DRAFT ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

OREGON STATE UNIVERSITY—CASCADES: LANDFILL REMEDIATION BEND, OREGON

Prepared for

OREGON STATE UNIVERSITY- CASCADES

December 17, 2018

Project No. 1290.01.04

Prepared by

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MAUL FOSTER ALONGI

DRAFT

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ECSI NO. 4884

The material and data in this report were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

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Brooke Harmon, PE
Staff Engineer

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ACRONYMS AND ABBREVIATIONS

1200-C Permit	National Pollutant Discharge Elimination System Construction Stormwater Discharge Permit 1200-C
ABCA	analysis of brownfield cleanup alternatives
ACM	asbestos-containing material
Apex	Apex Companies, LLC
bgs	below ground surface
CREC	controlled recognized environmental condition
cy	cubic yard
DEQ	Oregon Department of Environmental Quality
ESA	environmental site assessment
GBB	Gershman, Brickner & Bratton, Inc.
MFA	Maul Foster & Alongi, Inc.
OAR	Oregon Administrative Rule
OSU	Oregon State University
PPA	prospective purchaser agreement
RBC	DEQ risk-based concentration
Site	the former Deschutes County Landfill
Solid Waste Permit	DEQ Solid Waste Permit No. 215
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1 INTRODUCTION

This analysis of brownfield cleanup alternatives (ABCA) was completed for a 72-acre inactive construction and demolition waste landfill owned by OSU-Cascades located in Bend, Oregon (the Site, see Figure 1). This ABCA was prepared to meet the requirements of U.S. Environmental Protection Agency (USEPA) Brownfields Cleanup Grants program and the applicable Oregon Department of Environmental Quality (DEQ) regulatory requirements and remedial action objectives for protection of human health and the environment.

This ABCA report includes:

- Information about the Site, comprised by the areas identified as Cells 1, 2 and 3 (see Figure 2).
- Previous investigations and known contamination, cleanup standards, and applicable laws.
- Effectiveness, implementability, and cost of the evaluated cleanup alternatives.
- Selection of a preferred cleanup alternative.

Redevelopment is not being conducted specifically to improve environmental quality, but improvement is a collateral benefit. Redevelopment of the Site includes an expansion of the OSU-Cascades campus, which will serve the community and improve the environmental quality of the encumbered site. OSU-Cascades will develop a highly interdisciplinary and collaborative campus culture by creating facilities that serve a mix of program uses including academic facilities, housing, an innovation district with industry and research partners and recreation facilities.

2 BACKGROUND

2.1 Site Description

The Site is approximately 72 acres, located in the northwest quarter of Section 6, Township 18 south, Range 12, east of the Willamette Meridian. It is currently owned by OSU-Cascades and is in the southwest portion of Bend, Oregon. The Site is bordered to the north and west by residential properties, to the east by commercial development, and to the south by a former surface pumice mine owned by OSU-Cascades and the current OSU-Cascades campus.

The geology of the Site consists primarily of volcanic soils with tuff, cinder, and basalt. As a construction and demolition waste landfill, the Site has been extensively landfilled with mill waste, construction-demolition waste, and cover soil. The landfill was active from 1972 to 1996 to dispose

of construction and demolition waste, industrial waste, woodwaste, brush, and tires and operated under the DEQ Solid Waste Permit No. 215 (the Solid Waste Permit).

As shown on Figure 2, the site was developed in three distinct areas. A previous site investigation conducted by Gershman Brickner & Bratton, Inc. (GBB, 2008) estimated the waste limits (defined herein as waste cells) and composition in each area.

- Area 1 is in the eastern portion of the site (tax parcel 1812060000110 and 181206A000719). Area 1 is the oldest landfill area and was filled with a large quantity of woodwaste from local saw mills. Area 1 is 23.2 acres; however, the footprint of waste, Cell 1, extends beyond the western parcel boundary, into property owned by the Bend Park and Recreation District and is estimated to be approximately 24.7 acres. A portion of Cell 1 has been undergoing pyrolysis[1], and, therefore, has not received closure certification by DEQ.

- Area 2 is in the south-center portion of the site (southeast portion of tax parcel 1812060000111). The waste composition in Area 2 is very similar to that of Area 1, except that it also contains construction and demolition debris. Area 2 is 9.8 acres, and the waste footprint, Cell 2, is estimated to be 7.1 acres. Cell 2 was closed in 1997.

- Area 3 is in the western portion of the site (north portion of tax parcel 1812060000111). Area 3 is 39.4 acres, and the waste footprint, Cell 3, is estimated to be 19.5 acres. Cell 3 waste includes mill waste, construction and demolition debris, and large woody debris such as logs and stumps.[2] Cell 3 was closed in 1997.

2.2 Previous Investigations

Various environmental investigations have been conducted at the Site and are summarized below.

- **Subsurface Assessment (David Evans & Associates, Inc., 1997):** The primary focus of the 1997 investigation was the assessment of Area 1. Nine test pits ranging from 3 feet to 21 feet below ground surface (bgs) were advanced. Twenty-eight borings, ranging from 5.5 feet to 34.5 feet bgs, were advanced, meeting with refusal in some instances. Eight deeper borings were also advanced. This assessment identified the issue of pyrolysis associated with the anaerobic decomposition of woodwaste in the landfill.

- **Demolition Landfill Redevelopment Study (URS Corporation, 2002):** URS provided the County with a redevelopment study for the Site. The purpose of the report was to convey site conditions and to identify possible reuse. The report reviewed then-current vegetation, zoning, available utilities in the area, transportation considerations, and nearby water rights, as well as a groundwater beneficial use survey. The report included a property evaluation and identified potential reuse scenarios.

[1] Pyrolysis is thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen.
[2] Note that the permit allowed for disposal of industrial waste, but none was specifically identified in the prior investigations (GBB, 2008, Apex 2016).

- **Demolition Landfill Subsurface Investigations Study (GBB, 2008):** GBB provided the County a summary of completed site investigations and performed additional site assessment activities to supplement the 1997 DEA investigation and provide more information on the waste composition and the potential for impacts to the native material below the landfill. GBB completed full-depth drilling into waste and underlying soils; this included 13 exploratory borings and 14 shallow test pits (up to 20 feet bgs), as well as replacement of three landfill-gas wells and three temperature probes. Test pits were advanced primarily to identify waste composition and materials. Waste consisted primarily of ash, sawdust, metal, tires, woodwaste, roofing materials, and fill/fines. In addition, potential asbestos-containing materials (ACM) were observed in a few test pits. GBB also performed a subsurface magnetic and electrical resistivity survey to understand waste thicknesses.

  Waste and underlying soils from borings were sampled and analyzed for metals, total petroleum hydrocarbons, volatile organic compounds (VOCs), semivolatile organic compounds, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and pesticides/herbicides, in addition to moisture and organic content. The analytical results were screened against DEQ risk-based criteria (RBCs) established at the time. The results showed exceedances in soil of residential vapor intrusion, direct contact, and leaching to groundwater RBCs for several constituents.

  GBB concluded that the deepest point of waste in the landfill is more than 200 feet above the static groundwater level, and infiltration to the soil below the landfill was not indicated.

- **Phase I Environmental Site Assessment, Adjacent Property (PBS, 2013a):** PBS completed a Phase I environmental site assessment (ESA) for two properties owned by OSU-Cascades that are adjacent south of the Site (the pumice mine) and west of the Site (a strip between the landfill and SW Mount Washington Drive). The ESA identified no recognized environmental conditions pertaining to the properties but indicated that the adjacent landfill cap extended onto the properties and recommended an investigation to understand if landfill material was present.

- **Focused Site Investigation, Adjacent Property (PBS, 2013b):** Based on the 2013 PBS Phase I Environmental Site Assessment recommendation, PBS completed a focused subsurface investigation of two properties located south adjacent to the Site. Test pits advanced along the property boundary near Area 1 of the Site confirmed that solid waste material extends approximately 20 feet south from the northern edge of one of the properties and approximately 340 feet laterally along the boundary. Solid waste was not observed to extend onto the other adjacent property near Area 2 of the Site.

- **Phase II Characterization Report (PBS, 2013c):** PBS advanced three deep borings, ranging from 265 feet to 315 feet bgs, which were completed as monitoring wells in March and April 2013. Groundwater was encountered between 242 and 293 feet bgs at the Site. Groundwater was noted to be approximately 150 feet below fill waste and not in contact with landfill materials. Groundwater monitoring was completed in accordance with the Solid Waste Permit. Analytical results show a closure permit exceedance for pH in groundwater from two of the three monitoring wells. Arsenic, barium, chromium,

vanadium, and zinc were detected in one or more monitoring wells but at concentrations below USEPA maximum contaminant levels and DEQ guidance levels. Additionally, PBS visually assessed the pumice mine adjacent to the Site to interpret the subsurface geology within the uppermost 100 feet. Rock coring was completed at the Site to 260 feet bgs and a site geologic interpretation of the volcanoclastic material was provided.

- **Former Demolition Landfill Mitigation Evaluation (Apex, 2014):** Apex completed a geoenvironmental conditions summary for development of mitigation alternatives for future redevelopment at the Site. Apex identified four primary site redevelopment constraints: areas that contain significant landfill material, areas where pyrolysis may be occurring, requirements of the Solid Waste Permit pertaining to the Site, and migration/impacts to the surrounding community, including fugitive odors and trucking impacts. Many alternatives and approaches were identified, including avoidance of landfilled areas during redevelopment, excavation, and reconsolidation of landfill materials on site.
- **Focused Site Investigation (MFA, 2016):** Subsequent to the above-referenced investigations, MFA performed a focused subsurface investigation in 2016. This investigation included surface soil and soil vapor sampling. Lithology showed that cap thickness ranges from 0.5 feet to 5 feet in Areas 1 and 2. A deeper boring was advanced to confirm cap thickness in Area 3, where past investigations had observed a thicker cap. Observations at this boring showed a cap thickness of approximately 40 feet. Landfill soil gas samples were collected from temporary boreholes screened from approximately 5 feet to 10 feet bgs. Methane was not detected in soil gas collected from two borings but was detected in four borings from 1.2 percent to 10.8 percent. VOCs were detected in all samples; however, only two VOCs, ethylbenzene and naphthalene, were detected at concentrations exceeding their respective DEQ RBCs for urban residential vapor intrusion into buildings.
- **Phase 1 ESA (MFA, 2018):** MFA completed a Phase I ESA for OSU-Cascades to support the property transaction. Soil gas was identified as a recognized environmental condition, as methane levels were at or above the DEQ guidance concentration for methane mitigation for structure and confined-space entry and ethylbenzene and naphthalene were above DEQ's RBCs for urban residential vapor intrusion into buildings. The presence of the landfill and associated waste was identified as a controlled recognized environmental condition because detections of petroleum hydrocarbons, benzene, trichloroethylene, benzo(a)pyrene, arsenic, and lead were above the DEQ RBCs for residential receptors. Additionally, potential ACM is likely to be present in the landfill.

2.3 Nature and Extent of Contamination

While the conditions of the Solid Waste Permit for the landfill did not allow the intake of certain types of materials (e.g., municipal solid waste, used oil), not all portions of loads were inspected, and records indicate that there were periods of unattended dumping on some portions of the landfill. Samples collected from waste material within the landfill had concentrations of petroleum hydrocarbons, benzene, trichloroethylene, benzo(a)pyrene, arsenic, and lead above the DEQ RBCs for residential

receptors. There were two exceedances of soil vapor RBCs for urban residential and occupational direct contact for ethylbenzene and naphthalene and methane above DEQ guidance. As the landfill is unlined and contains constituents of concern, there is a possibility of a release from the Site; however, this possibility is considered applicable to soil, as groundwater appears 150 to 200 feet below the waste material. This controlled recognized environmental condition is currently managed through restricted access to the Site, the presence of the cover material, the depth at which native soil is present, the composition of substrate (largely basalt), and depth to groundwater. Additionally, the demolition and industrial waste landfill is managed through compliance with the Solid Waste Permit.

3 APPLICABLE REGULATIONS AND CLEANUP STANDARDS

3.1 State Oversight and Regulations

3.1.1 Cleanup

The DEQ is responsible for overseeing cleanup at the site. Documents prepared for this site are submitted to the DEQ under state Environmental Cleanup Site Information number 4884. The site cleanup is expected to be governed under Oregon Administrative Rule (OAR) 340-122—the Hazardous Substance and Remedial Action Rules. These rules require that any removal or remedial action be conducted in a manner that assures protection of the environment and present and future public health, safety, and welfare.

An Easement and Equitable Servitudes covering the Site, between the Board of Trustees of Oregon State University and the DEQ, was recorded on April 9, 2018. Additionally, remedial actions will be conducted under the Consent Judgment filed with the Circuit Court of the State of Oregon on June 6, 2018.

3.1.2 Solid Waste

The landfill is currently subject to the Solid Waste Permit, issued to the current owner and operator, Oregon State University; along with co-operator Deschutes County. As stated in the Easement and Equitable Servitudes, all site work in all portions of the Site where waste may be present shall be in accordance with the Solid Waste Permit.

3.2 Construction Permits

The project is exempt from the City of Bend clearing, grading, and erosion control permit as it is related to landfill operations, consistent with the DEQ permit related to postclosure activities at a landfill. However, the project will be subject to the Performance Standards (described in City of Bend Code Sections 16.10.070 through 16.10.100 and Section 16.15.040).

The National Pollutant Discharge Elimination System Construction Stormwater Discharge Permit 1200-C (1200-C Permit) regulates stormwater runoff to surface waters from construction activities that disturb one or more acres in Oregon. The 1200-C Permit is a general permit, meaning that it outlines requirements for site construction and is not specific to this site. An Erosion and Sediment Control Plan will be attached to the 1200-C Permit and is site-specific.

4 CLEANUP ALTERNATIVES

The purpose of this ABCA is to identify and evaluate remedial alternatives to address environmental contamination and ensure protectiveness of human health and the environment at the Site. This ABCA was completed in general accordance with USEPA guidelines for conducting an ABCA and Oregon regulations for conducting feasibility studies (OAR 340-122-0085).

4.1 Remedial Objectives

Typically, under DEQ removal authority (OAR 340-122-0090), remedial alternatives are evaluated using the following criteria:

- Effectiveness
- Long-term reliability
- Implementability
- Implementation risk
- Reasonableness of cost

The above factors are discussed below, along with a discussion of climate change and sustainability related to resilience per USEPA guidance (USEPA, 2014).

4.2 Remedial Alternatives

The objective of the remedial alternatives described below is to mitigate environmental risk and be protective of human health and the environment.

4.2.1 Alternative 1—Long-Term Monitoring

Alternative 1 includes no construction, only long-term monitoring and maintenance. Thirty years of monitoring are assumed. This alternative is included as a baseline condition. This alternative would not include any activities to remove or treat landfill waste. If landfill waste is left in place and the Solid Waste Permit requirements are not fully followed, human and ecological exposure is possible and a potential for contaminant migration via erosion.

Consistent with the Solid Waste Permit, the following engineering controls are likely:

- Long-term landfill gas perimeter and/or surface monitoring.
- Long-term site monitoring (inspections, landfill gas measurements).
- Long-term physical cap and surface maintenance (settlement, vegetation management, etc.).
- Subsurface temperature monitoring, with consideration for the area of pyrolysis in Cell 1.

Additionally, if conditions change, landfill gas extraction/venting systems and/or long-term groundwater monitoring may be required. Landfill gas, pyrolysis, and differential settlement are the primary concerns for short- and long-term development scenarios. Due to the arid climate and deep groundwater, leachate control is not likely a concern for this site.

4.2.2 Alternative 2—Landfill Consolidation

Alternative 2 assumes landfill waste would be processed into a beneficial material acceptable for reuse or, if unacceptable for reuse, consolidated into Cell 3. Alternative 2 is broken up into three phases based on OSU's current redevelopment plans.

Phase 1 includes remediation of the southern three acres of Area 2 to create property ready for redevelopment. Approximately 380,000 cubic yards (cy) of waste will be excavated and approximately 120,000 cy of that waste will be screened, processed, and stockpiled. Bulky woodwaste and other unacceptable material would be re-landfilled in Area 3 within the existing permitted landfill area. Some waste unacceptable for landfilling in Cell 3 would be removed and disposed of off-site. Acceptable screened material would be blended with on-site cover soil and backfilled in Area 2 to the desired finish grade; reclamation of the adjacent pumice mine is included in this phase. This phase would create 47.9 acres (3.1 acre of remediation in Area 2 and 44.8 acres of reclamation in the pumice mine) of property ready for redevelopment.

Phase 2 includes the remediation of the balance of Cell 2 and a portion of Cell 1. Approximately 320,000 cy of waste would be excavated and approximately 132,000 cy of that waste would be screened to create suitable backfill for use in Area 2 and Area 1. The woodwaste and non-screened waste would be re-landfilled in Area 3 within the existing permitted landfill area. In addition to the remediation of Area 2 and a portion of Area 1. This would create approximately 11 acres of property ready for redevelopment.

Phase 3 would include remediation of the remaining 18.4 acres of Area 1. The remediation would include excavation of the remaining 900,000 cy of waste in Cell 1. 250,000 cy of the excavated waste would be screened and stockpiled for blending with on-site soils for beneficial reuse. The woodwaste, processed pyrolysis material, and un-screened waste would be placed in Area 3. Screened waste would be blended with cover soil from on-site and then backfilled into Area 1 to a desired finish grade. This would create an additional 18.4 acres of developable land in Area 1.

Open spaces where waste is present, i.e., Cell 3, would likely require the following institutional and engineering controls:

- Long-term landfill gas perimeter and surface monitoring.
- Long-term site monitoring (inspections, landfill gas measurements).
- Long-term physical cap and surface maintenance (settlement, vegetation management, etc.).

Landfill gas and differential settlement are the primary concerns for short- and long-term development under this alternative. Due to the arid climate and deep groundwater, leachate control is not likely a concern for this site.

4.2.3 Alternative 3—Off-Site Disposal of Landfill Waste

The third redevelopment scenario (Alternative 3) assumes all landfill waste from Cells 1, 2, and 3 would be excavated and hauled to a designated landfill. Over 2 million cy of waste would be hauled approximately 6 miles to the Knott Landfill. Waste not acceptable for disposal at Knott Landfill would be treated and/or disposed of at other permitted facilities. Alternative 3 would require several years of constant truck-traffic. An estimated 100,000 truckloads of waste would reduce or eliminate the municipal landfill capacity for local waste disposal.

4.3 Evaluation of Cleanup Alternatives

4.3.1 Effectiveness

The alternatives are judged to be effective in addressing environmental risk. Alternative 1 does not actively address pyrolysis, although under the Solid Waste Permit, the DEQ can require management of this risk. Alternatives 2 and 3 are more effective, as they reduce and actively address the exposure of contaminants to human and/or ecological receptors.

4.3.2 Long-Term Reliability

Following well-established protocols as specified in the Solid Waste Permit, Alternatives 1 and 2 provide long-term reliability. They involve institutional controls (i.e., Solid Waste Permit) and the maintenance of engineering controls (i.e., cap) to prevent exposure of human and/or ecological receptors to contaminants. Alternative 3 would remove all landfill waste from the Site and not require long-term monitoring, thus it is judged to provide marginally more long-term reliability.

4.3.3 Implementability

Alternative 1 is readily implementable. Alternatives 2 and 3 utilize common construction practices, although Alternative 2 is more technically complex. Alternative 3 imparts significant negative impacts on the surrounding community to the point that it may be unacceptable, i.e., not fully implementable. Consequently, Alternative 2 is judged to be more implementable than Alternative 3.

4.3.4 Implementation Risk

Alternative 3 is judged to have more implementation risk than Alternative 2 due to the impact on the community (e.g., noise, dust and potential truck accidents). Alternative 3 involves an extensive amount of truck trips over an extended period; this off-site landfilling would also reduce or eliminate the local municipal landfill capacity for waste disposal. Alternative 2 and 3 would incorporate comparable on-site controls to reduce/eliminate releases (e.g., dust), excess noise and stormwater runoff. For all alternatives, worker risk would be minimized by adherence to a health and safety plan. Alternative 1 has limited action, so implementation risk is low.

4.3.5 Sustainability

Alternative 2 is judged to be more sustainable than Alternative 3, as it requires considerably less truck miles in terms of both waste off-site and backfill import. The additional emissions from construction activities in Alternative 3 are more significant than the emissions related to excavation, screening, and construction hauling in Alternative 2. Alternative 1 requires limited action; however, it does not actively address the concern of the presence of pyrolysis in Cell 1 and does not allow for redevelopment of a brownfield, whereas Alternative 2 allows for removal of the pyrolysis material and development. Redeveloping on brownfields allows for existing infrastructure to be utilized and is a more sustainable approach.

4.3.6 Climate Change Concerns

Climate change has the potential to increase variability in weather conditions in Oregon, including precipitation, temperature and snowpack. Taking a more active remediation approach to address and consolidate the landfill waste hedges against variability in the weather system and how it might impact the landfill waste material. Alternative 2 allows for an active remedial approach, while reducing greenhouse gas emissions as compared to Alternative 3.

4.3.7 Cost

The conceptual-level cost estimate to implement Alternative 1 is approximately $188,000. The conceptual-level cost estimate to implement Alternative 2 is approximately $53M. The conceptual-level cost estimate to implement Alternative 3 is approximately $249M. (See Tables).

4.3.8 Public Participation

OSU-Cascades participated in a public comment process in the issuance of the prospective purchaser agreement (PPA) in early 2018; this document reflects the approach outlined in the PPA. The ABCA process mandates that public concerns be addressed during the selection of a cleanup alternative. This ABCA report will be included in the USEPA grant application to be presented for public comment. Additional public comment period(s) will be included as required by the permitting process of the cleanup action.

5 PREFERRED CLEANUP ALTERNATIVE

The preferred remedial alternative is Alternative 2, which includes:

- Consolidation of waste from Cells 1 and 2 into Cell 3.
- Active remediation of pyrolysis in Cell 1.
- Screening and reuse of cover soil and waste material acceptable for engineered fill.
- Creation of approximately 116 acres of developable land (77 acres unencumbered and 39 acres of passive use).
- Capping of Cell 3.
- Long term monitoring and maintenance.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

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TABLES

Table 1 - Alternative 1 Conceptual Cost Estimate
Analysis of Brownfield Cleanup Alternatives
Oregon State University-Cascades

DRAFT - Alternative 1 Conceptual Cost Estimate	2001 NW 19th Avenue, Suite 200 Portland, OR 97209 971.544.2139 (p) 971.544.2140 (f) www.maulfoster.com
Project: Oregon State University - Cascades: Landfill Remediation	
Client: Oregon State University - Cascades	
Summary: Long-term Monitoring	
Project #/Task: 1290.01.04-9	
Prepared By: Brooke Harmon, PE	
Checked By: Jennifer King, PE	
Date: 11/18/2018	
Revision #.: 1	

Line Item	Frequency	Cost	Total Cost
Monitoring			
Monitoring (30 years)	annual	$5,000	
Maintenance (30 years)	every 5 years	$10,000	
ALTERNATIVE TOTAL (Net Present Value, Rounded to nearest $1000)			**$188,000**

Table 2 - Alternative 2 Conceptual Cost Estimate
Analysis of Brownfield Cleanup Alternatives
Oregon State University-Cascades

DRAFT - Alternative 2 Conceptual Cost Estimate	2001 NW 19th Avenue, Suite 200 Portland, OR 97209 971.544.2139 (p) 971.544.2140 (f) www.maulfoster.com
Project: Oregon State University - Cascades: Landfill Remediation	
Client: Oregon State University - Cascades	
Summary: Phased approach, consolidate landfill cells.	
Project #/Task: 1290.01.04-9	
Prepared By: Brooke Harmon, PE	
Checked By: Jennifer King, PE	
Date: 10/23/2018	
Revision #.: 1	

Line Item	Units	Unit Cost	No. of Units	Cost	Total Cost
Construction Cost					
Phase 1				$9,500,000	
Phase 2				$13,000,000	
Phase 3				$25,600,000	
Subtotal				$48,100,000	
Contingency			10%	$4,810,000	
Monitoring					
Monitoring (30 years)	annual	$5,000			
Maintenance (30 years)	every 5 years	$10,000			
Monitoring and Maintenance (NPV)				$188,000	
ALTERNATIVE TOTAL (Rounded to nearest $1000)					**$53,098,000**

NOTES:

CY = cubic yard

NPV = net present value

Table 3 - Alternative 3 Conceptual Cost Estimate
Analysis of Brownfield Cleanup Alternatives
Oregon State University-Cascades

DRAFT - Alternative 3 Conceptual Cost Estimate	
Project: Oregon State University - Cascades: Landfill Remediation	
Client: Oregon State University - Cascades	
Summary: Dispose of landfill waste offsite.	
Project #/Task: 1290.01.04-9	
Prepared By: Brooke Harmon, PE	
Checked By: Jennifer King, PE	
Date: 10/23/2018	
Revision #.: 1	

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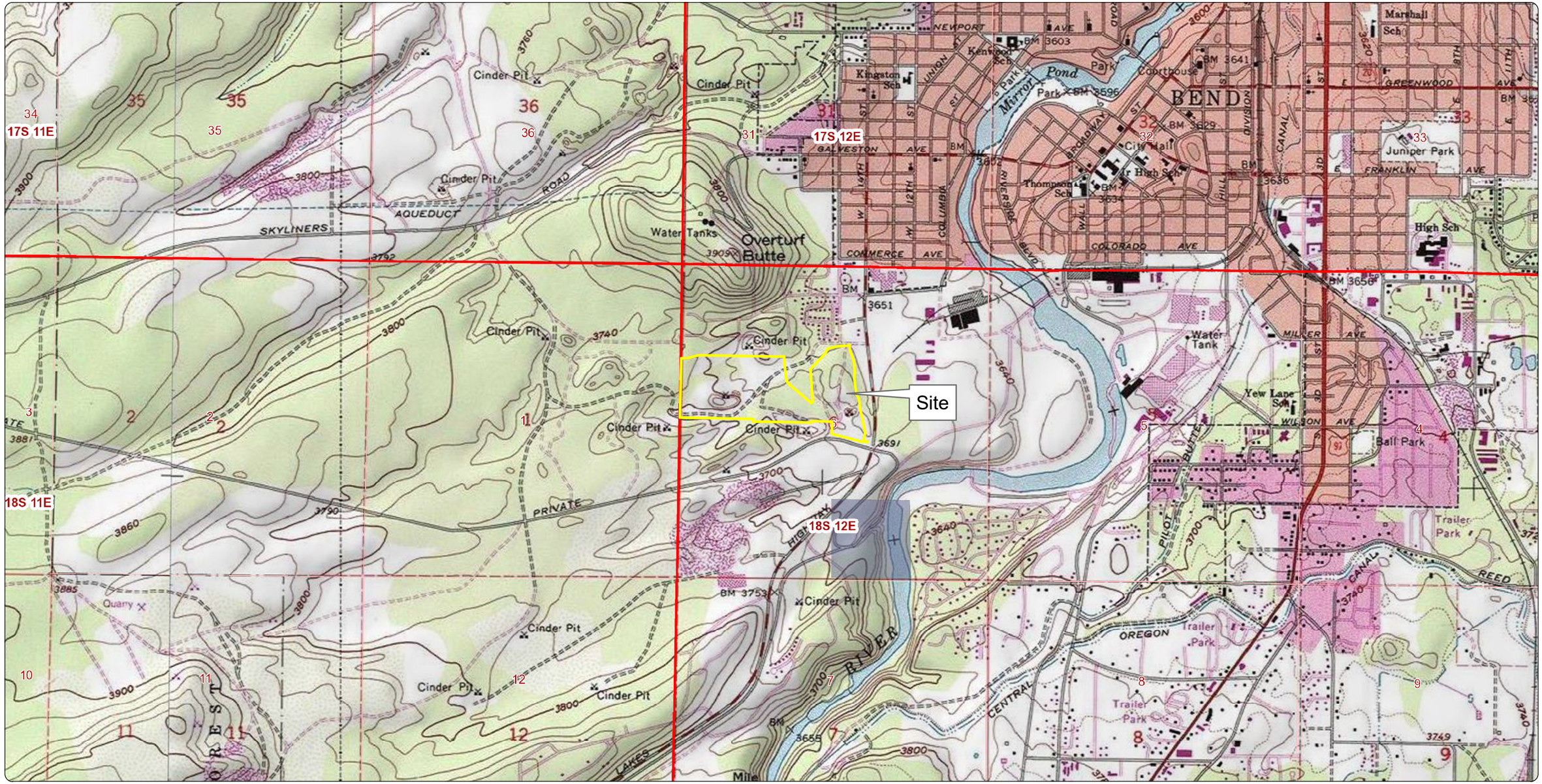
Line Item	Units	Unit Cost	No. of Units	Cost	Total Cost
Construction Cost					
Mobilization	LS	$1,068,000	1	$1,068,000	
Construction Surveying	LS	$15,000	1	$15,000	
Excavation of Waste	CY	$2	2,238,000	$4,476,000	
Excavation and Processing of Pyrolysis Waste	CY	$15	190,000	$2,850,000	
Removal and Stockpile of Cover Soil	CY	$4	528,000	$2,112,000	
Hauling & Disposal of Waste	TON	$50	3,885,000	$194,250,000	
Tire Collection and Disposal	TON	$177	3,400	$601,800	
Dust Control	LS	$500,000	1	$500,000	
Shoring	SF	$50	12,500	$625,000	
Temperature Monitoring/Fire Suppression	LS	$100,000	1	$100,000	
Subtotal				$206,597,800	
Contingency			20%	$41,319,560	
Professional Services					
Design/Permitting	LS	$800,000	1	$800,000	
Procurement/Contracting	LS	$75,000	1	$75,000	
Construction Oversight	LS	$300,000	1	$300,000	
Completion Report/As-Built	LS	$50,000	1	$50,000	
ALTERNATIVE TOTAL (Rounded to nearest $1000)					**$249,142,000**

NOTES:
CY = cubic yard
LS = lump sum
SF = square feet

FIGURES



Oregon State University Cascades Campus, Bend, Oregon
Source: US Geological Survey (1986) 7.5-minute topographic quadrangle: Bend, Section 6, Township 18 South, Range 12 East

Legend

Taxlots

Site Boundary (approximate)

Figure 1
Site Location

Oregon State University Cascades Campus
Bend, Oregon

0 810 1,620
Feet

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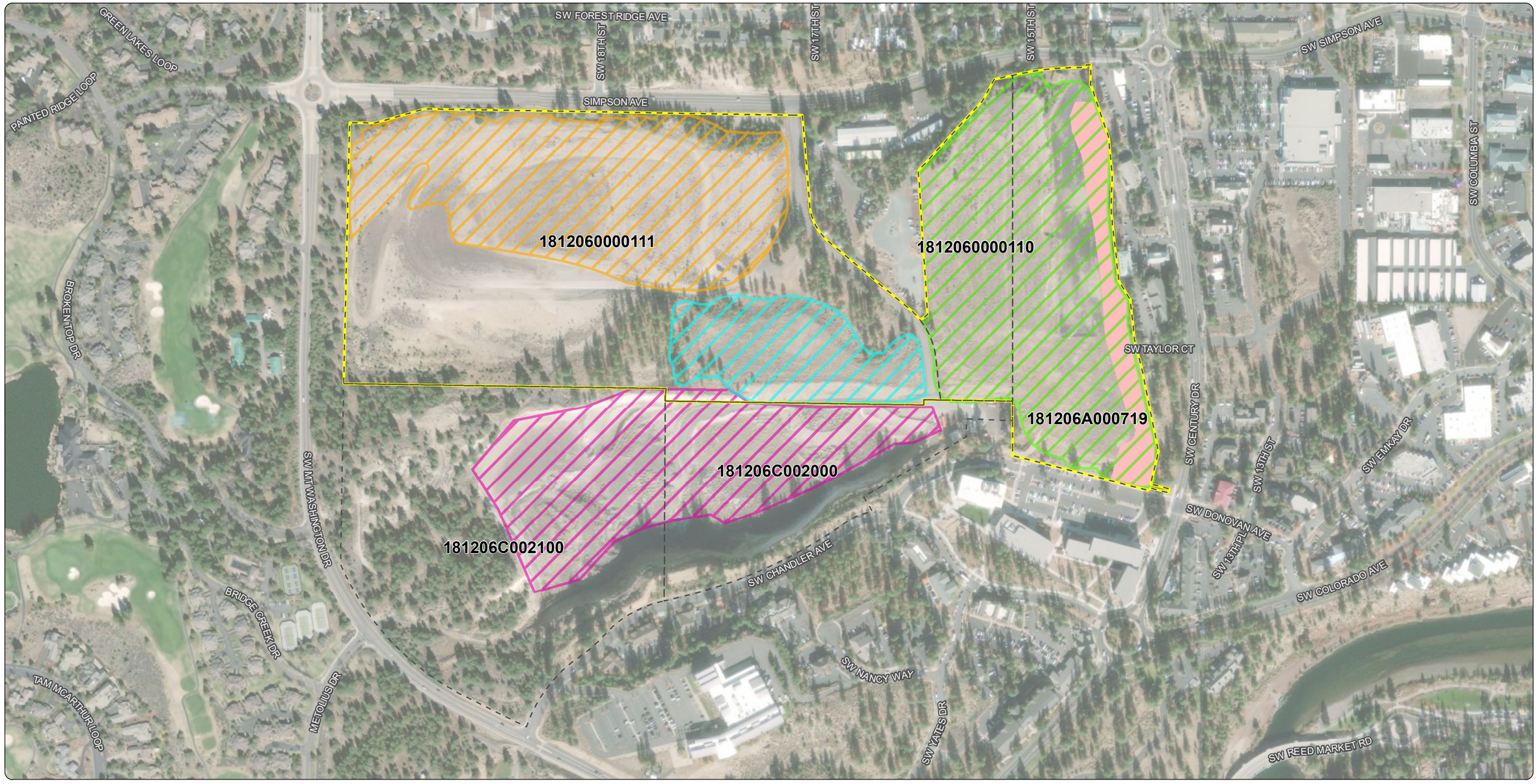

Oregon State University Cascades Campus, Bend, Oregon
Source: US Geological Survey (1986) 7.5-minute topographic quadrangle: Bend Section 6, Township 18 South, Range 12 East

Note:
The tax lot boundaries as shown are based on data obtained from Deschutes County and are current as of 6/21/2017. The property boundary is based on survey data provided by Sun Country Engineering & Surveying on 04/06/2018.

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Legend

Landfill Area

- Area 1
- Area 2
- Area 3
- Property_Boundary
- Pumice Mine
- Fence (approximate)
- Potential Pyrolysis Area
- Site Boundary (approximate)
- Taxlot

DRAFT

Figure 2
Site Overview/ Site Access

Oregon State University Cascades Campus
Bend, Oregon

0 190 380
Feet

Path: X:\1290.01 Oregon State University Cascades Campus\Projects\Fig2_Site_Overview_Access.mxd
Print Date: 12/17/2018
Approved By: cgokcora
Produced By: efrank
Project: 1290.01