[2] over the next 20 years, the projected quantity of feedstock is calculated to be 13,915 tonnes/year.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, an average of the peak months from Oliver and Osoyoos was calculated. During the peak month, the waste collected accounts for approximately 12% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 395 tonnes/week.

The assumed feedstock composition is presented in the table below. Generally the ratio of food waste/harvest waste to green/wood waste should be 1:1 for organics processing. As there is an adequate amount of green/wood waste available at the Site, additional bulking agent should not be required.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Manure	3,111	23%
Green and Wood Waste	7,006	50%
Food Waste and Compostable Paper (Including Harvest Waste)	3,797[1]	27%
Total	**13,915**	**100%**
Design Capacity (tonnes/week)	**395**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. Also includes harvest waste.

3.3.1 Compost Market Considerations

There is a high demand for compost in the area around the Oliver Landfill. Since this compost is primarily used for agriculture, it may be worthwhile to pursue higher compost quality to increase its marketability.

Compost made from biosolids and white wood is undesirable to potential customers. In Canada and the United States, organic food regulations prohibit the use of sewage sludge for growing food[3,4]. Agricultural operations seeking an organic certification will stay away from using compost that would affect the marketability of their crop.

To further increase the marketability of the finished compost product, certification through an independent reviewer such as Organic Materials Review Institute (OMRI) may be considered.

3.3.2 Other Design Considerations

The design capacity for the organic processing facility was estimated based on peak material quantities in 20 years. This ends up being a quantity approximately 24% greater than the current peak capacity. Therefore, in the initial years of operation, the facility will have extra processing capacity. Over time, the amount of material is anticipated to increase such that the facility will be operating its full capacity in 20 years.

[2] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx.

[3] Organic Product Systems Permitted Substances Lists, 2011. https://www.cog.ca/uploads/PSL.pdf.

[4] USDA National Organic Program, 2015. http://www.ams.usda.gov/AMSv1.0/NOPOrganicStandards.

One option to reduce the initial capital cost is to construct the facility in phases to meet the increase demand for processing feedstock (e.g., initially build for current capacity and expand every five years). Another option would be to partner with the private sector (e.g., adjacent cattle feedlot) to build and operate the facility.

3.3.2.1 Windrow Composting Option

Windrow composting is currently occurring at Oliver Landfill primarily for manure, green waste, and wood waste. This material is less putrescible than food waste and because the proximity to sensitive receptors is farther than most other sites, windrow composting can be conducted at that location with less problems. The benefits of windrow composting are low capital costs and process simplicity. The primary capital costs associated with a turned windrow system are construction of a compost pad and purchase of mobile equipment (e.g., a windrow turner). In terms of cost, the industry average for a windrow composting facility ranges from $30 to $60 per tonne[5], excluding costs for capital improvements (e.g., road work, utility connections). Food waste can be composted in windrows as well, but it increases the potential for odours and vectors, especially in large quantities.

Compared to the composting technologies that use some form of aeration, windrow composting requires more labour and space due to its longer processing time. It also requires more water (equivalent in weight to approximately 25% of the incoming feedstock) compared to enclosed systems. The composting phase for aerated systems is typically less than eight weeks, whereas windrow composting requires up to 12 weeks. To meet the Organic Matter Recycling Regulation (OMRR) requirements for pathogen reduction processes, windrows need to be turned at least five times during the composting phase[6]. This adds a significant amount of labour compared to aerated systems which either do not need turning, or only need a few turnings.

Labour requirements for turning can be reduced by using a windrow turner, such as a SCARAB. The City of Kelowna uses a SCARAB because they found it to be six times faster than turning piles using a front end loader. The about of organics composted by Kelowna is considerable more than in Oliver. Assuming a SCARAB is used for windrow turning, the additional labour for equipment operations is equivalent to approximately 0.25 FTE more than an aerated static pile composting facility. However, a limitation of a SCARAB is that it cannot be used to build the windrow geometry needed for cold weather composting. The maximum height is 3 m, compared to the 5.5 m height recommended for cold weather protection. Additional details on operational considerations for windrow composting for cold weather environments can be found in the *Osoyoos with Curbside SSO Feasibility Assessment*.

At this Site, the operating cost (including utilities, equipment maintenance, feedstock preparation, material movement, and screening) is estimated to be $35/tonne. This is comparable to the aerated static pile option, which as an operating cost estimate of $38/tonne.

Based on a 12-week composting phase, 6-week curing phase, and 6 months of storage capacity, approximately two hectares of land will be required for windrow composting at the Site. The currently available land is approximately two hectares, so there should be sufficient space.

To reduce costs and land area, a hybrid composting system can be used. Manure, green waste, and wood waste can be composted in windrows. An aerated system can be dedicated to processing food waste.

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[5] Osoyoos with Curbside SSO Feasibility Assessment, 2015.
[6] http://www.bclaws.ca/Recon/document/ID/freeside/18_2002.

3.4 Conceptual Layout

Site-specific information for each of the areas in the conceptual layouts are described below. Figures 2 to 5 provide layouts for each organics processing option.

3.4.1 Receiving Area

Design assumptions for the receiving area are described in the main body of the report. At this Site, the receiving area is a dome-shaped fabric building on top of concrete blocks. The building is approximately 22 m by 48 m.

3.4.2 Organics Processing Technologies and Area

Table 2 below is a summary of the organics processing technologies included in the feasibility assessment and rationale for inclusion. These technologies are described in the main body of the report.

Table 2: Rationale for Technologies Considered

Technology	Rationale
Aerated Static Pile	▪ Simple technology
Membrane Covered Aerated Static Pile	▪ Improves odour and moisture control ▪ Simple technology
In-Vessel Composting	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Technology is more suitable for larger facilities
Anaerobic Digestion	▪ Improves odour and moisture control ▪ Smaller operations footprint ▪ Opportunity for energy recovery ▪ Technology is more suitable for larger facilities

Table 3 below is a summary of the site-specific dimensions, residence time, and considerations for each option.

Table 3: Organics Processing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Residence Time (days)	35	42	28	21
Number of Piles/Vessels	8	9	8	4
Pile/Vessel Dimensions	32.5 m x 8.0 m x 3.0 m	25.0 m x 8.0 m x 3.5 m	23.1 m x 9.0 m x 3.0 m	32.0 m x 5.5 m x 2.6 m

3.4.3 Curing Area

Design assumptions for the curing area are described in the main body of the report. Table 4 below is a summary of the number of piles, pile dimensions, and residence time for curing associated with each option.

Table 4: Curing Area Specifications

Technology	Aerated Static Pile	Membrane Covered Aerated Static Pile[1]	In-Vessel Composting	Anaerobic Digestion (Primary)	Anaerobic Digestion (Secondary)
Residence Time (days)	35	14	42	28	21
Number of Piles	8	3	12	6	2
Pile Dimensions	25.5 m x 8.0 m x 3.0 m	25.0 m x 8.0 m x 3.5 m	23.1 m x 6.8 m x 3.0 m	29.4 m x 8.0 m x 3.0 m	26.4 m x 16.0 m x 3.0 m

[1] Compost curing is part of the technology package so it takes place within the footprint for organics processing.

4.0 COST ESTIMATE

Capital and annual operating costs for each of the options considered are presented in the tables below. Costs are also presented on a per tonne basis of organic material processed.

Table 5: Capital Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
General Site Grading and Preparation	$395,810	$357,485	$388,906	$382,038
Scale House	$0	$0	$0	$0
Leachate and Surface Water Management	$169,832	$167,720	$168,814	$171,914
Receiving Building	$493,636	$498,577	$498,577	$493,636
Organics Processing	$2,300,180	$4,596,318	$4,587,728	$10,308,692
Screening, Curing, and Storage	$332,104	$262,225	$341,524	$299,371
Equipment (Mobile)	$825,000	$825,000	$825,000	$825,000
Subtotal Capital (without mobile equipment)	**$3,691,562**	**$5,882,326**	**$5,985,549**	**$11,655,651**
Subtotal Capital (with mobile equipment)	**$4,516,562**	**$6,707,326**	**$6,810,549**	**$12,480,651**
Engineering (10% of non-mobile equipment capital)	$369,156	$588,233	$598,555	$1,165,565
Contingency (25% of non-mobile equipment capital)	$922,890	$1,470,581	$1,496,387	$2,913,913
Total Capital	**$5,808,609**	**$8,766,140**	**$8,905,491**	**$16,560,129**

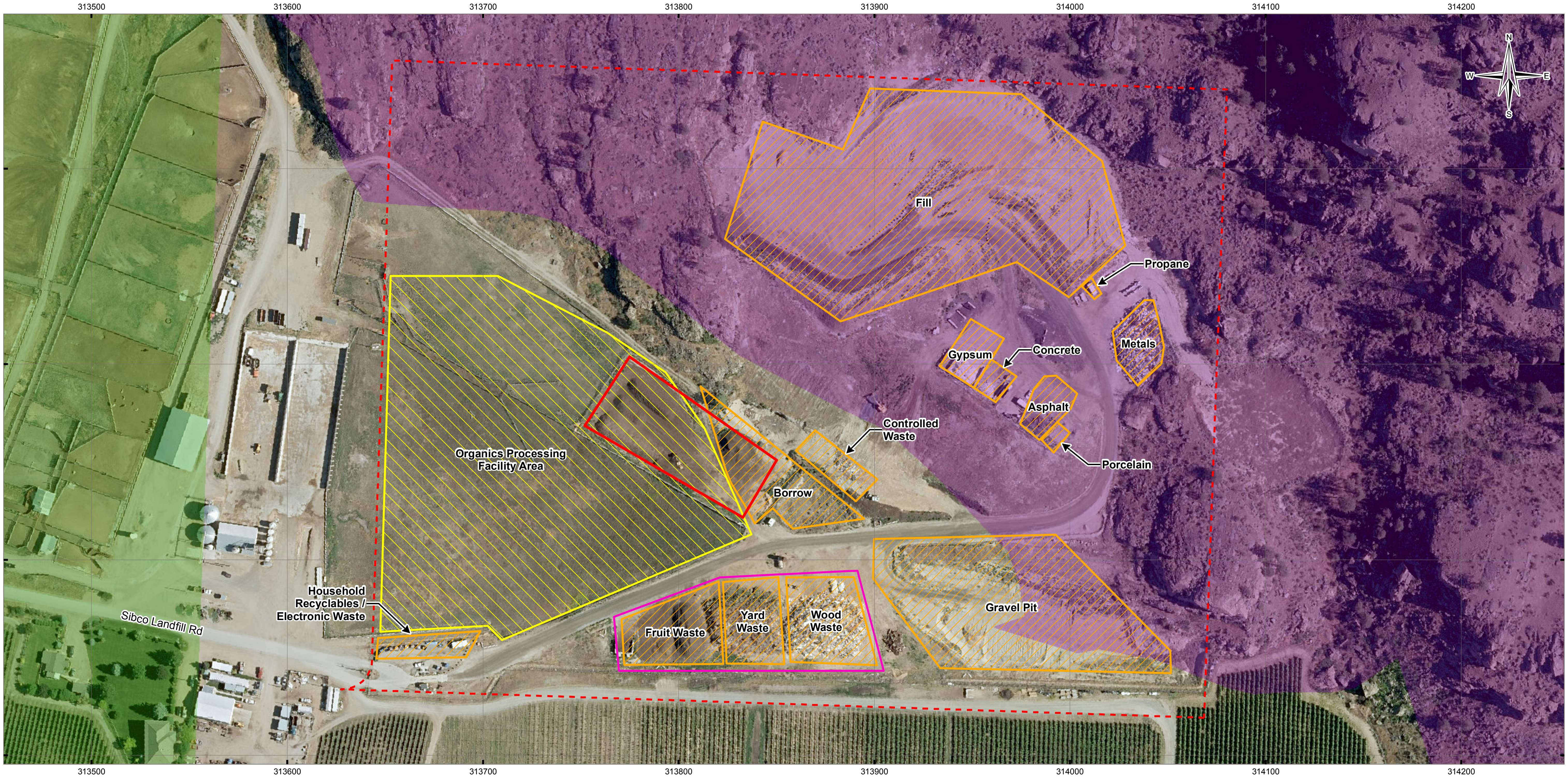
Table 6: Annual Operating Costs

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Electricity	$31,166	$26,435	$31,166	$28,209
Water	$905	$453	$453	$905
Diesel	$119,374	$133,309	$119,374	$139,473
Labour	$107,442	$114,911	$107,442	$118,215
Equipment Maintenance and Use	$232,302	$400,340	$348,658	$636,456
Bi-Product Revenue	-$52,205	-$52,205	-$52,205	-$122,602
Subtotal	$438,984	$623,243	$554,888	$800,656
Contingency (20%)	$87,797	$124,649	$110,978	$160,131
Total Operating	**$526,781**	**$747,892**	**$665,865**	**$960,788**

Table 7: Annualized and Cost per Tonne

Item	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Annualized Capital (20 years)	$506,421	$764,272	$776,421	$1,443,787
Annual Operating	$526,781	$747,892	$665,865	$960,788
Annualized Total	$1,033,202	$1,512,164	$1,442,287	$2,404,575
Cost per Tonne	**$74**	**$109**	**$104**	**$173**

Attachments:
Figure 1: Site Plan
Figure 2: Aerated Static Pile Site Layout
Figure 3: Membrane Covered Aerated Static Pile Site Layout
Figure 4: In-Vessel Composting Site Layout
Figure 5: Anaerobic Digestion Site Layout



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LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Compost Area
- Recieving and Composting Area
- Other Facility Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR and Environmentally Sensitive Habitat provided by RDOS.
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OLIVER LANDFILL, OLIVER, BC

Oliver Regional Facility Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:2,000
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Metres

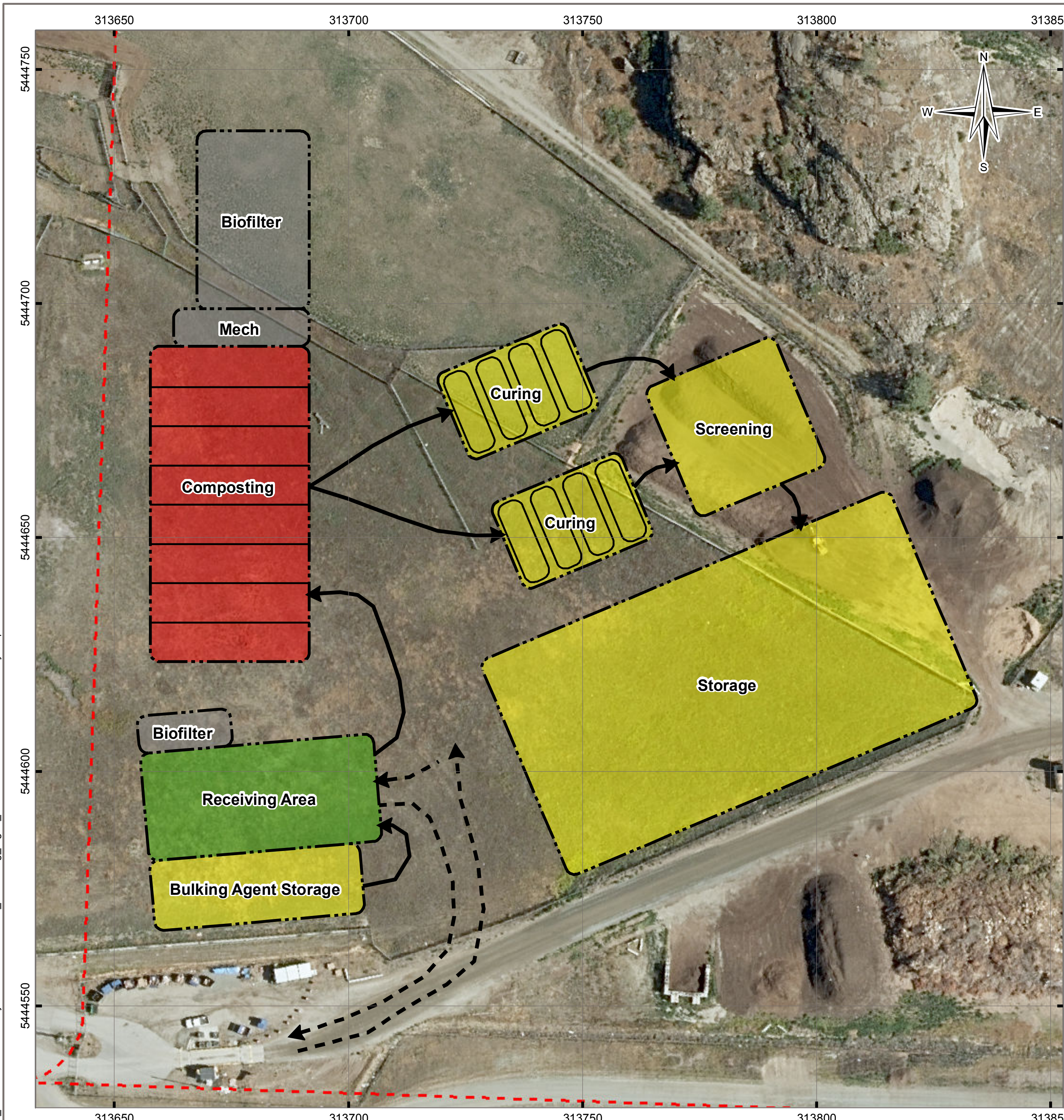
FILE NO.
SWM03094-01_OliverReg_Fig01_SitePlan.mxd

TETRA TECH EBA

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 7, 2015

Figure 1



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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OLIVER LANDFILL, OLIVER, BC

Oliver Regional Facility
Aerated Static Pile
Site Layout

PROJECTION
UTM Zone 11

DATUM
NAD83

CLIENT
Regional District of Okanagan-Similkameen

Scale: 1:1,200

20 10 0 20

Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_OliverReg_Fig02_ASP.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 7, 2015

Figure 2

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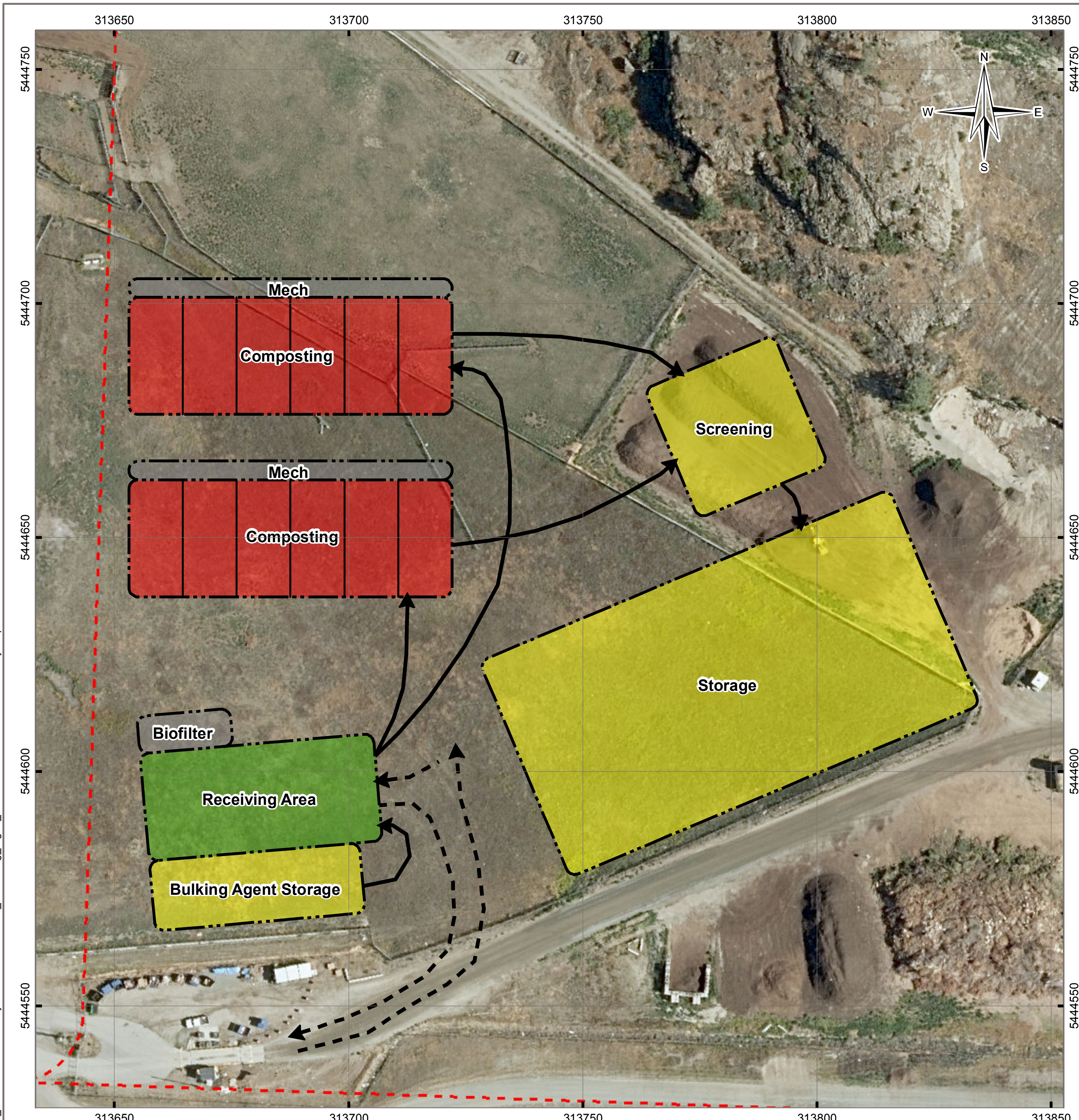

LEGEND

- Loader Movement
- Truck Movement
- Composting
- Screening and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OLIVER LANDFILL, OLIVER, BC

Oliver Regional Facility
Membrane Covered Aerated Static Pile
Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,200
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Metres

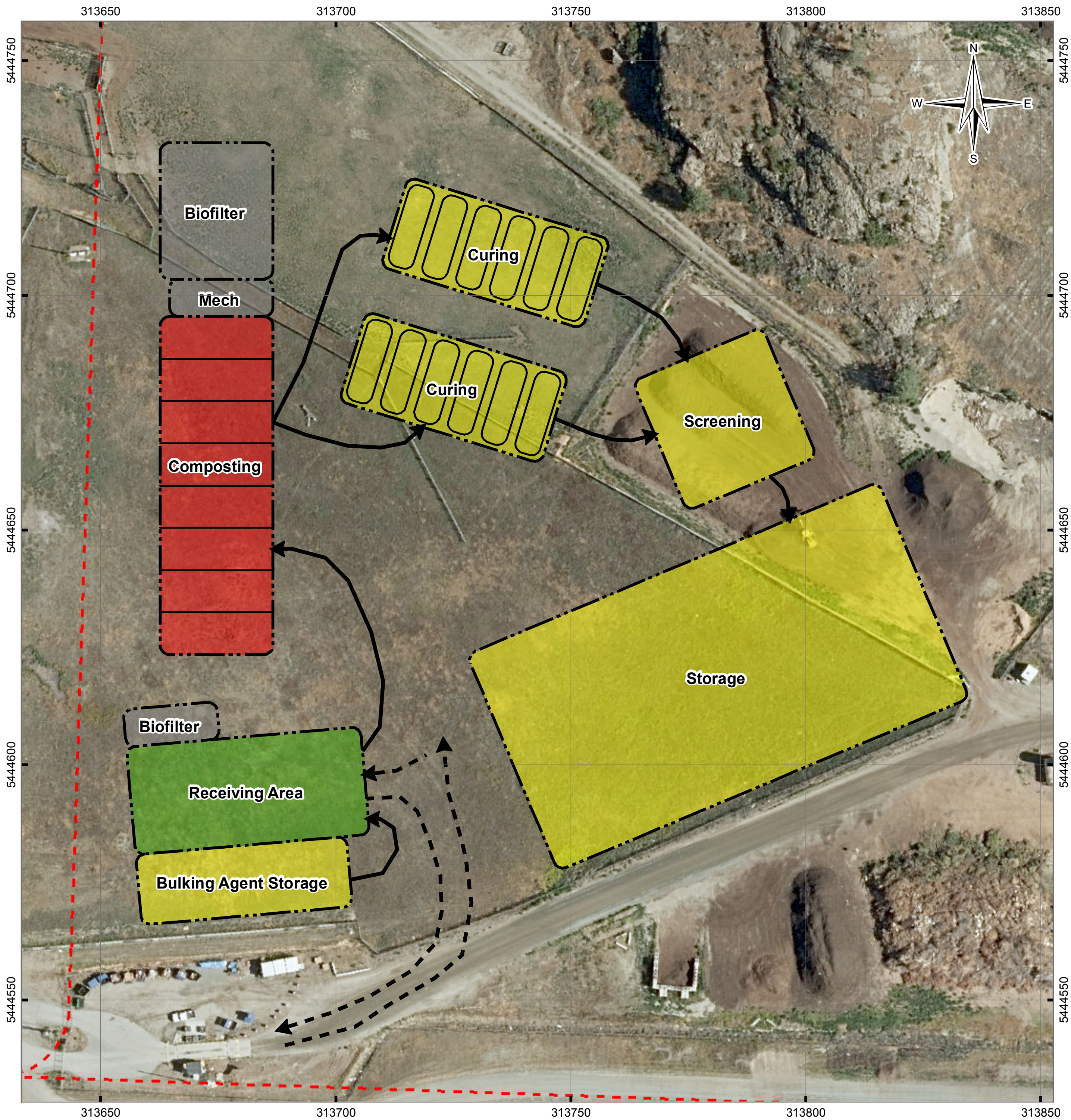
TETRA TECH EBA

FILE NO.
SWM03094-01_OliverReg_Fig03_Mem.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 7, 2015

Figure 3



LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OLIVER LANDFILL, OLIVER, BC

Oliver Regional Facility In-Vessel Composting Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,200
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_OliverReg_Fig04_InVessel.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	July 7, 2015

Figure 4

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LEGEND

- Loader Movement
- Truck Movement
- Composting
- Curing, Screening, and Storage
- Receiving Area
- Mech; Biofilter
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery provided by RDOS (2014).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT
OLIVER LANDFILL, OLIVER, BC

Oliver Regional Facility Anaerobic Digestion Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,200
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_OliverReg_Fig05_AD.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	DATE			
Tt EBA-VANC	July 7, 2015			

Figure 5

OSOYOOS WINDROW WITH SSO

1.0 INTRODUCTION

The following is an assessment of an option to add source separated organics (SSO) from residential sources (i.e. curbside collected) to the windrow composting process at Osoyoos Landfill (hereafter referred to as the "Site"), similar to the method used at the Grand Forks Landfill in the Regional District of Kootenay-Boundary. This report includes design assumptions for adapting the facility and considerations for operation.

1.1 Grand Forks Composting

Based on an interview with the operator of the Grand Forks Landfill composting site, the following is a summary of their operations:

- SSO from curbside collection is covered with wood chips as it arrives.
- SSO is blended with wood chips to a ratio of approximately 1:1 by volume to build windrows.
- Windrows are composted for three to four months, with a minimum of five turnings to meet Organic Matter Recycling Regulation (OMRR) standards.
- Water is added to the windrows in the spring and fall, but not the summer due to water restrictions.

2.0 SITE INFORMATION

The Site is 5 km northwest of the Town of Osoyoos, BC. It is an active landfill operated by the Town of Osoyoos through a contractor, B&B Wood Grinding. Additional information about the Site can be found in the *Osoyoos Landfill Feasibility Assessment*.

2.1 Service Area Assumptions

The Site's service area includes the Town of Osoyoos and Electoral Area A. The total service population is 6,737. For this assessment, it was assumed that SSO from residential curbside collection routes would be added to the existing yard waste composting facility at the Site.

3.0 CONCEPTUAL DESIGN AND OPERATIONAL CONSIDERATIONS

3.1 Proposed Location

The current location of the windrow composting facility is on the northeast corner of the Site (Figure 3.1). There is approximately 0.5 ha of available land in this area.

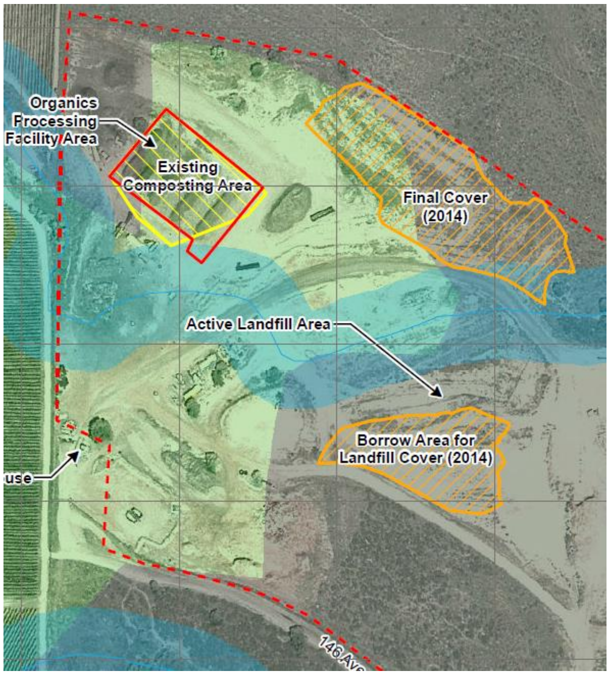

Figure 3.1: Windrow Composting Facility Location

3.2 Feedstock and Design Capacity

Feedstock estimates were calculated based on quantities of green and wood waste from 2013, with the addition of residential SSO that is currently in the waste disposal stream. It was assumed that 40% of current municipal solid waste (MSW) consists of material that could be SSO (e.g. food waste and soiled paper), of which 65% is divertible through a curbside organics collection program[1]. The estimated amount of organics feedstock is 1,066 tonnes/year. The assumed feedstock composition is based on current quantities of green and harvest waste, and projected quantities of SSO that would be collected. Assuming the community's growth rate of 1.1%[2] over the next 20 years, the annual quantity of feedstock is calculated to grow to be 1,327 tonnes/year. This would be approximately 1.6 times the size of the current yard waste operation.

The design capacity for this facility was determined based on the capacity needed for the peak month, when the greatest amount of organics would be received. Through reviewing monthly data for residential MSW collected in 2013, the peak month was August. During this month, the waste collected accounted for approximately 12% of all waste collected throughout the year. This percentage was applied for the total annual feedstock, resulting in a design capacity of 160 tonnes/month.

Note that residential curbside green and wood waste is only about 20% of the total feedstock. The effect of receiving SSO as a separate stream or commingled with green and wood waste will be relatively low from an operations perspective. The SSO will need to be amended with bulking agent in either case and it is anticipated to fluctuate seasonally regardless of collection method (see Section 3.3.1).

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[1] Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. http://www.rdosmaps.bc.ca/min_bylaws/ES/solid_waste/SWMP/2011_RDOS_SWMP_FINAL.pdf

[2] BC Stats Census Total Population Results, 2011. http://www.bcstats.gov.bc.ca/StatisticsBySubject/Census/2011Census/PopulationHousing/MunicipalitiesByRegionalDistrict.aspx

The assumed feedstock composition is presented in Table 1.

Table 1: Assumed Feedstock Composition (in 20 years)

Organic Material	Quantity (tonnes/yr)	Percent of Total Feedstock
Green and Wood Waste (Self-Haul)	747	78%
Green and Wood Waste (Curbside Collected)	289	
SSO (Including Harvest Waste)	291[1]	22%
Total	**1,327**	**100%**
Design Capacity (tonnes/month)	**160**	

[1] Assuming 40% of current MSW consists of food waste, of which 65% is diverted. Regional District of Okanagan-Similkameen Solid Waste Management Plan, 2011. Also includes harvest waste.

3.2.1 Compost Market Considerations

There is a high demand for compost in the area around the Osoyoos Landfill. Since this compost is primarily used for agriculture, it may be worthwhile to pursue higher compost quality to increase its marketability.

Compost made from biosolids and white wood is less desirable to potential customers. In Canada and the United States, organic food regulations prohibit the use of sewage sludge for growing food[3],[4]. Agricultural operations seeking an “Organic” certification will stay away from using compost that would affect the marketability of their crop.

To further increase the marketability of the finished compost product, certification through an independent reviewer such as Organic Materials Review Institute (OMRI) may be considered.

3.3 Conceptual Layout

The technology configuration for this conceptual design is a modification to the existing extended windrow design in place. A conceptual layout of the windrow composting facility is shown in Figure 2. The following sections describe the design assumptions and operating considerations for this type of facility.

3 Organic Product Systems Permitted Substances Lists, 2011. https://www.cog.ca/uploads/PSL.pdf
4 USDA National Organic Program, 2015. http://www.ams.usda.gov/AMSv1.0/NOPOrganicStandards

3.3.1 Receiving Area

It is recommended that a partially-enclosed structure is used for the receiving area to allow for proper material handling and preparation for composting in all weather conditions. A pre-fabricated clear span structure (Figure 3.1) oriented to block the prevailing wind from entering the open side can be used. Using a partial enclosure is more cost effective than full enclosure as lighting and ventilation can be omitted if desired. Two bunkers (10 m x 10 m x 5 m) for mixing and receiving with enough headspace for operate a bucket loader or excavator would be ideal for this type of facility.

Figure 3.1: Example of clear span structure

Once received, the SSO needs to be covered immediately with wood chips or unscreened compost upon arrival. This will minimize odours and vectors (birds, rodents, and insects). The incoming material will be amended daily and formed into an active windrow within each month. Feedstock preparation including shredding for particle size, addition of amendments for initial moisture adjustment, and structural/porosity adjustment will be needed for each batch. On a batch basis the amended SSO will be blended with newly received yard waste to create favourable moisture and bulk density characteristics for composting (e.g. initial moisture content of 50 to 60% and an initial bulk density of 400 to 550 kg/m^3).

Feedstock balancing is important with SSO as it will not be same percentage of incoming tonnes each month and it represents a more putrescible and potentially difficult feedstock with regard to odours and vectors. While the annual average SSO percentage is 22%, the percentage on a month to month basis is expected to vary significantly. The following graph (Figure 3.2) shows an estimate of this variation for design purposes.

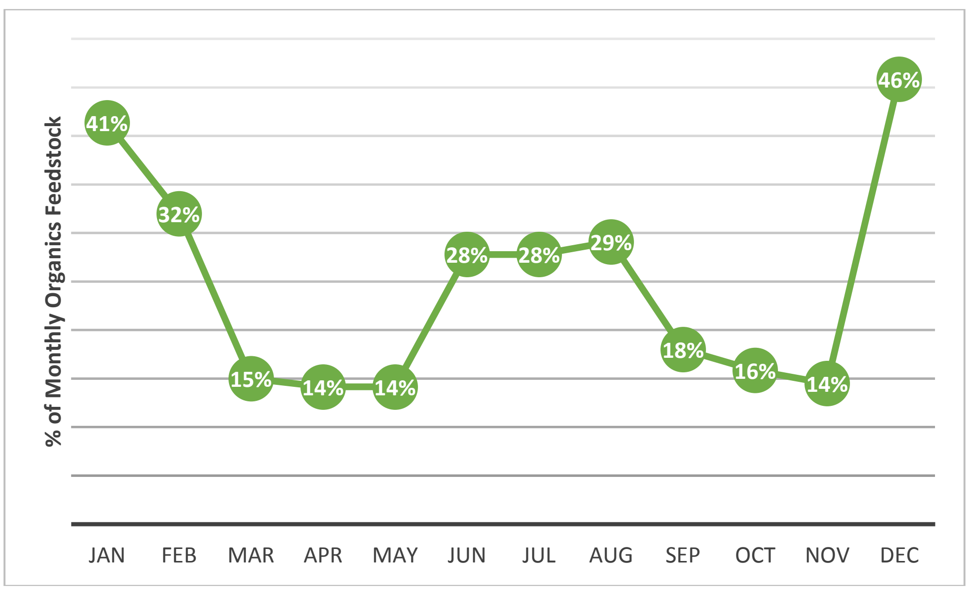


Figure 3.2: Monthly SSO quantities as a percentage of the total monthly organics feedstock

In the winter, yard waste quantities are normally very low while SSO quantities are expected to remain about the same from month to month. SSO may be as high as 46% of the incoming organics stream in December and as low as 14% when yard waste quantities are high during the spring and autumn. This requires the facility to maintain a supply of amendments that can provide structure for porosity, contains some composted material for inoculant, and consists of amendments with low moisture content to allow the higher moisture in the SSO to be absorbed. When the SSO percentage is high (December to February; and to a lesser extent June to August) these amendments will be needed. Less amendment would be required in the spring and fall when higher quantities of green and wood waste are typically received.

3.3.2 Composting Area

The active first stage of composting is typically defined as the first 15-30 days of the composting process, with 30 days being used for this facility due to is small scale. Composting can take place on the current compost pad at the Site.

The less active second stage of composting is the second 60 days (or more) of the composting process. Aging represents the transition from high heat production and active bacterial conversion of the recognizable feedstock into a brown, gray, or black organic material. Aging converts this organic material into a less-odourous, darker, more uniform texture, with favorable characteristics for plant cultivation and growth. Aging represents both bacterial and fungal conversion.

Windrow Size

It was assumed that the maximum size of each windrow batch would be 405 m^3. The recommended standard windrow cross section should be triangular with 11 meters across the bottom and the peak at 5.5 m high. With this scale of operation the batches will be at their maximum in August, with about 15 m of windrow length being built using this cross section. After time and temperature standards to comply with the OMRR are satisfied, windrows can be reconfigured to manage moisture, screening, and product marketing. Smaller cross sections can be used to allow more moisture loss as the piles age and are ready for screening.

Windrow Orientation

Orientation of the piles in parallel with the wind helps prevent convection of air through the cross section when the wind blows at 90 degrees to the windrow length. This orientation is important for winter operation as the temperature, wind, and incoming waste composition are all more challenging from an operations perspective. Low temperatures and cold, dry wind will also make outdoor windrow operation more difficult. There have been cases of steady cold wind stripping too much heat out of the piles for effective composting to continue. However, effective cold weather protection is possible in this type of climate and has been implemented at a compost facility in Moscow, Idaho[5] (approximately 400 km southeast of Osoyoos).

This orientation in parallel with the prevailing wind, combined with a large cross-section windrow shape will allow for effective composting in winter months as the windrow can retain its own heat and moisture to achieve time and temperature standards to be in compliance with OMRR.

Odour Control

Odour control is critical and agitation during the first 15 days after the initial build of each windrow is not recommended for this reason. High-moisture and/or high-calorie wastes bring higher odour potential (notably wet

[5] http://www.clearwatercomposting.com/

grass clippings and food waste). Pile leakage, leachate, and ponding or puddles of liquid (from the feedstock or commingled with stormwater) usually has high odour potential as well. Standing liquids of these types should always be prevented and minimized.

Water Use

Water availability may be limited in the summer months and the system should be designed to conserve moisture in the windrows. The addition of SSO is a net benefit in this regard as SSO can be 70 to 80% water content.

Water demand will follow the seasonal labour and activity rate each month, so the dry summer months represent the highest demand. This concept design takes full advantage of the water content in the SSO and minimizes moisture loss by design of larger cross sections. Nonetheless a demand budget of 25% of the incoming waste tonnes per year is recommended, which is 332 m^3 of water for process irrigation of the windrows. This is a general guideline for process demand only. Dust control, fire protection, and other utility demands are not included in this estimate of water use.

Mobile Equipment

The recommended material handling machine for this concept is a telescopic handler with light material bucket (Figure 3.3). The machine should have a vertical dump clearance of 6 m clear with dump bucket in the down position. The bucket should be 2.0 m^3 heaped capacity and the machine should have an adequate counterweight. As this type of equipment is not currently available at the Site, it will need to be either purchased by the RDOS, or brought in by a contractor and charged at a force account rate for usage.

Figure 3.3: Example of a telescopic handler

The telescopic handler is preferred over the standard articulated front end loader (which is available on site for general material movement) or track excavator. Both of these machines have higher capital and operating costs. However, the front end loader will not be able to construct a taller windrows.

Assuming a 2.0 m^3 load capability this machine would average approximately 6.7 hours per month in actual scoop, load, and carry activities. This estimate assumes that each windrow is turned a minimum of five times to meet OMRR standards. Screening would be convenient with this machine as well.

Staff Resources

The labour commitment for this operation will be in four functional primary areas:

- Feedstock preparation;
- Material handling;
- Screening and truck loading; and
- Facility repair and maintenance.

A single operator and single general mechanic that can also serve as oiler and general maintenance and labour is recommended. The budget for these four functional areas will be proportional to the material handling which paces the operation. With 6.7 hours/month for material handling, plus time for feedstock preparation and screening (assumed factor of 3.5 times the material handling hours) yields a reasonable budget for overall site labour for two workers that would share their time between composting and landfill site activities. This yields 24 hours for a machine operator and 24 hours for a mechanic/oiler, for a total of 48 hours per month on average. Assuming feedstock is delivered to the Site once per week, an average of 6 hours per week for a machine operator and mechanic/oiler would be needed to receive, prepare, and build the windrow. The monthly labour load will vary according to the overall tonnage rate at the facility each month, as it varies by season (Figure 3.4). An average of 48 hours per month yields a total of 576 employee-hours per year for the facility (0.25 FTE).

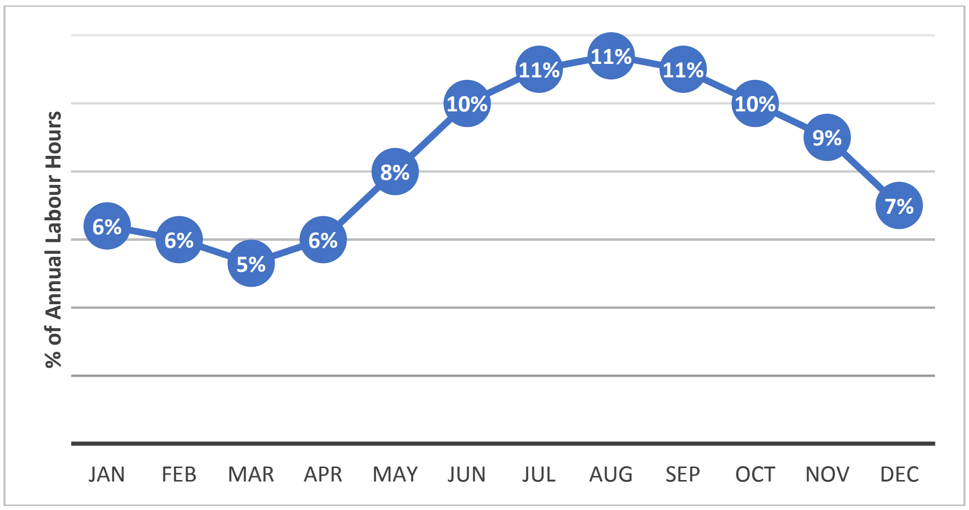


Figure 3.4: Monthly labour as a percentage of annual labour hours

4.0 FACILITY COSTS

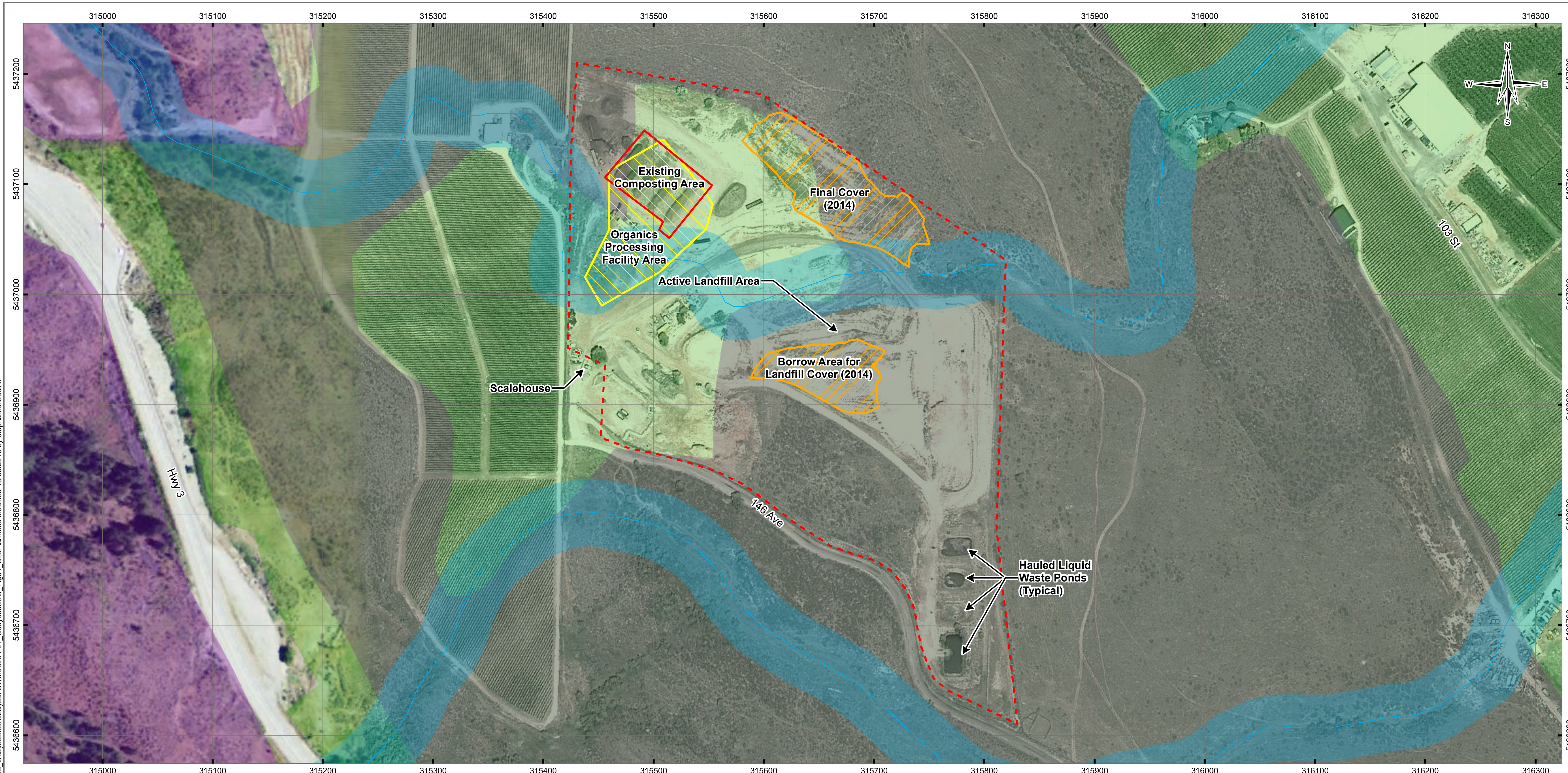
The approximate range for budgeting on a cost per tonne basis is presented in the following table. The capital budget is an allowance for cold weather protection (receiving/mixing structures) and a telescopic handler. All other capital improvements are assumed to be in place and have not been included in this budgetary estimate. Note that this is a general industry average, and is not specific to the Site.

Table 2: Budget Range for Windrow Facilities

Cost	Budget Range ($/tonne)
Amortized Capital[1]	$14.70 to $22.05
Operating	$18.70 to $37.40
Total	**$33.40 to $59.45**

[1] 7% discount rate, 20-year term

Attachments: Figure 1. Site Plan
Figure 2: Windrow Site Layout



LEGEND

- Property Boundary (Approximate)
- Organics Processing Facility Area
- Existing Composting Area
- Other Facility Area
- Watercourse / Waterbody
- Watercourse Development Area
- Agricultural Land Reserve
- Environmentally Sensitive Habitat

NOTES
Base data source:
ALR, Environmentally Sensitive Habitat and Watercourses provided by RDOS.
Imagery from Google Earth Pro; Digital Globe (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OSOYOOS WITH CURBSIDE SSO OSOYOOS, BC

Site Plan

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:3,500
50 25 0 50
Metres

TETRA TECH EBA

FILE NO.				
SWM03094-01_OsoyoosSSO_Fig01_SitePlan.mxd				
PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0
OFFICE	DATE			
Tt EBA-VANC	August 18, 2015			

Figure 1

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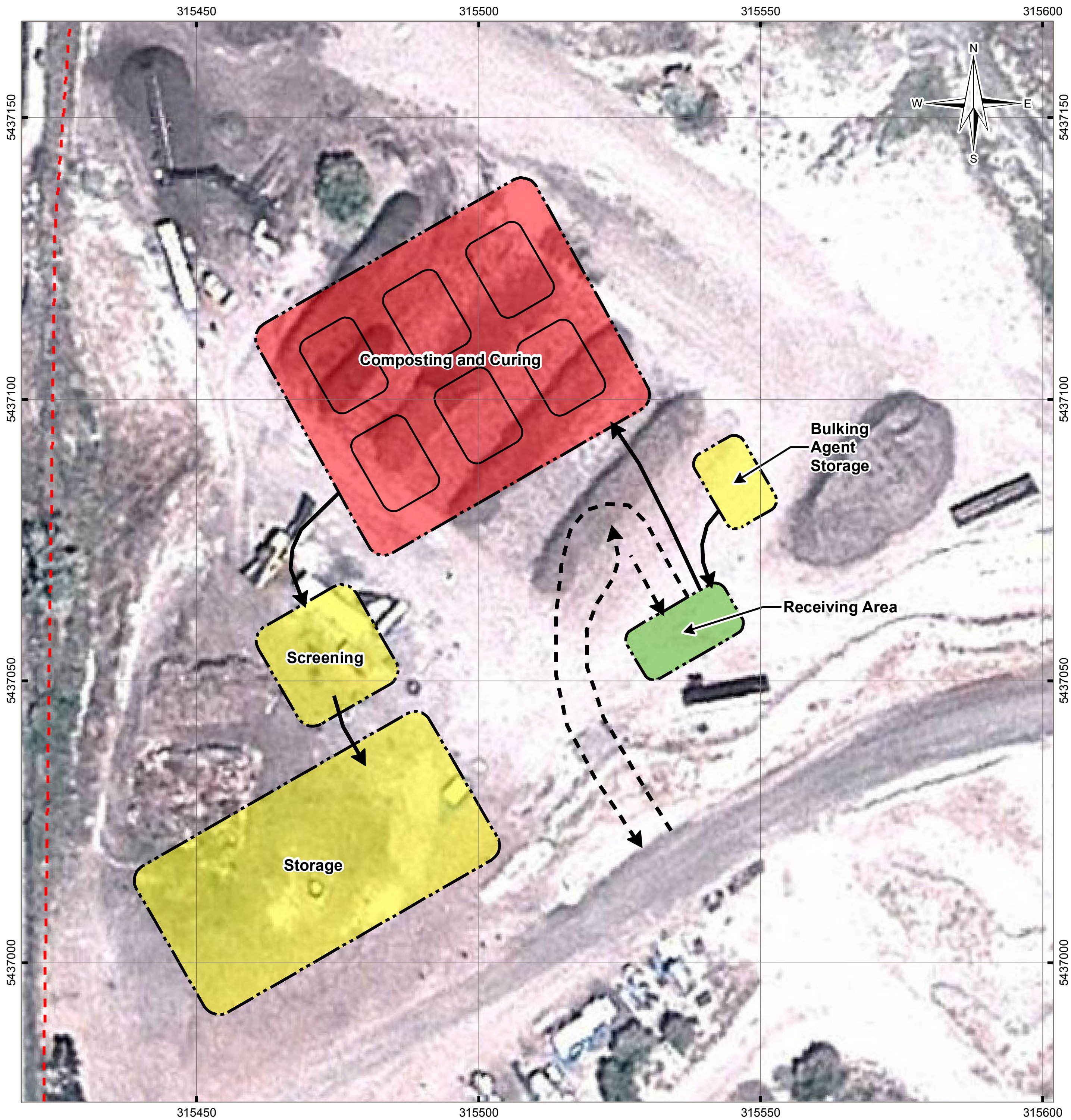

LEGEND

- Loader Movement
- Truck Movement
- Composting and Curing
- Screening and Storage
- Receiving Area
- Property Boundary (Approximate)

NOTES
Base data source:
Imagery from Google Earth Pro; Digital Globe (2012).

STATUS
ISSUED FOR REVIEW

ORGANIC MANAGEMENT CONSULTANT OSOYOOS WITH CURBSIDE SSO OSOYOOS, BC

Windrow Site Layout

PROJECTION	DATUM	CLIENT
UTM Zone 11	NAD83	Regional District of Okanagan-Similkameen

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH EBA

FILE NO.
SWM03094-01_OsoyoosSSO_Fig02_Windrow.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENVSWM03094-01	SL	MEZ	BL	0

OFFICE	DATE
Tt EBA-VANC	August 18, 2015

Figure 2

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APPENDIX C

COST ESTIMATE ASSUMPTIONS

General Unit Rates

Item	Unit	Unit Rate
Construction		
Mob/de-mob	each	$220,000.00
Land clearing	m^2	$10.00
Grading	m^2	$3.00
Access road construction	m	$333.00
Common excavation for storm water pond	m^3	$11.00
Geomembrane liner	m^2	$8.72
Clay liner for storm water pond	m^3	$15.00
Clay liner for screening and storage areas	m^3	$14.74
Surface water ditches	m	$46.00
Berms	m	$33.00
Supply and place concrete	m^3	$600.00
Supply and place aggregate	m^3	$60.00
Load, haul and place soil	m^3	$10.00
Equipment (Mobile)		
Wheel Loader	each	$200,000.00
Grinder	each	$200,000.00
Screener	each	$200,000.00
Airlift separator	each	$25,000.00
Utilities		
Electricity	kwh	$0.09
Water	m3	$0.22
Diesel	L	$1.40
Labour		
Machine operator (government)	hr	$39.32
Machine operator (contractor)	hr	$35.00
Labourer/litter picker	hr	$25.63
Compost technician	hr	$39.07

Item	Unit	Unit Rate
Scale operator (Summerland)	hr	$39.32
Scale operator (Princeton)	hr	$35.00
Contractor Equipment Rates		
Grinding (by volume)	m3	$7.00
Grinding (by time)	hrs	$1,000.00
Screening	hrs	$135.00
Loader	hrs	$135.00
Bi-Product Revenue		
Compost Sales	tonne	$12.50
Electricity Sales	kwh	$0.05
Other		
CAD/USD Exchange	$CAD:$USD	1.25
Equipment maintenance	% of purchase cost	10
Engineering	% of non-mobile equipment cost	10
Contingency (capital)	% of non-mobile equipment cost	25
Contingency (operating)	% of total	20

Organics Processing Technology (USD)

Site	Aerated Static Pile	Membrane Covered Aerated Static Pile	In-Vessel Composting	Anaerobic Digestion
Campbell Mountain Landfill	$2,786,000	$4,800,000	$5,786,000	$10,105,000
Summerland Landfill	$1,050,000	$2,400,000	$2,140,000	$5,258,000
Okanagan Falls Landfill	$552,000	$1,200,000	$1,120,000	N/A
Oliver Landfill	$690,000	$1,920,000	$1,400,000	N/A
Osoyoos Landfill	$552,000	$1,200,000	$1,120,000	N/A
Princeton Landfill	$552,000	$1,200,000	$1,120,000	N/A
Princeton Hayfield	$552,000	$1,200,000	$1,120,000	N/A
Keremeos Transfer Station	$552,000	$1,200,000	$1,120,000	N/A
Campbell Mountain Regional	$5,017,000	$6,750,000	$10,652,000	$17,121,000
Summerland Regional	$5,017,000	$6,750,000	$10,652,000	$17,121,000
Summerland Regional with RDCO Biosolids	$5,692,000	$8,000,000	$12,084,000	$19,293,000
Oliver Regional	$1,761,000	$3,600,000	$3,623,000	$6,466,000

Receiving Building

Site	Price (per building)
Campbell Mountain Landfill, Campbell Mountain and Summerland Regional Facilities, Oliver Regional	$246,000
Summerland Landfill	$151,000
Oliver Landfill	$105,000
Osoyoos Landfill	$96,000