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Former Demolition Landfill Mitigation Evaluation Deschutes, County Bend, Oregon

Prepared for:
Deschutes County

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Former Demolition Landfill MitigationEvaluation Deschutes County Bend, Oregon

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1.0 Introduction and Site Description

Apex Companies, LLC, has prepared this report for Deschutes County to describe the results of the geo-environmental review and remediation estimate for the former Deschutes County Demolition Landfill. This report is a companion report to the Deschutes County Landfill Reuse Evaluation (Reuse Evaluation), prepared by Mackenzie (Mackenzie, 2014). The purpose of Apex's and Mackenzie's work is to provide the County with an understanding of the potential value of the subject property, which accounts for development limitations associated with former landfill uses.

1.1 Purpose

This report is prepared to summarize the geo-environmental conditions at the former Deschutes County Demolition Landfill, and to develop mitigation alternatives that could be incorporated into future redevelopment scenarios that reflect a range of potential end uses. This report includes six sections, listed below:

- Section 1 – Introduction and Site Description
- Section 2 - Disposal Area Characteristics
- Section 3 - Redevelopment Constraints
- Section 4 - Mitigation Scenario Development
- Section 5 – Mitigation Cost Estimates
- Section 6 - Data Gaps

1.2 Site Description

The former Deschutes County Demolition Landfill site (the Site) is shown on Figures 1 and 2. It contains four tax lots (tax lots 100, 110, 111, and 719), for a total of 71.4 acres. There are three distinct former landfilling areas (Areas 1, 2, and 3), as shown on Figure 2. Tax lot 109, located at the approximate center of the Site is currently owned by City of Bend Parks and Recreation. Some landfill debris is present at tax lot 109; however, landfill mitigation (including possible relocation of the City of Bend Parks and Recreation facilities on tax lot 109, was not evaluated for this project. The landfill was first permitted in 1972 by DEQ. In 2008, a closure permit was issued for the landfill. The closure permit will require renewal in 2016.

The Site is bordered to the southeast by tax lot 100 which is owned by OSU Cascades and two parcels (tax lots 2000 and 2100) that are occupied by the former Robinson Quarry. OSU Cascades has an option to purchase tax lots 2000 and 2100. The properties to the west and north of the Site are developed for single-family residential uses. Properties to the east of the Site are used for retail and office uses.

Landfill Area 1 encompasses tax lots 110 and 719, and is approximately 23.2 acres in total size. Area 1 operated from the 1960s, prior to the 1972 permit, until 1980. Debris in the eastern portion (tax lot 110) of

this area reportedly consists of sander dust and fine wood waste, general wood waste, and pond sludge mixed with wood waste. This debris is present to depths of as much as approximately 90 feet below the ground surface (bgs). Approximately 10 feet of sand covers the debris. Some parts of tax lot 110 have experienced significant subsidence and low temperature underground combustion activity. Most of the subsidence and combustion has been observed at the eastern portion of this area, the location with the greatest vertical accumulation of landfill debris. The southeastern portion of Area 1 (tax lot 719) reportedly includes a large deposit of buried tires, mixed with wood-waste. Combustion and subsidence have not been documented at tax lot 719 to the extent observed at tax lot 110. A cross-section depicting the vertical distribution of landfill debris in Area 1 (reprinted from Gershman, Brickner, and Bratton; GBB, 2008) is included in Appendix A.

Landfill Area 2 is approximately 9.8 acres and encompasses most of tax lot 111. A small area at the northeast portion of tax lot 111 reportedly does not include landfill debris. Area 2 operated from 1988 to 1997. Approximately 30 to 90 feet of landfill debris, consisting primarily of wood debris, is present at Area 2. Signs of subsurface combustion have not been observed at Area 2.

Landfill Area 3 is approximately 39.4 acres and encompasses approximately half of tax lot 100. The southern portion of tax lot 100 reportedly does not include landfill debris. Area 3 operated from 1992 to 1996 and is the only portion of the former landfill that has been issued a closure permit from the Oregon Department of Environmental Quality (DEQ). The thickness of landfill debris ranges from approximately 25 feet at the west side of Area 3 to approximately 110 feet at the east side. Buried debris reportedly includes primarily construction and demolition wastes, with proportionally less wood waste than in Areas 1 and 2. Some timber and slash have reportedly been buried near the surface in northwest part of Area 3.

2.0 Disposal Area Characteristics

Each of the landfill areas occupy pumice pits that were excavated beginning in the 1960s. Landfilling at the Site generally occurred from east to west, beginning with Area 1. Initially, local lumber mills were the main users of the site, and significant quantities of timber-derived wood waste, the residues of timber production and the mill's operations, such as sawdust and ash, were generated and disposed of at the Site. Initially, the Site was operated as a non-regulated landfill. As such, no documentation describing the composition of the early wastes placed into the landfill is available. Regulation of the Site began in approximately 1972. Attendants were present during landfilling at Areas 2 and 3 to document that municipal solid waste (MSW) was excluded from those areas, however Area 1 was always operated as an unattended disposal area.

2.1 Geological and Hydrogeological Summary

PBS Environmental (PBS, 2013) summarized the geology of the Site based on borings, reconnaissance mapping, and previous work in the area. The geology is predominantly volcanic in origin, consisting of tuffs

of varying origin, overlying basalt flows. PBS (2013) indicated the geologic units likely to be beneath the Site consist of the following units from youngest to oldest:

- Shevlin Park Tuff, a dark gray to black, andesitic to dacitic pyroclastic flow deposit that typically contains lithic fragments of basalt, andesite, and rhyolite and exhibits dense welding in the lower portion of this unit;
- Tumalo Tuff, a pink, white, and gray rhyolitic air-fall pumice lapilli and ash deposit that has been designated as the "Bend Pumice" locally;
- Desert Spring Tuff, a brownish orange to dark gray, rhyodacitic pyroclastic flow deposit that displays a variable degree of welding;
- Basaltic cinder deposits associated with the Overturf Butte vent complex; and
- Basaltic lava flows associated with Overturf Butte vent complex.

These units were present in the three monitoring well borehole logs completed by PBS. Materials recovered from those borings include Tumalo Tuff and Pumice in the upper 21 to 75 feet bgs, underlain by 20 to 25 feet of Desert Springs Tuff, followed by Overturf Butte basalt to the total depths explored. The exception was in the MW-2 boring, where pumice and tuff units were absent or previously removed as part of the former quarry operations; in that boring, basalt was encountered at 21 feet bgs and extended to the total depth of the boring (265 feet bgs).

In 2013, Deschutes County retained PBS (2013) to install a groundwater monitoring well network to evaluate groundwater conditions in the vicinity of Area 3. As indicated in Section 1.2, Area 3 is the only landfill area that has a closure permit from the DEQ Solid Waste program. Three monitoring wells (MW-1, MW-2, and MW-3) were installed at the locations shown on Figure 2. The depths of the monitoring wells range from approximately 265 to 315 feet bgs. The depth to water in the wells ranged from approximately 245 feet to 297 feet from the top of the casing (TOC), which is approximately 242 to 294 feet bgs. These data indicate that groundwater is at least 150 below the deepest portions of the landfill cells, and not in contact with landfill materials. Based on the water level measurements in the wells, the inferred groundwater flow direction is to the east-northeast.

2.2 Waste Occurrence, Composition, and Volumes

Deschutes County retained GBB in 2008 to characterize the occurrence, nature, and volume of waste materials at the Site and to develop an information package that would be useful to future developers when considering redevelopment strategies for the property. GBB utilized a combination of historical resources, geophysical investigation data, and subsurface investigation data to describe the conditions in Areas 1, 2, and 3, estimate waste volumes and cover soil present in each area, and develop information regarding the composition and distribution of waste materials in each area. The result of GBB's work was an improved understanding of the lateral and vertical extents of debris, and the composition of waste materials, in each

area. GBB cautioned that the estimates of the extent and composition of debris were subject to significant uncertainty due to the significant volumes of material present in the landfill.

Historical information and data gathered by GBB (2008) indicate that landfill debris at the Site is composed largely of wood products derived from area mills. Wood wastes from former mills likely comprise the majority of the fill materials in Areas 1 and 2. The Brooks-Scanlon mill, later Crown Pacific Ltd., operated until 1994 and is a primary source of debris for the Site. Initially, Ponderosa Pine wood was milled at the Brooks-Scanlon facility. Subsequently, the facility manufactured plywood, molding, and particle board. Mill wastes identified at the Site include ash from wood-fired boiler systems, coarse sawdust, fine texture sander dust, mill ends and various wood trimmings.

Mill waste, presumably from the Crown Pacific Mill, was encountered in Area 3 during the 2008 explorations. The later years of operations at Area 3 (through 1996), coincide with a period when the City of Bend was growing rapidly. GBB (2008) concluded that significant deposits of demolition debris were likely disposed in Area 3, including remnants of razed structures, concrete and waste rock. Large quantities of woody debris, such as stumps, logs, and slash are also present in Area 3.

Landfilling at Areas 2 and 3 occurred under the oversight of an attendant. Therefore, MSW is confirmed absent from those areas. The 2008 GBB investigation did not find evidence of MSW in Area 1, however this area was always operated without an attendant.

The lateral extent of former landfill debris at Areas 1, 2, and 3, based on the GBB work, are shown on Figure 2. Cross-sections that show the vertical profile of debris in each area, including the thickness of cover soil, depth of landfilled materials, and depth to bedrock, are provided in Appendix A. The table below summarizes the characteristics of each landfill area, based on information compiled by GBB (2008).

Waste Occurrence, Composition, and Volumes

	Area 1		Area 2		Area 3	
Operation Period	1972-1987		1988-1992		1992-1996	
Size (acres)	23.2		9.8		39.4	
Waste Area (acres)	25.3		6.8		19.5	
Est. Waste Depth (ft)	60 – 70		70 - 80		70 - 80	
Est. Waste Volume	1,133,500		456,000		838,000	
Est. Cover Material Volume	258,000		24,000		245,900	
Estimated Materials	% of total	Volume (cy)	% of total	Volume (cy)	% of total	Volume (cy)

Ash	3.1	35,650	2.1	9,555	2.6	21,457
Gravel	0.9	10,223	0.0	0	0.0	0
Demolition Wastes	9.5	107,457	18.1	82,482	79.2	663,757
Reclmation Fill	1.0	11,638	0.5	2,422	0.8	6,395
Sawdust	7.0	78,987	8.1	36,877	0.0	0
Metal	0.6	7,119	0.0	0	0.3	2,140
Tires	0.3	3,638	0.0	0	0.0	0
Unidentified	43.1	488,883	0.0	0	3.0	25,138
Wood Waste	34.4	389,895	71.2	324,664	14.2	119,112
Total	100.0	1,133,500	100.0	456,000	100.0	838,000

Notes:

After GBB, 2008

2.3 Hazardous Substances

2.3.1 Soil Conditions

The GBB study (2008) includes the most comprehensive assessment of hazardous substances in landfilled materials. Thirteeen soil borings were completed by GBB and twenty samples of landfill material and native soil beneath landfill debris were analyzed. More than 220 individual chemicals and compounds were analyzed with very few detections (GBB, 2008). The soil samples beneath the landfill debris were obtained at the debris-soil interface, and approximately 20 feet below the debris. In general, the shallower samples (i.e., samples collected closer to the debris) were analyzed for the suite of constituents and the deeper samples was reserved for possible testing based on the shallow results.

In samples from the landfill debris, several constituents were sporadically detected. These constituents included arsenic, lead, petroleum products and associated compounds, (i.e., benzene and polycyclic aromatic hydrocarbons [PAHs]), and tetratchloroethylene. Several of the constituents in the waste materials were detected above one or more of DEQ's generic Risk-Based Concentrations (RBCs). Volatile organic compounds (VOCs) were largely not detected, polychlorinated biphenyls (PCBs) were not detected, and herbicides and pesticides were not detected. Many of the samples that reportedly exhibited petroleum hydrocarbon concentrations may have been affected by organic matter in the landfill materials; organic materials can bears a similar signature to petroleum compounds, resulting in an overestimate of the amount of petroleum hydrocarbons in a sample.

Potential asbestos-containing material (PACM) was observed in a few test pits. The presence of ACM is not unexpected, due to the timeframe landfilling activities occurred on the Site.

Nine samples were collected from soil beneath the landfill debris. The soil samples indicate that significant concentrations of hazardous substances have not migrated to soils beneath the debris. Of the nine samples

analyzed, four samples tested positive for a single organic constituent, including: a low concentration of methylene chloride in sample TB #45 (a likely laboratory contaminant); and low concentrations of p-isopropyltoluene (TB #44), toluene, (TB #46) and tetrachloroethene (TB #40). The concentrations of p-isopropyltoluene (TB #44), toluene, (TB #46) and tetrachloroethene (TB #40) were detected as singular contaminants (*i.e.,* other compounds that commonly occur with these chemicals were not detected). The source of these chemicals was not determined; however, the concentrations are relatively low and do not indicate significant migration from the waste.

2.3.2 Groundwater Conditions

As part of the 2013 groundwater study, PBS sampled groundwater from monitoring wells MW-1 through MW-3 (Figure 2) and analyzed the samples for a range of landfill chemical parameters and constituents. Monitoring wells MW-1 through MW-3 were installed to monitor groundwater conditions near Area 3 (a condition of the closure permit); however, monitoring well MW-3 is in a position that appears to also be hydraulically downgradient of Areas 1 and 2. Therefore, data from well MW-3 also provides significant information about groundwater quality adjacent to Areas 1 and 2.

PBS (2013) reported that the May 2013 groundwater results generally indicated very good groundwater quality with no obvious impacts from typical constituents of landfill leachate such as total dissolved solids (TDS), chloride, sulfate, ammonia, alkalinity, and chemical oxygen demand (COD). All of these constituents/parameters were either not detected, or were detected at concentrations significantly below applicable regulatory standards. No VOCs were detected and only five of the fifteen trace metals were detected. Three trace metals (arsenic, barium and vanadium) were detected in all three monitoring wells, zinc was detected in two wells (MW-1 and MW-2), and chromium was detected in one well (MW-2). All of the detected trace metals concentrations were significantly below regulatory criteria.

3.0 Redevelopment Constraints

In this section, geo-environmental constraints that affect Site redevelopment planning are summarized. The geo-environmental constraints listed in this section are used in Section 4 to develop a range of geo-environmental mitigation alternatives that could be implemented to redevelop the Site for non-landfill uses.

Information developed during studies completed on behalf of the County (GBB, 2008) indicates that landfill debris contains very low concentrations of hazardous substances at sporadic locations across the site. The previous studies further indicate that landfill leachate is not significantly impacting underlying soil, and groundwater has not been degraded by the landfill. As a result, hazardous substances are not expected to place significant redevelopment constraints on the Site.

The four primary Site redevelopment constraints are:

- Areas that contain landfill debris (50 out of 72 acres), particularly areas with significant quantities of organic materials, are subject to long-term settlement. Settlement is incompatible with load-bearing structures, without geotechnical mitigation.
- Portions of Area 1, where low temperature subsurface combustion occurs, require mitigation for safety purposes. Signs of subsurface combustion have been observed at the northeast part of Area 1.
- The Site is subject to the requirements of the DEQ Solid Waste permits. Redevelopment must be consistent with those permits. Unless the former landfill cells are completely removed and managed elsewhere, compliance monitoring and reporting will be required.
- During mitigation, impacts to community must be minimized. This includes odor and vector control during work that contacts landfill debris, minimizing trucking and transportation related impacts to the community, and maintaining capacity at the County's current landfill at Knott Road.

4.0 Mitigation Scenario Development

Three conceptual redevelopment scenarios, each representing a mix of possible end uses, were described in the Reuse Evaluation. The end uses included a range of residential land uses, senior care facilities, retail and commercial areas, educational facilities, and open space. This section describes approaches and costs for mitigating the geo-environmental constraints identified in Section 3, and the corresponding conceptual redevelopment scenarios.

Mitigation of the landfill areas to prepare for redevelopment is typically performed using stabilization techniques (soil stabilization or piles), or by removal of the waste materials and placement of structural backfill. These approaches are not considered viable for the Site because:

- Pile-based construction is expensive (additional cost of $20 to $30 per square foot) and construction would be difficult through the heterogeneous waste materials.
- Pile-based construction would not address areas outside of the footprint of engineered structures; therefore, significant portions of the Site would remain susceptible to subsidence.
- Stabilization would leave waste in place, with new buildings constructed on top. The presence of waste material and threat of possible future subsidence or subsurface combustion may limit development interest.
- Stabilization may not be practicably feasible due to the heterogeneous nature of the landfill debris.

Alternatives where landfill debris is removed and transferred to an off-site location, and excavated areas are backfilled with structural fill, provide the highest level of certainty that mitigation would result in buildable locations with the lowest future liabilities from the landfill wastes. However, removal and off-site disposal of landfill debris is costly, consumes valuable landfill capacity, and may adversely affect surrounding communities during construction.

4.1 Excavation and Disposal Alternative

Excavation and disposal alternatives will result in the best conditions for redevelopment because the Site would not be encumbered by DEQ Solid Waste permits, and soil settlement and combustion risks would be eliminated. However, excavation and disposal is costly, and presents the highest level of community risk and impact. Removal of all landfill debris from the Site and replacement with structural backfill would require:

- Excavating approximately 2.4 million cubic yards of landfill materials and 525,000 cubic yards of cover soil;
- Transporting approximately 2.4 million cubic yards of debris to the Knott Road Landfill (or other licensed disposal facility), resulting in approximately 80,000 round-trips to the landfill (assuming 30 cubic yard truck and trailers are used);
- Disposing approximately 2.4 million cubic yards of debris at the Knott Road Landfill, significantly reducing the capacity of the landfill and costing in the neighborhood 30 million dollars (assuming 2.4 million cubic yards of debris disposed at $25 per ton) for disposal alone; and
- Supply approximately 2.4 million cubic yards of soil for structural backfill and placement of the supplied fill and 525,000 cubic yards of cover soil. Similar to the disposal alternative, this will require approximately 80,000 round-trips to the site for fill delivery.

Site-wide excavation and disposal would cost in the range of $75 million. This cost is disproportionately high, relative to potential raw land values in the Site vicinity. This mitigation alternative also carries significant community impact because of number of truck trips to and from the Site and the premature filling of the Knott Road Landfill (or other licensed disposal facility).

GBB (2008) estimated that if the landfill materials were excavated, sorted, and processed for various end uses, including landfill daily cover, compost, boiler fuel for cogeneration facilities, and recycling, the landfill debris would generate approximately $5 million of revenue. The costs for excavating and handling (e.g., processing to sort/recycle/recover waste) landfill debris were not part of this cost estimate. Assuming the GBB estimates of material volumes and salvage values are correct, the salvage revenue would approximately equal the disposal costs. However, after accounting for excavating and handling costs, the salvage revenue would not offset enough of the project cost for full removal of landfill materials to be economically viable in the foreseeable future.

4.2 Excavation and Containment Alternative

A unique feature of the Site is that Area 3 was not completely filled before it was closed in 1998. After accounting for removing the cover soil that is present at Area 3, there is as much as a 90 foot difference

between the top of the waste materials and the approximate surrounding ground surface elevation (that is, the surface of the landfill debris at Area 3 is up to 90 feet below the surrounding areas). This low area in Area 3 could receive a significant amount of landfill materials excavated from Areas 1 and 2. By consolidating waste in Area 3, a mitigation alternative is created that would increase buildable areas (in Areas 1 and 2), manage post-construction liability (i.e., settlement and combustion), and greatly reduce the amount of truck traffic on public highways compared to the excavation and disposal alternative.

Three conceptual redevelopment alternatives were developed that utilize this consolidation approach. These three alternatives, described in detail in Sections 4.2.1 through 4.2.3, represent various combinations of proposed end uses, as described in the Reuse Evaluation. While there are many possible redevelopment scenarios that could be considered, the corresponding mitigation scenarios would be similar. Key elements of the consolidation approach include:

- Buildings and roads would be constructed in areas where landfilling operations have not occurred, or areas where landfill debris has been fully excavated and replaced with structural backfill. The extent of the former landfill areas that are treated vary for each redevelopment scheme.

- In the northeast portion of Area 1 where subsurface combustion has been observed, the upper 30 feet of landfill debris would be removed and replaced with 30 feet of structural backfill. The structural backfill is intended to remove voids and low density soil pockets that are subject to differential settlement, and provide a significant safety buffer between the surface and underlying combustible materials. This approach would minimize future risks of combustion related injuries and allow some uses of this area.

- Excavated landfill debris would be sorted, processed, and salvaged prior to placement in the Area 3 consolidation cell. Materials that are not salvageable or reusable at the Site (e.g., cover soil) would be placed in the consolidation cell. Based on estimated prepared by GBB (2008), it is assumed that sorting and salvaging would reduce excavated waste volumes by approximately 50 percent. This approach would maximize the opportunity to consolidate debris in the consolidation cell.

- For the mitigation scenarios where projected waste volumes exceed the capacity of the consolidation cell, the excess materials would be disposed at the Knott Road landfill.

Each of the consolidation mitigation alternatives is described below and the mitigation elements are summarized on Figures 3 through 5.

4.2.1 Alternative 2.1

Mitigation Alternative 1 provides for selective waste material excavation from Area 1 and Area 2, with consolidation in Area 3. The elements of consolidation Alternative 1 include:

- Northeast portion Area 1 - mitigate thermal risks by excavating 30 feet of waste, resulting in partial excavation of wastes in this area, and replacing it with structural backfill;
- Southern one-third of Area 1 – mitigate for road and retail/commercial area, resulting in complete excavation of wastes in this area, consolidate wastes to the Area 3 cell;
- Area 2 – excavate the easternmost lobe of the landfill cell, corresponding to an area of limited waste thickness (25 feet or less), and place structural backfill for future retail/commercial development; and
- Area 3 – existing cover soils would be removed from the Area 3 landfill cell, and landfill debris from Areas 1 and 2 would be placed in the Area 3 containment cell. Cover soils would be replaced after landfill debris is consolidated in the Area 3 containment cell.

Under this alternative, following landfill debris excavation and consolidation, redevelopment would occur on native soils or structural backfill. These mitigated redevelopment areas would not be subject to significant future settlement or subsurface combustion risks. Area 3 and other former landfilled areas in Area 1 and Area 2 where wastes are not completely replaced with structural fill would be maintained for open space uses.

4.2.2 Alternative 2

Consolidation Alternative 2 provides for selective landfill debris excavation from Area 1, complete excavation of landfill debris from Area 2, and consolidation of processed excavated debris in Area 3. The elements of Consolidation Alternative 2 include:

- Northeast portion Area 1 - mitigate thermal hazards by excavating 30 feet of waste and replacing it with structural backfill;
- Southern one-third of Area 1 - excavate all landfill debris to prepare for road and retail/commercial redevelopment, consolidate wastes to the Area 3 cell;
- Area 2 – excavate all landfill debris to prepare for future for housing and commercial uses, consolidate to the Area 3 cell;
- Area 3 – existing cover soils would be removed from the Area 3 landfill cell, and landfill debris from Areas 1 and 2 would be placed in the Area 3 containment cell. Cover soils would be replaced after landfill debris is consolidated in the Area 3 cell; and
- The portion of the excavated debris exceeding the consolidation cell capacity would be landfilled at the Knott Road Landfill.

Under this alternative, following landfill debris excavation and consolidation, redevelopment would occur on native soils or structural backfill. These mitigated redevelopment areas would not be subject to significant future settlement or subsurface combustion risks. Area 3 and other former landfilled areas in Area 1 where wastes are not completely replaced with structural fill would be maintained for open space uses.

4.2.3 Alternative 3

Consolidation Alternative 3 provides for selective landfill debris excavation from Area 1, complete excavation of landfill debris from Area 2, and consolidation of processed excavated debris in Area 3. Compared to Alternatives 1 and 2, Alternative 3 involves complete excavation and replacement of waste materials from the north portion of Area 1. The elements of mitigation Alternative 3 include:

- Northeast portion of Area 1 - excavate all landfill debris to prepare for future retail/commercial uses and, consolidate wastes to the Area 3 cell;
- Central portion of Area 1 - mitigate for thermal hazards by excavating 30 feet of waste and replacing it with structural backfill to prepare for light uses such as recreational fields or parking, and consolidate to the Area 3 cell;
- Southern one-third of Area 1 – excavate all landfill debris to prepare for educational uses, and consolidate to the Area 3 cell;
- Area 2 - excavate all landfill debris to prepare for educational uses, and consolidate to the Area 3 cell;
- Area 3 – existing cover soils would be removed from the Area 3 landfill cell, and landfill debris from Areas 1 and 2 would be placed in the Area 3 containment cell. Cover soils would be replaced after landfill debris is consolidated in the Area 3 cell; and
- The portion of the excavated debris exceeding the consolidation cell capacity would be landfilled at the Knott Road Landfill.

Under this alternative, following landfill debris excavation and consolidation, redevelopment would occur on native soils or structural backfill. These mitigated redevelopment areas would not be subject to significant future settlement or subsurface combustion risks. Area 3 and other former landfilled areas in Area 1 where wastes are not completely replaced with structural fill would be maintained for open space uses.

4.2.4 Waste Processing and Consolidation Cell

Figures 6 shows a plan view of the conceptual consolidation cell. Figures 7 and 8 show longitudinal and transverse profiles of the conceptual cell. The maximum capacity of the consolidation cell was estimated based on the assumption that, overall, the surface elevation of the consolidation cell would not exceed the elevation of Simpson Avenue. This corresponds to a total consolidation cell waste capacity of approximately 1.4 million cubic yards, resulting in approximately 600,000 cubic yards of additional capacity.

The consolidation cell could be constructed to hold significantly more waste materials. However, with increased volume, the height of the cell would increase, possibly creating aesthetic concerns.

The table below summarizes the waste volumes that would be incorporated into the consolidation cell under the three consolidation scenarios.

Alternative Summary Volumes

	Alternative 1	Alternative 2	Alternative 3
In-Place Waste Volume	786,000	1,169,000	1,361,000
Reduced Waste Volume	393,000	585,000	680,000
Area 3 Existing Waste Volume	826,000	826,000	826,000
Cell Capacity	1,402,000	1,402,000	1,402,000
Consolidation Cell Volume If Processed	1,219,000	1,411,000	1,506,000
Consolidation Cell Volume If Not Processed	1,612,000	1,995,000	2,167,000

Notes:
In-place volume is the volume of landfill debris scheduled for removal under each alternative.
Reduced waste volume is the volume of landfill debris that would be placed in the consolidation cell, after the debris is processed.
All units are bank cubic yards (in place volume)

The consolidation cell would include a 3 to 5 foot soil cover, and would be landscaped and vegetated, and incorporated into the development as open space.

4.3 Regulatory Context

The Site is regulated under Solid Waste permits issued by DEQ. Any mitigation approach implemented at the Site would be regulated through the DEQ Solid Waste program. DEQ approvals would occur through new closure permits (or modifications) that would be required for the changes to each of the permitted areas. County representatives and Apex met with DEQ Eastern Region Solid Waste and Environmental Assessment and Cleanup personnel on April 16 and April 22, 2014 to discuss the regulatory framework for redevelopment of the Site. DEQ representatives provided the following general information:

- To construct the consolidation cell, the DEQ solid waste closure permit for Area 3 would need to be revised and closure plans would need to be developed for areas where waste remains at Areas 1 and 2. These closure plans would include long-term groundwater monitoring and any institutional and/or engineering controls that could be required for the redevelopment (*e.g.,* buffer zones, methane collection, groundwater monitoring, soil cover monitoring).

- The proposed engineered soil cover at the Area 3 consolidation cell would likely be sufficient for leachate control. Iit is unlikely that a liner or a leachate collection system would be required.
- The potential for methane occurrence and migration to future structures will need to be evaluated before development can occur. The need for future methane controls would be based on this evaluation.
- During the consolidation process, field screening would be required to remove materials found that are not permitted for landfill disposal, such as tires.
- Nuisance odors and dust control would be required during construction.

The guidance listed above was presented in an informal setting. Prior to implementation of any redevelopment scenario, it will be necessary to solicit formal DEQ input, through the Solid Waste and Environmental Assessment and Cleanup programs.

5.0 Mitigation Cost Estimates

Tables 1 through 3 summarize the cost estimates for the consolidation alternatives described in Sections 4.2.1 through 4.2.3. Figures 3 through 5 show the areas where mitigation would be completed. These cost estimates were prepared for the purpose of evaluating representative mitigation costs, relative to the raw land values developed in the Reuse Evaluation. These estimates should not be used for budgeting or construction. Later in this section, cost estimate components that carry the most uncertainty are identified and discussed.

Two sets of cost estimates are provided on Table 1 through 3 for each mitigation alternative. The first estimate on each table assumes that all excavated debris is placed in the Area 3 consolidation cell. The second estimate on each table assumes that approximately 50 percent of the excavated debris is processed and re-used for beneficial purposes (e.g., compost, hog fuel, recycling). For the processing component of the mitigation alternative, the costs in the table reflect handling costs only. Proceeds from the sale of reclaimed products are not reflected in this estimate because the value of those materials is highly variable.

5.1 Unit Costs

The unit costs used in the estimates (Tables 1 through 3) were largely obtained based on costs for similar activities in the region, or obtained from literature sources. Soil and waste excavation and backfill, landfill costs, and wood processing carry the vast majority of the total estimated cost. The basis for the unit costs associated with these items is described below.

- Soil earthwork and structural backfill – these costs are based on project cost estimates and project data for similar projects in central and southern Oregon.

- Landfill costs – a landfill tip fee of $25 per ton was provided by the provided by County for the Knott Road Landfill.
- Wood processing – costs to process wood debris that is removed from the landfill was extrapolated from the cost of wood chipping in large scale forest product operations (see additional discussion in Section 6.0.

5.2 Mitigation Cost Summary

The table below summarizes the costs for each consolidation alternative. As previously discussed, each alternative includes costs for: (1) consolidation of landfill debris without processing (i.e., assumes no salvageable materials are reclaimed); and (2) consolidation of landfill debris after processing (i.e., assumes approximately 50 percent of landfill debris is reclaimed and transported off-site for beneficial uses).

Mitigation Costs

	Without Processing	With Processing
Alternative 1	$16,790,000	$18,690,000
Alternative 2	$29,530,000	$25,860,000
Alternative 3	$34,790,000	$29,490,000

Consolidation Alternative 1 is the lowest cost alternative because it provides for the least mitigation of landfill areas (and the least redevelopment opportunity). This alternative mitigates the combustion hazards at the east portion of Area 1. This alternative does not require any landfill disposal; therefore, impacts to the community are minimized. Between 400,000 cubic yards (if processed) and 800,000 cubic yards (if not processed) of waste would be placed. The final volume of waste remaining in Area 3 would range from 1.2 to 1.6 million cubic yards, depending on whether the wastes were processed for beneficial reuse first. The Area 3 consolidation cell could be designed to accommodate all the excavated wastes, whether or not processing occurs. Wastes would remain in place in portions of Area 1 and Area 2; these areas would be safe for open space uses but unsuitable for other development.

Consolidation Alternative 2 is the mid-range cost alternative because it provides for the complete mitigation of Area 2, as well as the southern portion of Area 1 for redevelopment. The central and northern portions of Area 1 would be mitigated to a level sufficient to address combustion hazards. This alternative would require landfill disposal if the waste is not processed. The final volume of waste generated would range from 1.4 to 2.0 million cubic yards, depending on whether the wastes were processed for beneficial reuse. Consolidation Alternative 2 provides increased mitigation at former landfill areas, allowing more redevelopment, while also mitigating for combustion hazards at the east portion of Area 1. Based on the height of the consolidation cell that would be required, placing the wastes in a consolidation cell without processing is unlikely, and landfill disposal of surplus unprocessed wastes would be required. Wastes

would remain in place in portions of Area 1 and Area 2; these areas would be safe for open space uses but unsuitable for other development.

Mitigation Alternative 3 is the most costly alternative because it provides for the complete mitigation of Area 2, and the southern and northern portions of Area 1 for redevelopment. The central portion of Area 1 would be mitigated to a level sufficient for redevelopment as recreational fields or parking. The east portion of Area 1 would be mitigated for combustion hazards. This alternative would require landfill disposal if the consolidation alternative is not pursued. The final volume of waste generated would range from 1.5 to 2.2 million cubic yards, depending on whether the wastes were processed for beneficial reuse first. Mitigation Alternative 3 provides for the greatest amount of mitigation at former landfill areas for redevelopment, while also mitigating for thermal risks in the east portion of Area 1. Based on the height of the consolidation cell that would be required, placing the wastes in a consolidation cell without processing is unlikely, and landfill disposal of surplus unprocessed wastes would be required. Wastes would remain in place in portions of Area 1, and this area would be suitable recreational fields or parking.

6.0 Data Gaps

The most significant costs for Site mitigation are associated with landfill debris excavation, transport, disposal, backfill, and processing. The unit costs that were applied to these activities for this study were developed based on regional pricing for similar projects. However, due to the large volumes of materials that would be handled under any of the mitigation scenarios described herein, small variations in unit costs could result in more significant changes to overall mitigation costs. The most significant cost data gaps are associated with the unit costs for obtaining soil for structural backfill and waste processing.

6.1 Backfill Sources

Costs for soil backfill are variable and market driven. The consolidation scenarios described herein include the supply and placement of 800,000 to 1.4 million cubic yards of structural soil backfill. Because this is a market driven cost, the costs for soil backfill cannot be refined based on additional assessment or pilot testing. Long range planning, that might include development of a large borrow source, or strategic partnering agreement with a private supplier could bring greater certainty to this cost estimate.

6.2 Waste Processing

The wood composition in landfilled materials, processing costs, practicability of processing for beneficial reuse, and odor and vector management during processing are data gaps. Processing is required if mitigation scenarios similar to either Consolidation Alternatives 2 or 3 are implemented. Either of these mitigation scenarios would generate more waste than the Area 3 consolidation cell could accommodate, and

would result in processing of 1.2 to 1.4 million cubic yards of material. The waste processing data gaps that have the potential for significant impact on project costs are described below.

Waste composition. The fraction of wood waste in materials was estimated by GBB based on a review of boring and test pit logs and extrapolation of waste volumes based on their experience. The cost estimates for processing assume a reduction of 50% waste volume through processing and recycling. There is potential that the portion of wood waste in some portions of the landfill that could be processed or recycled is less than 50 %. This would result in greater waste generation during mitigation.

Waste Processing Cost. Unit costs for processing wood waste and removing recyclable materials from landfill waste are not available due to the variability in the composition and associated processing requirements. To estimate this unit cost, literature-based processing costs for large timber slash operations were converted to a wood processing cost for wood debris at the Site. This cost development approach was applied because the unit of measure used by both the forest practice industry and co-generation or biomass facilities is the Bone Dry Ton (BDT). A Bone Dry Ton is the weight of 1 ton of chipped materials (commonly ¼-inch or less), after converting to dry weight. So, if the wood moisture content was 50%, two tons of chips (green weight) produce 1 BDT of chips.

The processing cost was derived based on the following equation:

$$P\left(\frac{\$}{bcy}\right) = F\left(\frac{\$}{bdt}\right) x\ M\left(\frac{bdt}{ton(green)}\right) x\ W\left(\frac{ton\,(green)}{cy(chipped)}\right) x\ I\ \frac{cy(chipped)}{bcy}$$

Where:

P = Processing cost for landfilled materials
F = Forest product processing cost equivalent ($15/bdt based on literature research)
M = Moisture content of chipped materials (assume 50%)
W = Specific gravity green chip materials (0.2 cy/ton, based on Table 7-2, Briggs, 1994)
I = Expansion factor – in place to chipped conversion (assume 3, based on Table 7-1, Briggs, 1994)

The unit cost for wood debris processing was estimated to be $4.50 per bank cubic yard (in place volume), based on a processing cost of $15 per BDT.

One option for managing the post-processed waste is for use as fuel in a co-generation plant. The closest co-generation plan is the Interfor Biomass Facility in Gilchrist, Oregon. Interfor currently pays between $15 and $25 per BDT. If the wood waste was transported to Interfor, the proceeds from sale of the chips is approximately equal to the on-Site wood waste processing costs at the low end of the price range. So,

worse case, proceeds of the sale would cover the processing costs, but might not fully cover the costs for transportation to the Interfor facility .

Beneficial Reuse. The Consolidation Alternatives described herein assume that compost (in addition to the sale of biomass) will be generated during wood waste processing, and sold. These assumptions lead to a reduction in landfill volume and offset some costs. The degree to which the wood waste can be composted requires evaluation, along with whether there may be chemical impacts in the resulting compost. There will likely be some chemical impacts in the landfilled materials from breakdown of wastes that were legally disposed. Before this compost would presumably be provided for sale to the public, it must be verified that it is free of harmful chemicals. If composting is not an alternative, finding an end use for some of the recovered wood waste materials may be difficult.

Since each of the variables used to establish the unit cost for wood waste processing are dependent on the physical properties of the wood debris that is buried at the Site, and the actual characteristics of the wood waste are unknown, pilot scale testing would be required to refine these costs and achieve a higher level of certainty for the mitigation estimates.

6.3 Landfill Gasses and Thermal Risks

The relatively dry climate in the Site area limits the risks of methane generation and migration to enclosed structures at and near the Site. However, evaluation of methane generation and migration potential will be required prior to a revision to the Site solid waste permit. In the unlikely event that methane mitigation is necessary, the costs for that work would be significantly less than any of the mitigation alternatives described herein and would presumably have little effect on overall redevelopment planning.

Under any of the mitigation scenarios described herein, at least 30 feet of landfill debris are excavated from the northeast portion of Area 1 (where combustion hazards have been observed) and replaced with a uniform layer of compacted fill. As described earlier, this layer will prevent contact with combustible debris and minimize the potential for differential settlement that leads to voids and sinkholes. The 30 foot removal/fill thickness is a conservative estimate based on our experience mitigating settlement and based on heat transport in the subsurface. It may be possible to significantly reduce the removal/fill thickness in this area (and reduce costs); however, thermal modeling is required to refine these estimates.

7.0 Summary and Conclusions

The former demolition landfill operated from the 1960s to 1996 and includes three former disposal areas (Area 1 through Area 3). Areas 1 and 2 have received significant amounts of wood and other wastes from former wood mills, while Area 3 contains a proportionately higher amount of general demolition and

construction debris. Area 3 was only partially landfilled, and significant capacity remained when it was closed.

Work completed to date has shown that constituents or chemicals from the landfilled materials have not migrated from the landfill areas and affected soil or groundwater. Risks at the site are largely physical. There is an area near the east side of Area 1 where low temperature combustion is occurring at depth, and a disproportionate amount of subsidence has been observed in the same areas, compared to the rest of the site.

The mitigation required to construction a development on the former landfilled areas, while leaving the landfill debris in place will be cost prohibitive, or possibly impracticable. Also, these conditions would not attract significant developer interest to attract the type of investment described in the Reuse Evaluation. Mitigation scenarios were developed that account for a heat trapping layer of soil to be placed in the Area 1 thermal risk area, complete removal of varying amounts of waste from Area 1 and Area 2, and transfer of wastes to a consolidation cell constructed in Area 3.

Waste processing to remove salvageable materials was evaluated for each mitigation alternative. Due to the volumes of waste that would be generated, Mitigation Alternative 1, which accounts for the least waste removal, is the only alternative that could be completed regardless of whether or not processing occurs. The waste generated if Mitigation Alternatives 2 or 3 were implemented would greatly exceed the capacity of the consolidation cell.

The most significant mitigation costs are associated with landfill debris excavation, transport, disposal, backfill, and processing. Due to the large volumes of materials that would be handled under any of the mitigation scenarios described herein, small variations in unit costs could result in more significant changes to the overall costs. The cost estimate is most sensitive to the cost to supply backfill, and the costs for waste processing. Pilot testing of the excavation and waste processing approach would be very useful to both refine the unit costs for processing, and test the overall feasibility of excavating waste materials and processing for beneficial reuse.

8.0 References

Briggs, 1994. *Forest Products Measurements and Conversion Factors: With Special Emphasis on the U.S. Pacific Northwest*, University of Washington. 1994.

DEA et al, 1997. *Demolition Landfill Subsurface Fire Assessment*, Prepared by David Evans and Associates, Bend, Oregon. June, 1997.

GBB, 2008. *Demolition Landfill Subsurface Investigations Study*, prepared by Gershman, Brickner, and Bratton, Fairfax, Virginia. October 31, 2008.

Mackenzie, 2014. Deschutes County Landfill Site Reuse Evaluation, prepared by Mackenzie, Portland, Oregon. May 14, 2014.

PBS, 2013. *Phase II Characterization Report – Groundwater Assessment Monitoring, Demolition Landfill, 19755 Simpson Avenue*, prepared by PBS Environmental of Bend, Oregon. June, 2013.

Siemens, 1997. *Geotechnical Reconnaissance for Demolition Landfill Closure*, prepared by Siemens and Associates, Bend, Oregon. October, 1997.

Table 1
Mitigation Alternative 1
Former Deschutes County Demolition Landfill
Bend, Oregon

DRAFT - NOT FOR CONSTRUCTION

Consolidation Only

Item	Quantity	Unit	Unit Cost	Total Price
Permitting and Engineering Design				$ 750,000
Mob and Demob				$ 50,000
Erosion Controls - Install Silt Fence	7,500	lf	$ 2.00	$ 15,000
Erosion Controls - Construction Entrance	1	est.	$ 5,000.00	$ 5,000
Remove Area 1 Cover Soil and Stockpile, Use as a Backfill	193,500	bcy	$ 3.70	$ 716,000
Remove Area 3 Cover Soil and Stockpile, Use as Backfill	246,000	bcy	$ 3.70	$ 910,000
Partial Excavation Area #1, Excavate Cell #2	786,457	bcy	$ 2.50	$ 1,966,000
Transport to Cell #3 and Place	786,457	bcy	$ 4.00	$ 3,146,000
Place Cover Soil Over Cell 3	47,585	bcy	$ 2.00	$ 95,000
Backfill West Section Cell 3 with Structural Backfill (incl. supply)	386,579	bcy	$ 10.00	$ 3,866,000
Backfill Area 1, #2 with Remaining Cover Soil	391,915	bcy	$ 2.00	$ 784,000
Backfill Remainder Area #1, #2 with Structural Backfill (incl. supply)	394,542	bcy	$ 10.00	$ 3,945,000
Temp Hydroseeding	70	acres	$ 2,500.00	$ 175,000
Survey Crew	70	acres	$ 1,000.00	$ 70,000
Field Management and Quality Assurance	12	month	$ 25,000.00	$ 300,000
			Total Estimated Cost	$ 16,790,000

Consolidation After Processing

Item	Quantity	Unit	Unit Cost	Total Price
Permitting and Engineering Design				$ 750,000
Mob and Demob				$ 50,000
Erosion Controls - Install Silt Fence	7,500	lf	$ 2.00	$ 15,000
Erosion Controls - Construction Entrance	1	est.	$ 5,000.00	$ 5,000
Remove Area 1 Cover Soil and Stockpile, Use as a Backfill	193,500	bcy	$ 3.70	$ 716,000
Remove Area 3 Cover Soil and Stockpile, Use as Backfill	246,000	bcy	$ 3.70	$ 910,000
Partial Excavation Area #1, Excavate Cell #2	786,457	bcy	$ 2.50	$ 1,966,000
Sort, Recycle, Compost	786,457	bcy	$ 4.50	$ 3,539,000
Transport Remainder to Cell 3 and Place	393,228	bcy	$ 4.00	$ 1,573,000
Place Cover Soil Over Cell 3	47,585	bcy	$ 2.00	$ 95,000
Backfill West Section Cell 3 with Structural Backfill (incl. supply)	386,579	bcy	$ 10.00	$ 3,866,000
Backfill Area 1, #2 with Remaining Cover Soil	391,915	bcy	$ 2.00	$ 784,000
Backfill Remainder Area #1, #2 with Structural Backfill (incl. supply)	394,542	bcy	$ 10.00	$ 3,945,000
Temp Hydroseeding	70	acres	$ 1,500.00	$ 105,000
Survey Crew	70	acres	$ 1,000.00	$ 70,000
Field Management and Quality Assurance	12	month	$ 25,000.00	$ 300,000
			Total Estimated Cost	$ 18,690,000

Table 2
Mitigation Alternative 2
Former Deschutes County Demolition Landfill
Bend, Oregon

DRAFT - NOT FOR CONSTRUCTION

Consolidation Only

Item	Quantity	Unit	Unit Cost	Total Price
Permitting and Engineering Design				$ 750,000
Mob and Demob				$ 50,000
Erosion Controls - Install Silt Fence	7,500	lf	$ 2.00	$ 15,000
Erosion Controls - Construction Entrance				$ 5,000
Remove Area 1 Cover Soil and Stockpile, Use as a Backfill	193,500	bcy	$ 3.70	$ 716,000
Remove Area 2 Cover Soil and Stockpile, Use as a Backfill	24,000	bcy	$ 3.70	$ 89,000
Remove Area 3 Cover Soil and Stockpile, Use as Backfill	246,000	bcy	$ 3.70	$ 910,000
Partial Excavation Area #1, Excavate Area #2	1,169,347	bcy	$ 2.50	$ 2,923,000
Transport to Cell #3 and Place	576,000	bcy	$ 4.00	$ 2,304,000
Trucking to Landfill and Disposal (Excess capacity)	296,673	tons	$ 30.00	$ 8,900,000
Place Cover Soil Over Cell 3	47,585	bcy	$ 2.00	$ 95,000
Backfill West Section Cell 3 with Structural Backfill (incl. supply)	386,579	bcy	$ 10.00	$ 3,866,000
Backfill Area 1, #2 with Remaining Cover Soil	415,915	bcy	$ 2.00	$ 832,000
Backfill Remainder Area #1, #2 with Structural Backfill (incl. supply)	753,432	bcy	$ 10.00	$ 7,534,000
Temp Hydroseeding	70	acres	$ 2,500.00	$ 175,000
Survey Crew	70	acres	$ 1,000.00	$ 70,000
Field Management and Quality Assurance	12	month	$ 25,000.00	$ 300,000
			Total Estimated Cost	$ 29,530,000

Consolidation After Processing

Item	Quantity	Unit	Unit Cost	Total Price
Permitting and Engineering Design				$ 750,000
Mob and Demob				$ 50,000
Install silt fence	7,500	lf	$ 2.00	$ 15,000
Erosion Controls - Construction Entrance				$ 5,000
Remove Area 1 cover soil and stockpile for use as a backfill	193,500	bcy	$ 3.70	$ 716,000
Remove Area 2 cover soil and stockpile for use as a backfill	24,000	bcy	$ 3.70	$ 89,000
Remove Area 3 cover soil and stockpile for use as a backfill	246,000	bcy	$ 3.70	$ 910,000
Partial Excavation Area #1, Excavate Area #2	1,169,347	bcy	$ 2.50	$ 2,923,000
Sort, Recycle, Compost	1,169,347	bcy	$ 4.50	$ 5,262,000
Transport Remainder to Cell 3 and Place	584,673	bcy	$ 4.00	$ 2,339,000
Place cover soil over Cell 3	47,585	bcy	$ 2.00	$ 95,000
Backfill West Section Cell 3 with Structural Backfill (incl. supply)	386,579	bcy	$ 10.00	$ 3,866,000
Backfill Area 1, #2 with remaining cover soil	415,915	bcy	$ 2.00	$ 832,000
Backfill remainder Area #1, #2 with structural backfill (incl. supply)	753,432	bcy	$ 10.00	$ 7,534,000
Temp Hydroseeding	70	acres	$ 1,500.00	$ 105,000
Survey Crew	70	acres	$ 1,000.00	$ 70,000
Field Management and Quality Assurance	12	month	$ 25,000.00	$ 300,000
			Total Estimated Cost	$ 25,860,000

Table 3
Mitigation Alternative 3
Former Deschutes County Demolition Landfill
Bend, Oregon

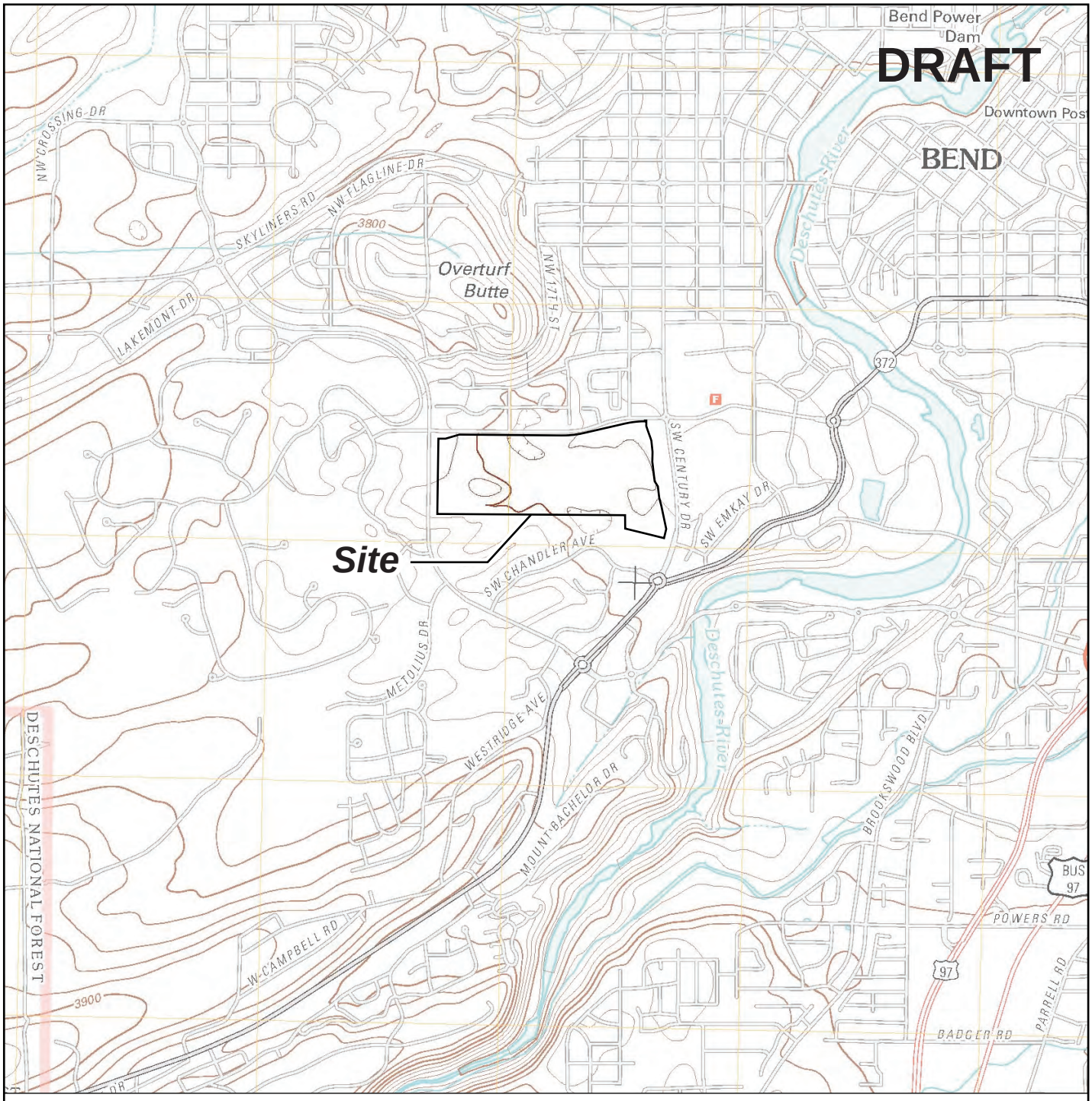
DRAFT - NOT FOR CONSTRUCTION

Consolidation Only

Item	Quantity	Unit	Unit Cost	Total Price
Permitting and Engineering Design				$ 750,000
Mob and Demob				$ 50,000
Erosion Controls - Install Silt Fence	7,500	lf	$ 2.00	$ 15,000
Erosion Controls - Construction Entrance				$ 5,000
Remove Area 1 Cover Soil and Stockpile, Use as a Backfill	193,500	bcy	$ 3.70	$ 715,950
Remove Area 2 Cover Soil and Stockpile, Use as a Backfill	24,000	bcy	$ 3.70	$ 88,800
Remove Area 3 Cover Soil and Stockpile, Use as Backfill	246,000	bcy	$ 3.70	$ 910,200
Partial Excavation Area #1, Excavate Area #2	1,360,533	bcy	$ 2.50	$ 3,400,000
Transport to Cell #3 and Place	576,000	bcy	$ 4.00	$ 2,300,000
Trucking to Landfill and Disposal (Excess capacity)	392,267	tons	$ 30.00	$ 11,770,000
Place Cover Soil Over Cell 3	47,585	bcy	$ 2.00	$ 95,000
Backfill West Section Cell 3 with Structural Backfill (incl. supply)	386,579	bcy	$ 10.00	$ 3,870,000
Backfill Area 1, #2 with Remaining Cover Soil	415,915	bcy	$ 2.00	$ 830,000
Backfill Remainder Area #1, #2 with Structural Backfill (incl. supply)	944,618	bcy	$ 10.00	$ 9,450,000
Temp Hydroseeding	70	acres	$ 2,500.00	$ 175,000
Survey Crew	70	acres	$ 1,000.00	$ 70,000
Field Management and Quality Assurance	12	month	$ 25,000.00	$ 300,000
			Total Estimated Cost	$ 34,790,000

Consolidation After Processing

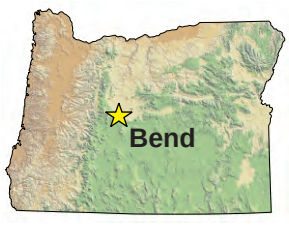
Item	Quantity	Unit	Unit Cost	Total Price
Permitting and Engineering Design				$ 750,000
Mob and Demob				$ 50,000
Install silt fence	7,500	lf	$ 2.00	$ 15,000
Erosion Controls - Construction Entrance				$ 5,000
Remove Area 1 cover soil and stockpile for use as a backfill	193,500	bcy	$ 3.70	$ 716,000
Remove Area 2 cover soil and stockpile for use as a backfill	24,000	bcy	$ 3.70	$ 89,000
Remove Area 3 cover soil and stockpile for use as a backfill	246,000	bcy	$ 3.70	$ 910,000
Partial Excavation Area #1, Excavate Area #2	1,360,533	bcy	$ 2.50	$ 3,400,000
Sort, Recycle, Compost	1,360,533	bcy	$ 4.50	$ 6,120,000
Transport Remainder to Cell 3 and Place	680,267	bcy	$ 4.00	$ 2,720,000
Place cover soil over Cell 3	47,585	bcy	$ 2.00	$ 95,000
Backfill West Section Cell 3 with Structural Backfill (incl. supply)	386,579	bcy	$ 10.00	$ 3,865,790
Backfill Area 1, #2 with remaining cover soil	415,915	bcy	$ 2.00	$ 830,000
Backfill remainder Area #1, #2 with structural backfill (incl. supply)	944,618	bcy	$ 10.00	$ 9,450,000
Temp Hydroseeding	70	acres	$ 1,500.00	$ 105,000
Survey Crew	70	acres	$ 1,000.00	$ 70,000
Field Management and Quality Assurance	12	month	$ 25,000.00	$ 300,000
			Total Estimated Cost	$ 29,490,000



Note: Base map prepared from USGS 7.5-minute quadrangle of Bend, OR, dated 2011 as provided by USGS.gov.

0 2,000 4,000

Approximate Scale in Feet



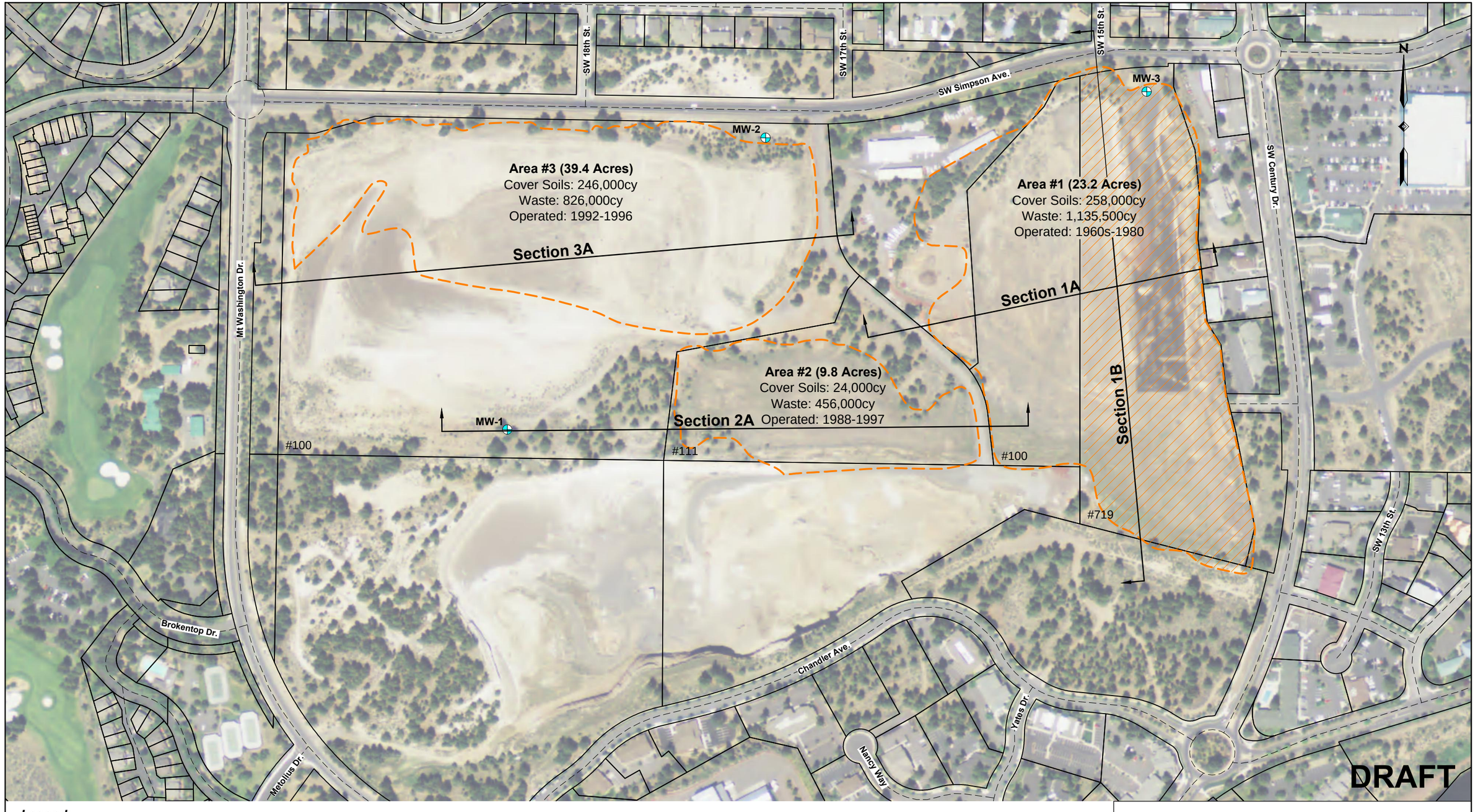
N

Site Location Map

Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	2112-01	Figure
June 2014		1



Legend:

- MW-9 — Monitoring Well Location
- Former Landfilling Areas
- Mill Waste (Sludge and Sander Dust)
- 1A — Cross-Section Location
- Road Centerline
- Deschutes County Taxlots
- #100 — Deschutes County Taxlot Number

0 300 600

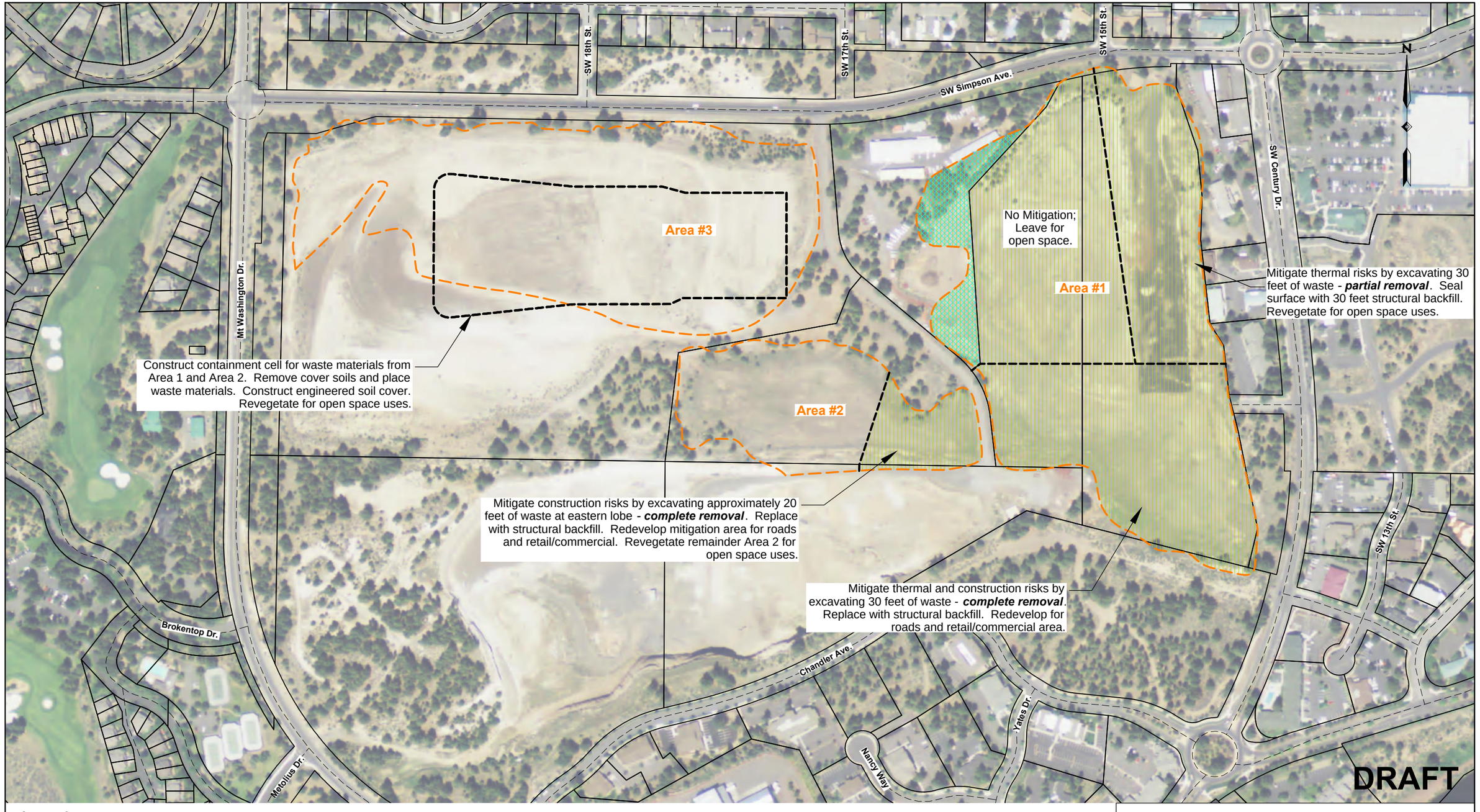
Scale in Feet

Landfill Overview

Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	2112-00	Figure
June 2014		2



Legend:

- Former Landfilling Areas
- Road Centerline
- Deschutes County Taxlots
- Waste Materials Encroaching on Off-site Property
- Soil Mitigation Area

0 300 600

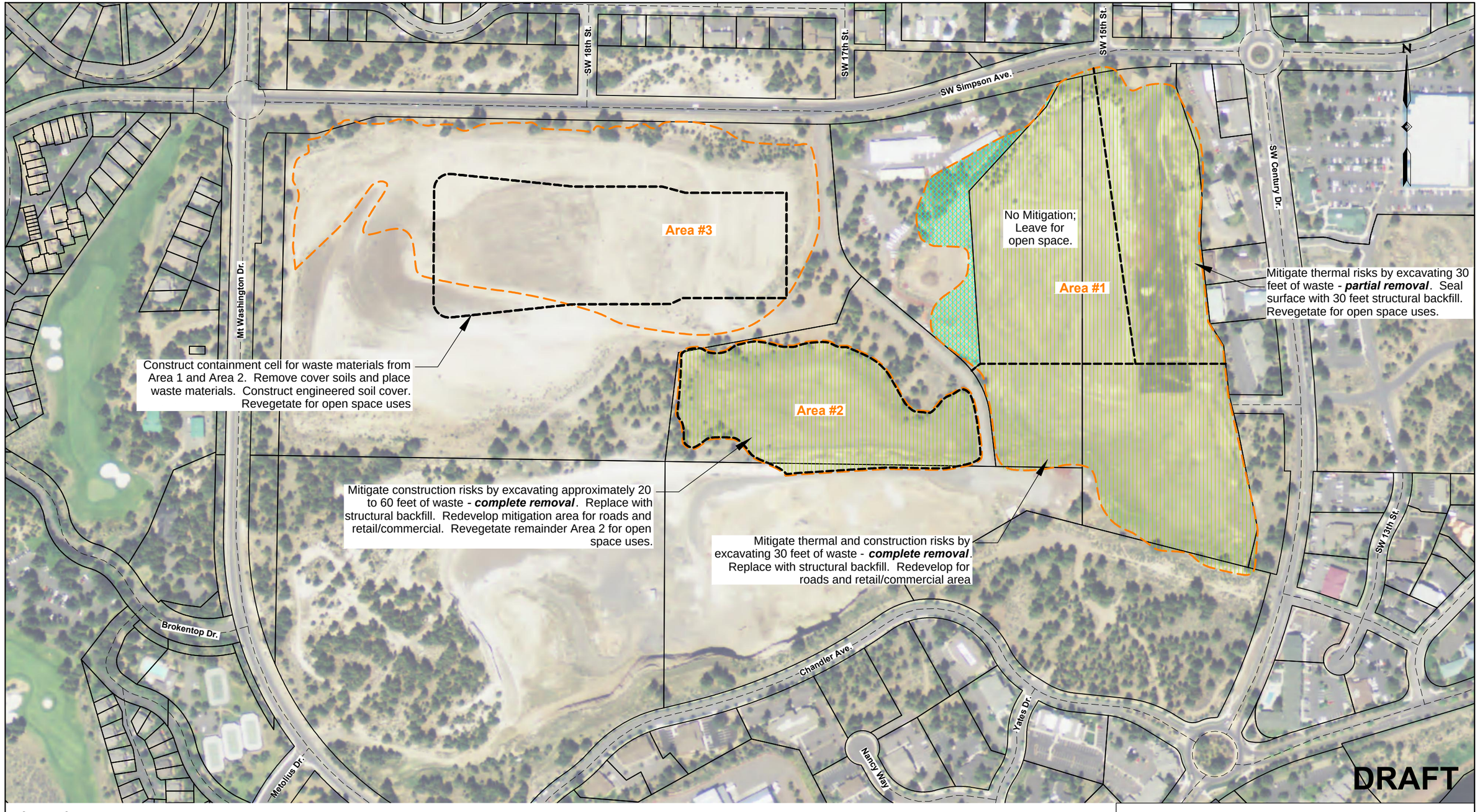
Scale in Feet

Mitigation Alternative 1

Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	2112-00	Figure
June 2014		3



Legend:

- Former Landfilling Areas
- Road Centerline
- Deschutes County Taxlots
- Waste Materials Encroaching on Off-site Property
- Soil Mitigation Area

0 300 600

Scale in Feet

Mitigation Alternative 2

Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	2112-00	Figure
June 2014		4

Mitigate thermal and construction risks by excavating 30 feet of waste - ***complete removal***. Replace with structural backfill. Redevelop for roads and retail/commercial area

Area #3

No Mitigation; Leave for open space.

Area #1

Mitigate thermal and construction risks by excavating up to 30 feet of waste - ***partial removal***. Replace with structural backfill. Redevelop for athletic fields and/or parking uses.

Construct containment cell for waste materials from Area 1 and Area 2. Remove cover soils. Place waste materials Area 1 and Area 2. Construct engineered soil cover. Revegetate for open space uses

Area #2

Mitigate construction risks by excavating approximately 20 to 60 feet of waste - ***complete removal***. Replace with structural backfill. Redevelop mitigation area for roads and retail/commercial. Revegetate remainder Area 2 for open space uses.

Mitigate thermal and construction risks by excavating 30 feet of waste - ***complete removal***. Replace with structural backfill. Redevelop for roads and retail/commercial area

SW 18th St.

SW 17th St.

SW 15th St.

SW Simpson Ave.

SW Century Dr.

SW 13th St.

Mt Washington Dr.

Brokentop Dr.

Metolius Dr.

Chandler Ave.

Yates Dr.

Nancy Way

N

DRAFT

Legend:

- Former Landfilling Areas
- Road Centerline
- Deschutes County Taxlots
- Waste Materials Encroaching on Off-site Property
- Soil Mitigation Area

0 300 600

Scale in Feet

Mitigation Alternative 3

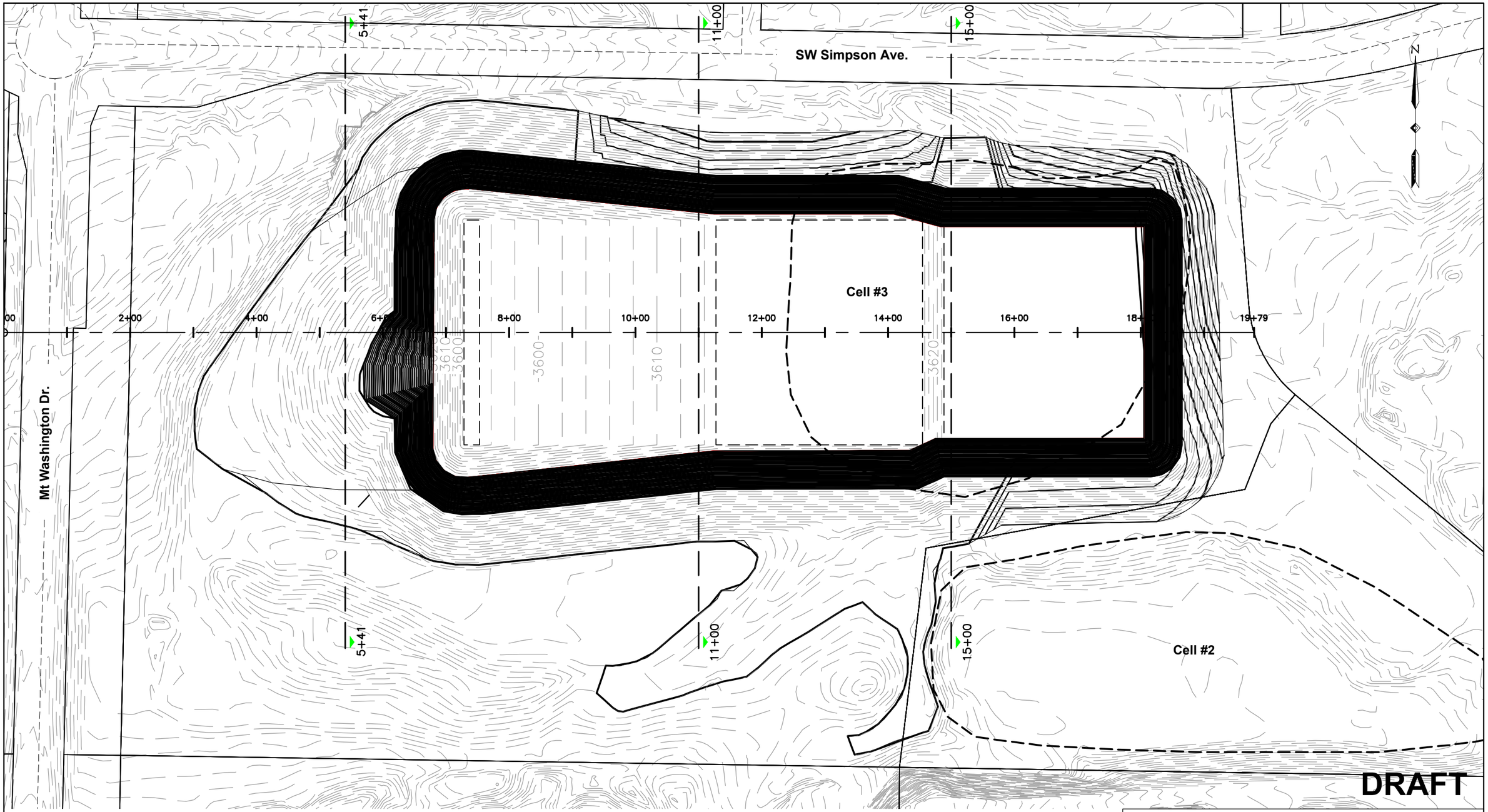
Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number 2112-00

June 2014

Figure 5



Legend:

- Former Landfilling Areas
- Road Centerline
- Deschutes County Taxlots

NOTE: Base map prepared from GIS files provided by Bend, Oregon.

0 150 300

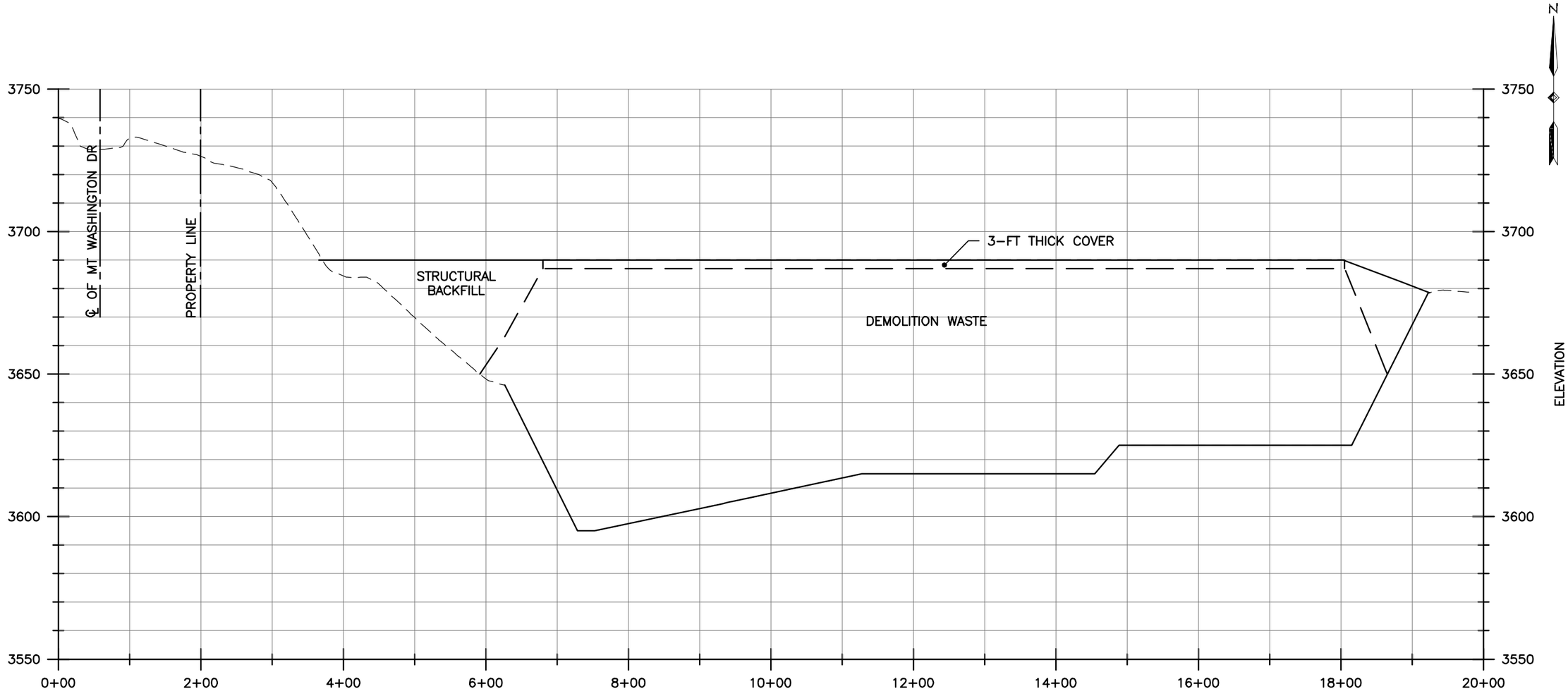
Scale in Feet

Cell #3 Consolidation

Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	2112-00	Figure
June 2014		6



3A PROFILE

DRAFT

Volume:

3' Cover	47,585 Cu. Yd.
Demolition Waste	1,401,884 Cu. Yd.
Structural Backfill	386,579 Cu. Yd.

0 150 300

Scale in Feet

Cell #3 Consolidation Profile

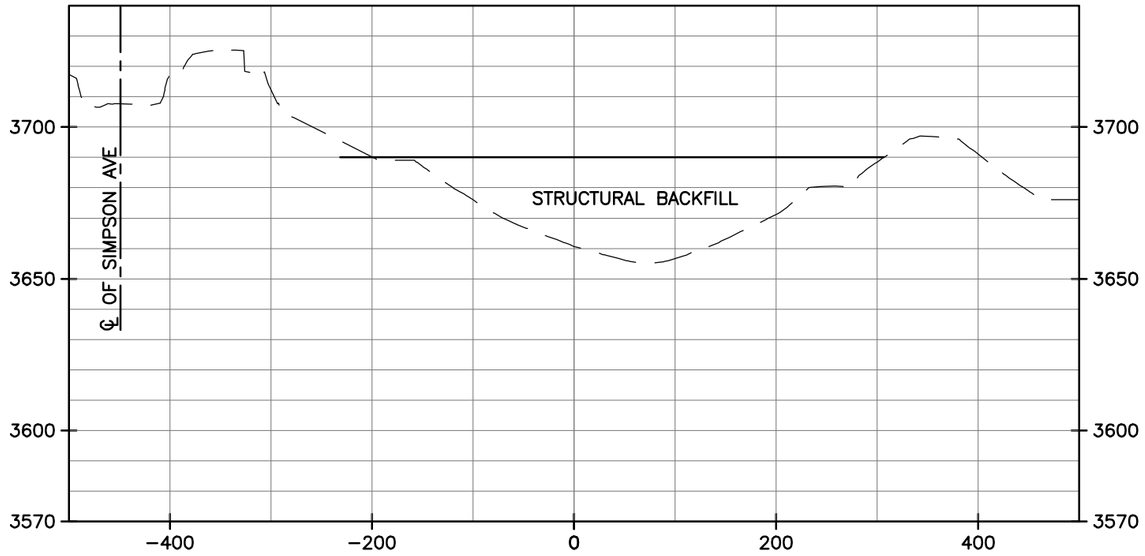
Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

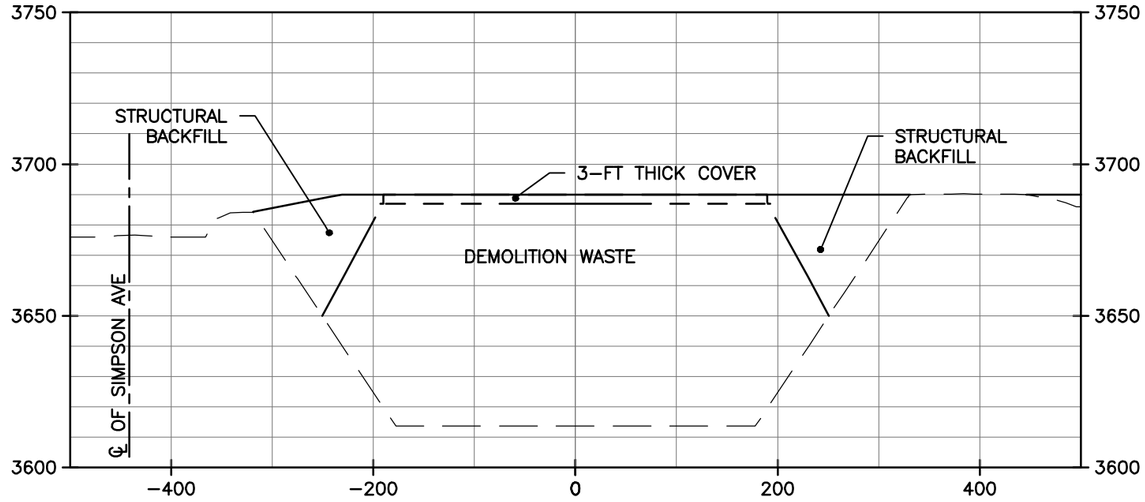
Project Number 2112-00

June 2014

Figure 7



CROSS SECTION
STA. 5+40.59



CROSS SECTION
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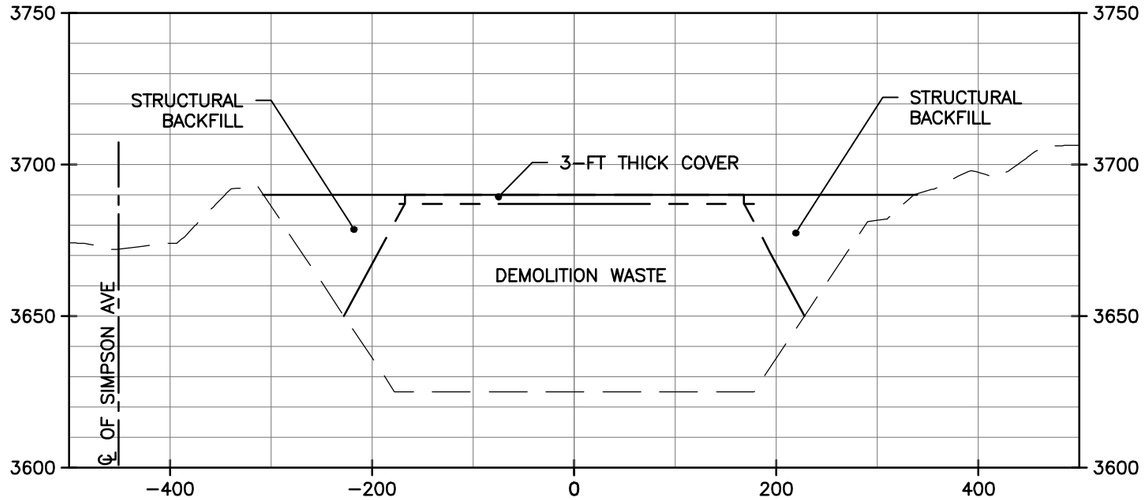

CROSS SECTION
STA. 15+00.00

0 300 600
Scale in Feet

DRAFT

Cell #3 Consolidation Cross-Sections

Deschutes County Demolition Landfill
Bend, Oregon

Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	2112-00	Figure
June 2014		8

Figure 6-1 - Estimate of Area 1 Fill Volumes with Sectional Cuts

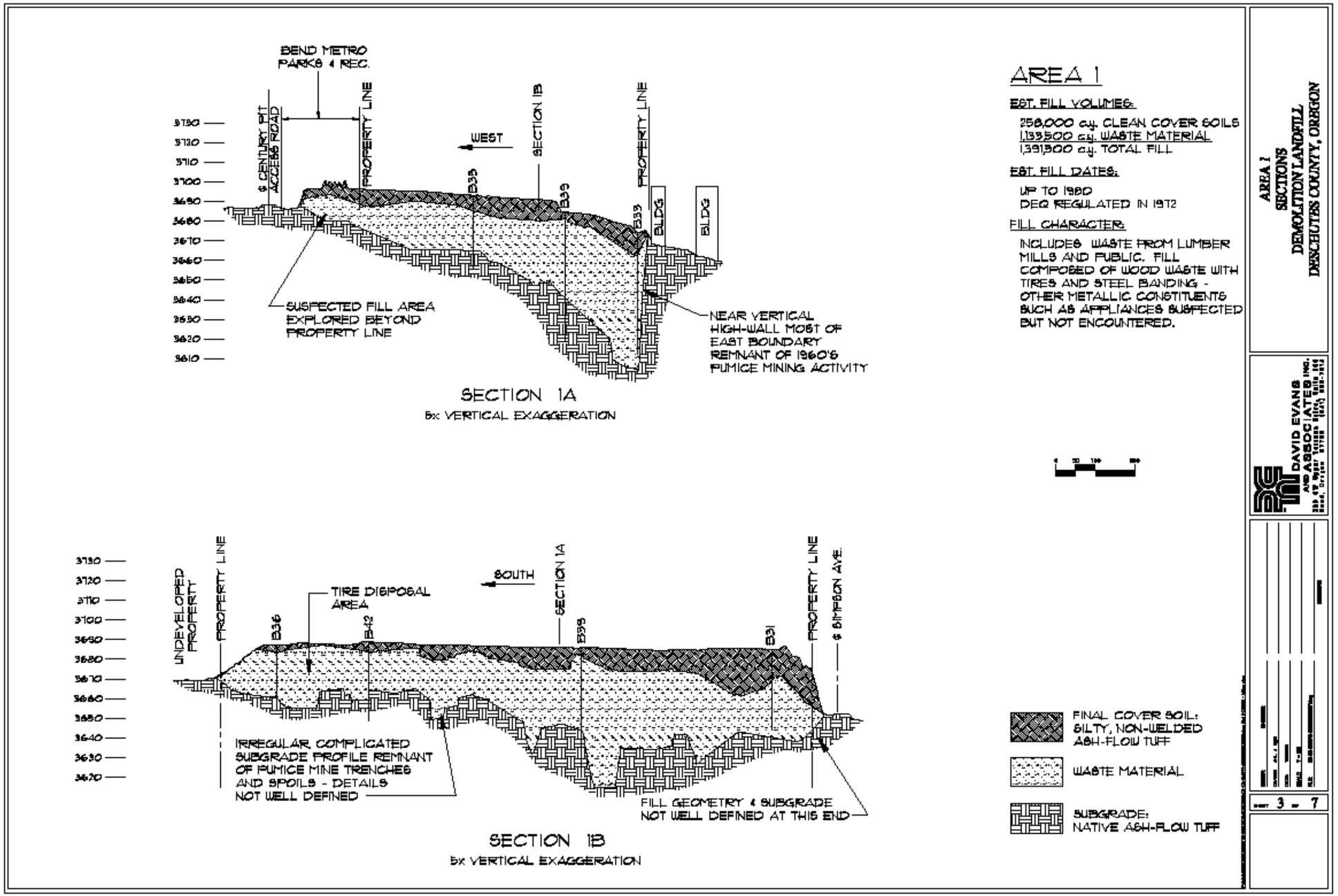

Figure 6-2 - Estimate of Area 2 Fill Volumes with Sectional Cuts

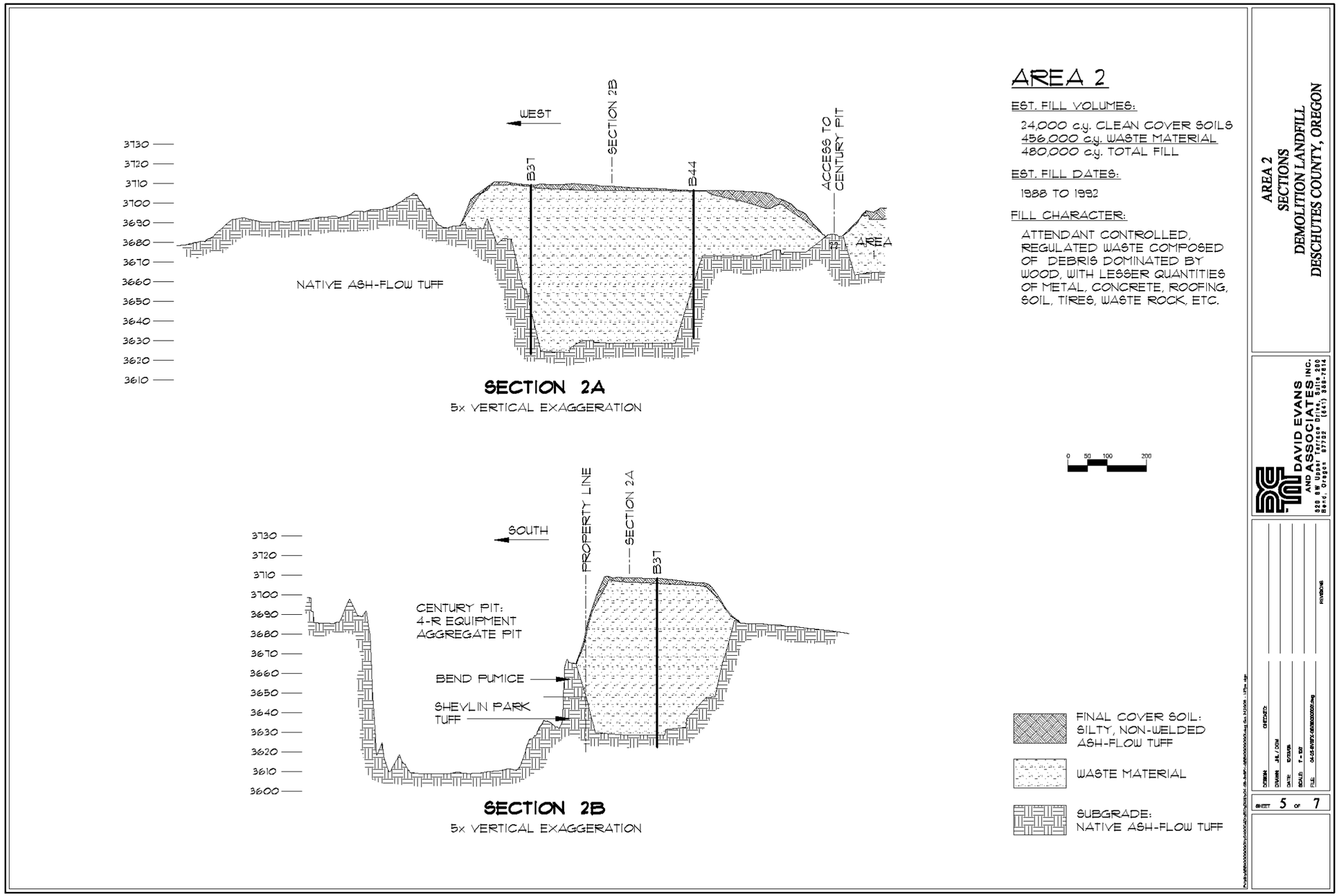

Figure 6-3 - Estimate of Area 3 Fill Volumes with Sectional Cuts