ENGINEERING DESIGN REPORT

SHORTSTACK BELMONT
2721-2731 SE BELMONT STREET
PORTLAND, OREGON
ESCI SITE ID#5731

Prepared for
SHORTSTACK BELMONT LLC
June 21, 2023
Project No. M2473.01.001

Prepared by
Maul Foster & Alongi, Inc.
3140 NE Broadway Street, Portland, OR 97232

MAUL
FOSTER
ALONGI

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

MAUL FOSTER & ALONGI, INC.

Krysta Krippaehne-Stein

Krysta Krippaehne-Stein, EIT
Staff Engineer

EXPIRES: 6/30/2023
This digital seal certifies the signatory and document content.

Cem Gokcora, PE
Senior Engineer

CONTENTS

ACRONYMS AND ABBREVIATIONS

BES	City of Portland Bureau of Environmental Services
CES	Cascade Environmental Solutions
CMMP	*Contaminated Media Management Plan*
DEQ	Oregon Department of Environmental Quality
EDR	*Engineering Design Report*
EES	*Easement and Equitable Servitudes*
EPA	U.S. Environmental Protection Agency
LADBS	City of Los Angeles Department of Building and Safety
MFA	Maul Foster & Alongi, Inc.
NAVFAC	Naval Facilities Engineering Command
PCE	tetrachloroethylene
PVC	polyvinyl chloride
RA	remedial action
RAP	remedial action work plan
RD	remedial design
Shortstack	Shortstack Belmont LLC
the Site	2721-2731 SE Belmont Street, Portland, Oregon

1 INTRODUCTION

On behalf of Shortstack Belmont LLC (Shortstack), and with funding from the City of Portland Bureau of Environmental Services (BES), Maul Foster & Alongi, Inc. (MFA), has prepared this *Engineering Design Report* (EDR) for the Shortstack Belmont site located at 2721-2731 SE Belmont Street, Portland, Oregon (the Site). The 0.24-acre Site comprises tax parcel 1S1E01BB 6900 in Multnomah County, township 1 south, range 1 east, section 1 of the Willamette Meridian and is currently vacant and includes a commercial, one-story building and a paved parking area. The objective of this EDR is to present the basis of design for the selected remedial action (RA).

1.1 Background

The Site historically operated as a dry cleaner. During its operation, dry cleaning solvents containing tetrachloroethylene (PCE) were released to the subsurface and impacted soil, groundwater, soil gas, and indoor air at the Site. Subsequent subsurface investigations identified the presence of PCE in soil gas at concentrations exceeding the Oregon Department of Environmental Quality (DEQ) vapor intrusion into buildings risk-based screening levels for occupational and urban residential receptors (2018).

The Site was enrolled in the DEQ Voluntary Cleanup Program (DEQ File No. 5731) via the Independent Cleanup Pathway in 2012. A vapor extraction system comprised of perforated extraction pipes beneath the floor slab of the existing Site building attached to a vacuum blower was installed in 2014 as an interim RA measure. The active vapor extraction system operated from October 2014 through 2016 when concentrations of PCE in indoor air were reduced to acceptable levels for occupational receptors.

A Consent Order, also known as a Prospective Purchaser Agreement, between SE 28th & Belmont, LLC, and the DEQ was recorded with Multnomah County on March 4, 2016. An amendment to the Scope of Work was issued by DEQ on June 14, 2022, with the selected RA consisting of the following elements:

- Design and incorporation of a vapor mitigation system into any future building on the Site (intended for occupancy) to mitigate the intrusion of soil gas vapors into the indoor air of the building at concentrations that would pose unacceptable risks to residents and employees of the buildings.
- Prior to the removal of any soils, pavements, or structures on the Site, an update to the existing *Contaminated Media Management Plan* (CMMP) (GeoDesign, Inc. 2016) will be completed.
- Preparation of a remedial action work plan (RAP) describing the proposed engineering controls for vapor mitigation.

- Predesign risk evaluation to confirm passive venting is adequately protective of human health, along with system design plans stamped by a professional engineer registered in the State of Oregon. Engineering controls will be designed to facilitate performance testing.
- Preparation of a sampling and analysis plan that will describe the proposed vapor mitigation system performance testing that will include sample collection and analysis.
- Conduct two performance tests of the engineering controls to demonstrate the effectiveness of the vapor mitigation system. The tests will be conducted during times likely to capture both wet and dry subsurface soil conditions.
- Enter into and record a new *Easement and Equitable Servitudes* (EES) on the Site, replacing and superseding the EES recorded with Multnomah County on April 13, 2016. The new EES will require ongoing operation and maintenance of the engineering controls until such time it is demonstrated to DEQ's satisfaction that unacceptable risks from intrusion of soil gas vapors associated with the Site into the indoor air of any building on the Site no longer exists. The new EES has been approved by the DEQ and is in the process of being recorded with Multnomah County.
- In the event performance testing does not confirm the effectiveness of the engineering controls in addressing unacceptable risks to on-site receptors, the system will be converted from passive to active venting using industry-standard equipment and systems. Supplemental performance testing may be performed to assess the need for system conversion.
- Conduct all Site work required to complete the RAs in conformance with DEQ-approved plans, specifications, and associated documents.

In accordance with the Consent Order and amended Scope of Work, MFA prepared a RAP in December 2022 to provide a framework and schedule for developing the remedial design (RD) documents for the selected remedy at the Site (MFA 2022). As outlined in the RAP, this EDR includes the following:

- Organizational chart providing lines of communication for the project team(s) to be used throughout the project (see Section 1.2)
- Design criteria/standards (see Section 3)
- Drawing index and preliminary drawings (see Design Drawings)
- Detailed description of RA activities to be performed (see Section 5)

Note that the RAP also called for the EDR elements listed below. These were partially addressed in this submittal for the reasons given:

- Design/analysis calculations – The work products to date as provided in this EDR illustrate all major system components and many of the associated details. The primary analyses informing the design will be reflected in the pending Risk Evaluation, which

estimates projected system performance. The Risk Evaluation will be provided under separate cover.

- Specifications—annotated outline, to include best management practices detailed in the updated CMMP and design submittals – The design drawings and associated construction details provide the bulk of this reporting element.

- References to the updated CMMP and other pertinent documents – The updated CMMP addresses excavation during site redevelopment activities as they pertain to soil (handling, sampling and hauling), soil gas, and indoor air contamination. The updated CMMP will be provided under a separate cover. Other pertinent documents have been referenced.

1.2 Project Organization

This section outlines the project organization, reporting relationships, and lines of communication related to the RD/RA. An organization chart is presented in the figure.

- **Shortstack**: Shortstack or its assigns expects to be the owner of the Site as of approximately April 2023. When the purchase is finalized, they will be responsible for the implementation, operations, and maintenance of the remedy. Shortstack has received a City of Portland grant that is funding the completion of this EDR and other project elements. The Shortstack project managers are Anna Mackay, anna@sister-city.com, and Jessy Ledesma, jessy@homework-dev.com.

- **BES**: BES is funding this phase of the RD/RA work through a Community-Wide Assessment Grant under a grant provided by the U.S. Environmental Protection Agency (EPA) Brownfields Assessment Program. BES will fund project work through their consultant, Cascade Environmental Solutions (CES).

- **CES**: CES is the primary consultant for the RD/RA project work. The CES project manager is Jennifer Levy, 503-805-4846, jlevy@cascade-environmental.com.

- **MFA**: MFA and CES have been the consultants on the project to date, and MFA is a subcontractor to CES. MFA will assist with specific portions of the redevelopment design documents (e.g., vapor mitigation system design specifications, vapor barrier design, and other documents), as requested by CES. An MFA engineer licensed in Oregon will stamp final design project documents. The MFA project manager for the project is Krysta Krippaehne-Stein, 360-947-2218, kstein@maulfoster.com.

- **The DEQ**: The DEQ will continue as the primary regulatory authority. The DEQ will continue to review and, when acceptable, approve RD/RA plans and specifications associated with the remedy. The DEQ project manager is Kevin Dana, 503-229-5369, kevin.dana@deq.oregon.gov.

2 PROPOSED REMEDIATION/REDEVELOPMENT

The proposed redevelopment includes three four-story residential buildings. The northern building encompasses approximately 2,955 square feet, and the first level is occupied by apartment units, mechanical rooms, and an enclosed bike storage facility. The two southern buildings each encompass approximately 1,390 square feet, and the first levels are occupied by apartment units and a trash facility. The redevelopment will also include construction of a courtyard, landscape areas, stormwater management facilities, and utilities. Remediation activities will include the following:

- Installation of a vapor barrier system
- Installation of a passive vapor collection and conveyance system, including monitoring ports and probes for future system performance confirmation

3 DESIGN CRITERIA/STANDARDS

The design adheres to City of Portland development standards. MFA is applying standard techniques, protocols, materials, and equipment associated with proposed remediation system (passive vapor extraction).

The design for the vapor collection system components followed the City of Los Angeles Department of Building and Safety (LADBS) methane mitigation standards (2006). The sub-slab impervious geomembrane liner was specified in accordance with the DEQ's *Solid Waste Landfill Guidance* (n.d.). Additionally, the U.S. Environmental Protection Agency's *Technical Guide for Assessing and Mitigating Vapor Intrusion Pathway from Subsurface Vapor Source to Indoor Air* (EPA 2015) was followed.

4 CONSTRUCTION SCHEDULE

Construction is anticipated to begin in September 2023 and is scheduled to be completed in summer 2024.

5 REMEDIAL ACTIONS

RAs will address the design components described in the following sections:

- Vapor Mitigation (Section 5.1)
- Utilities (Section 5.2)
- Institutional Controls (Section 5.3)

A draft construction quality assurance plan is included in Appendix A to ensure that the remedy fulfills the requirements of the DEQ and meets or exceeds all performance standards, design criteria, and plans.

5.1 Vapor Mitigation

Based on the detection of PCE in soil gas samples at concentrations exceeding the DEQ vapor intrusion into buildings risk-based concentrations for urban residential receptors (2018), a vapor collection and conveyance system is being designed (shown in the attached Design Drawings), consistent with LADBS methane mitigation standards, with the following features:

- An impervious vapor barrier under the proposed building slabs (see Section 5.1.1).
- A passive vapor venting system under the vapor barrier consisting of perforated pipe or flat vent pipe in a rock trench, connected to aboveground vent risers (see Section 5.1.2). The passive venting system can be converted to an active venting system with the addition of blowers/fans, if necessary.
- Vapor-monitoring probes installed above vapor barriers and below concrete building slabs (see Section 5.1.3).
- Geocomposite installed along a retaining wall (see Section 5.1.4).
- Trench dams to prevent migration of vapors through utility trenches (see Section 5.2).
- Institutional controls as outlined in the EES (see Section 5.3).

5.1.1 Membrane

An impervious membrane (GSE White Smooth Geomembrane or approved equivalent, see product specification sheet in Appendix B) will be installed below concrete building slabs and foundations to prevent vapor intrusion through cracks, penetrations, or expansion joints. The membrane will be installed below the building slabs surrounded by the inner face of the exterior footings and on the exterior surface of walls from the finished grade level to a minimum of 6 inches below the bottom of the adjoining building slab. Impervious membrane will not be installed under exterior or interior footings. The membrane will consist of 30 mil high-density polyethylene. Installation will comply with the manufacturer's installation manual. Floor penetrations for utilities and conduits will be connected directly to the membrane and will be terminated in the slab.

Where footings, plumbing pipes, electrical conduits, and other materials penetrate the impervious membrane, the penetrations will be sealed by using sleeves or boots composed of the same material or other approved materials and methods in accordance with the specifications of the membrane manufacturer (as shown on Design Drawing C3.0, Details 2 and 3). A gastight seal will be provided

where the impervious membrane is attached to all interior footings and exterior wall footings (as shown on Design Drawings C3.1, Details 1 through 6).

A gravel blanket overlain by a geocomposite (geonet wrapped in geotextile, GSE FabriNet 200 mil Geocomposite or approved equivalent, see product specification sheet in Appendix B) bottom cushion layer will be installed under the impervious membrane and above the compacted soil subgrade. The thickness of the gravel blanket will be a minimum of 4 inches. The gravel will consist of washed particles that have no more than one fractured face. Acceptable gradations for gravel and sand are listed in the Design Drawings (Sheet C1.0). The thickness of the proposed geocomposite is 200 mil. A nonwoven, needle-punched geotextile (TenCate Mirafi PT08 or approved equivalent, see product specification sheet in Appendix B) is proposed for the geomembrane top cushion layer between the geomembrane and the slab, as recommended by *Vapor Intrusion Mitigation in Construction of New Buildings Fact Sheet* (NAVFAC n.d.). Any welding or grinding work over the top cushion layer will be shielded with temporary wood panels (covering the work area), and the work area is to be inspected as outlined in the draft construction quality assurance plan.

The impervious membrane protection will be installed in the following sequence:

- Finish the gravel blanket surfacing smooth using mechanical means (e.g., roller).
- Prepare protective course for impervious membrane:
  - Place geocomposite layer as geomembrane bottom cushion layer.
- Deploy geomembrane per Design Drawings and per manufacturer's recommendations.
- Place a nonwoven geotextile layer with a minimum weight of 8 ounces per square yard over the impervious membrane as the top cushion layer.
- Place concrete, reinforcing steel, piping, and other forms so that they will not be supported directly on the impervious membrane. Equipment will not be driven over the impervious membrane or its protective covering.

5.1.2 Passive Venting System

Passive venting will be provided below slabs of proposed buildings to allow collection and venting of subsurface vapors. Passive vents will consist of perforated horizontal pipes connected to solid wall header pipes and discharging to vents located above the buildings. The perforated pipes will be low-profile flat vent (AWD Sitedrain Strip 6400 or approved equivalent, see product specification sheet in Appendix B). Combination vent/condensation pipes will be installed at a minimum of 1 percent slope. Excess undulations in the perforated pipes, which may impede the passage of vapors, will be avoided (e.g., perforated pipes will not be deformed to pass below interior footings). Collection pipes will be installed with maximum 25-foot horizontal spacing, with a maximum distance of 12.5 feet from the edge of the slab, following the LADBS methane mitigation standards.

The perforated pipes will be installed in a gravel blanket beneath the impervious membrane and above the compacted soil subgrade. The gravel thickness around perforated pipes will be a minimum of 3 inches. If sand is used as the gravel blanket, a geofabric will be placed around the perforated pipes to

prevent sand from entering them. Gravel will be composed entirely of particles that have no more than one fractured face.

The depth to groundwater is anticipated to be approximately 60 to 80 feet below ground surface with perched groundwater present at approximately 18 feet below ground surface, therefore groundwater is not anticipated to be detected in the sub-slab vapor collection system.

To protect the performance of the venting system, dimpled perforations will be oriented downward to prevent the accumulation of condensation or other moisture in the pipe. Any condensate that may be generated in the sub-slab vent will percolate into the soil through the nonwoven fabric. The condensate generated in the solid wall conveyance pipes will be routed to the Site's sanitary sewer system at sewer manholes through a P-trap connection (preventing vapors from entering the sanitary system).

Passive vents will be installed for each building to discharge vapors collected by the subsurface collection system. Vertical vents (risers) will consist of a solid wall high density polyethylene vertical pipe stack connected directly to the header or collection pipe. Vertical pipes will run inside the building walls and terminate 5 feet above the roof. Vent outlets will be located a minimum of 10 feet horizontally from other building system vents (plumbing, heating, etc.), and a minimum of 3 feet horizontally from any parapet or building wall. All ventilation piping will be clearly labeled with placards or adhesive labels indicating the presence of vapors. Vents will also be equipped with a vent cap to prevent intrusion of rainwater or snow to the system. In addition, the specified vent cap, Aura aluminum- vent cap by Active Ventilation Products, Inc., or equivalent, will induce negative pressure in the vent line response to wind currents.

The proposed passive venting systems are designed to allow conversion to active venting systems if warranted based on postconstruction performance testing. Conversion could consist of the addition of powered fans and blowers on strategically identified vent risers to depressurize the sub-slab. LADBS active vapor intrusion mitigation standards would generally be followed for sizing the blowers, with the design goal of selecting fans or blowers capable of ventilating the gravel blanket and perforated horizontal pipe spaces at a rate of three air exchanges per hour. The monitoring data gathered during two postconstruction performance tests will be, in part, the basis for active depressurization system design, as warranted.

The proposed horizontal vent pipe has a compressive strength of 6,000 pounds per square foot, which is adequate to resist vacuum induced pipe collapse (should an active system be installed). Due to its extruded dimpled polymeric perforated core, which is wrapped in a nonwoven geotextile, the vent will not collapse from a vacuum unless the entire surface area of fabric is completely blocked off. Since a geocomposite vent layer will be installed (extending the limits of depressurized zone to the entire slab) directly over the flat vent, at least the top 12-inch-wide surface will always be protected from blockage. Additionally, the rock that the flat vent will be placed over is specified so that the fines (material passing sieve no. 200) will be limited to less than 2 percent.

5.1.3 Vapor Monitoring Ports and Probes

To determine whether any PCE or related compounds are present above the vapor barrier, and as part of the performance monitoring and documentation process, horizontal vapor probes will be installed within a geocomposite monitoring layer above the vapor barrier and below the building slabs in conjunction with the passive venting system at select locations that would allow the installation of a monitoring port adjacent to the building. The monitoring areas with corresponding monitoring ports and probes are shown on Design Drawing C2.0, and the sub-slab system is shown on Design Drawing C3.3, Detail 1. The geocomposite monitoring layer will consist of AWD Sitedrain Strip 9400 (see product specification sheet in Appendix B). The probes will consist of a small-diameter (0.50-inch), solid wall high density polyethylene pipe, with 5 feet of perforations at the end. The pipe will be installed within the geocomposite directly above the membrane liner. The probe will terminate with a locking ball valve outside of the building footprint in a sealed access box. One monitoring port and probe will be provided for each vapor collection manifold.

A monitoring port is also proposed at each vertical riser pipe above the roof line as shown in Detail 2 of Design Drawing C3.3.

Site vapor monitoring as outlined in a future sampling and analysis plan will be conducted as part of two performance tests of the engineering controls. Sub-slab monitoring ports and vent riser monitoring ports will be used for post remediation sampling to inspect presence of vapor above and below the liner.

5.1.4 Retaining Wall Geocomposite

A portion of the northern building will be constructed partially below grade with a retaining wall along a portion of the eastern wall of the building. A geocomposite material (AWD Sitedrain Sheet 184 or approved equivalent, see product specification sheet in Appendix B) will be installed between the retaining wall and adjacent soil to create a preferential pathway for vapors to migrate upward rather than through the retaining wall and into the building. The geocomposite will be composed of a dimpled polymeric core with a nonwoven geotextile bonded to the dimple side. The dimple side will be installed against the retaining wall using installation methods outlined in the manufacturer's installation manual. This product will also be used at the vertical face of the stem walls as shown in Details 4 through 6 on Design Drawings C3.1.

5.2 Utilities

Sewer and potable water systems do not require specialized design elements, although trench backfill must be considered. Specifically, subsurface utility trenches and conduits can potentially provide preferential pathways for vapor migration. Therefore, utility trenches within the property boundary will use a trench dam consisting of cement/bentonite grout backfill to provide a nonporous channel that will prevent vapor migration within the backfill, as shown in Detail 2 on Design Drawings C3.2. Gasketed pipe will also be used to prevent vapor intrusion into open conduits.

A trench dam will have a minimum length of twice the width of the trench or a minimum of 36 inches in length. The entire cross section of trenches will be backfilled to provide a minimum of 6 inches of trench dam material around all conduits and pipes. Trench dam materials may be of the following:

- Bentonite cement slurry—a mixture of 4 percent Type 2 cement and 2 percent powdered bentonite, or
- Compacted native backfill—native soil will be compacted to at least 90 percent relative compaction in accordance with ASTM International D-1557 testing procedures.

All manholes and other underground electric enclosures that are intended for personnel entry will be naturally ventilated at all times to open air in an approved manner to prevent the buildup of vapors. Approved seals will be used to prevent water and vapors from entering the sides of the underground electrical enclosures. Personnel entry access cover will be provided with an approved restraining system. All wiring terminations, equipment, and insulating materials in the enclosure will be suitable for a wet location. Approved duct seals will be used to prevent water from the conduits entering or leaving the manholes and other underground electrical enclosures intended for personnel entry. The seal will have a depth not less than the diameter of the conduit.

5.3 Institutional Controls

Institutional controls currently in place are described in an EES recorded with Multnomah County on April 13, 2016. As part of the RA, Shortstack will enter into and record a new EES on the Site. Shortstack purchased the Site on April 28, 2023, and Shortstack submitted a Notice of Transfer Letter to the DEQ on May 2, 2023. The DEQ approved the new EES dated March 31, 2023. Shortstack is in the process of recording the EES with Multnomah County.

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.

Preliminary design elements and other content 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.

REFERENCES

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DEQ. 2018. *Risk-Based Concentrations for Individual Chemicals*. Oregon Department of Environmental Quality. May.

EPA. 2015. *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor to Indoor Air*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June.

LADBS. 2006. *Standard Plan: Methane Hazard Mitigation. City of Los Angeles Department of Building and Safety*. June 16. Revised March 8, 2010.

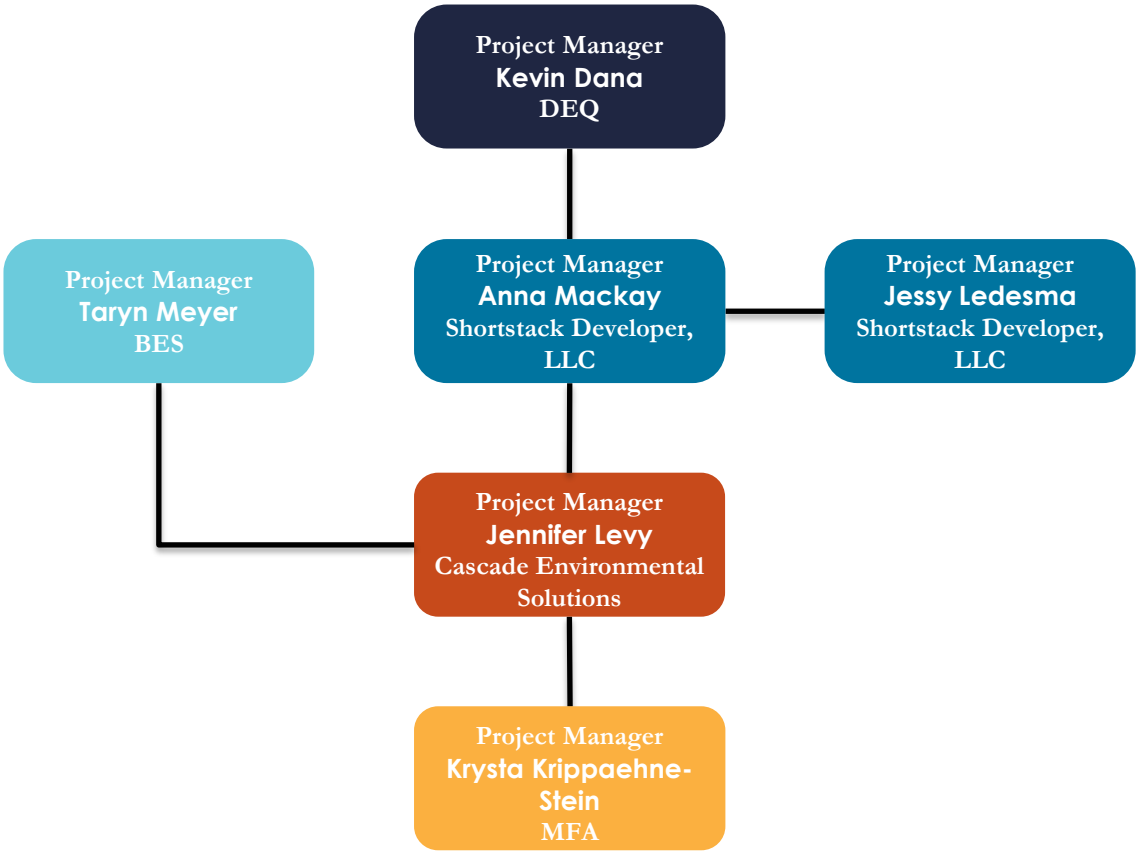
GeoDesign, Inc. 2016. *Contaminated Media Management Plan, 2721-2731 SE Belmont Street, Portland, Oregon, ESCI No. 5731*. Prepared for Oregon Department of Environmental Quality Northwest Region and Green Light Development. May.

MFA. 2022. *Remedial Action Work Plan, Shortstack Developer, LLC, 2721-2731 SE Belmont Street, Portland, Oregon, ECSI Site ID#5731*. Prepared for Shortstack Developer, LLC. Maul Foster & Alongi, Inc.: Portland, OR. December 21.

NAVFAC. n.d. *Vapor Intrusion Mitigation in Construction of New Buildings Fact Sheet*. Naval Facilities Engineering Command.

FIGURE

Figure
SHORTSTACK DEVELOPER, LLC
Engineering Design
Organization Chart



Legend

Oregon Department of Environmental Quality: oversight.

City of Portland Bureau of Environmental Services: funding agency.

Shortstack Developer, LLC: future Site owner, project implementation, operations, and maintenance.

Cascade Environmental Solutions: technical lead, deliverables, schedules, budgets subcontractor administration, information management, project implementation.

Maul Foster & Alongi, Inc.: remedial design.

DESIGN DRAWINGS

SHORTSTACK BELMONT VAPOR MITIGATION PLAN SET

PREPARED FOR:

SHORTSTACK BELMONT LLC

LOCATED IN SEC. 1, T. 1 S., R. 1 E., W.M., MULTNOMAH COUNTY, PORTLAND, OREGON

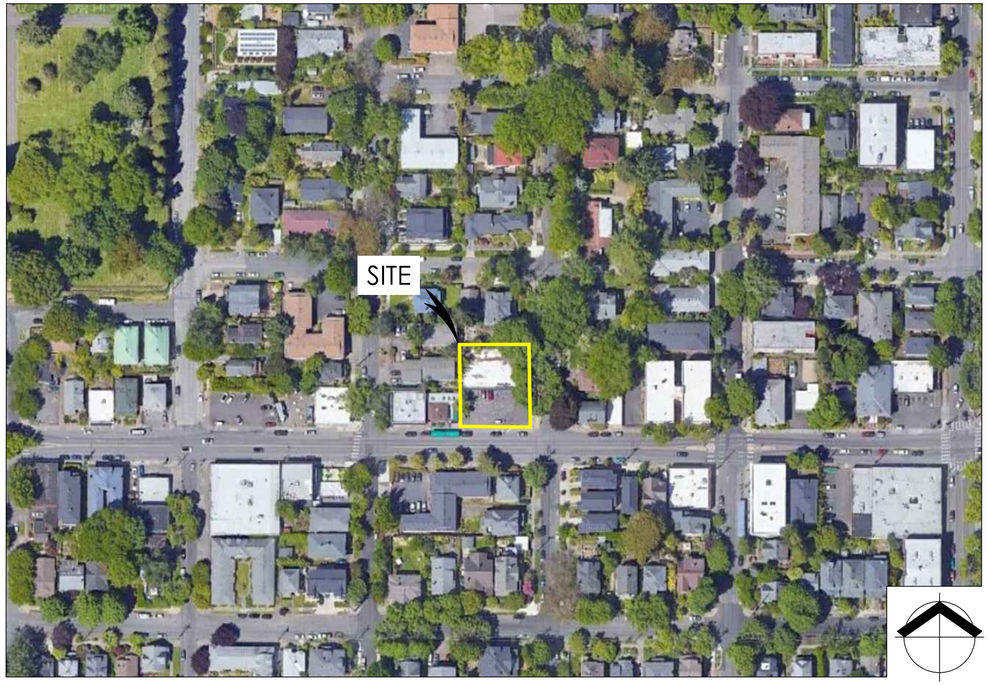
PROJECT CONTACTS

CLIENT	ENVIRONMENTAL ENGINEER
SHORTSTACK DEVELOPER, LLC 1017 N REVERE STREET PORTLAND, OREGON 97227 P: 540-846-4299 ANNA MACKAY ANNA@SISTER-CITY.COM	MAUL, FOSTER & ALONGI, INC. 3140 NE BROADWAY STREET PORTLAND, OREGON 97232 P: 503-501-5210 TED WALL TWALL@MAULFOSTER.COM
ARCHITECT WORKS PROGRESS ARCHITECTURE 811 SE STARK STREET, SUITE 210 PORTLAND, OREGON 97214 P: 503-234-2945 KEEGAN HEBERT KEEGAN@WORKSARCHITECTURE.NET	

PROJECT SUMMARY

SITE ADDRESS:
2721–2731 SE BELMONT STREET
MULTNOMAH COUNTY
PORTLAND, OREGON 97214

WORK DESCRIPTION:
THE PROPOSED WORK INCLUDES INSTALLATION OF A SUB–SLAB VAPOR BARRIER AND PASSIVE VAPOR MITIGATION SYSTEM.



VICINITY MAP

NOT TO SCALE

SHEET INDEX

GENERAL NOTES

1. CONTRACTOR TO VERIFY ALL UTILITY LOCATIONS AND DEPTHS PRIOR TO CONSTRUCTION. A MINIMUM OF TWO FULL BUSINESS DAYS PRIOR TO BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL CALL 811 (UTILITY NOTIFICATION CENTER) FOR LOCATION MARK–UP OF EXISTING UTILITIES.
2. ALL CONSTRUCTION, MATERIALS, AND WORKMANSHIP SHALL CONFORM TO THE LATEST STANDARDS AND PRACTICES OF THE CITY PORTLAND AND THE LATEST EDITION OF THE "OREGON STANDARD SPECIFICATIONS FOR CONSTRUCTION" PREPARED BY ODOT/APWA.
3. IN CASE OF A CONFLICT BETWEEN THE REGULATORY STANDARDS OR SPECIFICATIONS, THE MORE STRINGENT REQUIREMENT WILL PREVAIL.
4. ANY CHANGES TO THE DESIGN AND/OR CONSTRUCTION SHALL BE APPROVED BY THE OWNER OR ENGINEER.
5. APPROVAL OF THESE PLANS DOES NOT CONSTITUTE AN APPROVAL OF ANY OTHER CONSTRUCTION NOT SPECIFICALLY SHOWN ON THE PLANS. PLANS FOR STRUCTURES SUCH AS BRIDGES, BUILDINGS, TANKS, VAULTS, ROCKERIES, AND RETAINING WALLS MAY REQUIRE A SEPARATE REVIEW AND APPROVAL BY THE BUILDING DEPARTMENT PRIOR TO CONSTRUCTION.
6. A COPY OF THESE APPROVED PLANS SHALL BE ON THE JOB SITE WHENEVER CONSTRUCTION IS IN PROGRESS.
7. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ALL CONSTRUCTION EASEMENTS AND PERMITS NECESSARY TO PERFORM THE WORK.
8. THE CONTRACTOR IS RESPONSIBLE FOR ALL CONSTRUCTION STAKING.
9. PUBLIC AND PRIVATE DRAINAGE WAYS SHALL BE PROTECTED FROM POLLUTION. NO MATERIAL IS TO BE DISCHARGED TO OR DEPOSITED IN STORMWATER SYSTEMS THAT MAY RESULT IN VIOLATION OF STATE OR FEDERAL WATER QUALITY STANDARDS.
10. ALL CONSTRUCTION WITHIN THE PUBLIC RIGHT–OF–WAY SHALL HAVE AN APPROVED PUBLIC RIGHT–OF–WAY WORK PERMIT PRIOR TO ANY CONSTRUCTION ACTIVITY WITHIN THE RIGHT–OF–WAY.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING ADEQUATE SAFEGUARDS, SAFETY DEVICES, PROTECTIVE EQUIPMENT, FLAGGERS, AND ANY OTHER NEEDED ACTIONS TO PROTECT THE LIFE, HEALTH, AND SAFETY OF THE PUBLIC, AND TO PROTECT PROPERTY IN CONNECTION WITH THE PERFORMANCE OF WORK COVERED BY THE CONTRACTOR. ALL TRAFFIC CONTROL DEVICES SHALL CONFORM TO THE LATEST ADOPTED EDITION OF THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" (MUTCD) PUBLISHED BY THE U.S. DEPARTMENT OF TRANSPORTATION. TWO–WAY TRAFFIC MUST BE MAINTAINED AT ALL TIMES ON THE ADJACENT PUBLIC STREETS.
12. ANY PUBLIC OR PRIVATE CURB, GUTTER, SIDEWALK, OR ASPHALT DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED TO CITY OF PORTLAND STANDARDS AND PRACTICES.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE INTEGRITY OF ADJACENT UTILITIES WHICH MAY INCLUDE, BUT ARE NOT LIMITED TO, WATER, SANITARY SEWER, STORMWATER, POWER, TELEPHONE, CABLE TV, GAS, IRRIGATION, AND STREET LIGHTING. THE CONTRACTOR SHALL NOTIFY RESIDENTS AND BUSINESSES 48 HOURS IN ADVANCE OF ANY WORK AFFECTING ACCESS OR SERVICE AND SHALL MINIMIZE INTERRUPTIONS TO DRIVEWAYS FOR RESIDENTS AND BUSINESSES ADJACENT TO THE PROJECT.
14. ALL LAWN AND VEGETATED AREAS DISTURBED WILL BE RESTORED TO ORIGINAL CONDITION. ANY DISTURBANCE OR DAMAGE TO OTHER PROPERTY ON ADJACENT PARCELS OR IN THE PUBLIC RIGHT OF WAY SHALL ALSO BE REPAIRED OR RESTORED TO ORIGINAL CONDITION.
15. THE VAPOR MITIGATION SYSTEM DESIGN SHOWN IS IN PROGRESS, SUBJECT TO CHANGE BASED ON FURTHER REFINEMENT WITH THE DESIGN TEAM.
16. ALL WORK SHOULD BE COMPLETED IN ACCORDANCE WITH THE PROCEDURES OUTLINED IN THE CONTAMINATED MEDIA MANAGEMENT PLAN.

PRELIMINARY

MAUL FOSTER ALONGI
3140 NE BROADWAY ST
PORTLAND, OR 97232
PHONE: 971.544.2139
www.maulfoster.com

REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
JAN. 11, 2005
CEM E. GOKCORA

EXPIRES: 6/30/2023
This digital seal certifies the signatory and document content.

SHORTSTACK BELMONT VAPOR MITIGATION SYSTEM PLAN SET
SHORTSTACK BELMONT LLC
PORTLAND, OREGON

ISSUE	DATE	DESCRIPTION
B	4/20/2023	90% DESIGN DRAWINGS
A	2/14/2023	ENGINEERING DESIGN REPORT SUBMITTAL

PROJECT: M2473.01.001
DESIGNED: K. KRIPPAEHNE-STEIN
DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

SHEET TITLE
COVER SHEET

SHEET
C0.0

PLOTTED ON: 2023-06-20 3:05 PM PLOTTED BY: Krysta Krippaehne-Stein FILENAME: G:\PROJECTS\M2473.01 Shortstack - Belmont\PLANS\C03 COVER SHEET.dwg

CONSTRUCTION NOTES

I. MITIGATION REQUIREMENTS

A. NOTIFICATION PLACARD

1. A PERMANENT NOTIFICATION PLACARD IS REQUIRED TO INDICATE THE PRESENCE OF THE IMPERVIOUS MEMBRANE.

2. THE NOTIFICATION PLACARD SHALL BE POSTED AND MAINTAINED AT THE FRONT OF THE BUILDING THAT IS CONSTRUCTED WITH AN IMPERVIOUS MEMBRANE.

3. THE NOTIFICATION PLACARD SHALL BE UNCOVERED AND LOCATED IN CONSPICUOUS LOCATION. WHEN CAST IN FLOORS, SHALL ALSO REMAIN UNCOVERED AND IN A CONSPICUOUS LOCATION.

4. THE LETTERING SHALL BE LEGIBLE FROM 10 FEET AWAY AND AT LEAST 1 INCH HIGH.

II. DESIGN CRITERIA

A. PASSIVE SYSTEM

5. SUB-SLAB VENT SYSTEM

SUB-SLAB VENT SYSTEM SHALL CONSIST OF PERFORATED HORIZONTAL PIPES, GRAVEL BLANKET UNDER IMPERVIOUS MEMBRANE, GRAVEL AROUND PERFORATED HORIZONTAL PIPES AND VENT RISERS.

A. PERFORATED HORIZONTAL PIPES:

I. PERFORATED HORIZONTAL PIPES SHALL BE APPROVED AND LISTED, MINIMUM SCHEDULE 40, SLOTTED OR SITE DRAIN STRIP 6400 OR APPROVED EQUAL.

2. IMPERVIOUS MEMBRANE

A. IMPERVIOUS MEMBRANE PROTECTION PRIOR TO FLOOR SLAB PLACEMENT

I. INSTALLATION SEQUENCE FOR PROTECTION MATERIAL BELOW THE IMPERVIOUS MEMBRANE:

a. FINISH THE GRAVEL BLANKET SMOOTH USING MECHANICAL MEANS (E.G., ROLLER).

b. PLACE 200 MIL GEOCOMPOSITE OVER THE GRAVEL BLANKET TO PROTECT THE GEOMEMBRANE.

II. INSTALLATION SEQUENCE FOR PROTECTION MATERIAL ABOVE THE IMPERVIOUS MEMBRANE:

a. PLACE GEOTEXTILE FABRIC OVER THE GEOMEMBRANE.

b. PLACE CONCRETE, REINFORCING STEEL, PIPING AND OTHER FORMS SO AS NOT TO BE SUPPORTED DIRECTLY ON THE IMPERVIOUS MEMBRANE. EQUIPMENT SHALL NOT BE DRIVEN OVER THE IMPERVIOUS MEMBRANE OR ITS PROTECTIVE COVERING.

c. IF THERE ARE ANY REBAR WELDING, GRINDING, OR HEAT GENERATING WORK TO OCCUR OVER THE MEMBRANE OR ITS PROTECTIVE LAYER, THE CONTRACTOR SHALL USE WOODEN PANELS (OR EQUAL) AT THE ACTIVE WORK AREAS UNDERLYING LAYER PROTECTION. THE AREA OF THE WOODEN PANEL SHIELD SHALL BE INSPECTED AFTER WELDING OR GRINDING ACTIVITIES ARE COMPLETED, WITH PARTICULAR ATTENTION TO THE PERIMETER TO VERIFY THAT SPARKS/BURRS HAVE NOT DAMAGED THE GEOMEMBRANE.

B. IMPERVIOUS MEMBRANE SHALL BE 30 MIL HDPE. LINER INSTALLATION SHALL FOLLOW THE MANUFACTURER'S INSTALLATION GUIDELINES. MATERIAL SUBSTITUTIONS TO BE APPROVED BY DESIGN ENGINEER.

C. MISCELLANEOUS SYSTEMS

1. TRENCH DAM

TRENCH DAMS ARE INTENDED TO PREVENT TRAVEL OF UNDERGROUND VAPOR INTO BUILDINGS OR STRUCTURES ALONG THE TRENCH BACKFILL.

D. A TRENCH DAM SHALL BE INSTALLED IN ALL ELECTRICAL, PLUMBING, GAS, OR OTHER TRENCHES BENEATH THE BUILDING FOUNDATION.

E. IF PIPING AND CONDUITS ARE PLACED BEFORE CERTIFIED COMPACTED SOIL AS PART OF THE SITE PREPARATION FOR THE BUILDING PAD, THEN TRENCH DAMS WILL NOT BE REQUIRED.

F. TRENCH DAMS SHALL BE INSTALLED IN THE TRENCH IMMEDIATELY ADJACENT TO THE EXTERIOR PERIMETER OF THE BUILDING FOUNDATION.

G. A TRENCH DAM SHALL HAVE A MINIMUM LENGTH OF TWICE THE WIDTH OF THE TRENCH OR A MINIMUM OF 36 INCHES IN LENGTH.

H. TRENCH DAMS MAY BE OF THE FOLLOWING:

I. BENTONITE CEMENT SLURRY - A MIXTURE OF 4% TYPE II CEMENT, AND 2% POWDERED BENTONITE, OR

II. COMPACTED NATIVE BACKFILL - NATIVE SOIL SHALL BE COMPACTED TO AT LEAST 90% RELATIVE COMPACTION IN ACCORDANCE WITH ASTM D-1557 TESTING PROCEDURES.

a. THE ENTIRE CROSS SECTION OF TRENCHES SHALL BE BACKFILLED TO PROVIDE A MINIMUM OF 6 INCHES OF TRENCH DAM MATERIAL AROUND ALL CONDUITS AND PIPES.

2. WIRING

II. OUTDOOR ENCLOSURES

ALL OUTDOOR ENCLOSURES WITH OPEN BOTTOMS, WHEN INSTALLED ON GRADE OR FINISHED FLOORS, SHALL BE MOUNTED ON A MINIMUM 2-IN. (5.08 CM.) THICK CONCRETE PAD OVER A 30 MIL (.076 CM.) HIGH DENSITY POLYETHYLENE (HDPE) OR EQUIVALENT APPROVED IMPERVIOUS MEMBRANE. ALL MEMBRANE PENETRATIONS SHALL BE SUITABLY SEALED AGAINST TRANSMISSION OF GAS INTO THE ENCLOSURE.

3. MANHOLES AND OTHER UNDERGROUND ELECTRIC ENCLOSURES INTENDED FOR PERSONNEL ENTRY

THE PROVISIONS OF THIS SECTION ARE APPLICABLE TO ALL MANHOLES AND OTHER UNDERGROUND ELECTRIC ENCLOSURES THAT ARE INTENDED FOR PERSONNEL ENTRY. THE ENCLOSURES HEREWITH WILL BE REFERRED TO AS UNDERGROUND ELECTRICAL ENCLOSURES.

A. VENT SYSTEM

I. UNDERGROUND ELECTRICAL ENCLOSURES SHALL BE NATURALLY VENTILATED AT ALL TIME TO OPEN AIR IN AN APPROVED MANNER TO PREVENT THE BUILD-UP OF VAPORS.

II. MECHANICAL VENTILATION IN LIEU MAY BE USED WHEN BACK-UP POWER SUFFICIENT TO RUN THE SYSTEM FOR 24 HOURS IS PROVIDED AND A VISUAL AND AUDIBLE MAIN POWER FAILURE ALARM AT A READILY ACCESSIBLE LOCATION.

B. ENCLOSURE EXTERIOR

I. APPROVED SEALS SHALL BE USED TO PREVENT WATER AND VAPORS FROM ENTERING THE SIDES OF THE UNDERGROUND ELECTRICAL ENCLOSURES.

II. UNDERGROUND ELECTRICAL ENCLOSURES PERSONNEL ENTRY ACCESS COVER SHALL BE PROVIDED WITH AN APPROVED RESTRAINING SYSTEM.

III. SOIL GASES UNDER THE UNDERGROUND ELECTRICAL ENCLOSURE SHALL BE VENTED IN A MANNER SHOWN IN THE STANDARD PLAN DETAILS.

C. ENCLOSURE INTERIOR

I. ALL WIRING TERMINATIONS, EQUIPMENT AND INSULATING MATERIALS WITHIN THE ENCLOSURE SHALL BE SUITABLE FOR WET LOCATION.

II. APPROVED DUCT SEALS SHALL BE USED TO PREVENT WATER FROM THE CONDUITS ENTERING OR LEAVING THE MANHOLES AND OTHER UNDERGROUND ELECTRICAL ENCLOSURES INTENDED FOR PERSONNEL ENTRY. THE SEAL SHALL HAVE A DEPTH OF NOT LESS THAN THE DIAMETER OF THE CONDUIT.

SPECIFICATIONS FOR GRAVEL

SIEVE SIZE	PERCENTAGE PASSING SIEVE	
	3/4" Gravel	3/8" Gravel
1-1/2" (37.5 mm)	100	-
1" (25.0 mm)	90-100	-
3/4" (19.0 mm)	55-85	100
3/8" (9.5 mm)	8-20	85-100
No. 4 (4.75 mm)	0-5	0-30
No. 8 (2.36 mm)	0-5	0-10
No. 200 (75um)	0-2	0-2
ASTM C 131 TEST GRADING	B	C

SPECIFICATIONS FOR SAND

SIEVE SIZE	PERCENTAGE PASSING SIEVE
3/8" (9.5 mm)	100
No. 4 (4.75 mm)	90-100
No. 8 (2.36 mm)	75-90
No. 16 (1.18 mm)	55-75
No. 30 (600 um)	30-50
No. 50 (300 um)	10-25
No. 100 (150 um)	2-10
No. 200 (75 um)	0-5

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JAN. 11, 2005
CEM E. GOKCORA
EXPIRES: 6/30/2023
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SHORTSTACK BELMONT VAPOR MITIGATION SYSTEM PLAN SET
SHORTSTACK BELMONT LLC
PORTLAND, OREGON

ISSUE	DATE	DESCRIPTION
B	6/20/2023	90% DESIGN DRAWINGS
A	3/24/2023	ENGINEERING DESIGN REPORT SUBMITTAL

PROJECT: M2473.01.001
DESIGNED: K. KRIPPAEHNE-STEIN
DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

SHEET TITLE
CONSTRUCTION NOTES

SHEET
C1.0

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ABBREVIATIONS

AC	ACRE, ASPHALT CONCRETE PAVEMENT
ACOE	ARMY CORPS OF ENGINEERS
AD	AREA DRAIN
AGG	AGGREGATE
AIR	AIR RELIEF
AMSL	ABOVE MEAN SEA LEVEL
AP	ANGLE POINT
APN	APPARENT PARCEL NUMBER
APPD	APPROVED
APPROX, ±	APPROXIMAT(-E, -LY)
ASPH	ASPHALT
ASSY	ASSEMBLY
BCR	BEGIN CURB RETURN
BF	BUTTERFLY
BGS	BELOW GROUND SURFACE
BLDG	BUILDING
BLVD	BOULEVARD
BM	BENCHMARK
BMP	BEST MANAGEMENT PRACTICE
BO	BLOW-OFF
BOC	BACK OF CURB
BOT, BTM	BOTTOM
B.O.W.	BOTTOM OF WALL
BVC	BEGING VERTICAL CURVE
CB	CATCH BASIN
CDF	CONTROLLED DENSITY FILL
CEM	CEMENT
CF	CUBIC FEET
CFS	CUBIC FEET PER SECOND
CIP	CAST IRON PIPE
CIR	CIRCLE
CK	CHECK
CL, ℄	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
COMP	COMPACTION
CONC	CONCRETE
CPE	CORRUGATED POLYETHYLENE
CPL	COUPLING
CT	COURT
CTR	CENTER
CULV	CULVERT
CY	CUBIC YARD
D	DEPTH
DEG	DEGREE(-S)
DI	DUCTILE IRON
DIA	DIAMETER
DIM.	DIMENSION(-S)
DIP, D.I.P.	DUCTILE IRON PIPE
DOT	DEPARTMENT OF TRANSPORTATION
DR	DIMENSION RATIO
DTL	DETAIL
DWG(S)	DRAWING(-S)
E	EAST
EA	EACH
ECR	END CURB RETURN
EG	EXISTING GROUND
EL, ELEV	ELEVATION
ELB, ELL	ELBOW
ELEC	ELECTRIC(-AL)
ENGR	ENGINEER
ENTR	ENTRANCE
EP, EOP	EDGE OF PAVEMENT
EQ	EQUAL(-LY)
ESC	EROSION CONTROL
ESMT	EASEMENT
EST	ESTIMATE(-D)
EVC	END VERTICAL CURVE
EXC	EXCAVATE
EX., EXTG.	EXISTING
EW	EACH WAY
FF	FINISH FLOOR
FG	FINISH GRADE
FH	FIRE HYDRANT
FL	FLOW LINE
FLG	FLANGE
FM	FORCE MAIN
FT	FEET, FOOT
GAL	GALLON(-S)
GM	GAS METER
GND	GROUND
GP	GUARD POST
GPM	GALLONS PER MINUTE
GRD	GRADE
GV	GAS VALVE, GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
HGT, HT	HEIGHT
HP	HORSEPOWER
HORZ	HORIZONTAL
HYD	HYDRANT
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IN	INCH(-ES)
INTX	INTERSECTION
INV	INVERT
IP	IRON PIPE
L	LENGTH
LAT	LATERAL
LB	POUND(-S)
LF	LINEAR FEET
LONG.	LONGITUDINAL
LT	LEFT
MAX	MAXIMUM
MFA	MAUL FOSTER & ALONGI, INC.
MFR	MANUFACTURER
MH	MANHOLE
MIC	MONUMENT (IN CASE)
MIN	MINIMUM; MINUTE
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MON	MONUMENT (SURFACE)
MW	MONITORING WELL
N	NORTH
N/A	NOT APPLICABLE
NAT G, NG	NATURAL GAS
NE	NORTHEAST
NO.	NUMBER
NTS	NOT TO SCALE
NW	NORTHWEST
OC	ON CENTER
OD	OUTSIDE DIAMETER
OHP	OVERHEAD POWER
OT	OWNERSHIP TIE
P	PIPE
P TRAN	PAD MOUNTED TRANSFORMER
PC	POINT OF CURVATURE
PCC	PORTLAND CEMENT CONCRETE
PEN.	PENETRATION
PERF	PERFORAT(-E, -ED, -ES, -ION)
P.L., PL	PROPERTY LINE, PLACE
POW V	POWER VAULT
PP	POWER POLE
PROP.	PROPOSED
PS	PUMP STATION
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PT	POINT OF TANGENT
PV	PLUG VALVE
PVI	POINT OF VERTICAL INTERSECTION
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
R, RAD	RADIUS
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RD	ROOF DRAIN
RED	REDUCER
REQD	REQUIRED
REQT	REQUIREMENT
REV	REVISION
R/W, ROW	RIGHT OF WAY
RT	RIGHT
S	SOUTH, SLOPE
SB	SOIL BORING
SCH	SCHEDULE
SD	STORM DRAIN
SDR	STANDARD DIMENSION RATIO
SE	SOUTHEAST
SF	SQUARE FEET
SHT	SHEET
SL	SLOPE
SPEC	SPECIFICATIONS
SQ	SQUARE
SQ IN	SQUARE INCHES
SRF	SURFACE
ST	STREET
STA	STATION
STD	STANDARD
STL	STEEL
STRM	STORM
STRUCT	STRUCTUR(-E, -AL)
SSWR	SANITARY SEWER
SW,S/W	SIDEWALK, SOUTHWEST
TB	THRUST BLOCK
TBM	TEMPORARY BENCHMARK
TC	TOP OF CURB
TEL, TELE	TELEPHONE
TEMP	TEMPORARY
TP	TOP OF PAVEMENT, TEL POLE, TURNING POINT
TW	TOP OF WALL
TYP	TYPICAL
UG	UNDERGROUND
UGE	UNDERGROUND ELECTRIC
UTIL	UTILITY
VC	VERTICAL CURVE
VERT	VERTICAL
VOL	VOLUME
W	WIDTH; WIDE; WEST
W/	WITH
WATR	WATER
WM	WATER METER
W/O	WITHOUT
WSE	WATER SURFACE ELEVATION
WV	GATE/GENERAL WATER VALVE
YD	YARD
YR	YEAR

GENERAL LEGEND

GAS/POWER/TELEPHONE SYMBOLS

SYMBOL EXIST.	SYMBOL PROP.	DESCRIPTION
		GAS METER
		GAS VALVE
		PAD MOUNTED TRANSFORMER
P		POWER VAULT
		TRANSMISSION TOWER
		UTILITY POLE
		UTILITY POLE ANCHOR
		TELEPHONE RISER
T		TELEPHONE VAULT
		LIGHT POLE

SURVEY SYMBOLS

SYMBOL THEOR./ EXIST.	SYMBOL FOUND/ PROP.	DESCRIPTION
		ANGLE POINT
		BENCH MARK
		BLOCK CORNER
		IRON PIPE
		MONUMENT
		OWNERSHIP TIE
		SECTION DATA:
		SECTION CENTER
		SECTION CORNER
		QUARTER CORNER
		SIXTEENTH CORNER
		CLOSING CORNER
MC WC	MC WC	MEANDER CORNER
		WITNESS CORNER
		SOIL BORING
		SPOT ELEVATION

27	EXISTING GRADE MAJOR CONTOUR
27	EXISTING GRADE MINOR CONTOUR
SD_x	EXISTING STORM DRAIN PIPE
W_x	EXISTING WATER PIPE
SS_x	EXISTING SANITARY SEWER PIPE
	EXISTING AC PAVEMENT
	EXISTING CONCRETE SURFACING
	EXISTING GRAVEL SURFACING
	EXISTING BUILDING
	EXISTING FENCE LINE
	EXISTING ROAD CENTERLINE
	EXISTING RIGHT-OF-WAY
PL	EXISTING PROPERTY LINE

WATER SYMBOLS

SYMBOL EXIST.	SYMBOL PROP.	DESCRIPTION
		CAP/PLUG
		COUPLING
		GUARD POST / BOLLARD
		REDUCER
		THRUST BLOCK
		WATER METER
		DOUBLE CHECK VALVE ASSEMBLY
		FIRE HYDRANT
		AIR RELIEF
		BLOW-OFF VALVE
		CHECK VALVE
		GATE VALVE
		BENDS:
		90 DEGREE BEND
		45 DEGREE BEND
		22.5 DEGREE BEND
		11.25 DEGREE BEND
		VERTICAL BEND
		TEE
		CROSS

SANITARY/STORM SEWER SYMBOLS

SYMBOL EXIST.	SYMBOL PROP.	DESCRIPTION
		SAN. SEWER CLEAN OUT
	S	SAN. SEWER MANHOLE
		STORM DRAIN CATCH BASIN
		STORM DRAIN CULVERT
	D	STORM DRAIN MANHOLE
		DRY WELL
		AREA DRAIN

27	PROPOSED GRADE MAJOR CONTOUR (5.0' INTERVAL)
27	PROPOSED GRADE MINOR CONTOUR (1.0' INTERVAL)
	PROPOSED STORM DRAIN PIPE
	PROPOSED WATER PIPE
	PROPOSED SANITARY SEWER PIPE
	PROPOSED AC PAVEMENT
	PROPOSED CONCRETE SURFACING
	PROPOSED GRAVEL SURFACING
	PROPOSED BUILDING
	PROPOSED FENCE LINE
	PROPOSED ROAD CENTERLINE
	PROPOSED RIGHT-OF-WAY
PL	PROPOSED PROPERTY LINE

MITIGATION SYSTEM SYMBOLS

SYMBOL	DESCRIPTION
	VENT RISER
	PERFORATED SUB-SLAB VAPOR COLLECTION PIPE
	MONITORING PORT AND PROBE
	IMPERVIOUS MEMBRANE
	GEOCOMPOSITE MONITORING LAYER

SECTION NUMBER 1 / C1.X — SECTION REFERENCE SHEET

TYPICAL SECTION CALLOUT

DETAIL NUMBER X / C1.X — DETAIL REFERENCE SHEET

TYPICAL DETAIL CALLOUT

SF	PROPOSED SEDIMENT FENCE
OR OR	PROPOSED FLOW DIRECTION
	PROPOSED GRADE BREAK
	PROPOSED DITCH FLOW LINE
	PROPOSED COMPOST SOCK
	PROPOSED PAINT STRIPE
	PROPOSED TRUNCATED DOMES
	EXISTING FLOW DIRECTION
P	EXISTING OVERHEAD POWER
E_x	EXISTING UNDERGROUND POWER
T	EXISTING UNDERGROUND TELEPHONE
G	EXISTING UNDERGROUND GAS

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DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

SHEET TITLE
MASTER LEGEND

SHEET
C 1.1

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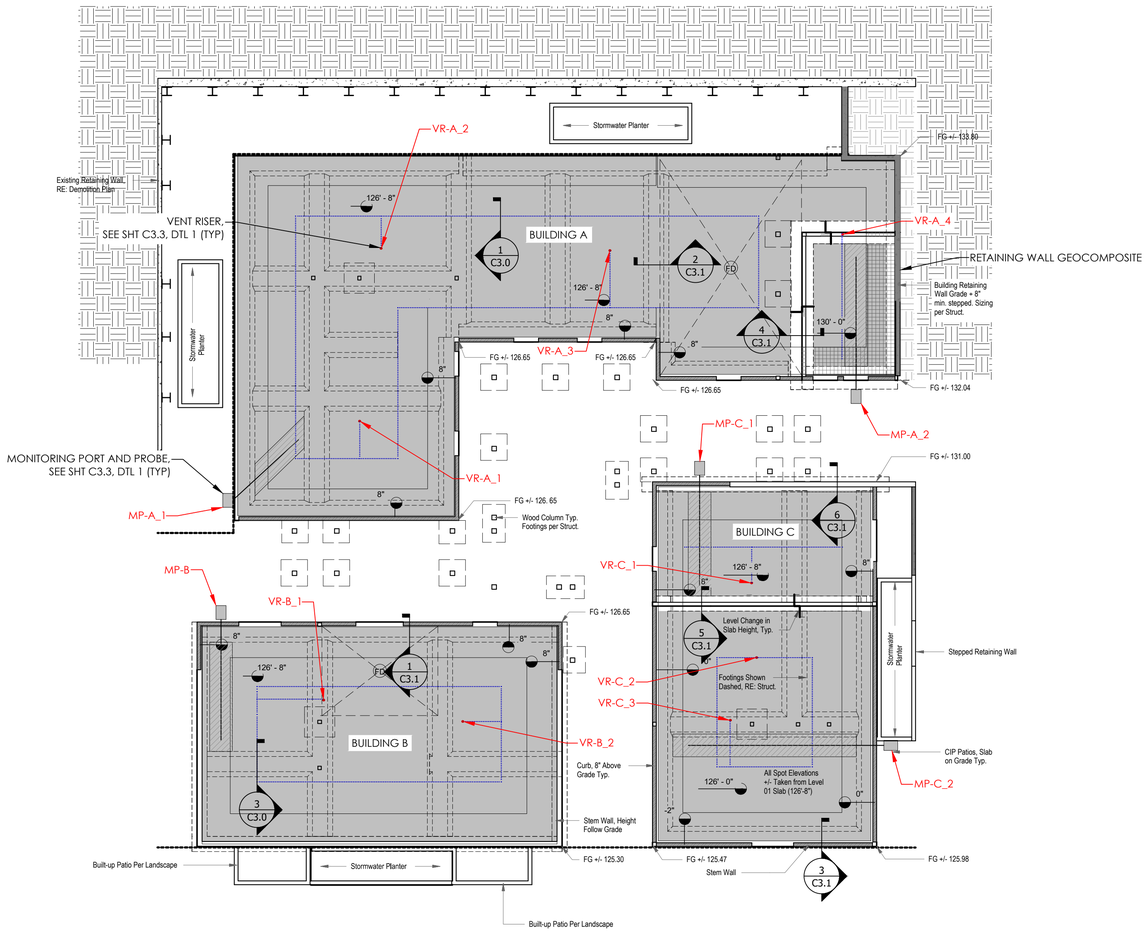
LEGEND:

VR-XX	VERTICAL VENT RISER PIPE
MP-XX	MONITORING PORT



BUILDING PLANS PROVIDED BY WORKS PROGRESS ARCHITECTURE

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SCALE
0 10' 20'
NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

SHEET TITLE

VAPOR MITIGATION SYSTEM - SLAB

SHEET
C2.0

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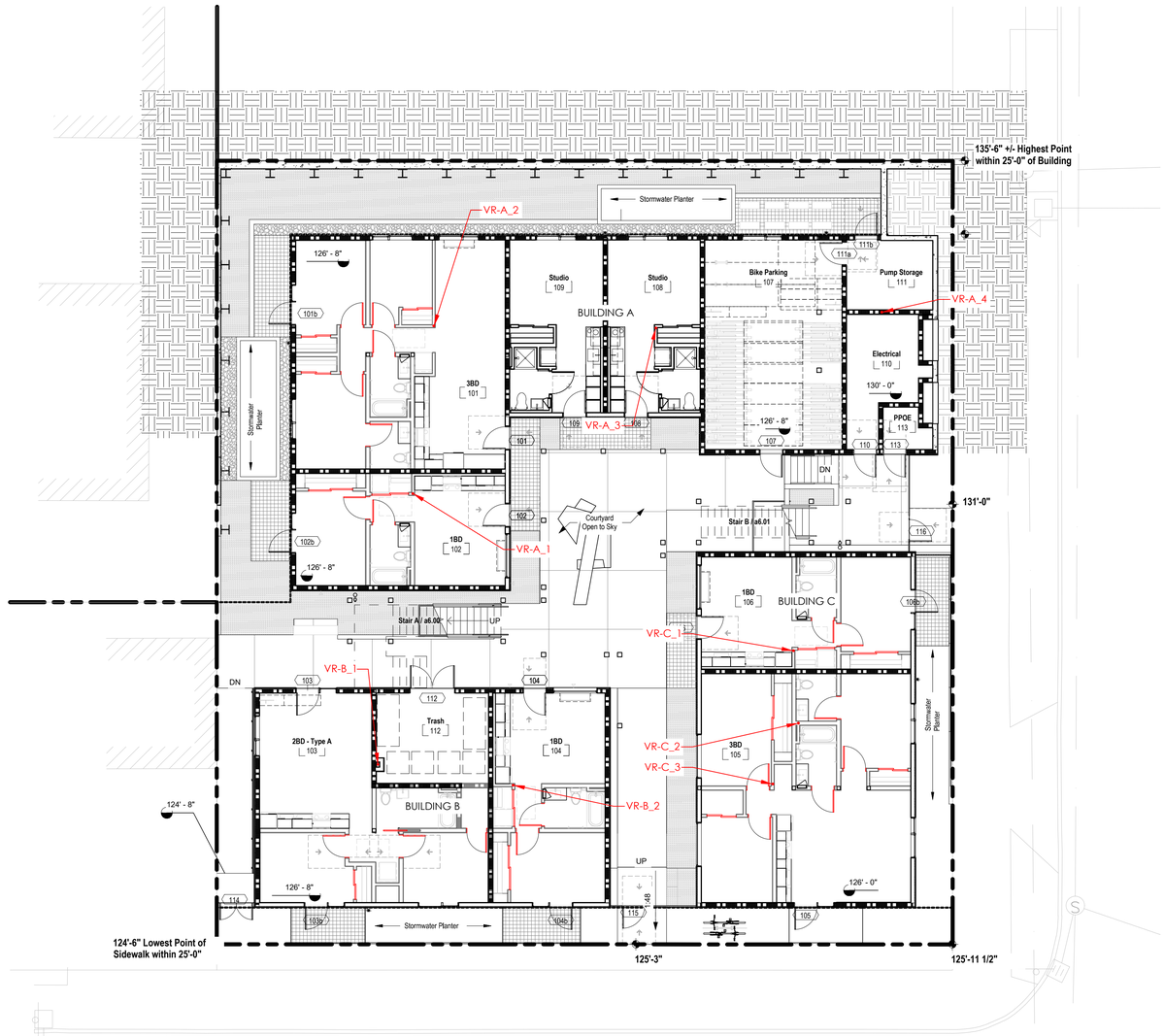

LEGEND:

VR-XX	VERTICAL VENT RISER PIPE
MP-XX	MONITORING PORT

BUILDING PLANS PROVIDED BY WORKS PROGRESS ARCHITECTURE

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SHEET TITLE
VAPOR MITIGATION SYSTEM - LEVEL 1

SHEET
C2.1

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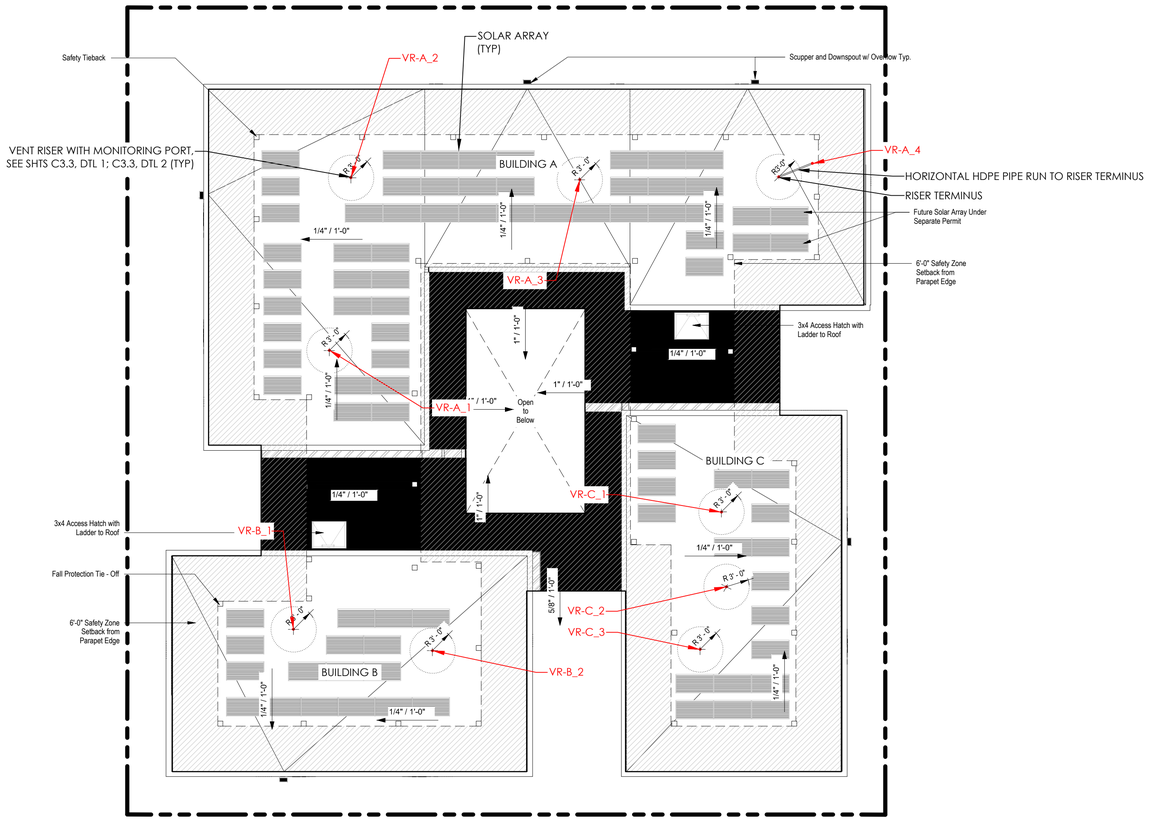
LEGEND:

VR-XX	VERTICAL VENT RISER PIPE
MP-XX	MONITORING PORT
	SAFETY ZONE SETBACK



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SHEET TITLE

VAPOR MITIGATION SYSTEM - ROOF

SHEET

C2.2

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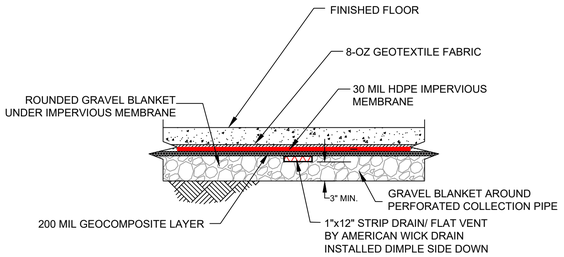
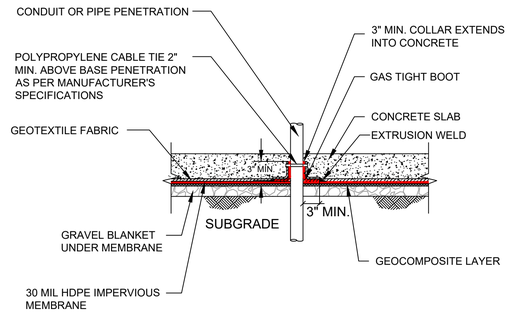


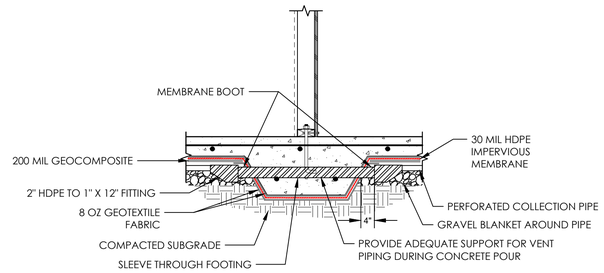
NOTE:
1. IMPERVIOUS MEMBRANE SHALL BE UNDERLAIN BY SMALL DIAMETER ROUNDED GRAVEL BLANKET, GEOCOMPOSITE CUSHION LAYER, OR SAND LAYER TO PREVENT LINER PUNCTURE.

1 SUB-SLAB VENT SYSTEM
NTS



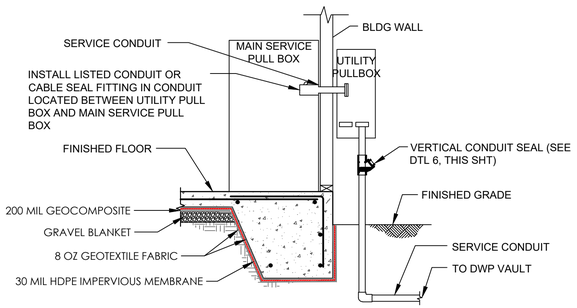
NOTE:
1. IMPERVIOUS MEMBRANE SHALL BE UNDERLAIN BY SMALL DIAMETER ROUNDED GRAVEL BLANKET, GEOCOMPOSITE CUSHION LAYER, OR SAND LAYER TO PREVENT LINER PUNCTURE.

2 MEMBRANE BOOT
NTS



NOTE:
1. IMPERVIOUS MEMBRANE SHALL BE UNDERLAIN BY SMALL DIAMETER ROUNDED GRAVEL BLANKET, GEOCOMPOSITE CUSHION LAYER, OR SAND LAYER TO PREVENT LINER PUNCTURE.

3 SUB-SLAB HORIZONTAL VENT PIPE AT INTERIOR FOOTING
NTS



NOTES:
1. PIPING AND CONDUIT SHALL BE PROTECTED FROM CORROSION AND STRUCTURAL SETTLEMENT AS FOLLOWS:
   A. TAPE SHALL BE APPLIED ON CONDUIT AND PIPING ENCASED IN CEMENT SLURRY OR CONCRETE.
   B. TAPE SHALL BE PS-37-90, BLACK PLASTIC PVC OR PE PRESSURE - SENSITIVE CORROSION PREVENTIVE TAPE.
2. IMPERVIOUS MEMBRANE SHALL BE UNDERLAIN BY SMALL DIAMETER ROUNDED GRAVEL BLANKET, GEOTEXTILE CUSHION LAYER, OR SAND LAYER TO PREVENT LINER PUNCTURE.

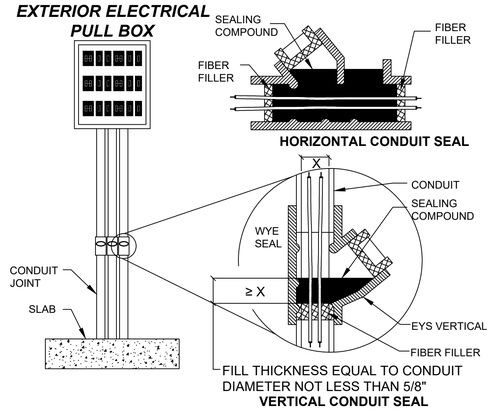
4 CONDUIT CABLE SEAL FITTINGS
NTS

WARNING

THIS BUILDING IS PROTECTED WITH A VAPOR CONTROL BARRIER. ANY PROPOSED PENETRATION OR ALTERATION OF FLOOR SLAB REQUIRES NOTIFICATION OF THE BUILDING OFFICIAL AND INSPECTION BY AN ENGINEER. DEQ MUST BE NOTIFIED OF ANY PENETRATION OR ALTERATIONS OF THE VAPOR BARRIER LINER, AND REPAIRS ARE SUBJECT TO DEQ'S REVIEW FOR APPROVAL.

NOTES:
1. THIS NOTIFICATION IS TO BE PERMANENTLY STAMPED OR ETCHED IN THE SURFACE OF THE SLAB OR OTHER LOCATION APPROVED BY THE BUILDING INSPECTOR AT THE TIME OF CONSTRUCTION.
2. ALL LETTERS 1/2" (MIN.) IN HEIGHT.
3. AT LEAST ONE REQUIRED PER BUILDING.
4. THIS NOTIFICATION SHALL BE POSTED AND MAINTAINED AT THE FRONT ENTRANCE OF THE BUILDING.

5 VAPOR MEMBRANE NOTIFICATION PLACARD
NTS



6 CONDUIT SEAL
NTS

FOUNDATION DETAILS PROVIDED BY DCI ENGINEERS

PRELIMINARY

MAUL FOSTER ALONGI
3140 NE BROADWAY STREET
PORTLAND, OR 97232
PHONE: 971.544.2139
www.maulfoster.com

REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
JAN. 11, 2005
CRM E. GOKCORA
EXPIRES: 6/30/2023
This digital seal certifies the signatory and document content.

SHORTSTACK BELMONT VAPOR MITIGATION SYSTEM PLAN SET
SHORTSTACK BELMONT LLC
PORTLAND, OREGON

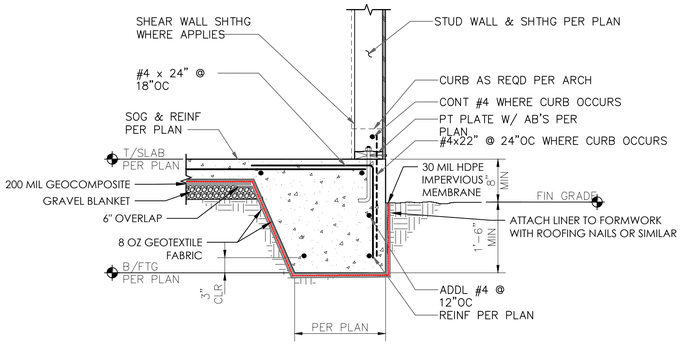
ISSUE	DATE	DESCRIPTION
B	6/20/2023	90% DESIGN DRAWINGS
A	2/24/2023	ENGINEERING DESIGN REPORT SUBMITTAL

PROJECT: M2473.01.001
DESIGNED: K. KRIPPAEHNE-STEIN
DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

SHEET TITLE
VAPOR MITIGATION SYSTEM DETAILS I

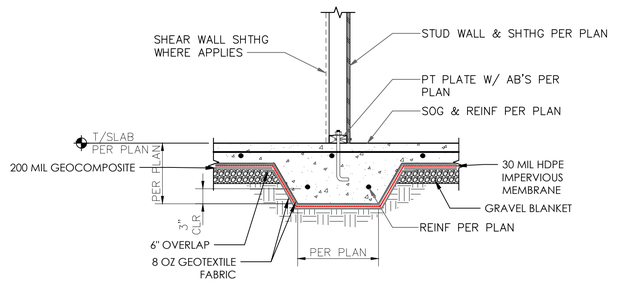
SHEET
C3.0

PLOTTED ON: 2023-06-20 3:38 PM
PLOTTED BY: Krysta Krippaehne-Stein
FILENAME: G:\PROJECTS\M2473.01 Shortstack - Belmont\PLANS\C3.0 VAPOR MITIGATION SYSTEM DETAILS I.dwg



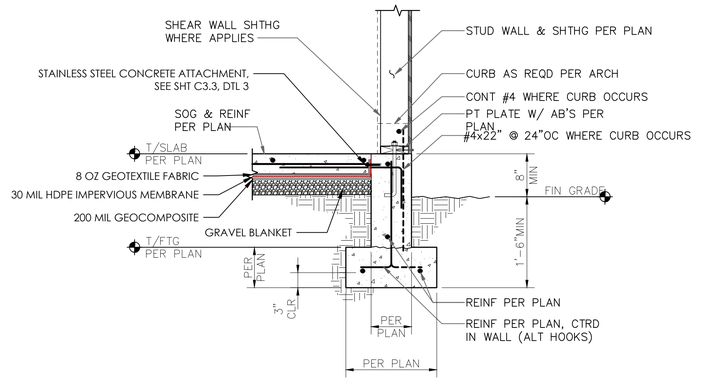
1 EXTERIOR THICKENED SLAB EDGE FOOTING AT STUD WALL

NTS



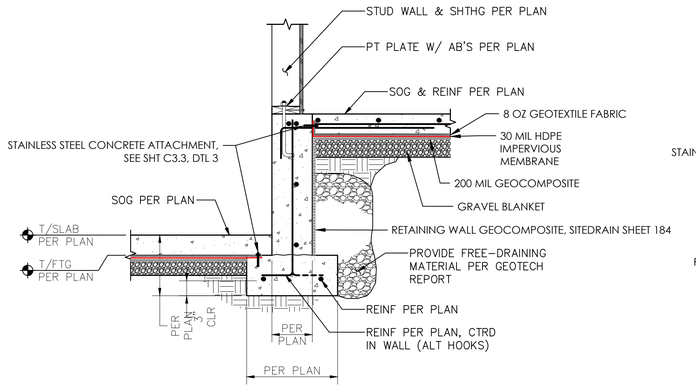
2 INTERIOR THICKENED SLAB FOOTING AT STUD WALL

NTS



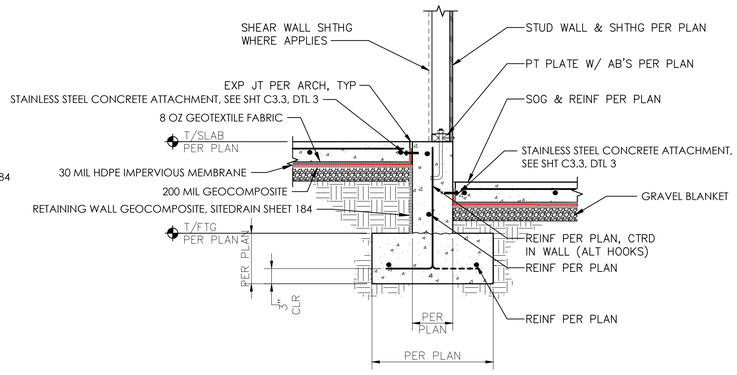
3 EXTERIOR FOOTING AND STEMWALL

NTS



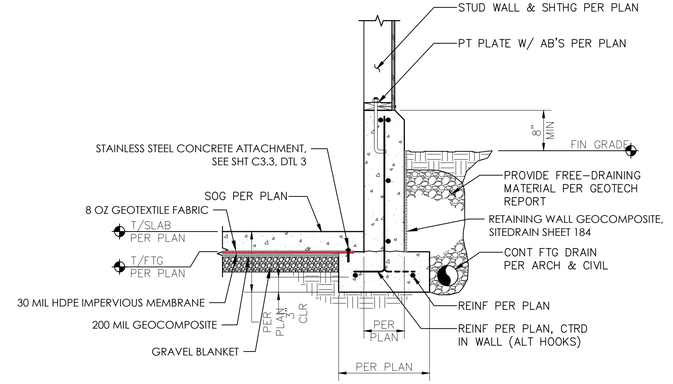
4 EXTERIOR STUD WALL CONCRETE RETAINING WALL AND FOOTING

NTS



5 INTERIOR STEMWALL AT STUD WALL

NTS



6 EXTERIOR STUD WALL CONCRETE RETAINING WALL AND FOOTING

NTS

FOUNDATION DETAILS PROVIDED BY DCI ENGINEERS

PRELIMINARY

MAUL FOSTER ALONGI
3140 NE BROADWAY STREET
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PHONE: 971.544.2139
www.maulfoster.com

REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
JAN. 11, 2005
CEM E. GOKCORA

EXPIRES: 6/30/2023
This digital seal certifies the signatory and document content.

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SHORTSTACK BELMONT LLC
PORTLAND, OREGON

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PROJECT: M2473.01.001
DESIGNED: K. KRIPPAEHNE-STEIN
DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

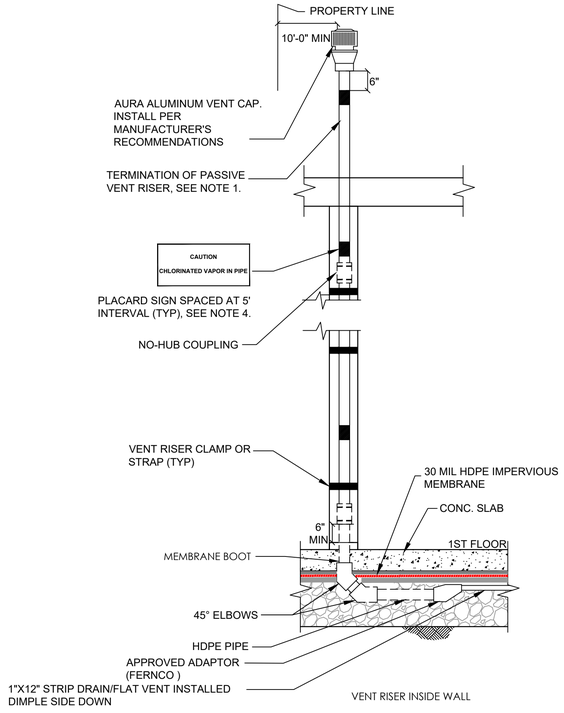
SHEET TITLE

VAPOR MITIGATION SYSTEM DETAILS II

SHEET

C3.1

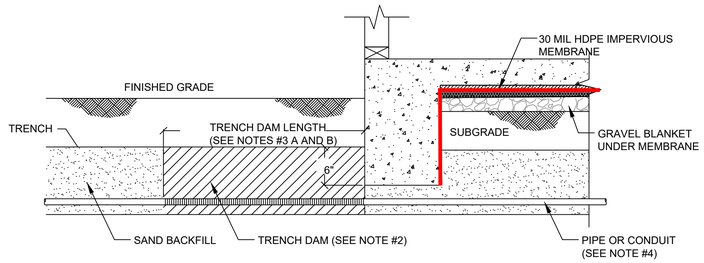
PLOTTED ON: 2023-06-20 3:39 PM
PLOTTED BY: Krysta Krippaehne-Stein
FILENAME: G:\PROJECTS\M2473.01 Shortstack - Belmont\PLANS\C3.0 VAPOR MITIGATION SYSTEM DETAILS.1.dwg



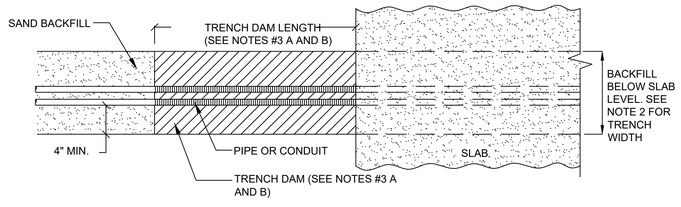
NOTES:

1. TERMINATION OF PASSIVE VENT RISER SHALL BE AS FOLLOWS:
   A. 10' MIN. AWAY FROM, AND AT LEAST 3' ABOVE ANY OPENABLE WINDOW, DOOR, OPENING OR AIR INTAKE, OR VENT SHAFT.
   B. 4' MIN. IN EVERY DIRECTION FROM ANY LOT LINE, ALLEY, AND STREET.
   C. EXTEND THROUGH THE VENT FLASHING 5' VERTICALLY ABOVE THE ROOF, AND 3' MIN. HORIZONTALLY FROM ANY PARAPET OR BUILDING WALL.
2. WRAP ALL PIPING WITH APPROVED MATERIAL THROUGH CONCRETE SLAB OR FLOOR.
3. THE PIPING OF THE VENTING SYSTEM SHALL BE TESTED WITH AIR IN ACCORDANCE WITH THE 2021 UNIFORM PLUMBING CODE.
4. PLACARD SIGN SHALL BE 3" HIGH X 4" WIDE, MADE OF PLASTIC WITH ADHESIVE BACKING, AND HAVE 1/4" HIGH BLACK LETTERS ON WHITE BACKGROUND.
5. VENT RISERS SHALL BE OF HDPE PIPE AND 2" DIAMETER.

1 VENT RISER
NTS



SECTION:

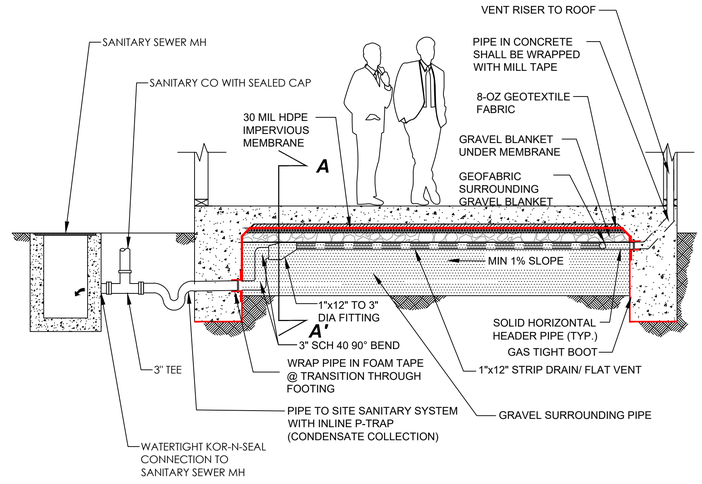


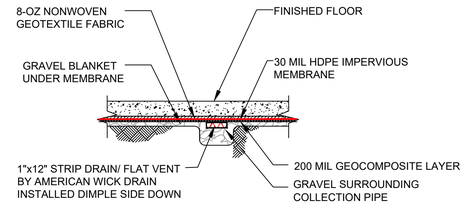
PLAN VIEW:

NOTES:

1. ALL TRENCH DAMS SHALL BE INSTALLED IN TRENCHES CONTAINING PIPING AND CONDUIT.
2. THE WIDTH OF A TRENCH DAM SHALL BE ONE HALF THE LENGTH.
3. TRENCH DAMS SHALL BE CONSTRUCTED OF ONE OF THE FOLLOWING:
   A. BENTONITE CEMENT SLURRY THREE FEET LONG: A MIXTURE OF 4% TYPE II CEMENT, AND 2% POWDERED BENTONITE.
   B. COMPACTED NATIVE SOILS BACKFILL FIVE FEET LONG: NATIVE SOILS SHALL BE COMPACTED AT LEAST 90% RELATIVE COMPACTION IN ACCORDANCE WITH ASTM D-1557 TESTING PROCEDURES.
   C. CONCRETE MIXES OTHER THAN BENTONITE CEMENT SLURRY MAY BE USED PROVIDED CONDUIT OR PIPING IS WRAPPED WITH HIGH DENSITY PVC FOAM TAPE, CLOSED CELLS, ADHESIVE BACKED, 1/4" THICK BY ½" WIDE SHALL BE APPLIED TO CLEAR SURFACE WITH ENDS BUTTED TOGETHER AT MOST VISIBLE LOCATIONS IN TRENCH DAM.
4. PIPING AND CONDUIT SHALL BE PROTECTED FROM CORROSION AND STRUCTURAL SETTLEMENT AS FOLLOWS:
   A. TAPE SHALL BE APPLIED ON CONDUIT AND PIPING ENCASED IN CEMENT SLURRY OR CONCRETE.
   B. TAPE SHALL BE PS-37-90, BLACK PLASTIC PVC OR PE PRESSURE-SENSITIVE CORROSION PREVENTIVE TAPE.
5. UTILITY PLAN IS CURRENTLY BEING DEVELOPED. SEE UTILITY PLAN FOR TRENCH DAM LOCATIONS.
6. UTILITIES THAT DO NOT GO UNDER OR THROUGH FOOTINGS DO NOT REQUIRE TRENCH DAMS.

2 TRENCH DAM
NTS





SECTION A - A'

NOTES:

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   B. TAPE SHALL BE PS-37-90, BLACK PLASTIC PVC OR PE PRESSURE-SENSITIVE CORROSION PREVENTIVE TAPE.
2. VAPOR COLLECTION PIPE SHALL BE SOLID PIPE BETWEEN VAPOR COLLECTION MAIN LINE AND SANITARY SEWER.
3. CONTRACTOR TO FIELD VERIFY LOW POINT IN VAPOR COLLECTION LINE TO ENSURE POSITIVE DRAINAGE TO SANITARY SEWER THROUGH THE CONDENSATE SUMP DRAIN.
4. CONDENSATE TO BE COLLECTED AT THE LOWEST POINT OF THE VAPOR COLLECTION SYSTEM AND CONNECTED TO SITE SANITARY SEWER.

3 COMBINATION DEWATERING AND VENT PIPE
NTS

PRELIMINARY

MAUL FOSTER ALONGI
3140 NE BROADWAY STREET
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PHONE: 971.544.2139
www.maulfoster.com

REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
JAN. 11, 2005
CEM E. GOKCORA
EXPIRES: 6/30/2023
This digital seal certifies the signatory and document content.

SHORTSTACK BELMONT VAPOR MITIGATION SYSTEM PLAN SET
SHORTSTACK BELMONT LLC
PORTLAND, OREGON

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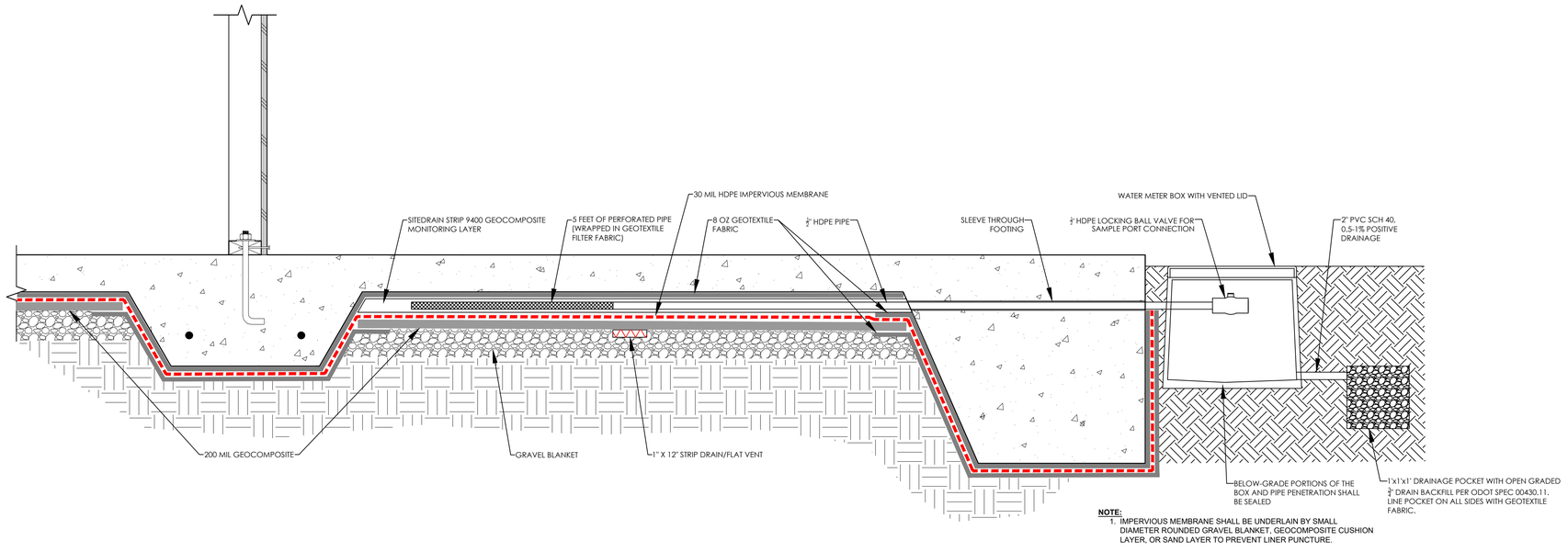
A	2/24/2023	ENGINEERING DESIGN REPORT SUBMITTAL

PROJECT: M2473.01.001
DESIGNED: K. KRIPPAEHNE-STEIN
DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

SHEET TITLE
VAPOR MITIGATION SYSTEM DETAILS III

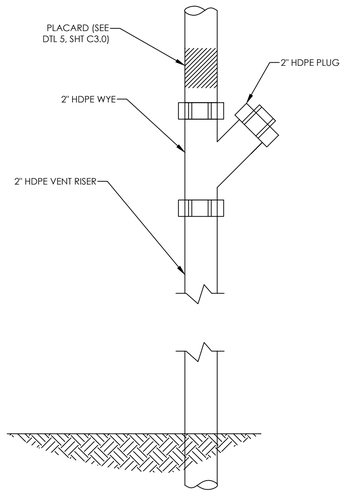
SHEET
C3.2

PLOTTED ON: 2023-06-20 3:43 PM PLOTTED BY: Krysta Krippaehne-Stein FILENAME: G:\PROJECTS\M2473.01 Shortstack - Belmont\PLANS\C3.0 VAPOR MITIGATION SYSTEM DETAILS I.dwg

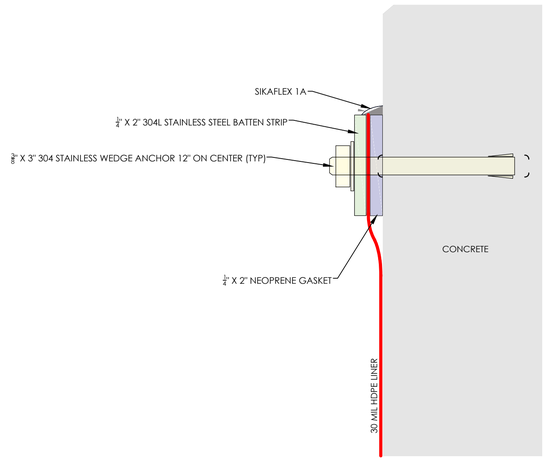


NOTE:
1. IMPERVIOUS MEMBRANE SHALL BE UNDERLAIN BY SMALL DIAMETER ROUNDED GRAVEL BLANKET, GEOCOMPOSITE CUSHION LAYER, OR SAND LAYER TO PREVENT LINER PUNCTURE.

1 SUB-SLAB MONITORING PORT AND MONITORING PROBE
NTS



2 VENT RISER MONITORING PORT
NTS



3 STAINLESS STEEL CONCRETE ATTACHMENT
NTS

FOUNDATION DETAILS PROVIDED BY DCI ENGINEERS

PRELIMINARY

MAUL FOSTER ALONGI
3140 NE BROADWAY STREET
PORTLAND, OR 97232
PHONE: 971.544.2139
www.maulfoster.com

REGISTERED PROFESSIONAL ENGINEER
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EXPIRES: 6/30/2023
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SHORTSTACK BELMONT VAPOR MITIGATION SYSTEM PLAN SET
SHORTSTACK BELMONT LLC
PORTLAND, OREGON

ISSUE	DATE	DESCRIPTION
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PROJECT: M2473.01.001
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DRAWN: K. KRIPPAEHNE-STEIN
CHECKED: C. GOKCORA/T. WALL
SCALE

SHEET TITLE
VAPOR MITIGATION SYSTEM DETAILS IV

SHEET
C3.3

PLOTTED ON: 2023-06-20 3:40 PM PLOTTED BY: Krysta Krippaehne-Stein FILENAME: G:\PROJECTS\M2473.01 Shortstack - Belmont\PLANS\C3.0 VAPOR MITIGATION SYSTEM DETAILS I.dwg

APPENDIX A

DRAFT CONSTRUCTION QUALITY ASSURANCE PLAN

DRAFT CONSTRUCTION QUALITY ASSURANCE PLAN

SHORTSTACK BELMONT
2721-2731 SE BELMONT STREET
PORTLAND, OREGON
ESCI SITE ID#5731

Prepared for
SHORTSTACK BELMONT LLC
June 21, 2023
Project No. M2473.01.001

Prepared by
Maul Foster & Alongi, Inc.
3140 NE Broadway Street, Portland, OR 97232

MAUL
FOSTER
ALONGI

DRAFT CONSTRUCTION QUALITY ASSURANCE PLAN

SHORTSTACK BELMONT
2721-2731 SE BELMONT STREET
PORTLAND, OREGON
ESCI SITE ID#5731

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

MAUL FOSTER & ALONGI, INC.

Krysta Krippaehne-Stein, EIT
Staff Engineer

Cem Gokcora, PE
Senior Engineer

CONTENTS

TABLES AND ILLUSTRATIONS

ACRONYMS AND ABBREVIATIONS

CES	Cascade Environmental Solutions
CQA	construction quality assurance
CQAP	construction quality assurance plan
DEQ	Oregon Department of Environmental Quality
HDPE	high-density polyethylene
MFA	Maul Foster & Alongi, Inc.
Owen Gabbert	Owen Gabbert LLC
psi	pound-force per square inch
QA	quality assurance
QC	quality control
RFI	Request for Information
Shortstack	Shortstack Belmont LLC
the Site	2721-2731 SE Belmont Street, Portland, Oregon

1 INTRODUCTION

This construction quality assurance plan (CQAP) was prepared on behalf of Shortstack Belmont LLC (Shortstack), to ensure that the remediation and redevelopment of the Shortstack Belmont site located at 2721-2731 SE Belmont Street, Portland, Oregon (the Site) fulfills the requirements of the Oregon Department of Environmental Quality (DEQ) and that the remedy meets or exceeds all performance standards, design criteria, and plans.

The proposed remediation activities will include the following:

- Installation of an impervious vapor barrier under the building slabs
- Installation of a passive vapor venting system under the vapor barrier consisting of flat vent pipe in a rock trench, connected to aboveground vent stacks
- Installation of vapor monitoring probes installed below building slab and above sub-slab vapor barrier
- Installation of geocomposite along a retaining wall
- Installation of trench dams to prevent migration of vapors through utility trenches

This CQAP summarizes minimum quality assurance (QA) and quality control (QC) requirements for the vapor collection and barrier system components, and materials established in the design report and design plans (which includes technical specifications). If alternative materials are used for construction, acceptable construction quality assurance (CQA) procedures must be implemented to meet the intent of this CQAP.

1.1 Construction Quality Assurance Plan Scope and Purpose

This CQAP describes the CQA necessary to ensure that proper construction techniques and procedures are used during construction of the remedial action activities for the Site. The CQAP contains the procedures for verifying that the materials used, and the installations of those materials, comply with the construction drawings, including the technical construction notes.

Construction requirements are established by the plans and are outlined in this document only as they pertain to QA. The criteria for acceptance will be as defined in the plans. This CQAP does not establish procedures for controlling or guiding the operations of the manufacturer of materials or the construction contractors, nor does it relieve them of their contractual responsibility to set up the necessary procedures and controls within their organizations to produce the quality of work called for in the plans. This CQAP is not intended to function as or replace the contractors' internal QA procedures.

2 RESPONSIBILITIES AND AUTHORITIES

This section provides the project team organizational structure, responsibilities, and lines of authority. Project activities will be performed within the framework of the organization and the functions presented in this section. The project team organizational structure is presented in the attached figure. Contact information for key project individuals is provided in the attached table.

2.1 Oregon Department of Environmental Quality

The DEQ administers the overall cleanup of the Site and is the lead agency for remedial actions completed by the owner. The DEQ will review and authorize the project design, as well as this CQAP. The DEQ may participate in preconstruction site walks, site visits during remedy implementation, and prefinal inspections. The DEQ will be consulted prior to any work changes to determine if additional review or approval is needed. See Section 3 for more information about project communications. The DEQ project manager will also review the final completion report for the project (see the attached table for contact information).

2.2 Owner

Shortstack is the owner of the Site as of April 28, 2023. Shortstack has contracted with the following organizations to complete the project, specifically relating to the vapor collection and barrier system installation:

- Maul Foster & Alongi, Inc. (MFA) as the design engineer and the CQA engineer for all components related to the vapor collection and barrier system construction and installation
- Cascade Environmental Solutions (CES) are the project environmental consultant and will be part of the CQA team, supporting MFA
- Owen Gabbert LLC (Owen Gabbert) as the general contractor
- Layfield Group as the vapor barrier system installer

2.3 Design Engineer and CQA Team

MFA is the design engineer and the CQA engineer for the project. MFA and CES will comprise the CQA team. MFA designed the vapor collection and barrier system and the CQA team will verify that construction is in compliance with the plans and specifications and the design intent.

As the design engineer, MFA is responsible for the design as well as design-related site engineering. Site engineering includes: (1) review and approval of product and construction submittals required by the specifications; (2) addressing technical issues related to construction; (3) providing interpretation

of the plans and specifications; and (4) completing design modifications and technical revisions as necessary.

The CQA team is responsible for certifying to the DEQ that the vapor collection and barrier system construction is in compliance with the plans and technical specifications and the design intent. Specific responsibilities of the CQA team include: (1) providing a professional engineer registered in the state of Oregon; (2) verifying that the construction QA procedures are implemented correctly; (3) coordinating with the contractor for CQA documentation; and (4) preparing the final completion report.

The CQA team, through their assigned CQA inspector(s), will provide limited construction observation (only for installation/construction of the remediation components) and will coordinate with the contractor for the implementation of the CQA program described in this CQAP. Activities identified in the construction notes on the plans as being completed by the design engineer will be completed or coordinated by MFA. The CQA team will keep the owner and the DEQ apprised of the status of the construction work.

Responsibilities of the CQA team related specifically to the remediation components of the construction include the following:

- Preconstruction Meeting: The CQA team will coordinate and attend the preconstruction meeting with the owner and the construction contractors.
- Weekly Progress Meetings during remediation activities: The CQA team will attend weekly coordination meetings with the owner and the construction contractors.
- Stakeholder Coordination: The CQA team will coordinate with other project stakeholders regarding periodic site visits, meetings, and reporting.
- Construction Observation and QA: Through the implementation of the CQA measures described in this plan, the CQA team will document that the contractor's work conforms to the construction documents. The CQA team will witness the contractors' QC program, including any field testing completed by the construction contractors. The CQA team will coordinate with the contractor and document that the contractor is implementing the QA testing and measurements specified in this plan and will verify that materials delivered to the job site are in accordance with construction documents before they are used.
- Submittals and Shop Drawing Review: As the design engineer, MFA will review submittals and shop drawings and provide approval or take other actions, as appropriate. MFA will evaluate consistency with construction documents. MFA will work with the construction contractors to track the submittal schedules and maintain records of the submittals.
- Requests for Information (RFIs) Responses: MFA will receive, track, and respond to all RFIs that are submitted by the construction contractors.
- Evaluation of Substitutions: MFA will evaluate contractor-requested substitutions.

- Change Orders and Work Change Directives: The CQA team will work with the owner and the construction contractors, as necessary, to evaluate and negotiate change order requests and to prepare work change directives to resolve issues that develop during construction.
- Field Notes: during each site visit, the CQA team will prepare field notes documenting observations and project status. The CQA inspectors will include the following minimum information in the daily notes: weather, on-site contractor/subcontractor personnel, equipment used, construction activities being performed, samples collected, field test results, and construction issues (if any).
- Monthly Progress Summary: The CQA team will prepare a summary e-mail describing the project progress on a monthly basis, highlighting significant field observations and communications. The CQA team will include the following minimum information in the monthly progress summary: list of work completed, sampling results, map indicating active areas of work and completed work, photos, issues encountered/resolutions, and list of upcoming activities.
- Photographic Documentation: The CQA team will photographically document the construction progress, project milestones, and key design components. The photographs will be logged and included in the completion report.
- Record Drawings: throughout construction, MFA will maintain a set of redline drawings to document project revisions. These redline drawings will be used for comparison to the contractor as-built drawings and will ultimately be used to prepare record drawings for the project. A final topographic and bathymetric survey will be performed for the Site when remedial work is complete. MFA will produce the record drawings required for submittal with the completion report.
- Evaluation of Payment Applications: The CQA team will review construction contractor applications for payment to evaluate whether they align with the construction progress.
- Inspections: The CQA team will coordinate and attend the prefinal and final inspections.
- Completion Report: As the design engineer, MFA will receive and review all closeout materials from the contractor and will prepare a completion report, including final record drawings.

MFA's project managers for this project are Ted Wall, PE, and Krysta Krippaehne-Stein. CES's project manager is Jennifer Levy. They will be the primary contacts for the owner and will provide overall project direction to the CQA team.

2.4 Construction Contractor Responsibilities

Owen Gabbert has been retained by the owner to perform construction and regular QC tasks required by the project plans. Owen Gabbert will assist the CQA team with documentation of the CQA protocol/testing.

In addition, Layfield Group, the vapor collection and barrier system installer, will be performing CQA activities as outlined in Section 4 and will report the results to the CQA team daily.

3 PROJECT COMMUNICATIONS AND REPORTING

This section describes the communication protocol and reporting activities for the project.

The CQA team will prepare weekly field notes that document observations and project status. The CQA team will file these notes during weekly progress meeting visits (limited to the remediation activities) so that they are available as a record of project activities. A summary of field activities and progress will be reported to the DEQ on a monthly basis while the remedy implementation is being conducted. The monthly summary will include information regarding work completed, progress map, photos, issues encountered/resolutions, and upcoming activities.

Beyond the weekly notes and monthly summaries, the CQA team will proactively communicate with the DEQ when major project milestones arise (e.g., completion of remedial activity) and at major decision points throughout the project. Contact information for key project individuals is provided in the attached table.

4 QUALITY ASSURANCE PROCEDURES

This section discusses the CQA aspects of the project. It identifies the construction activities that require monitoring and establishes the procedures for monitoring each activity. Performance standards and acceptance criteria have been established by MFA in the project plans. The performance standards and inspection activities are detailed in this section. CQA forms that will be used by the on-site CQA inspectors are included as Appendices A, B, and C. The relevant CQA personnel will complete these forms daily during critical operations, such as the deployment of geomembrane liner, for continuous documentation of materials and workmanship.

4.1 Construction Monitoring

Each unit of construction will be monitored and documented to verify compliance with the plans and specifications and to confirm that construction was executed correctly, using industry standard construction methods and the proper materials. MFA will perform monitoring related to preparation and installation of the sub-slab vapor collection and barrier system.

The CQA inspector will review materials delivered to the Site. Prior to liner installation, the CQA inspector will review the subgrade preparation and the construction of the sub-slab vent piping. The CQA inspector will verify that the subgrade is generally smooth, without protrusions that could damage the membrane.

The vapor collection and barrier system installer shall follow manufacturer's installation instructions for placement, seaming, penetration repair, and perimeter seal, and will implement the vendor-provided CQA protocol as summarized in Section 4.2 in coordination with the design engineer.

4.2 Vapor Collection and Vapor Barrier

4.2.1 Sub-Slab and Sub-Pavement Vapor Barrier Systems

Sub-slab and sub-pavement vapor barrier systems are comprised of a collector vent pipe in a collector gravel trench overlain by an impervious membrane with bottom and top cushion layers.

The vapor collection and barrier system installer will follow the CQA protocol outlined in the following section and will report the CQA notes and testing results to the design engineer daily.

4.2.1.1 Sub-Slab Vapor Collection System

The sub-slab vapor collector piping system is comprised of a 4-inch thick, clean gravel blanket, as identified on design drawings, surrounding a prefabricated strip drain/flat vent. Sub-slab vapor collection piping shall be a geocomposite strip drain composed of a dimpled polymetric perforated core fully wrapped in a non-woven geotextile (SiteDrain™ Strip 6400 or Vapor-Vent).

An inspection checklist for installed piping is provided in Appendix A. The design engineer will coordinate with the installer to document the installation compliance with the design and specifications.

4.2.1.1.1 Delivery, Storage, and Handling

A. Deliver materials to project site as specified by manufacturer labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for handling.

B. Store materials as specified by the manufacturer in a clean, dry protected location within the temperature range required by manufacturer. Protect stored materials from direct sunlight.

C. Remove and replace material that is damaged.

4.2.1.1.2 Subgrade Preparation

A. With installer present, examine building subgrades, areas, and conditions under which vapor vent system will be installed for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Verify building subgrade surface is free of protrusions, debris, and rock greater than 8 inches in diameter.

C. Verify building subgrade is prepared to the elevations and grades identified in the design drawings.

4.2.1.1.3 Sub-slab Vapor Collection Pipe Installation

A. Install sub-slab vent piping over substrate material where designated on drawings with the flat base of the core placed down and shall be overlapped in accordance with manufacturer's recommendations.

B. At areas where sub-slab vent piping intersects, cut and fold back fabric to expose the dimpled core. Arrange the strips so that the top strip interconnects into the bottom strip. Unfold fabric to cover the core, and use reinforcing tape, as approved by the manufacturer, to seal the connection to prevent sand or gravel from entering the core.

C. Place solid pipe over or through concrete surface and attach flat vent to 2-inch-diameter HDPE adapter (i.e., Vapor-Vent End Out) at both ends of the pipe before connecting the adapter to the pipe reducer.

D. Use flat vent to circular pipe adapter with the specified diameter piping as shown on Design Drawings.

4.2.1.1.4 Placement of Overlying and Adjacent Materials

A. All overlying and adjacent material shall be placed or installed using approved procedures and guidelines to prevent damage to the strip geocomposite.

B. Equipment shall not be directly driven over, and stakes or any other materials may not be driven through the strip geocomposite.

4.2.1.2 Sub-Slab Monitoring Ports and Probes

Verify monitoring probes are installed in general conformance with Detail 1 on Design Drawings C3.3. Also verify that monitoring ports are properly sealed and installed at the general locations shown on Design Drawing C2.0, and in general conformance with Detail 1 on Design Drawing C3.3.

4.2.1.3 Geocomposite (Bottom Cushion) Layer

A geocomposite comprised of 200-mil-thick geonet heat-laminated on both sides with a non-woven needle-punched geotextile (6 ounces per square yard) product is selected for the geomembrane cushion layer, to be placed over the sub-slab vent trench and immediately below the geomembrane.

4.2.1.3.1 Delivery, Storage, and Handling

A. Upon arrival on site, QA personnel will inventory all materials on site.

B. Roll numbers will be logged on the Inventory Check List (Appendix B).

C. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

D. Rolls of material shall be unloaded with equipment that will not damage the geonet or geocomposite.

E. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geocomposites.

F. Materials should be stored in a flat, dry, and well-drained area.

G. The surface shall be free of sharp rocks or other objects that could damage the materials.

4.2.1.3.2 Bottom Cushion Layer Deployment

A. Verify that the application surface is free of sharp rocks or other objects that could otherwise cause damage to the materials.

B. Geocomposites direct flow predominately in the machine direction (along the roll length) and thus should be installed in the intended direction of flow.

C. Verify that the circular side should be placed against the sub-slab vent layer.

D. In the presence of wind, the leading edge of the material shall be weighted with temporary ballasting, such as sandbags, until the final cover is placed.

E. Care shall be taken to assure that any underlying layers are not damaged during placement. Low ground pressure machines, such as ATVs, to facilitate deployment over the geosynthetic layers is allowed. Low ground pressure machines are machines with a ground pressure less than 8 pound-force per square inch (psi).

F. Care shall be taken to avoid entrapment of stones, mud, and other materials during placement operations.

G. The recommended geonet overlap in the machine direction is 3 to 5 inches. The recommended overlap in the transverse direction is 6 to 12 inches.

H. The geotextile on the bottom shall be overlapped and the geotextile on top shall be overlapped, or heat bonded.

4.2.1.3.3 Cover/Backfill Material Placement

A. Any cover or backfill material, such as soil, that is placed over or adjacent to any of the specified geosynthetics material shall be placed with care to assure the material is not damaged.

B. Care shall be taken to minimize any movement of the geocomposite and to assure that no tensile stress is induced in the material.

C. Cover or backfill soils (if any) deployed over or adjacent to the geocomposite should be free of all sharp objects, sharp rocks, and sticks.

4.2.1.4 Impervious Membrane Layer

The selected impervious membrane for this project is 30 mil white HDPE geomembrane. Below is the proposed CQA protocol:

4.2.1.4.1 Delivery, Storage, and Handling

A. Rolls of material shall be unloaded with equipment that will not damage the geomembrane.

B. Fabric-straps, spreader bars, stinger bars, or other approved equipment shall be used for handling rolls of geomembrane.

C. Upon arrival on site, QA personnel will inventory all materials on site.

D. Roll numbers will be logged on the Inventory Check List (Appendix C: Attachment A).

E. Any visible damage to roll materials should be noted on the roll and Inventory Check List.

4.2.1.4.2 Panel Placement

A. Each panel will be assigned a number (i.e., 1, 2, 3…). Agreement to a panel numbering system should be made at the pre-construction meeting. However, it is essential that the installer, the owner representative, and QA inspector agree.

B. Panel numbers shall be written in large block letters in the center of each deployed panel. The roll number, date of deployment, and length should be noted below the panel number. All notes should be made so that they are easily visible from a distance. On long panels it is beneficial to write information on both ends.

C. Panel numbers shall be logged on the Panel Placement Log (Appendix C: Attachment C) along with the roll number and other information necessary to complete the form.

D. If there is a partial roll left after deployment, it is important to write the last four digits of the roll number in several locations on the roll along with the estimated length for future identification.

E. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage.

F. Place temporary ballast, such as sandbags, on geomembrane that will not damage the geomembrane and to prevent wind uplift.

G. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking is not permitted on the geomembrane.

H. Do not allow heavy vehicular traffic directly on geomembrane. Rubber tired and tracked ATV's and equipment are acceptable if contact pressure is less than 8 psi.

   - Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
   - Prior to driving on any geomembrane layer, check for sharp edges, embedded rocks, or other foreign objects that may protrude in the tires and tracks.
   - The path driven on geomembranes shall be as straight as possible with no sharp turns, sudden stops, or quick starts.
   - Areas where driving occurs shall be continuously and thoroughly inspected throughout the deployment process by the contractor and the CQA inspector.

4.2.1.4.3 Trial Welds

A. Always perform trial welds in the same conditions that exist on the job. Run the trial welds on the ground, not the installed liner. Do not use a wind break unless you are using one on the job.

B. Seaming apparatus shall be allowed to warm up a minimum of 10 minutes before performing trial welds.

C. Each seaming apparatus along with a welding technician will pass a trial weld prior to use. Trial welds to be performed in the morning and afternoon, as a minimum, as well as whenever there is a power shutdown.

D. Fusion or wedge welds will always be performed or conducted on samples at least 6.0 feet long. Extrusion welds will be done on samples at least 3.0 feet long.

E. Operating temperatures should be monitored while welding. The welding technician should verify that the equipment is capable of maintaining temperature while welding.

F. Sampling Procedure:

- Cut five 1-inch-wide specimens from the trial weld sample. Specimens will always be cut using a 1-inch die cutter, so the peel values may be used for qualitative analysis.
- When cutting coupons from the trial weld samples, the inside and outside tracks on the coupon should be identified to assist in troubleshooting problems in case the weld fails. The outside track will be defined as the track, which would be peeled if pulling the overlap exposed in a typical installation, or the seam that is closest to the edge of the top sheet. The inside track is the seam closest to the edge of the bottom sheet.

G. Cutter:

- Only cut one sample at a time to avoid damaging the die cutter.
- Samples should be free of sand and grit prior to cutting sample.
- Inspect the die edge weekly for nicks, dents or signs of dullness. Dullness of the cutting edge may damage the units.
- Remove die when edge has been dulled and lightly reshape it with a medium hand file. When wear is excessive return it for a replacement die.
- When the cutting board becomes deeply scored and/or interferes with coupon cutting it should be replaced.
- To adjust the depth of the die cut into the cutting board, after replacing the cutting board or sharpening the die, 0.015-inch-washer shims can be added or removed between the cutting ram and the ram extension. Only add shims when cutting is difficult due to lack of depth of cut.

H. Trial Weld Testing:

- Allow coupons to cool prior to testing. Avoid separating the coupons while hot as failure of the sheet may be initiated and false readings indicated.

- In extreme heat the coupons may need to be cooled, using water or an insulated cooler prior to peel testing. Lab conditions specify 70 degrees (plus or minus 4 degrees) Fahrenheit. Coupon temperatures greater than 70 degrees may result in lowered strengths.
- Visually inspect the coupons for squeeze-out, footprint, pressure, and general appearance.
- Each of the five coupons will be tested in peel on the field tensiometer at a separation rate of 2 inches per minute. In addition to the peel tests, shear tests will be performed.

4.2.1.4.4 Pass/Fail Criteria

A. Criteria for passing trial welds will be as follows:
   - Seam must exhibit film tear bond. Trial welds should have no incursion into the weld.
   - Peel and shear values shall meet or exceed the values as listed in Appendix C: Attachment D, Table 1 for HDPE smooth or textured sheet (at 2 inches per minute).
   - Both tracks of fusion welded samples must pass for the trial weld to be considered acceptable. If any of the five coupons fail due to seam incursion (no film tear bond) or low strength values, the trial weld must be performed again.
   - The QA personnel will give approval to proceed with welding after observing and recording all trial welds.

B. All trial weld data will be logged on the Trial Weld Log (Appendix C: Attachment E).

C. When logging fusion welded peel values on the Trial Weld Log indicate the values. for the outside track first, followed by the inside track.

D. Speed and temperature settings will be recorded for each machine trial weld as appropriate.

4.2.1.4.5 Field Seaming

A. The seam number takes the identity of the panels on each side. The seam between panels 1 and 2 becomes seam 1/2.

B. Welding technicians will record their initials, machine number, date and time at the start of every seam and on the Seam Log (Appendix C: Attachment F). The technician should also periodically mark temperatures along the seam and at the end of the seam.

C. Approved processes for field seaming and repairing are fusion welding and extrusion welding. All welding equipment shall have accurate temperature monitoring devices installed and working to ensure proper measurement.

D. Fusion welding shall be used for seaming panels together and is not used for patching or detail work. The site manager shall verify that:
   - The equipment used is functioning properly.
   - All work is performed on clean surfaces and done in a professional manner. No seaming will be performed in adverse weather conditions.

E. Extrusion welding shall be used primarily for repairs, patching, and special detail fabricating and may be used for seaming. The site manager shall verify that:
    - Equipment used is functioning properly.
    - Welding personnel are purging the extrusion welders of heat degraded extrudate prior to actual use.
    - All work is performed on clean surfaces and done in a professional manner. No seaming will be performed in adverse weather conditions.

F. For seam preparation, the welding technician shall verify that:
    - Prior to seaming, the seaming area is free of moisture, dust, dirt, sand or debris of any nature.
    - The seam is overlapped properly for fusion welding.
    - The seam is overlapped or extended beyond damaged areas at least 4 inches when extrusion welding.
    - The seam is properly heat tacked and abraded prior to extrusion welding.
    - Seams are welded with fewest number of unmatched wrinkles or "fish mouths".

G. No seaming will be performed in ambient air temperatures or adverse weather conditions that would jeopardize the integrity of the liner installation.

4.2.1.4.6 Membrane Terminations

A. Stainless steel batten strips along with stainless steel anchor, moldable sealant, and polyurethane-based elastomeric sealant (i.e., SikaFlex 1A) shall be used for geomembrane horizontal and vertical terminations at the edge of concrete footings, as depicted in Details 3 through 6 on Design Drawing C3.1 and Detail 3 on Design Drawing C3.3. Terminations at the thickened slab edge shall be per Detail 1 on Design Drawing C3.1.

4.2.1.4.7 Non-Destructive Testing

A. All seams shall be non-destructively tested over their full length using an air pressure or vacuum test. The purpose of this test is to check the continuity of the seam.

B. For air pressure testing, the following procedures are applicable to those seams welded with a double seam fusion welder.
    - The equipment used shall consist of an air tank or pump capable of producing a minimum 35 psi and a sharp needle with a pressure gauge attached to insert into the air chamber.
    - Seal both ends of the seam by heating and squeezing them together. Insert the needle with the gauge into the air channel. Pressurize the air channel to 30 psi. Note time test starts and wait a minimum of 5 minutes to check. If pressure after five minutes has dropped less than 2 psi then the test is successful (Thickness of material may cause variance).
    - Cut opposite seam end and listen for pressure release to verify full seam has been tested.

- If the test fails, follow these procedures.
    - While channel is under pressure walk the length of the seam listening for a leak.
    - While channel is under pressure apply a soapy solution to the seam edge and look for bubbles formed by air escaping.
    - Re-test the seam in smaller increments until the leak is found.
- Once the leak is found using one of the procedures above, cut out the area and retest the portions of the seams between the leak areas per item B above. Continue this procedure until all sections of the seam pass the pressure test.
- Repair the leak with a patch and vacuum test.

C. For vacuum testing, the following procedures are applicable to those seams welded with an extrusion welder.

- The equipment used shall consist of a vacuum pumping device, a vacuum box and a foaming agent in solution.
- Wet a section with the foaming agent, place vacuum box over wetted area. Evacuate air from the vacuum box to a pressure suitable to affect a seal between the box and geomembrane. Observe the seam through the viewing window for the presence of soap bubbles emitting from the seam.
- If no bubbles are observed, move box to the next area for testing. If bubbles are observed, mark the area of the leak for repair per Section 4.2.1.4.9 and re-test per this section.
- All non-destructive tests will be noted in the Non-Destructive Logs (Appendix C - Attachments H-I).

4.2.1.4.8 Defects and Repairs

A. All seams and non-seam areas of the geomembrane lining system shall be examined for defects.

B. Identification of the defect should be made using the following procedures:

- For any defect in the seam or sheet that is an actual breach (hole) in the liner, installation personnel shall circle the defect and mark with the letter P alongside the circle. The letter P indicates a patch is required.
- For any defect that is not an actual hole, installation personnel shall circle the defect indicating that the repair method may be only an extruded bead and that a patch is not required.
- Each suspect area that has been identified as repair shall be repaired in accordance with Section 4.2.1.4.9 and in the non-destructively testing per Section 4.2.1.4.7. After all work is completed, the site manager will conduct a final walk-through to confirm all repairs have been completed and debris removed. Only after this final evaluation by the site manager, the owner, and the agent shall any material be placed over the installed liner.

4.2.1.4.9 Repair Procedures

A. Any portion of the geomembrane lining system exhibiting a defect that has been marked for repair may be repaired with any one or combination of the following procedures:

- Patching—used to repair holes, tears, undispersed raw materials in the sheet.
- Grind and Reweld—used to repair small sections of extrusion welded seams.
- Spot Welding—Used to repair small minor, localized flaws.
- Flap Welding—Used to extrusion weld the flap of a fusion weld in lieu of a full cap.
- Capping—Used to repair failed seams.

B. The following conditions shall apply to the above methods:

- Surfaces of the geomembrane which are to be repaired shall be prepared according to this section.
- All surfaces must be clean and dry at the time of the repair.
- All seaming equipment used in repairing procedures shall be qualified.
- All patches and caps shall extend at least 4 inches beyond the edge of the defect, and all patches must have rounded corners.
- All cut out holes in liner must have rounded corners of 3-inch minimum radius.

C. Patches should be labeled in numerical order, i.e., RP-1, RP-2, etc... This should carry through any layer, and do not start with the number 1 again.

4.2.1.4.10 As-Built Drawings

A. As-built drawings will be provided at the completion of the project.

B. As-built drawings will include geomembrane panels and panel numbers with the last four digits of the roll number.

C. Panel numbers and the full roll numbers will correspond with the Panel Placement Log (Appendix C: Attachment C).

D. All destructive testing and repair locations will be placed on the as-built drawings.

4.2.1.5 Top Cushion Layer for Impervious Membrane

A non-woven needle punched geotextile weighing 8-ounce per square yard is selected for the top geomembrane cushion layer between impervious geomembrane and bottom of the slab. The following are the CQA procedures to be followed:

4.2.1.5.1 Delivery, Storage and Handling

A. Upon arrival on site, QA personnel will inventory all materials on-site.

B. Verify geotextile rolls are delivered with opaque protective coverings.

C. Verify geotextile rolls are unloaded, handled, and transported with nylon or other cloth straps that do not damage the geotextile rolls or the protective coverings.

D. Verify geotextile rolls are stored and protected from damage and damaged protective coverings are replaced.

E. Verify that manufacturer's quality control testing reports for geotextiles delivered to the site.

4.2.1.5.2 Geotextile Installation

A. Verify underlying geomembrane installation is complete and in accordance with Section 4.2.1.3.

B. Verify geotextiles are installed with sufficient tension to prevent excessive overlapping, insufficient overlapping, wrinkles, and folds.

C. Verify geotextile panels are overlapped with sufficient material to create a flat or prayer fold for sewing operations.

D. Verify underlying geomembrane installations are not damaged by installation equipment or methods and that damaged geomembrane is completely repaired.

E. Verify rocks, excessive dust, excessive moisture or other materials that could damage, hamper sewing operations, or clog the geotextile are not entrapped under the geotextile or within the overlap.

F. Verify that all geotextile filter seams are sewn.

G. Verify geotextiles are adequately ballasted during placement operations and that ballast is left in place until geotextiles are covered with the overlying material.

H. Verify in-place geotextiles are not left exposed and uncovered beyond the time limitations recommended by the manufacturer.

4.2.1.5.3 Repair

A. Verify damaged geotextiles are removed entirely or repaired in accordance with the following guidelines:

- Repair (patching) material is the same material as the damaged geotextile.
- Patches extend a minimum of 12 inches in all directions beyond the damaged area. The machine direction of the patches aligns with the machine direction of the damaged geotextile.
- Hand or machine sew patches in place with approved polymeric thread.

4.2.1.5.4 Sewing

A. Verify all geotextile filter and geotextile cushion seams are sewn.
B. Verify overlaps are cleaned of soil materials that could adversely affect sewing operations.
C. Verify flat or prayer fold is made within the overlap.

4.2.1.6 Work over Top Cushion Layer

A. Verify visually that the entirety of the deployed impervious membrane (white) is covered with top cushion layer (black).

B. Inspect any visible surface damage to the cushion layer and/or impervious membrane to ensure that there are no penetrations of the membrane.

C. Verify that care is taken to assure that any underlying layers are not damaged during work above the top cushion layer.

D. If there are any rebar welding, grinding, or heat generating work to occur, the Contractor shall use wooden panels (or equal) at the active work areas for underlying layer protection. The area of the wooden panel shield shall be inspected after welding or grinding activities are completed with particular attention to the perimeter to verify that sparks/burrs have not damaged the membrane.

E. Prior to slab pour, verify that the underlying layers are intact, or repair any damaged area per relevant repair section of this report.

4.3 Retaining Wall Geocomposite

Geocomposite material is proposed to be installed along the vertical face of site retaining wall to provide venting of any vapor (to atmosphere) that may be collected along the retaining wall as shown on Detail 6 on Design Drawings C3.1 and manufacturer's recommendations.

4.4 Utilities

The design engineer will verify (and confirm compliance with the design drawings) the construction of trench dams for all utilities that will be extended to the building crossing the property line, as shown on Detail 2 on Design Drawing C3.2, and the relevant site-civil utility plan.

5 FIELD CHANGES

All design and field change requests from the construction contractors must be made to MFA in writing in the form of an RFI. Change requests by MFA will be reviewed with the owner before they are issued to the construction contractors. MFA will review changes to ensure that they conform to the performance standards and the design intent, are consistent with cleanup objectives, and are protective of human health and the environment. If the change request is approved, MFA will provide a written change order to the construction contractors.

5.1 Changes Authorized by Owner

Upon review of construction contractor-submitted RFIs or at any time necessary, the owner may use a change order consistent with construction standards to authorize changes in the work.

5.2 Problem Identification and Corrective Measures

MFA will work closely with the owner and the contractor's superintendent to address suspected deviations from the design as they occur, in order to avoid having to note construction problems. A problem is defined as material or workmanship that does not meet the requirements of the plans for the project, or as any obvious defect in material or workmanship. Upon identification of a problem, MFA will note the following information in the daily field notes, as well as include pertinent information on the working as-built marked drawings with as much detail as possible:

- A location and applicable area or volume of the problem
- Description of the problem with sufficient detail and supporting sketches or photographic information
- When and by whom the problem was found, with reference to applicable inspections or a weekly summary report
- Corrective measure(s) taken by the construction contractors
- Entity and person approving any corrective measure(s)

5.3 Problem or Work Deficiency Meetings

A special meeting will be held when a problem or deficiency is present or is likely to occur. At a minimum, the design engineer, the owner, the applicable construction contractor(s), and applicable subcontractors shall attend the meeting. Others may also attend at the request of MFA or the owner. The purpose of the meeting is to resolve the problem as expediently as possible by:

- Defining and discussing the problem or deficiency
- Reviewing alternative solutions
- Implementing an action plan

The meeting will be documented by MFA, and within three days of the meeting, minutes will be distributed to the owner, the applicable construction contractor(s), and other appropriate parties.

6 QUALITY ASSURANCE AND QUALITY CONTROL DOCUMENTATION

During construction, the CQA team will be responsible for compiling and organizing all CQA documentation. This includes a copy of the project construction drawings, technical specifications (listed in the construction notes), this CQAP, submittals, plans, and the installer's CQA test results.

Duplicate digital records will be made on a daily basis to avoid the loss of valuable information that would occur if the originals were destroyed.

6.1 Submittals

The submittal process is described in detail in the Submittal Procedures of the construction notes. The contractor's QC reports, weekly status reports, record data, final field report, and all other submittal items will be submitted to MFA's on-site CQA inspectors. Submittals are classified as:

- SD-01: Preconstruction Submittal
- SD-02: Construction Submittal
- SD-03: Post-construction Submittal

MFA will review submittals from the construction contractors for compliance with the plans. Submittal review codes will be used to indicate approval, revision requirements, and rejection. The code status will be tracked by MFA on the project submittal tracking form. MFA will coordinate communication of code status with the owner and the applicable contractor. The coding will be as follows:

- A—Reviewed No Exceptions
- B—Reviewed Exceptions Noted
- C—Revise and Resubmit
- D—Rejected

6.2 Inspections

Critical components of the work will be inspected by the on-site CQA inspectors before the construction contractors proceed. The results of these inspections will be communicated to the DEQ in the monthly updates discussed in Section 3 and in the project completion report.

6.2.1 Inspection of Materials

All materials, equipment, and supplies that arrive at the Site will be visually inspected by the CQA inspectors to ensure that the products are as ordered or as specified, and any deviations will be relayed to the applicable construction contractor and the owner immediately. As materials are received, they will be documented in the daily field notes and checked against approved material submittals. This documentation will be included with other inspection documentation for the purposes of completing the final completion report.

6.3 Inspection and Testing Records

All observations, results of field tests, and results of laboratory tests performed on or off site will be recorded. Recorded observations may be in the form of notes, charts, sketches, photographs, or any

combination thereof. As a minimum, the inspection documentation will include the following information:

- Description or title of the inspection activity, with the date on which the activity was inspected
- Location of the inspection activity or location from which the sample was obtained
- Type of inspection activity and procedure used
- Recorded observation or test data
- Results of the inspection activity (e.g., pass/fail); comparison with specification requirements
- Personnel involved in the inspection besides the individual preparing the data sheet
- Signature of the CQA inspectors, accompanied by the date

In addition to construction-contractor-supplied documentation, the CQA team will generate weekly field notes, monthly reports to the DEQ, and a remedial action completion report, as described in the next section.

6.4 Final Reporting

The owner anticipates providing a completion report to the DEQ within 90 days of demobilization of equipment from the Site. In the report, the MFA project manager and the engineer of record registered in the state of Oregon will state that the project has been constructed consistent with the design and plans, as modified (if applicable), and that the remedial action is complete consistent with the *Engineering Design Report*.[1] The completion report will summarize the activities of the project and document all aspects of the QA program. At a minimum, the following information will be contained in the report:

- Copies of all QA/QC documentation
- A narrative describing the project's construction
- A set of final as-built drawings for the project
- A description of all construction issues that arose and how they were resolved
- A description of any change orders
- A description of any changes from the plans
- A statement that the project has been constructed in substantial compliance with the design, plans, and related documents

[1] MFA. 2023. *Engineering Design Report, Shortstack Belmont, 2721-2731 SE Belmont Street, Portland, Oregon, ESCI Site ID#5731.* Maul Foster & Alongi, Inc., Portland, OR. June 21.

LIMITATIONS

The services undertaken in completing this plan 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 plan is solely for the use and information of our client unless otherwise noted. Any reliance on this plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this plan 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 plan.

TABLE

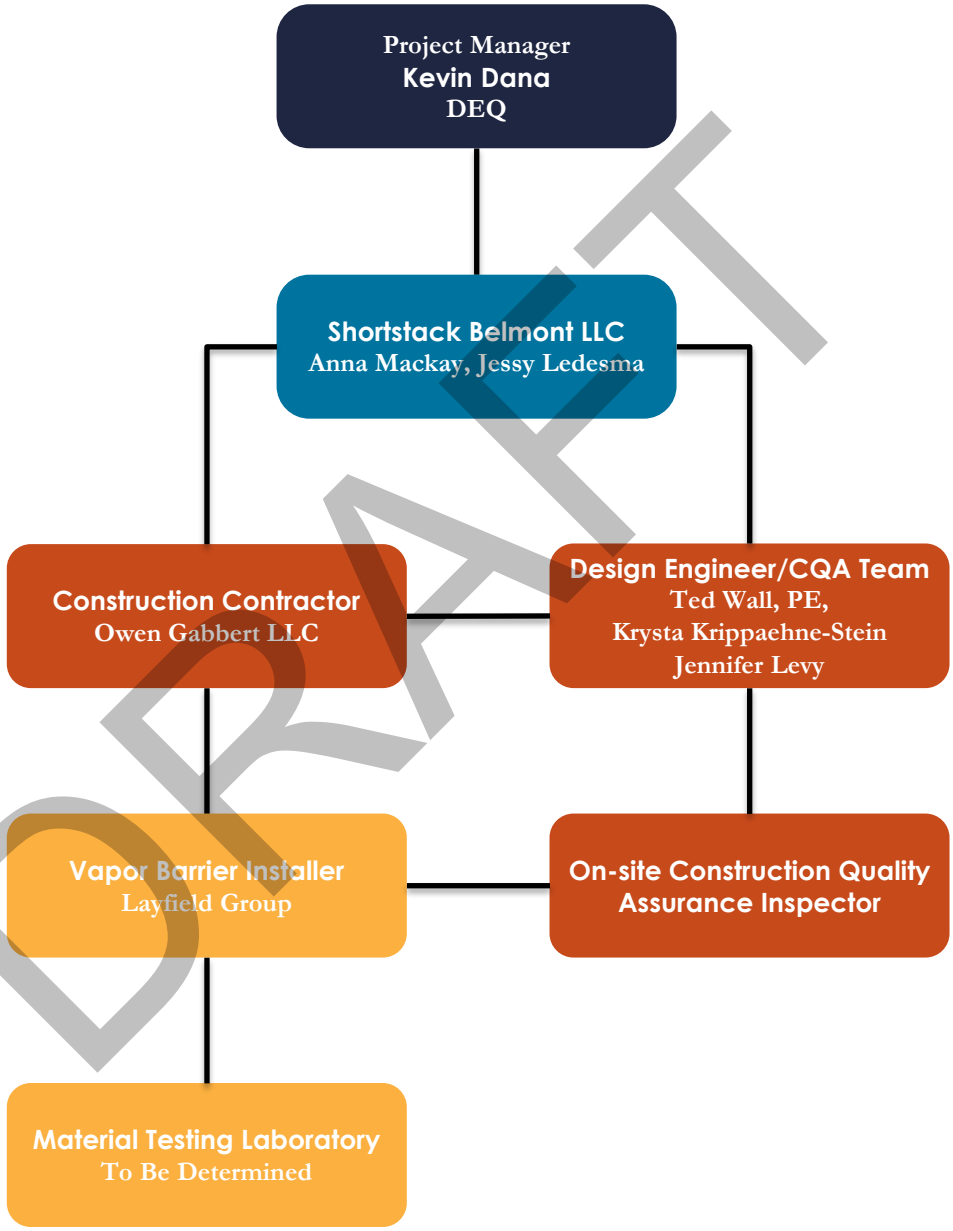
Table
Contact List
Shortstack Belmont Remediation Project
Shortstack Belmont LLC
Portland, Oregon

Contact Name	Title	Company	E-mail	Telephone	Cell Phone
Anna Mackay	Owner's Representative	Shortstack Belmont LLC	anna@sister-city.com	540.846.4299	N/A
Jessy Ledesma	Owner's Representative	Shortstack Belmont LLC	jessy@homework-dev.com	360.927.7488	N/A
Kevin Dana	Project Manager	DEQ	kevin.dana@deq.oregon.gov	503.229.5369	N/A
Brian Purdy	Construction Contractor	Owen Gabbert LLC	brian@cutwaterpdx.com	971.940.3356	N/A
Ted Wall	Project Manager	MFA	twall@maulfoster.com	503.501.5210	503.939.4849
Krysta Krippaehne-Stein	Project Manager	MFA	kstein@maulfoster.com	971.713.3573	503.828.8961
Jennifer Levy	Project Manager	CES	jlevy@cascade-environmental.com	503.805.4846	N/A
TBD	CQA Inspector	TBD	TBD	TBD	TBD
TBD	Vapor Barrier Installer	Layfield Group	TBD	TBD	TBD

NOTES:
CES = Cascade Environmental Solutions.
CQA = construction quality assurance.
DEQ = Oregon Department of Environmental Quality.
MFA = Maul Foster & Alongi, Inc.
N/A = not applicable.
TBD = to be determined.

FIGURE

Figure
SHORTSTACK BELMONT LLC
Shortstack Belmont Remediation Project
Organization Chart



APPENDIX A

VAPOR COLLECTION PIPING INSTALLATION CQA FORM

VAPOR COLLECTION SYSTEM INSPECTION

Project Name:	Shortstack Belmont
Project Number:	M2473.01.001
Date:	
Weather:	
MFA Inspector:	
Signature:	

Note that this inspection does not include aboveground gas detection and/or monitoring infrastructure. High points and low points are to be verified through use of a surveyor's level or a GIS grade checking receiver, or visually verified. Provide note(s) if any of the answers below are "No."

Building Vapor Collection Pipe System

	Yes	No	NA	Note #
• Is the pipe free of apparent defects, dirt, and debris?	☐	☐	☐	_____
• Are there any apparent undulations in the pipe that could trap gas and prevent migration to the risers?	☐	☐	☐	_____
• Is the pipe a flat vent 1"x12" with properly installed fittings at riser locations?	☐	☐	☐	_____
• Does the pipe appear to be properly joined at all connections and fittings?	☐	☐	☐	_____
• Is there maximum 12.5' spacing between walls and pipes?	☐	☐	☐	_____
• Is there maximum 25' spacing between pipes?	☐	☐	☐	_____
• Are the plan-view layout and location of the pipes in general accordance with C2.0?	☐	☐	☐	_____
• Is the pipe installed in general accordance with the detail on sheets C3.0 through C3.3?	☐	☐	☐	_____

• Are the vapor collection vent risers in general accordance with the Detail 1 on sheet C3.2 and Detail 2 on sheet C3.3?	☐	☐	☐	_____
• Are the monitoring ports properly sealed, installed at the general locations shown on sheet C2.0 and in general accordance with Detail 1 on sheet C3.3?	☐	☐	☐	_____
• Are the pipe penetrations through grade beams and footings installed in general accordance with Detail 2 on sheet C3.0?	☐	☐	☐	_____

Notes:

APPENDIX B

GEOCOMPOSITE INVENTORY CHECKLIST

Inventory Check List

Project:_____ Site Manager: _____ Date:

Project # _____ QA Technician: _____ Page: _____ of ____

Material	Roll #	Used	Material	Roll #	Used	Material	Roll #	Used	Material	Roll #	Used

Appendix B: Certificate of Acceptance

Job.: _____

Project: _____
Client: _____
Bill To: _____
_____
_____

Job Description: _____
% Complete of Total Job: _____

Material	Estimated Square Feet	Final Quantity/Description

I, the undersigned, duly represntative of:
Do hereby take over and accept the work described above from the date hereof and confirm to the best of my knwledge the work has been completed in accordance with specifications and the terms and conditions of the contract.

Name	Signature	Title	Date

Certificate accepted by Environmental Representative.

Name	Signature	Title	Date

APPENDIX C

GEOMEMBRANE CQA FORMS

Inventory Check List

Project:_____ Site Manager: _____ Date:

Project # _____ QA Technician: _____ Page: _____ of ____

Material	Roll #	Used	Material	Roll #	Used	Material	Roll #	Used	Material	Roll #	Used

Subgrade Surface Acceptance

Date: _____

Project: _____ Site Manager:_____

Project #: _____

Location:_____ Partial: _____

Final: _____

This document only applies to the acceptability of surface conditions for installation of geosynthetic products. ___ does not accept responsibility
for compaction, elevation or moisture content, nor for the surface maintenance during deployment. Structural integrity of the subgrade and maintenance of these conditions are the responsibility of the owner or earthwork contractor.

_____

_____

_____

_____

_____

For _____ : For Owner / Contractor:

_____ _____

_____ _____

Acceptance Number:_____ Area Accepted: _____ s.f Total Area Accepted to date: _____ s.f.

ATTACHMENT C

Panel Placement Log

Project Name: _____
Location: _____ Site Supervisor: _____
Job Number: _____ Type of Materials: _____
Q.A. Tech.: _____ Sheet Thickness: _____

Panel Number	Roll Number	Deployment Date	Width (Feet)	Length (Feet)	Squar Feet	Squar Feet (Cumulative)	A/T 1	A/T 2

ATTACHMENT D

TABLE 1. HDPE Seam Strength Properties

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	81	65	52
60	121	98	78
80	162	130	104
100	203	162	130

TABLE 1. LLDPE Seam Strength Properties

Material (Mil)	Shear Strength (PPI)	Fusion Peel (PPI)	Extrusion Peel (PPI)
40	60	50	48
60	90	75	72
80	120	100	96
100	150	125	120

Trial Weld Log

Project Name: _____
Location: _____
Job Number: _____
Q.A.: _____

Site Supervisor: _____
Type of Material: _____
Sheet Thickness: _____

Fusion (ppi) Extrusion (ppi)
Min. Peel _____ Min. Peel_____
Min. Sheer _____ Min. Sheer_____

Trial No.	Date of Trial	Time of Trial	Technicians ID Number	Ambient Temp.	Welder Type	Wedge Mass	Speed Preheat	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Pass Fail

ATTACHMENT F

Seam Log

Project Name: _____
Location: _____ Site Supervisor: _____
Job Number: _____ Type of Materials: _____
Q.A. Tech.: _____ Sheet Thickness: _____

Seam Number	Time of Weld	Date of Weld	Type of Weld	Length of Seam	Machine Num-ber	Technician ID Number

ATTACHMENT G

Destructive Test Log

Project Name: ______________________________

Location: ________________________________

Job Number: ______________________________

Q.A.: ____________________________________

Site Supervisor: ____________________

Type of Material: ____________________

Sheet Thickness: ____________________

Fusion (ppi) Extrusion (ppi)

Min. Peel _____ Min. Peel_____

Min. Sheer _____ Min. Sheer_____

Sample Number	Date Welded	Seam Number	Technicians ID Number	Machine Type & No.	Location	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Peel ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Shear ppi	Pass Fail

ATTACHMENT H

Repair Log - Vacuum Test

Project Name: _____
Location: _____ Site Supervisor: _____
Job Number: _____ Type of Materials: _____
Q.A. Tech.: _____ Sheet Thickness: _____

Repair Number	Weld Date	Machine Number	Tech ID	Location	Test Date	Tech ID	Pass/Fail

ATTACHMENT I

Non-Destructive Log - Air Test

Project Name: _____
Location: _____ Site Supervisor: _____
Job Number: _____ Type of Materials: _____
Q.A. Tech.: _____ Sheet Thickness: _____

Seam Number	Test Date	Technician ID Number	Air Pressure Test		Test Result (P or F)	Location
			psi start	psi finish		

APPENDIX B

PRODUCT SPECIFICATION SHEETS

Cushion above HDPE liner

TENCATE GEOSYNTHETICS
Americas

Mirafi® PT08 (PT800E)

Mirafi® PT08 is a 8 oz. nominal weight needlepunched nonwoven cushion geotextile composed of polymeric fibers, which are formed into a stable network such that the fibers retain their relative position. Mirafi® PT08 is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

TenCate Geosynthetics Americas Laboratories is accredited by Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP).

Mechanical Properties	Test Method	Unit	Typical Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D4632	lbs (N)	135 (601)	135 (601)
Grab Tensile Elongation	ASTM D4632	%	75	90
Trapezoid Tear Strength	ASTM D4533	lbs (N)	60 (267)	65 (289)
Puncture Strength	ASTM D4833	lbs (N)	65 (289)	
Permittivity	ASTM D4491	sec^{-1}	2.4	
Flow Rate	ASTM D4491	gal/min/ft^2 (l/min/m^2)	180 (7333)	

Physical Properties	Unit	Roll Size
Roll Dimensions (width x length)	ft (m)	15 x 300 (4.57 x 91.4)
Roll Area	yd^2 (m^2)	500 (418)

365 South Holland Drive
Pendergrass, GA 30567

Tel 706 693 2226
Tel 888 795 0808

Fax 706 693 4400
www.tencate.com

FGS000810
ETQR3

GAI-LAP-25-97

Cushion below HDPE liner

PRODUCT DATA SHEET

GSE FabriNet 200 mil Geocomposite

GSE FabriNet geocomposite consists of a 200 mil thick GSE HyperNet geonet heat-laminated on one or both sides with a GSE nonwoven needle-punched geotextile. The geotextile is available in mass per unit area range of 6 oz/yd² to 16 oz/yd². The geocomposite is designed and formulated to perform drainage function under a range of anticipated site loads, gradients and boundary conditions.

AT THE CORE:

A 200 mil thick HyperNet geonet heat-laminated on one or both sides with a nonwoven needlepunched geotextile.

Product Specifications

Tested Property	Test Method	Frequency	Minimum Average Roll Value[1]		
Geocomposite			6 oz/yd²	8 oz/yd²	10 oz/yd²
Transmissivity[2], gal/min/ft, (m²/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft²	 0.5 (1x10⁻⁴) 4.8 (1x10⁻³)	 0.5 (1x10⁻⁴) 4.8 (1x10⁻³)	 0.4 (9x10⁻⁵) 4.3 (9x10⁻⁴)
Ply Adhesion, lb/in	ASTM D 7005	1/50,000 ft²	1.0	1.0	1.0
Geonet Core[1,3] – GSE HyperNet					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft²	200	200	200
Transmissivity[2], gal/min/ft (m²/sec)	ASTM D 4716		9.6 (2 x 10⁻³)	9.6 (2 x 10⁻³)	9.6 (2 x 10⁻³)
Density, g/cm³	ASTM D 1505	1/50,000 ft²	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 7179	1/50,000 ft²	45	45	45
Carbon Black Content, %	ASTM D 4218	1/50,000 ft²	2.0	2.0	2.0
Geotextile[1,3]					
Mass per Unit Area, oz/yd²	ASTM D 5261	1/90,000 ft²	6	8	10
Grab Tensile Strength, lb	ASTM D 4632	1/90,000 ft²	160	220	260
Grab Elongation	ASTM D 4632	1/90,000 ft²	50%	50%	50%
CBR Puncture Strength, lb	ASTM D 6241	1/540,000 ft²	435	575	725
Trapezoidal Tear Strength, lb	ASTM D 4533	1/90,000 ft²	65	90	100
AOS, US sieve[1], (mm)	ASTM D 4751	1/540,000 ft²	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec⁻¹	ASTM D 4491	1/540,000 ft²	1.5	1.3	1.0
Water Flow Rate, gpm/ft²	ASTM D 4491	1/540,000 ft²	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS[4]					
Roll Width, ft			14.75	14.75	14.75
Roll Length, ft	Double-Sided Composite Single-Sided Composite		270 300	260 300	230 290
Roll Area, ft²	Double-Sided Composite Single-Sided Composite		3,982 4,425	3,835 4,425	3,392 4,277

NOTES:

- [1] All geotextile properties are minimum average roll values except AOS which is maximum average roll value and UV resistance is typical value. Geonet core thickness is nominal value.
- [2] Gradient of 0.1, normal load of 10,000 psf, water at 70˚F between steel plates for 15 minutes. Contact GSE for performance transmissivity value for use in design.
- [3] Component properties prior to lamination.
- [4] Roll widths and lengths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

DURABILITY RUNS DEEP

For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

1" x 12" Flat Vent Pipe

SITEDRAIN™ STRIP 6400

PREFABRICATED STRIP DRAIN / FLAT VENT PIPE

AWD
AMERICAN WICK DRAIN

PRODUCT OVERVIEW

SITEDRAIN Strip 6400 geocomposite strip drain products are composed of a dimpled polymeric perforated core fully wrapped in a nonwoven geotextile. The geotextile allows water to pass through while retaining backfill materials. The perforated core allows water collection from all sides and provides a continuous flow path to designated drainage exits.

SITEDRAIN Strip 6400 products provide a value engineered alternative to perforated pipe and aggregate subsurface drainage systems requiring moderate strength, high flow capacity, and a geotextile meeting AASHTO M288 Class 3 subsurface drainage requirements.

PROPERTY [1]	TEST METHOD	UNIT OF MEASURE	Typical Value	MARV
GEOTEXTILE				
Material [2]			PP, NPNW	PP, NPNW
Survivability	AASHTO M288	Class	3	3
Grab Tensile Strength	ASTM D4632	lbs	135	120
		N	601	534
Grab Elongation	ASTM D4632	%	60	50
CBR Puncture	ASTM D6241	lbs	365	340
		N	1,624	1,512
Trapezoidal Tear	ASTM D4533	lbs	60	50
		N	267	222
UV Resistance	ASTM D4355	% / 500 Hrs	70	70
Apparent Opening Size (AOS) [3]	ASTM D4751	sieve	70	70
		mm	0.212	0.212
Permittivity	ASTM D4491	sec^{-1}	2.4	1.7
Water Flow Rate	ASTM D4491	gpm / ft^2	175	140
		Lpm / m^2	7,130	5,704
CORE				
Compressive Strength	ASTM D6364 ASTM D1621	psf	6,000	-
		kPa	287	-
Thickness	ASTM D5199	in	1.0	-
		mm	25.4	-
In-Plane Flow Rate [4]	ASTM D4716	gpm/ft	21	-
		Lpm/m	261	-

MODEL	WIDTH	ROLL LENGTH	ROLL WEIGHT	ITEM CODE
6406	6"	150'	23 lbs	10400
6412	12"	150'	44 lbs	10410
6412	12"	500'	150 lbs	11340
6418	18"	150'	69 lbs	10420
6418	18"	500'	230 lbs	11350
6424	24"	150'	87 lbs	10430
6424	24"	500'	290 lbs	11170
6436	36"	100'	87 lbs	10440

[1] Unless otherwise noted, all physical and performance properties listed are Typical Value or Minimum Average Roll Value (MARV) as defined in ASTM D4439.
[2] PP = Polypropylene; NPNW = Needle-Punched Nonwoven; WM = Woven Monofilament; SBNW = Spunbonded Nonwoven
[3] Values for AOS represent Maximum Average Roll Value (MaxARV).
[4] In-plane flow rate measured at 3,600 psf (172 kPa) compressive load and a hydraulic gradient of 0.1.

American Wick Drain • 1209 Airport Road, Monroe, NC 28110 USA • TF: +1.800.242.9425 • PH: +1.704.238.9200 • EMAIL: info@awd-usa.com • WEB: awd-usa.com

30 Mil HDPE Liner

PRODUCT DATA SHEET

GSE White Smooth Geomembrane

GSE White is a smooth high density polyethylene (HDPE) geomembrane manufactured with the highest quality resin specifically formulated for flexible geomembranes. GSE White has a UV stabilized upper white surface that reflects light, improves damage detection, reduces wrinkles and subgrade desiccation. This product is used in applications that require enhanced quality assurance measures over standard geomembranes.

[*]

AT THE CORE:
An HDPE geomembrane that has a UV stabilized upper white surface that reflects light, improves damage detection, reduces wrinkles and lessens subgrade desiccation.

Product Specifications

These product specifications meet GRI GM13

Tested Property	Test Method	Frequency	Minimum Average Value				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, mil Lowest Individual Reading	ASTM D 5199	every roll	30 27	40 36	60 54	80 72	100 90
Density, g/cm³	ASTM D 1505	200,000 lb	0.940	0.940	0.940	0.940	0.940
Tensile Properties (each direction) Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, %	ASTM D 6693, Type IV Dumbbell, 2 ipm G.L. 2.0 in G.L. 1.3 in	20,000 lb	 114 63 700 12	 152 84 700 12	 228 126 700 12	 304 168 700 12	 380 210 700 12
Tear Resistance, lb	ASTM D 1004	45,000 lb	21	28	42	56	70
Puncture Resistance, lb	ASTM D 4833	45,000 lb	54	72	108	144	180
Carbon Black Content[1], % (Range)	ASTM D 1603*/4218	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note[2]	Note[2]	Note[2]	Note[2]	Note[2]
Notched Constant Tensile Load, hr	ASTM D 5397, Appendix	200,000 lb	500	500	500	500	500
Oxidative Induction Time, mins	ASTM D 3895, 200º C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
TYPICAL ROLL DIMENSIONS							
Roll Length[3], ft			1,120	870	560	430	340
Roll Width[3], ft			22.5	22.5	22.5	22.5	22.5
Roll Area, ft²			25,200	19,575	12,600	9,675	7,650

NOTES:
- [1]GSE White may have an overall ash content greater than 3.0% due to the white layer. These values apply to the black layer only.
- [2]Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- [3]Roll lengths and widths have a tolerance of ±1%.
- GSE White is available in rolls weighing approximately 3,900 lb.
- All GSE geomembranes have dimensional stability of ±2% when tested according to ASTM D 1204 and LTB of <-77°C when tested according to ASTM D 746.
- *Modified.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

DURABILITY RUNS DEEP

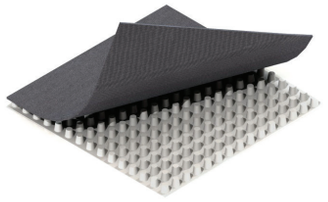
For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

Retaining Wall Geocomposite

SITEDRAIN™ SHEET 184

PREFABRICATED SHEET DRAIN

AWD
AMERICAN WICK DRAIN



PRODUCT OVERVIEW

SITEDRAIN Sheet 184 geocomposite drain is composed of a dimpled polymeric core with a nonwoven geotextile bonded to the dimple side. The geotextile allows water to pass through while retaining backfill materials. The solid core allows water collection from one side and provides a continuous flow path to designated drainage exits.

SITEDRAIN Sheet 184 is an economical solution for single-sided subsurface drainage applications requiring high strength, high flow capacity, and a geotextile meeting AASHTO M288 Class 3 subsurface drainage requirements.

PROPERTY [1]	TEST METHOD	UNIT OF MEASURE	Typical Value	MARV
GEOTEXTILE				
Material [2]			PP, NPNW	PP, NPNW
Survivability	AASHTO M288	Class	3	3
Grab Tensile Strength	ASTM D4632	lbs	135	120
		N	601	534
Grab Elongation	ASTM D4632	%	60	50
CBR Puncture	ASTM D6241	lbs	365	340
		N	1,624	1,512
Trapezoidal Tear	ASTM D4533	lbs	60	50
		N	267	222
UV Resistance	ASTM D4355	% / 500 Hrs	70	70
Apparent Opening Size (AOS) [3]	ASTM D4751	sieve	70	70
		mm	0.212	0.212
Permittivity	ASTM D4491	sec^{-1}	2.4	1.7
Water Flow Rate	ASTM D4491	gpm / ft^2	175	140
		Lpm / m^2	7,130	5,704
CORE				
Compressive Strength	ASTM D6364 ASTM D1621	psf	18,000	-
		kPa	862	-
Thickness	ASTM D5199	in	0.4	-
		mm	10	-
In-Plane Flow Rate [4]	ASTM D4716	gpm/ft	21	-
		Lpm/m	261	-
COMPOSITE				
Available Roll Sizes	Dimensions (ft)	Weight (lbs)	AWD Item Code	
	4 x 50	47	10100	
	6 x 50	65	14320	

[1] Unless otherwise noted, all physical and performance properties listed are Typical Value or Minimum Average Roll Value (MARV) as defined in ASTM D4439.
[2] PP = Polypropylene; NPNW = Needle-Punched Nonwoven; WM = Woven Monofilament; SBNW = Spunbonded Nonwoven
[3] Values for AOS represent Maximum Average Roll Value (MaxARV).
[4] In-plane flow rate measured at 3,600 psf (172 kPa) compressive load and a hydraulic gradient of 1.0.

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Monitoring Layer Geocomposite

SITEDRAIN™ STRIP 9400

PREFABRICATED STRIP DRAIN

AWD
AMERICAN WICK DRAIN

PRODUCT OVERVIEW

SITEDRAIN Strip 9400 geocomposite strip drain products are composed of a dimpled polymeric perforated core fully wrapped in a nonwoven geotextile. The geotextile allows water to pass through while retaining backfill materials. The perforated core allows water collection from all sides and provides a continuous flow path to designated drainage exits.

SITEDRAIN Strip 9400 products provide a value engineered alternative to perforated pipe and aggregate subsurface drainage systems requiring high strength, high flow capacity, and a geotextile meeting AASHTO M288 Class 3 subsurface drainage requirements.

PROPERTY [1]	TEST METHOD	UNIT OF MEASURE	Typical Value	MARV
GEOTEXTILE				
Material [2]			PP, NPNW	PP, NPNW
Survivability	AASHTO M288	Class	3	3
Grab Tensile Strength	ASTM D4632	lbs	135	120
		N	601	534
Grab Elongation	ASTM D4632	%	60	50
CBR Puncture	ASTM D6241	lbs	365	340
		N	1,624	1,512
Trapezoidal Tear	ASTM D4533	lbs	60	50
		N	267	222
UV Resistance	ASTM D4355	% / 500 Hrs	70	70
Apparent Opening Size (AOS) [3]	ASTM D4751	sieve	70	70
		mm	0.212	0.212
Permittivity	ASTM D4491	sec^{-1}	2.4	1.7
Water Flow Rate	ASTM D4491	gpm / ft^2	175	140
		Lpm / m^2	7,130	5,704
CORE				
Compressive Strength	ASTM D6364 ASTM D1621	psf	9,500	-
		kPa	455	-
Thickness	ASTM D5199	in	1.0	-
		mm	25.4	-
In-Plane Flow Rate [4]	ASTM D4716	gpm/ft	21	-
		Lpm/m	261	-

MODEL	WIDTH	ROLL LENGTH	ROLL WEIGHT	ITEM CODE
9406	6"	150'	26 lbs	10600
9412	12"	150'	48 lbs	10610
9412	12"	500'	160 lbs	11270
9418	18"	150'	72 lbs	10620
9418	18"	500'	240 lbs	11280
9424	24"	150'	90 lbs	10630
9424	24"	500'	300 lbs	11290
9436	36"	100'	90 lbs	10640

[1] Unless otherwise noted, all physical and performance properties listed are Typical Value or Minimum Average Roll Value (MARV) as defined in ASTM D4439.
[2] PP = Polypropylene; NPNW = Needle-Punched Nonwoven; WM = Woven Monofilament; SBNW = Spunbonded Nonwoven
[3] Values for AOS represent Maximum Average Roll Value (MaxARV).
[4] In-plane flow rate measured at 3,600 psf (172 kPa) compressive load and a hydraulic gradient of 0.1.

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