Attachment P-4

Closure Plan

CLOSURE/POST-CLOSURE PLAN
KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II
KEKAHA, KAUAʻI, HAWAIʻI

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ACRONYMS AND ABBREVIATIONS

%	percent
§	Section
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act (“Super Fund”)
C/PC	closure/post-closure
cf/ac	cubic foot per acre
CFR	Code of Federal Regulations
CH_4	Methane
CQA	construction quality assurance
DOH	Department of Health, State of Hawaii
EPA	Environmental Protection Agency, United States
ft	feet
GCCS	Gas Collection and Control System
GCL	geosynthetic clay liner
HAR	Hawaii Administrative Rules
HDPE	high density polyethylene
HEER	Hazard Evaluation and Emergency Response Officer
HELP	hydrologic evaluation of landfill performance
H_2S	Hydrogen Sulfide
in.	inch
KLF	Kekaha Municipal Solid Waste Landfill
LDPE	low density polyethylene
LFG	landfill gas
m^3	cubic meter
Mg	mega grams
msl	mean sea level
NCP	National Oil & Hazardous Substances Pollution Contingency Plan
NMOC	non-methane organic compound
NSPS	New Source Performance Standards
ppm	part per million
RCRA	Resource Conservation and Recovery Act
U.S.	United States
yd^3	cubic yard

1.0 INTRODUCTION

Kekaha Municipal Solid Waste Landfill (KLF) Phase II, located at 6900-A Kaumualiʻi Highway, Kekaha, Hawaiʻi, consists of 14 subcells under the original landfill footprint, 3 vertical expansions, 2 lateral expansions, and 1 proposed vertical expansion underway. The lateral expansions include the 6.4-acre Cell 1 and the 6.6-acre Cell 2.The proposed fourth vertical expansion would extend Phase II upward from the currently permitted maximum elevation of 121.2 feet (ft) above mean sea level (msl) to a new permitted maximum elevation of 171.5 ft above msl. This proposed vertical expansion would be within the existing permitted footprint of the Phase II landfill area and would be constructed above the existing Resource Conservation and Recovery Act (RCRA) Subtitle D base liner (Tetra Tech, 2023). The entire Phase II landfill must be properly closed when it reaches its permitted capacity. State regulations for landfill closure are specified in the Hawaii Administrative Rules (HAR), Title 11, Chapter 58.1, Section 1-17(DOH 1994), which applies to municipal solid waste landfills that accepted waste after October 9, 1991, and which are based on the federal Resource Conservation and Recovery Act (RCRA), Subtitle D requirements. Final closure of Phase II will commence within 30 days of the final receipt of waste.

At the request of the County of Kauaʻi, AECOM Technical Services, Inc. has prepared this Closure/Post-Closure (C/PC) Plan for the entire Phase II landfill. The C/PC has also been revised by Tetra Tech to include updates for the proposed vertical expansion. A C/PC Plan is required to address surface water management, landfill gas (LFG) management, leachate management, maintenance and monitoring requirements, and provide recommendations for the final cover system to fulfill State of Hawaiʻi Department of Health (DOH) regulations and guidelines for landfills.

The purpose of this C/PC Plan is to ensure long-term protection of the environment and public health. This is accomplished in part by the specification of an environmentally responsible cover and appurtenances, which prevent erosion of the cover materials and infiltration of surface water into the waste mass, and facilitate the minimization of leachate generation as well as the collection and extraction of LFG and leachate. The post-closure maintenance and monitoring requirements are intended to ensure proper functioning of the landfill systems during the 30-year post-closure care period. The findings and recommendations of this C/PC Plan, after review and approval by the DOH, will form the basis of design for the landfill closure construction plans and specifications.

1.1 SITE BACKGROUND

The KLF is located near the town of Kekaha in the coastal area on the southwest side of the island of Kauaʻi as shown in Figure 1. The Phase I, which was closed by 1993, with a maximum elevation of 45 ft above msl, is located a short distance southwest of the existing Phase II landfill. The existing Phase II landfill was constructed in 1993, and is bounded by Kaumualiʻi Highway to the northeast, an unpaved access road and agriculture land to the southeast, aquaculture to the northwest, and the Phase I area to the southwest. The land surrounding the site is generally flat, with a gentle slope toward the sea. Land in site vicinity is approximately 8 to 10 ft above msl. The landfill basegrade elevation of Phase II varies from approximately 7 to 12 ft above msl, and drains toward the northeast. The existing Phase II landfill side-slopes are 3.5:1 (horizontal:vertical), with a 3 percent (%) top-slope. Sheet C-100 shows existing conditions at the site.

The existing Phase II landfill consists of approximately 63 acres, with approximately 44 acres designated for waste disposal and the remainder used for various site facilities including support buildings, roads, and buffer zones. The 44 acre disposal area includes the original waste disposal area (31.2 acres) and two expansion areas, Cell 1 (6.3 acres) and Cell 2 (5.9 acres) (collectively referred it as Phase II disposal area). The Phase II landfill accepts municipal non-hazardous waste from residential, commercial, and industrial sources, and is also permitted to receive specific special wastes, including, but not limited to, wastewater treatment sludge, industrial process wastes, treated medical waste, asbestos materials, and petroleum contaminated soils. Placement of refuse is ongoing.

The currently permitted final elevation of the landfill after placement of the final cover is 121.2 ft. The proposed vertical expansion would extend to a new permitted maximum elevation of 171.5 ft above msl, adding approximately 50 ft of height to the currently permitted maximum. Proposed final grades are shown on Sheet C-102: *Final Cover Grading Plan* and Sheet C-301*: Landfill Cross Sections*. Phase II is partially visible from Kaumuali‘i Highway and the shoreline and is visible from most viewpoints to the northwest where the vegetation along Kaumuali‘i Highway consists mostly of grasses and low lying shrubs. The Phase II landfill is partially obscured from viewpoints to the southeast due to tree lines located along Kaumuali‘i Highway and the access road adjacent to the southeastern boundary of the KLF facility that create a vegetative visual buffer. Where visible, the Phase II landfill has the appearance of an earthen mound. The maximum height of the facility would increase by approximately 50 ft. with the proposed expansion, thus potentially increasing visibility of the site from surrounding areas (Tetra Tech, 2023).The KLF is owned and operated by the County of Kaua‘i Department of Public Works Solid Waste Division.

2.0 LANDFILL CLOSURE

2.1 CLOSURE ACTIVITIES

Final closure will be completed once the landfill reaches design grades. Closure will start within 30 days of the last receipt of waste with placement of the minimum 12 inches of intermediate cover. The landfill will be graded to the final elevations which provides for long-term settlement of the waste to allow for continued proper drainage and final cover maintenance of the closed landfill. A minimum of 12 inches of intermediate cover will be installed after waste placement activities are complete to provide vector and odor control. Major closure activities include the placement of final cover; establishment of vegetative cover; completion of LFG management features and surface water control features; integrating the landfill gas collection and control system (GCCS) into the final cover; and inspection, documentation, and certification of these activities. Existing perimeter fencing will remain in place to provide security during the 30-year post-closure care period.

The top of refuse will be graded with a minimum slope of 3%. The landfill maximum side-slopes will be 3.5 to 1 (28.6%). The final cover surface will maintain grades as shown on Sheet C-102: *Final Cover Grading Plan*.

Surface drainage systems at the Phase II landfill consist of diversion berms, benches, down chutes, culverts, and perimeter infiltration ditches as shown on Sheet C-103 *Surface Water Management Plan*, and Sheet C-506: *Stormwater Details*. Additionally, a subsurface geocomposite drainage layer in the cover will route water to a drain along the toe of the landfill side slopes and then discharge through various outlet points to the perimeter infiltration ditches. Landfill settlement, erosion, and excessive vegetation/debris can negatively impact the capacity of these features.

The GCCS will be in place well before closure and will be integrated into the final cover during closure, as detailed in Section 2.3. The LFG collection and control system Design Plan is included as Appendix A. Upon approval of the Phase II Vertical expansion, the GCCS Title V permit and New Source Performance Standards for Municipal Solid Waste Landfills (NSPS) GCCS Design Plan will be updated to address converting from 40 CFR 60 Subpart WWW to the Subpart XXX NSPS requirements due to the increased capacity being approved after July 2014.

2.2 FINAL COVER DETAILS

This section discusses the proposed design of the final cover, which follows the HAR design requirements, and evaluates surface water infiltration through the proposed cover and infiltration through the bottom liner.

2.2.1 HAR Design Requirements

HAR 11-58.1-17(a)(1) (DOH 1994) requires that landfill covers have an 18-inch infiltration layer with a permeability of less than or equal to the permeability of any bottom liner system or 1×10^{-5} centimeters per second, whichever is less permeable, overlain by a minimum 6-inch-thick erosion layer that can sustain native plant growth, or equivalent alternatives. The existing landfill bottom liner consists of a prepared subgrade, geosynthetic clay liner (GCL), and a 60-mil high density polyethylene (HDPE) liner. The HAR requirements are met if less water infiltrates the cover than passes through the bottom liner. Section 2.2.3 and Appendix B include an evaluation of the infiltration through the proposed final cover and bottom liner, including supporting calculations.

2.2.2 Proposed Design

The proposed cover system is shown in Detail 4 on Sheet C-501, *Liner and LCRS Details*. The intermediate cover is anticipated to be in place at the time of final cover placement, and will be used as a soil foundation layer under the proposed final cover system, to provide firm and uniform support for the final cover. Overlying the intermediate cover will be a 6-inch grading layer to obtain the grade and surface upon which the GCL and 40-mil linear low density polyethylene (LDPE) geomembrane will be installed. The GCL and geomembrane will be the primary barriers to impede infiltration of moisture into the landfill, minimizing leachate production and inhibiting gas emissions. This 6-inch grading layer may not be required if the condition of the intermediate cover can meet the necessary design criteria to provide adequate surface for the overlying geosynthetics.

A geocomposite drainage layer will be placed over the geomembrane to promote lateral drainage of surface water, reducing the potential for ponding on the cap and promoting overall slope stability. Finally, a topsoil rooting zone will provide a medium to establish and maintain a vegetative layer. The grass surface will promote evapotranspiration of storm water, and will stabilize the cover, decreasing the potential for erosion. The complete landfill cover also removes the pathways for exposure to the landfill.

The composite final cover system will cover the entire landfill, and will tie into the bottom composite liner system, as shown in Detail 7 on Sheet 501, *Liner and LCRS Details*. As shown in Detail 4 on Sheet 501, *Liner and LCRS Details*, the proposed cover system and other material layers, from top to bottom, are as follows:

- 18-inch vegetative/protective soil layer
- Geocomposite drainage layer
- 40-mil linear Low Density Polyethylene (LDPE) liner
- Geosynthetic Clay Liner (GCL)
- 6-inch minimum grading layer
- 12 inches of intermediate cover material
- Top of waste

18-inch Vegetative/Protective Soil Layer. The proposed vegetative/protective soil layer is sufficiently thick to protect the geosynthetic materials. The 18-inch vegetative/protective soil layer will include a minimum of 6 inches of topsoil or soil capable of sustaining growth of vegetation with minimal irrigation. The vegetative cover to be established on the vegetative layer surface will be a mixture of native grasses. The mixture of grasses will be selected to be amenable to the soil quality, thickness, slopes, and moisture conditions that are anticipated for the Phase II landfill, and to minimize the need for continued maintenance. Mulch may also be used as necessary to provide erosion control. Due to the use of the geomembrane in the final cover system, root penetration from the vegetation into the waste is not expected.

Geocomposite Drainage Layer. The drainage layer in the final cover system will contain a geocomposite drainage layer designed to divert any water infiltrating the surface to a sub-drain system at the toe of final cover slopes. The sub-drain system will consist of a network of 2-inch pipe outlets spaced to provide free drainage from the geocomposite. The transmissivity of the proposed geocomposite system was evaluated using a seepage stability calculation, and the resulting safety factors were protective for the site (Appendix C).

40-mil Linear LDPE Liner and GCL. The 40-mil linear LDPE liner will be placed on the GCL, which will overlay the grading layer. The 6-inch-minimum grading layer will be placed on top of the intermediate cover on the landfill. The grading layer will be free from stones, waste, sticks, or any other deleterious material that may damage the GCL or geomembrane. The construction quality assurance plan will be prepared prior to construction and will address the geomembrane placement and grading layer requirements in further detail.

The selection of the final cover materials, especially geosynthetic materials, must meet the minimum interface friction angles defined on the Final Cover Drainage Layer Analysis and Slope Stability calculation in Appendix C.

2.2.3 Cover System Evaluation

The proposed cover system was evaluated for performance-based surface water infiltration through the cover and permitted bottom liner systems using the Hydrologic Evaluation of Landfill Performance (HELP) model. The HELP model is a computer analysis tool developed by the United States (U.S.) Army Corps of Engineers that computes runoff, evapotranspiration, percolation, and lateral drainage based on characteristics of the site and components of the cover system. This model was used to compare performance of the proposed cover and the permitted bottom liner. The permitted bottom liner consists of a 60-mil HDPE and GCL over a prepared subgrade. Table 2-1 summarizes the results of the cover evaluation, showing the calculated average annual percolation through the cover and liner systems, and indicating that the infiltration through the final cover is less than through the bottom liner, as required. Site-specific data, when available, was input for evapotranspiration, weather, and precipitation data. A detailed discussion of the input assumptions and parameters and complete output is included in Appendix B. The HELP modeling analysis of the cover and permitted liner systems shows that the proposed cover system should be effective in maintaining infiltration of surface water into the landfill at rates below the exfiltration of liquids through the permitted bottom liner, thereby meeting the requirements of HAR and providing protection against excessive leachate generation. The HELP model developed by AECOM has been approved for final cover and no changes are proposed with the vertical expansion. This is conservative since the steeper cover slopes and shorter drainage lengths over the cover in the vertical expansion design would reduce potential infiltration of precipitation into the final cover.

Table 2-1: Final Cover System Evaluation

Parameter	Evaluation Results
Average Head on the Final Cover Geomembrane (in.)	0.017 in.
Infiltration Through Final Cover (cf/ac)	6.755 cf/acre
Average Head on the Bottom Liner Geomembrane (in.)	11.450 in.
Infiltration Through Bottom Liner System (cf/ac)	8.019 cf/acre

Notes:
Evaluation is based on average annual HELP model results, see Appendix B.

in.	inch
cf/ac	cubic foot per acre

2.3 LFG COLLECTION SYSTEM BASIS OF DESIGN

The existing Phase II landfill has a design capacity greater than 2.5 million Mg and 2.5 million cubic meters (including all of the Phase I and Phase II landfill areas). Therefore, the facility is subject to the Clean Air Act Title V requirements, and has submitted a GCCS design plan to the regulatory authorities. Design of the GCCS was completed and the GCCS installed in 2016. The GCCS was initially started in November of 2016 and permanently started in May of 2017 (see Sheet C-110, Existing GCCS Conditions).

2.3.1 Non-major Initial Covered Source Air Permit

On September 10, 2014, DOH issued a Covered Source permit (0802-01-C) for the landfill that addresses air emissions and gas collection and control from the facility. The site is in compliance with the current applicable provisions of the permit.

2.3.2 Gas Collection System Implementation Schedule

A gas collection and control system designed in accordance with the NSPS was installed and operational prior to December 2016. The facility may also elect to install an energy recovery facility at some point in the future. Upon HDOH approval of the proposed expansion of the landfill design capacity, the site will be subject to the NSPS Subpart XXX as opposed to the NSPS Subpart WWW. As such, the NSPS WWW GCCS Design Plan will need to be updated to an NSPS XXX GCCS

Design Plan. The GCCS as it exists should meet both regulations related to design, with the majority of the changes between the two regulations being operational and reporting changes.

2.3.3 Gas Collection System Design

A gas collection system was designed to cover the entire existing site, including the Phase I closed area and Phase II, with provisions to incorporate the previously anticipated lateral landfill expansions which have now been implemented. The GCCS plan was submitted to DOH and EPA in May 2015, and will be amended to include the proposed vertical landfill expansion for Phase 2. The GCCS consists of vertical gas extraction wells, associated header piping, condensate management, and a flare. A gas recovery system may be pursued at some future date.

The current landfill gas collection system design includes coverage of the currently required areas and has been designed to allow for incorporation of future landfill fill areas and even landfill expansion fill areas. The system design and calculations are consistent with the requirements for the NSPS. The current vertical expansion will add gas extraction wells in the Cell 2 area and change gas pipe routing to conform to the new slopes and fill mass. No other significant changes to the previous design will be necessary. GCCS Details can be found on Sheets C-510 through C-518. Conceptual design of GCCS improvements in support of the vertical expansion are shown on Sheets C-112 and C-113, GCCS Construction Site Plan - Phases I and II respectively, with the latter showing the GCCS at final grades.

The proposed gas collection wells, gas collection piping, and control device will meet the requirements listed in 40 CFR §60.759 and 40 CFR §60.769 as follows:

- Air intrusion will be minimized by ensuring the well screen is no closer than 15 ft to the surface.
- Damage to underlying liners will be avoided by ensuring the well bore does not extend closer than 10 ft to the material.
- Corrosion resistant materials, such as polyvinyl chloride (PVC) and HDPE will be used.
- Extraction wells will have connector assemblies (closing valves, sampling ports, etc.) suitable for NSPS monitoring.
- There will be a sufficient density of extraction devices to ensure gas is collected from all areas warranting control.
- The gas system will allow for expandability and accessibility: blind flanges have been incorporated into the design in order to allow for future gas system expansions; in addition, HDPE pipes can be cut and new components fused in place to expand the system as required.
- The flexibility of the material and the modulus of elasticity of both HDPE and PVC are sufficient to prevent collapse due to settlement and to withstand planned overburden and traffic loads.
- The active gas extraction system will be designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control, over the intended use period of the gas control system equipment.
- An enclosed flare will continue to be used for control and will be designed and operated in accordance with applicable Subparts of 40 CFR 60, NSPS.

2.4 CLOSURE/POST-CLOSURE PROCEDURES

The sequence of tasks below will allow the County of Kauaʻi to complete landfill closure construction and begin post-closure care in accordance with State of Hawaiʻi, HAR 11-58.1 (DOH 1994) and

RCRA Subtitle D. The items below may be modified depending on specific construction activities utilized and the Construction Quality Assurance (CQA) plan.

1. Complete the C/PC Plan and prepare detailed construction drawings as necessary to allow the start of construction.
2. Prepare a comprehensive CQA plan.
3. Obtain permits and approvals needed to start construction.
4. Start closure construction including structure removal and site security.
5. Perform mobilization, clearing, and grubbing.
6. Install the gas collection pipes and other appurtenances within the limits of waste.
7. Grade the intermediate cover to provide a smooth surface and place the 6-inch minimum grading layer at the necessary elevations.
8. Inspect the grading layer for irregularities and items detrimental to geosynthetic placement.
9. Place geosynthetics (GCL, geomembrane, and geocomposite).
10. Place topsoil/rooting zone soil layer and construct surface water features (diversion berms, channels, etc.) while taking care to protect the geosynthetics from damage.
11. Complete closure construction and establish vegetation on the final cover.
12. Complete landfill closure documentation report (including Contaminant Release Log). The contaminant release log will document reportable spills, as defined under the National Oil & Hazardous Substances Pollution Contingency Plan **(**NCP), Comprehensive Environmental Response, Compensation, & Liability Act ("Super-fund" or CERCLA), Hazard Evaluation and Emergency Response Officer (HEER), and other similar regulations.
13. Begin post-closure monitoring in accordance with C/PC Plan, HAR 11-58.1, and RCRA Subtitle D.
14. Evaluate the monitoring results to evaluate the need for corrective action or repairs.
15. If monitoring results indicate the need, implement corrective action (e.g., repair liner, install additional gas wells, etc.) and repairs as necessary. After corrective action and repairs are carried out, or if they are not necessary, continue with the monitoring program.

2.5 MAXIMUM CLOSURE AREA

The final cover will likely be placed incrementally as areas of the landfill reach final grade. Until final cover is placed in areas that have reached final grade, the maximum closure area is the entire Phase II landfill, including lateral expansion Cells 1 and 2, comprising approximately 44 acres. As landfill areas reach final grade and final cover is placed, the maximum closure area remaining to be closed when the landfill reaches capacity, as well as anticipated closure costs, can be reduced accordingly.

2.6 CLOSURE SCHEDULE

The KLF Phase II landfill is currently permitted to receive municipal solid waste from residential, commercial, and industrial sources to a maximum height of 121.2 ft. Based on current and recent landfilling rates, and the remaining permitted capacity, including the previously permitted lateral expansion of Cell 2, the existing Phase II landfill is expected to reach capacity in approximately 2027. With the proposed vertical expansion to a final height of 171.5 ft above msl, an additional 2.96 years of capacity is anticipated. Therefore, the KLF is expected to reach capacity in approximately 2030.

Placement of the final cover will begin 30 days after full capacity is reached or within 1 year of the most recent receipt of wastes if airspace remains unless approved by the Director of the DOH. Closure construction will be completed within 180 days unless an extension is approved by the Director of the DOH.

2.7 CLOSURE NOTIFICATION REQUIREMENTS

Throughout the life of the landfill, the County of Kauaʻi will maintain the closure plan in the landfill operating record. The County must inform the Director of the DOH when the following items have been added to the operating record: the closure plan; any notice of intent to close the landfill; and closure certification(s) performed by a registered professional engineer. The County must also notify the Director, in writing, 18 months prior to the projected date of attainment of full-permitted capacity, and the projected closure date. In addition, after closure activities are completed for all landfill cells, the County must submit a notation on the deed to the landfill property to advise any potential purchaser of the property that the property has been previously used as a landfill facility and that the use of the land is restricted. The Director will also be notified when this notation has been placed on the deed and in the landfill operating record. The schedule of required notification is as follows:

1.	C/PC Plan Notice	After preparation of C/PC Plan and placement of plan in operating record
2.	Notice of Intent to Begin Closure	Prior to beginning closure
3.	Full-Permitted Capacity	Anticipated approximately 2030
4.	Closure Certification	Following Closure
5.	Deed Restriction	Following Closure

2.8 PROJECT COST ESTIMATE

Table 2-2 presents the estimated construction costs for the proposed closure cover system for the entire Phase II landfill, including expansion Cells 1 and 2. Table 2-3 presents the estimated annual costs for post-closure care.

Table 2-2: Estimated Cost for Closure Construction

Item	Quantity	Unit	Unit Cost ($)	Amount ($)
Mobilization/Demobilization	1	LS	$2,380,353	$2,380,353
6-inch Grading Layer	1,994,751	SF	$0.38	$752,021
GCL	1,994,751	SF	$1.38	$2,748,767
Geomembrane (40-mil LLDPE, Textured)	1,994,751	SF	$0.81	$1,607,769
Geocomposite Drainage Layer	1,994,751	SF	$1.17	$2,333,859
18-inch Vegetative/Protective Soil Layer	110,820	CY	$67.93	$7,527,969
Tie then-existing GCCS into cover liner	1	LS	$1,599,650	$1,599,650
Access Road Gravel	1,811	CY	$87.40	$158,298
Access Road Geotextile	65,707	SF	$0.68	$44,418
Revegetation - Turf Establishment	1,994,751	SF	$0.32	$638,320
Diversion Berms	2,150	CY	$80.13	$172,280
Erosion Control Matting Along Diversion Berm	191,950	SF	$1.89	$361,826
Surface Water Drainage (Letdowns)	1,050	CY	$321.10	$337,155
Site Access Control	1	LS	$28,080	$28,080
Subtotal				$20,690,765
Contingency @ 15%				$3,103,615
Construction Cost				$23,794,380
Administrative, Legal, & Engineering @ 10%				$2,379,438
State General Excise Tax @ 4.166%				$991,274
Closure Cost				$27,165,092

LF	linear feet
LS	lump sum
SF	square foot
CY	cubic yard

Assumptions:
[a] Costs are in present worth dollars.

Post-closure monitoring (as required by RCRA Subtitle D and HAR 11-58.1) will provide the data needed to ensure that the landfill does not pose unacceptable risks to human health or the environment. By default, post-closure landfill monitoring (i.e., groundwater and LFG monitoring) is required for 30 years under HAR 11.58.1 and RCRA. The DOH Director may reduce the length of the post-closure care period, the latter if the County of Kauaʻi can demonstrate to the Director's satisfaction that the reduced period is sufficient to protect human health and the environment, or may extend the period, if necessary. Table 2-3 shows the cost estimates for post-closure monitoring and other anticipated requirements.

Table 2-3: Estimated Cost of Annual Post-Closure Care

Activity	Cost/Event	Events/ Year	Cost ($)
Final Cover, Surface Drainage, and Leachate Management Inspection	$2,500	2	$5,000
Final Cover Maintenance	$12,800	2	$25,600
Surveys	$30,000	0.2	$6,000
Surface Water Control Feature Operation and Maintenance	$15,700	1	$15,700
Leachate Management System Operation and Maintenance	$3,800	12	$45,600
Gas System Monitoring Inspection; LFG Probe Measurement	$5,400	4	$21,600
LFG Management System Operation and Maintenance	$22,500	12	$270,000
Groundwater and Leachate Sampling	$26,900	4	$107,600
Miscellaneous Maintenance (fencing, groundwater monitoring wells, etc.)	$3,700	1	$3,700
Annual Monitoring Report Preparation	$15,000	1	$15,000
Subtotal			$515,800
Contingency @ 15%			$77,370
Total Annual Post-closure Cost			$593,170

Assumptions:
Hourly rate for a staff engineer of $120/hour was used for calculations.
Costs are in present worth dollars.

3.0 POST-CLOSURE PLAN

3.1 MONITORING AND MAINTENANCE ACTIVITIES

Post-closure maintenance and monitoring will be necessary to ensure the long-term integrity of the closed landfill and its associated environmental control systems. The objective of post-closure care will be to maintain and monitor the following closure features at the Phase II landfill:

- Final cover system
- Surface Water Drainage Control Features
- GCCS
- Leachate Collection System
- Groundwater Monitoring Wells

The following sections identify requirements for maintenance and monitoring at the Phase II landfill.

3.1.1 Post-Closure Requirements

The post-closure requirements for landfills defined by HAR 11-58.1-17 (b) are applicable to the Phase II landfill. Accordingly, this post-closure plan includes:

- A description of the monitoring and maintenance activities required, and the frequency of the activities.
- Name, address, and telephone number of the person or office to contact during the post-closure period.
- A description of the planned use of the property during the post-closure period.

The length of the post-closure care period is expected to be 30 years. However, the length of the period may be decreased if the County of Kauaʻi demonstrates to the DOH that a reduced period is sufficient to protect human health and the environment, and the DOH may extend the period under certain conditions. Any reduction in the post-closure care would have to be approved by the DOH prior to implementation. An annual post-closure monitoring report will be prepared and submitted to the DOH during the post-closure care period. Following completion of the post-closure care period, notification will be sent to the DOH verifying that post-closure care has been completed.

3.1.2 Inspection Plan

A qualified individual will inspect the closed landfill and surrounding areas on a routine, semi-annual basis throughout the 30-year post-closure care period. Semi-annual inspections will allow any defects (i.e., settlement, subsidence, erosion) in the landfill systems to be detected and repaired before they develop into major problems. The frequency of inspections, which are noted above in Table 2-3, may be changed during the 30-year post-closure care period. A written record of the inspections will be made and retained (see example Inspection Form in Appendix D).

Inspections will consist of the inspector walking throughout the site and documenting observations. Defects that are detected will be addressed at a minimum of annually or as necessary to prevent more significant problems from developing. The inspections will focus on the integrity and operability of the various landfill systems. Likewise, the condition, accessibility, and visibility of all monitoring wells will be judged. The cover will be inspected for signs of erosion damage and any settlement, subsidence, or displacement.

- *Final Cover System:* All surveyed benchmarks will be evaluated as to their integrity and visibility. The cover will be inspected for signs of erosion damage and any settlement, subsidence, displacement, or vegetative distress.
- *Surface Water Control Features:* The system will be inspected for erosion, scouring, clogging, excess vegetation**,** and differential settlement. The surface water control features will be repaired as necessary and be kept free of debris and sediment that may prevent the system from operating correctly. Conveyance pipes will be cleaned out as necessary. Diversion berms and perimeter infiltration ditches will be regraded, if necessary, to provide continued drainage of surface water runoff.
- *LFG Control System:* Inspection will include ensuring that the gas collection system is operational. The gas collection system will be inspected for proper operation of or damage to valves, emergency switches, wellheads, flares, and any other applicable components. See Appendix A for additional discussion of the gas management system.
- *LFG Monitoring System:* Inspection will include checking the gas monitoring probes for damage, water submersion, or other defects that prevent monitoring.
- *Leachate Collection Systems:* The system will be inspected to ensure it is operational. The leachate collection and treatment system inspection will include, but not be limited to: checking for sediment buildup within wet wells, collection lines, and the evaporation lagoon; testing level switches and control devices; testing operation of pumps, aerators, and lagoon level switches; recording leachate pumped quantities as measured by the flowmeter; and testing backup pumps and emergency systems.
- *Groundwater Monitoring Wells:* The wells will be inspected to ensure the wells are functional. Inspection will include judging the condition, accessibility, and visibility of all monitoring wells. Current groundwater monitoring well locations are shown on Figure 2.

3.1.3 Monitoring Plan

- *LFG Control System:* The GCCS will be inspected regularly in conjunction with the scheduled monitoring tasks. The explosive gas and LFG monitoring program contained in the Operating Plan will continue to be implemented during the 30-year post-closure care period. Following design and construction of the LFG system, a site-specific monitoring and maintenance plan will be prepared.
- *LFG Monitoring System:* The LFG monitoring system will be inspected regularly in conjunction with the scheduled monitoring tasks. The explosive gas and LFG monitoring program contained in the Operating Plan will continue to be implemented during the 30-year post-closure care period. The gas probes should be monitored for methane concentrations. The concentration of methane gas should not exceed 5% methane by volume in air at the landfill boundary. LFG concentrations should be measured with a meter capable of detecting gases at the following levels:
  - Methane (CH_4) up to 100% by volume in air
  - Oxygen between 19.5 to 23.5% by volume in air
  - Hydrogen sulfide (H_2S) with a minimum detection level of 10 ppm
  - Carbon monoxide with a minimum detection level of 100 ppm

  If gas monitoring of the perimeter probes shows the presence of methane exceeding the lower explosive limit (5% by volume), remedial action may be required. Additional vents may be required. Evidence of dead grass, an indication of LFG migration, should be noted during quarterly inspections.

- *Leachate Collection System Monitoring:* System monitoring includes leachate levels in the evaporation lagoon and on the bottom liner. Leachate levels on the liner will be maintained at less than 1 foot of head throughout the 30-year post-closure care period. Additionally, the leachate collection system will be inspected regularly in conjunction with the scheduled monitoring tasks. Monitoring of the leachate collection system includes:
  - Visual inspection of leachate pump stations to ensure proper operational function
  - Manual pumping of leachate if automatic controls are temporarily inoperative
  - Visual inspection of leachate levels and aerator operation in the evaporation pond
  - Recording leachate pumped quantities
  - Exercising pump station sumps to verify operational function
- *Groundwater Monitoring System:* A *Final Monitoring and Reporting Program* (Sanifill and Baquerizo 1996) was prepared for the Phase II landfill and approved by the State prior to closure of the landfill. The *Final Monitoring and Reporting Program* was prepared in accordance with applicable sections of HAR §11-58.1-16 and with the *State of Hawaii Landfill Groundwater Guidance Document* (DOH 2002). An updated groundwater monitoring plan was prepared in conjunction with a previous vertical expansion and approved by the DOH in 2013 (AECOM 2013). An additional update to the groundwater monitoring plan was subsequently submitted as part of the 2016 Cell 2 Expansion solid waste permit application The latest update to the groundwater monitoring plan is the *Groundwater and Leachate Monitoring Plan* prepared by Geosyntec in 2020 (included in the 2023 Phase II Vertical Expansion solid waste permit application), which entirely replaces all previous plans. The groundwater will continue to be monitored through the entire post-closure care period. Statistical analyses will be performed on collected data to determine whether a statistically significant increase in any parameter has occurred.

3.1.4 Maintenance Plan

Maintenance and repairs will be carried out annually, or more frequently, if necessary to prevent further damage to landfill systems. Minor repairs may be required to ensure the integrity and proper function of fencing and monitoring points. The primary landfill systems are discussed in the following paragraphs.

- *Final Cover System:* Defects that may require corrective action include erosion, differential settlement resulting in ponding water, odor, cracks, slope failure, and any other defects that could impair the performance of the final cover. Cracks greater than 1-inch wide or gullies 6 inches or deeper in the final cover will be repaired. Any erosion damage, which may occur as a result of extremely heavy rainfall, will be repaired. Repairs will be made in accordance with the type and extent of defect. During all cover construction activities, temporary berms, ditches, and straw mulch will be used as needed to prevent further erosion damage until site conditions permit repair, or repairs have reestablished vegetation. Such action should minimize problems associated with increased surface water infiltration, LFG venting through the cover, and the attraction of vectors. Recently filled and covered areas will require the most maintenance; however, the landfill should stabilize over time such that less maintenance would be required each year. Generally, a 3- to 5-year stabilization period is anticipated. Residual settlement of the closed landfill is anticipated, but it is expected to be minimal and confined to localized areas.
- *Surface Water Drainage Control Features:* Defects in the surface water control system can result in accelerated erosion of the landfill cover. Defects identified during the site inspection will be repaired using proper maintenance procedures as necessary to ensure proper functioning of the surface water control system. Periodic maintenance during the 30-year post-closure care period is expected to clean out excessive vegetation, accumulated silt, and debris from drainage features. Erosion or scouring repairs may also be needed. It is

expected that maintenance can be performed by a small crew of laborers, or with a small backhoe.

- *LFG Collection and Monitoring System:* The system components will be repaired and replaced as required to maintain full system operation. Preventative maintenance will be performed on all mechanical equipment at manufacturer-recommended intervals. Preventative maintenance includes cleaning, lubricating, and replacing worn parts. The gas collection piping will be thoroughly inspected annually for potential failure points, and necessary repairs will be noted and implemented. System failures, such as pipe leaks or breaks, which reduce gas collection efficiency and control effectiveness, will be addressed in a timely manner to conform to operating permit conditions.
- *Leachate Collection System:* Leachate will be pumped into the evaporation lagoon where it will be aerated and allowed to evaporate. Maintenance and operation of the leachate collection system will be in accordance with the requirements of HAR §11-58.1-14. Maintenance of the leachate management system during the 30-year post-closure care period will include inspection of the system, repair as warranted, and periodic replacement of pumps and lagoon aerators. Periodic cleaning of leachate collection pipes may also be required. Leachate generation rates are expected decrease over time following landfill closure.
- *Groundwater Monitoring Wells:* Any required maintenance or repairs noted during inspection or monitoring will be carried out. Required maintenance may include repair and replacement of locks, pipes, and other appurtenances. If monitoring wells are damaged beyond repair or are otherwise unable to be monitored, the wells may have to be abandoned and re-installed.

3.1.5 Summary of Post-Closure Activities

The frequency of monitoring and maintenance activities will be in accordance with the Operating Plan, the final groundwater monitoring plan, and a schedule approved by the Department of Health. The proposed frequency is semi-annual monitoring events. Table 3-1 provides a summary of post-closure activities, including potential problem areas.

Table 3-1: Post-Closure Inspection Requirements

Item	Frequency of Inspection/Monitoring	Potential Problems to Guard Against
Final Cover	Semi-annually	Erosion, cracks, exposed or damaged geocomposite or geomembrane, surficial cover soil failures
Vegetative Cover	Semi-annually	Dead plants, vegetative overgrowth at drainage structures
Final Grades	Semi-annually	Standing water
Surface Drainage System	Semi-annually	Debris/vegetation, or erosion that hamper water flow away from the site
LFG Monitoring and Vent Inspection	Quarterly	Odors, high readings in perimeter monitoring probes, vent “leaning”
Groundwater Monitoring Sampling	To be determined	Leachate release, damaged wells, inoperable sampling equipment, leachate levels

POST-CLOSURE CONTACT

The contact during the 30-year post-closure care period will be the site owner:

Solid Waste Coordinator (or equivalent)
County of Kauaʻi
Department of Public Works
Solid Waste Division
4444 Rice Street, Suite 275
Līhuʻe, HI 96766
Phone: (808) 241-4996

3.2 POST-CLOSURE LAND USE

After construction of the cover system, the planned use is a “closed landfill” or greenspace. This planned use will not impact or jeopardize the designed cover, surface water, leachate, or other landfill systems. The Phase II landfill may be suitable for recreational uses during the post-closure period, if pre-approved by the DOH. Post-closure use of the landfill site will not disturb the integrity of the final cover, liner, or any other closure system components.

4.0 REFERENCES

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DOH. 2002. *State of Hawaii Landfill Groundwater Monitoring Guidance Document.* Ver. 1.8. Honolulu: Solid and Hazardous Waste Branch. September.

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Tetra Tech BAS, Inc. 2023. *Draft Environmental Assessment, Kekaha Municipal Landfill, Phase II Vertical Expansion Kekaha, Kauaʻi, Hawaiʻi.* August.

FIGURES

TETRA TECH

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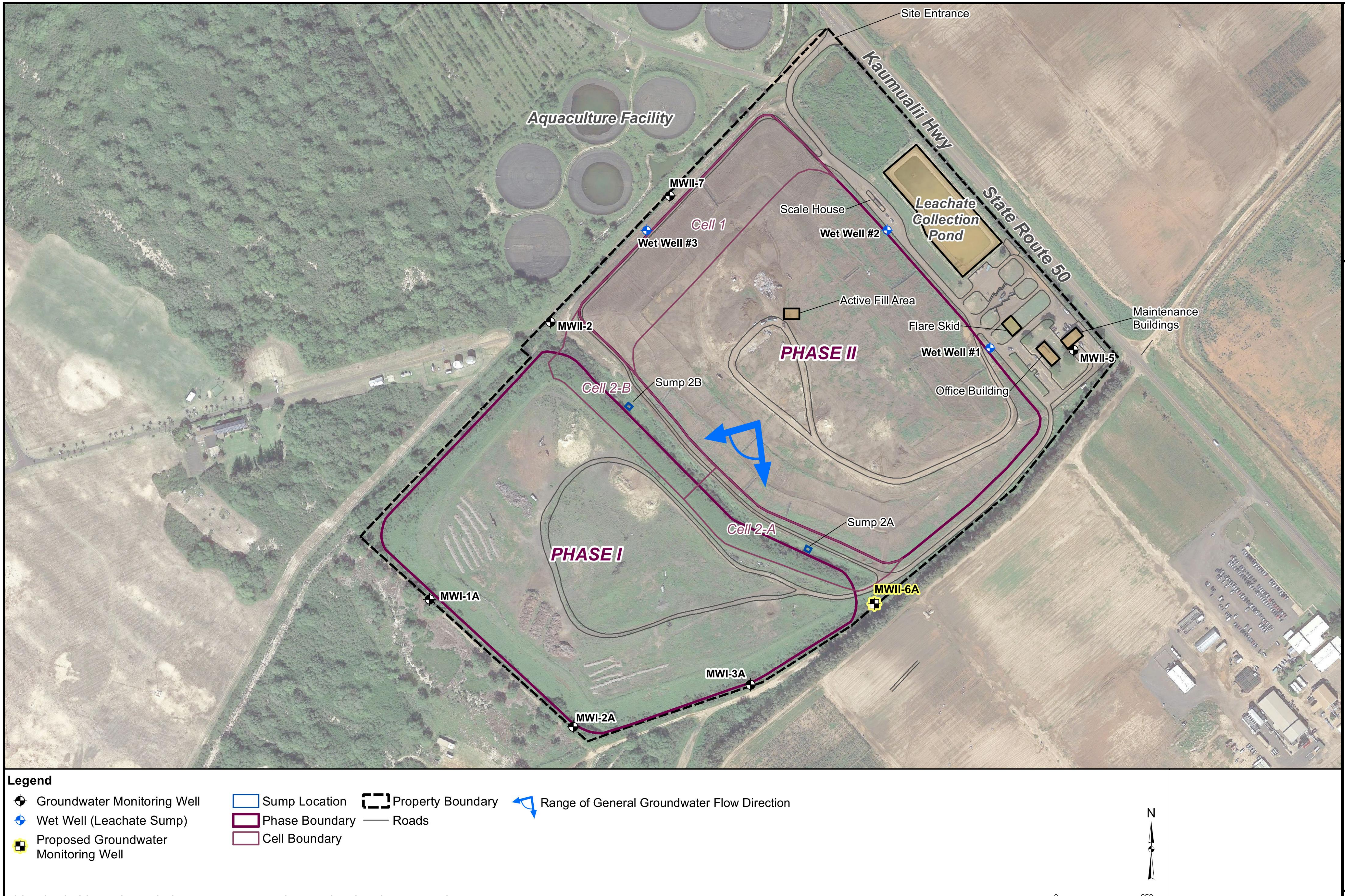
DATE: NOV. 2023

COUNTY OF KAUAI - KEKAHA MUNICIPAL SOLID WASTE LANDFILL

SITE LOCATION MAP

FIGURE 1

G:\dwg\Kauai County\Kekaha Vertical Expansion\CAD\SheetFiles\Figures\Figure 1 Site Location Map



SOURCE: GEOSYNTEC 2020 GROUNDWATER AND LEACHATE MONITORING PLAN, MARCH 2020

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COUNTY OF KAUAI - KEKAHA MUNICIPAL SOLID WASTE LANDFILL

MONITORING WELL NETWORK

FIGURE 2

G:\dwg\Kauai County\Kekaha Vertical Expansion\CAD\SheetFiles\Figures\Figure 2 Monitoring Well Network

SHEETS

ABBREVIATIONS

Ø/DIA	DIAMETER
DWG	DRAWING
ELEV	ELEVATION
E	EASTING
EG	EXISTING GRADE
FT	FEET
FG	FINAL GRADE
HDOH	HAWAII DEPARTMENT OF HEALTH
HDPE	HIGH DENSITY POLYETHYLENE
LCRS	LEACHATE COLLECTION AND REMOVAL SYSTEM
MIN	MINIMUM
N	NORTHING
(NIC)	NOT IN CONTRACT
NTS	NOT TO SCALE
%	PERCENT
PERF	PERFORATED
PVC	POLYVINYL CHLORIDE
R/W	RIGHT OF WAY
S	SLOPE
SDR	STANDARD DIMENSION RATIO
SG	SUBGRADE
TYP	TYPICAL
WSEL	WATER SURFACE ELEVATION
W/	WITH

PERMIT DESIGN DRAWINGS FOR THE

PHASE II - VERTICAL EXPANSION

KEKAHA MUNICIPAL SOLID WASTE LANDFILL

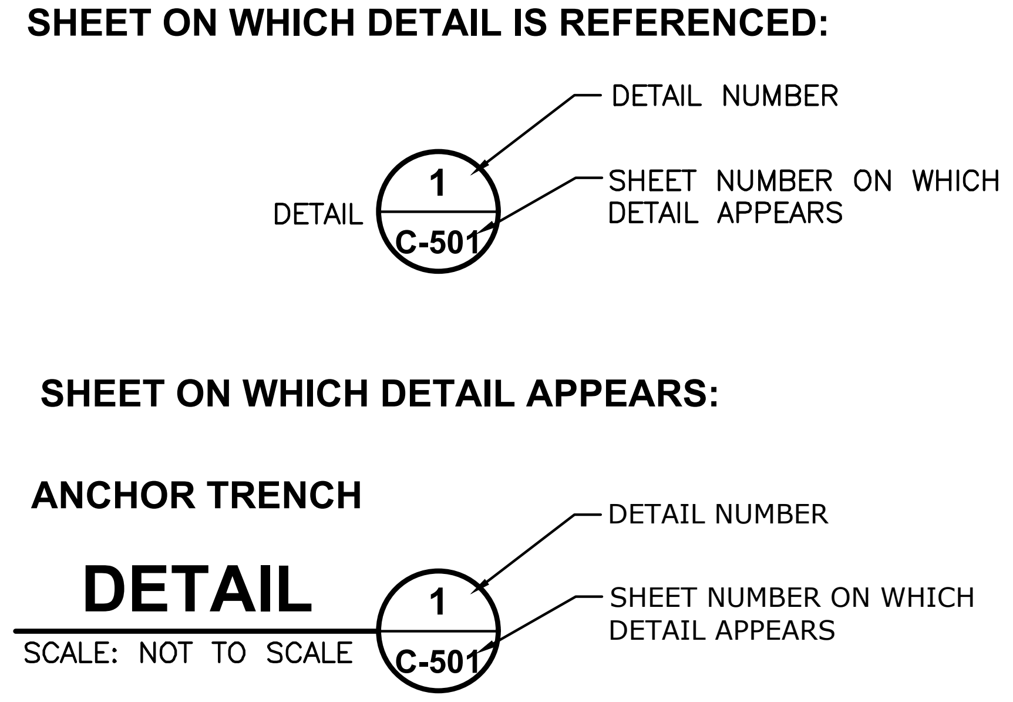
KAUA'I COUNTY, HAWAII

PREPARED FOR

COUNTY OF KAUA'I DEPARTMENT OF PUBLIC WORKS
SOLID WASTE DIVISION

NOVEMBER 2023

DETAIL INDICATOR:



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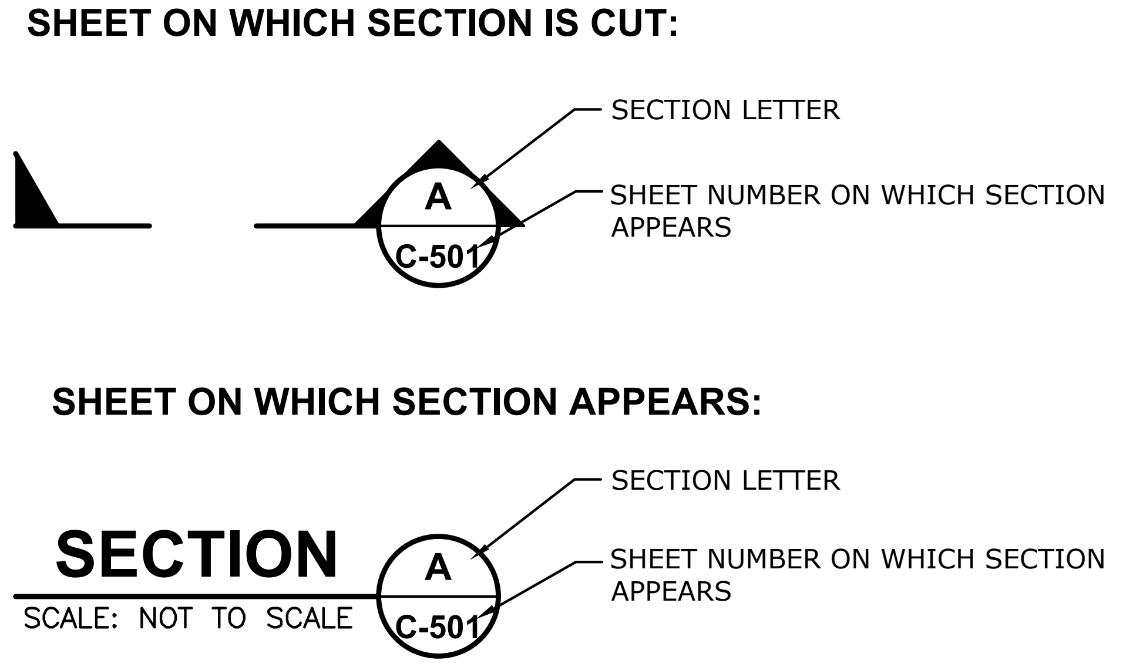
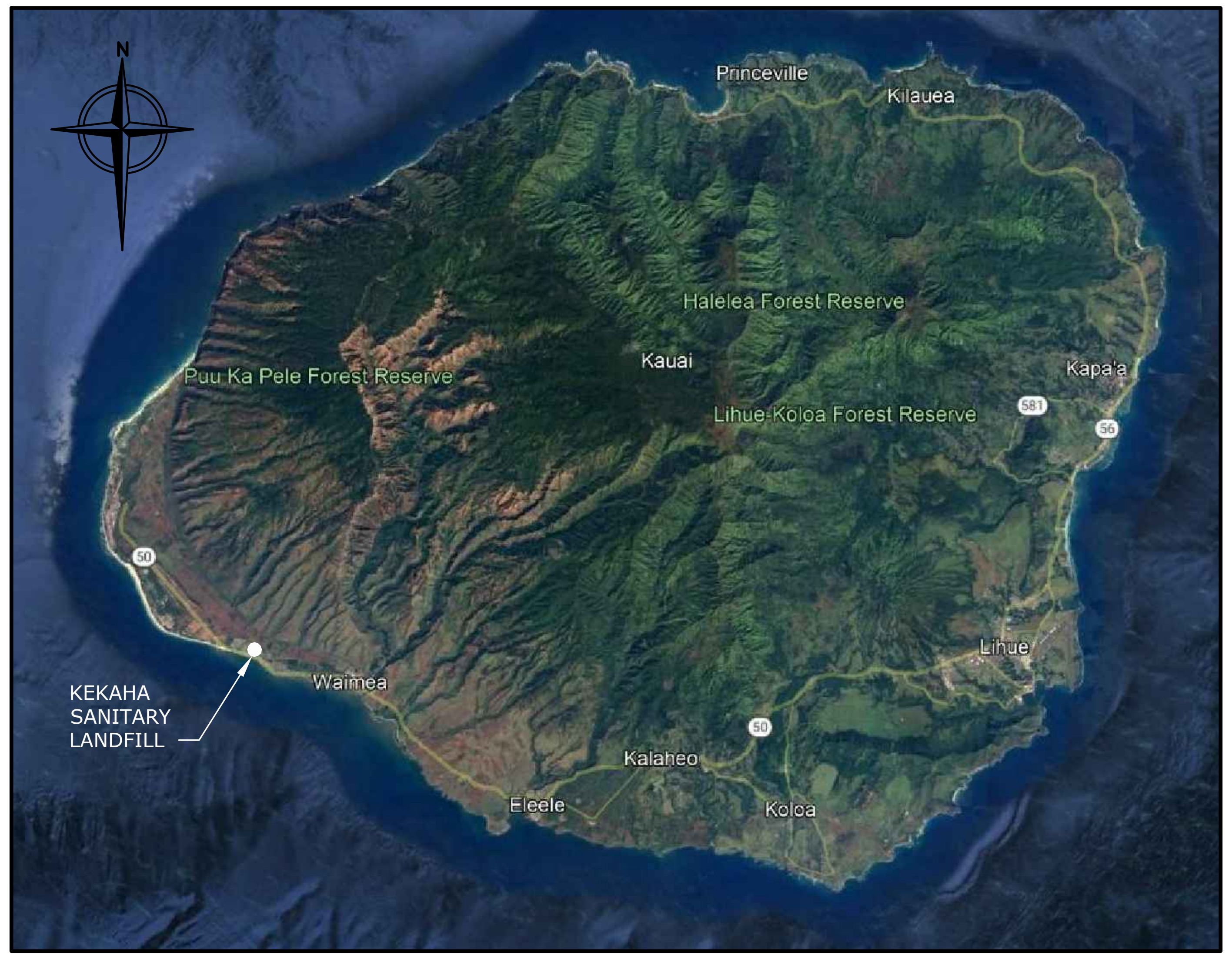
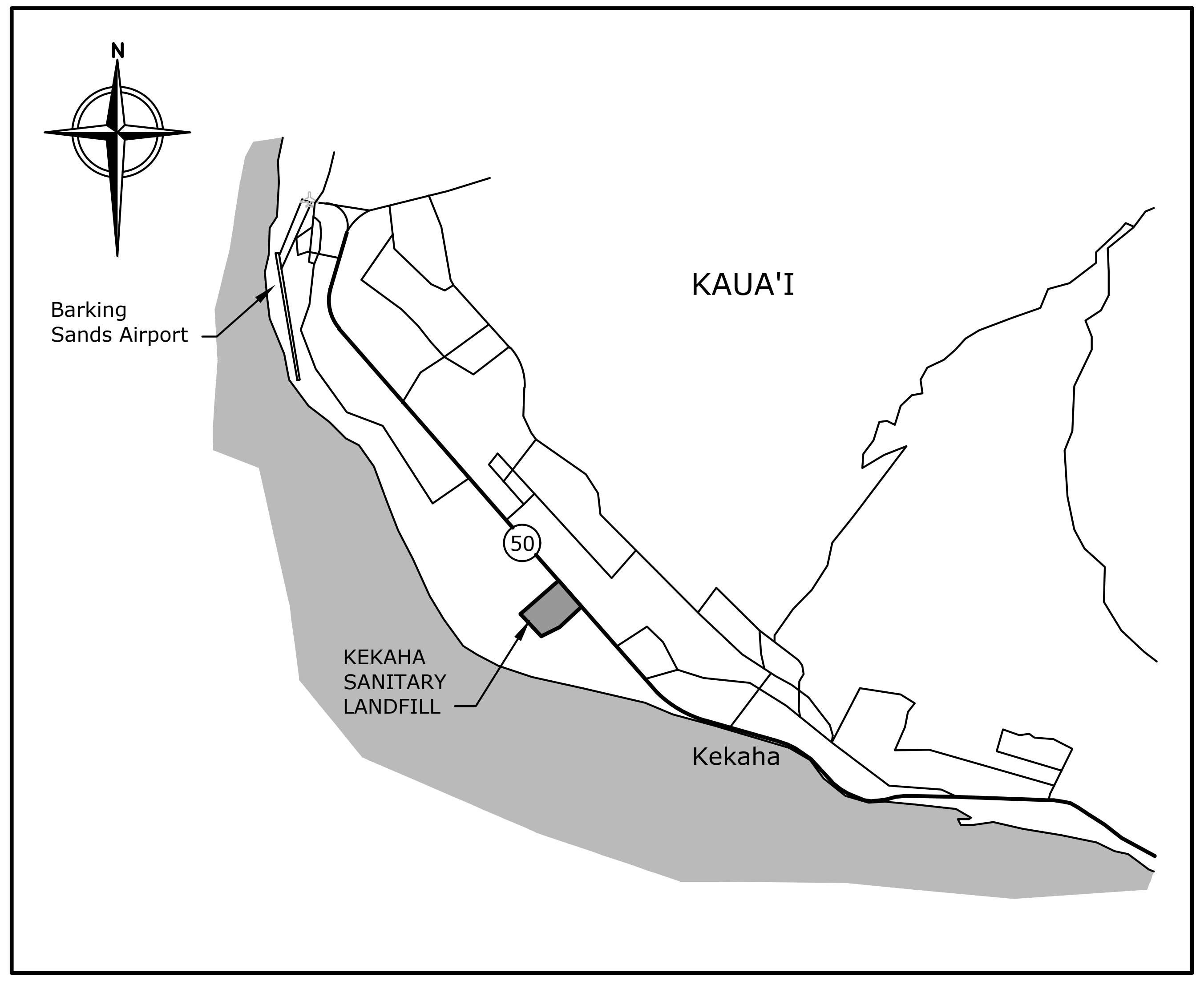




SOURCE: GOOGLE EARTH 2022

VICINITY MAP



SOURCE: MAP DATA 2022 GOOGLE

0 1 2
SCALE IN MILES

LOCATION MAP

SHEET INDEX

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NOTES:

1. THE EXISTING UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE, AND UTILITY LINES MAY EXIST WHERE NONE ARE SHOWN. SOME INFORMATION MAY HAVE BEEN DERIVED FROM INFORMATION PROVIDED TO THE ENGINEER BY OTHERS. SUCH INFORMATION MAY BE INCOMPLETE OR MAY BE OBSOLETE BY THE TIME CONSTRUCTION COMMENCES. CONTACT BLUE STAKE AT 811 AND ANY NON-PARTICIPATING UTILITY COMPANIES AT LEAST 48 HOURS BEFORE CONSTRUCTION. THE CONTRACTOR SHALL EXCAVATE AND VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF PERTINENT UTILITIES, LANDFILL LINERS, AND OTHER EXISTING FEATURES IN OR NEAR THE AREA OF WORK, WHETHER INDICATED ON THESE DRAWINGS OR NOT. SHOULD A CONFLICT EXIST, THE CONTRACTOR SHALL NOTIFY THE ENGINEER AS SOON AS POSSIBLE. THE CONTRACTOR SHALL EXERCISE DUE CARE TO AVOID DISTURBING ANY UNDERGROUND UTILITIES. THE CONTRACTOR SHALL COORDINATE ANY POTENTIAL DISRUPTIONS IN UTILITY SERVICE WITH THE UTILITY COMPANIES AFFECTED AT LEAST 24 HOURS PRIOR TO THE DISRUPTION. THE CONTRACTOR SHALL REPAIR DAMAGE TO EXISTING UTILITIES AT THE CONTRACTOR'S EXPENSE.
2. CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND COORDINATE SITE CONDITIONS WITH THE DRAWINGS PRIOR TO CONSTRUCTION, ANY DISCREPANCIES OR OMISSIONS SHALL BE RESOLVED WITH THE PROJECT ENGINEER. DO NOT USE SCALED DIMENSIONS.

USA NORTH 811
Call 811 Before You Dig

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HAWAII U.S.A.
11/29/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION
COVER SHEET

DESIGNED BY : GRB	CHECKED BY : CHM	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB	FILE : 220048-C-001_COVER SHEET.dwg

SHEET
C-001

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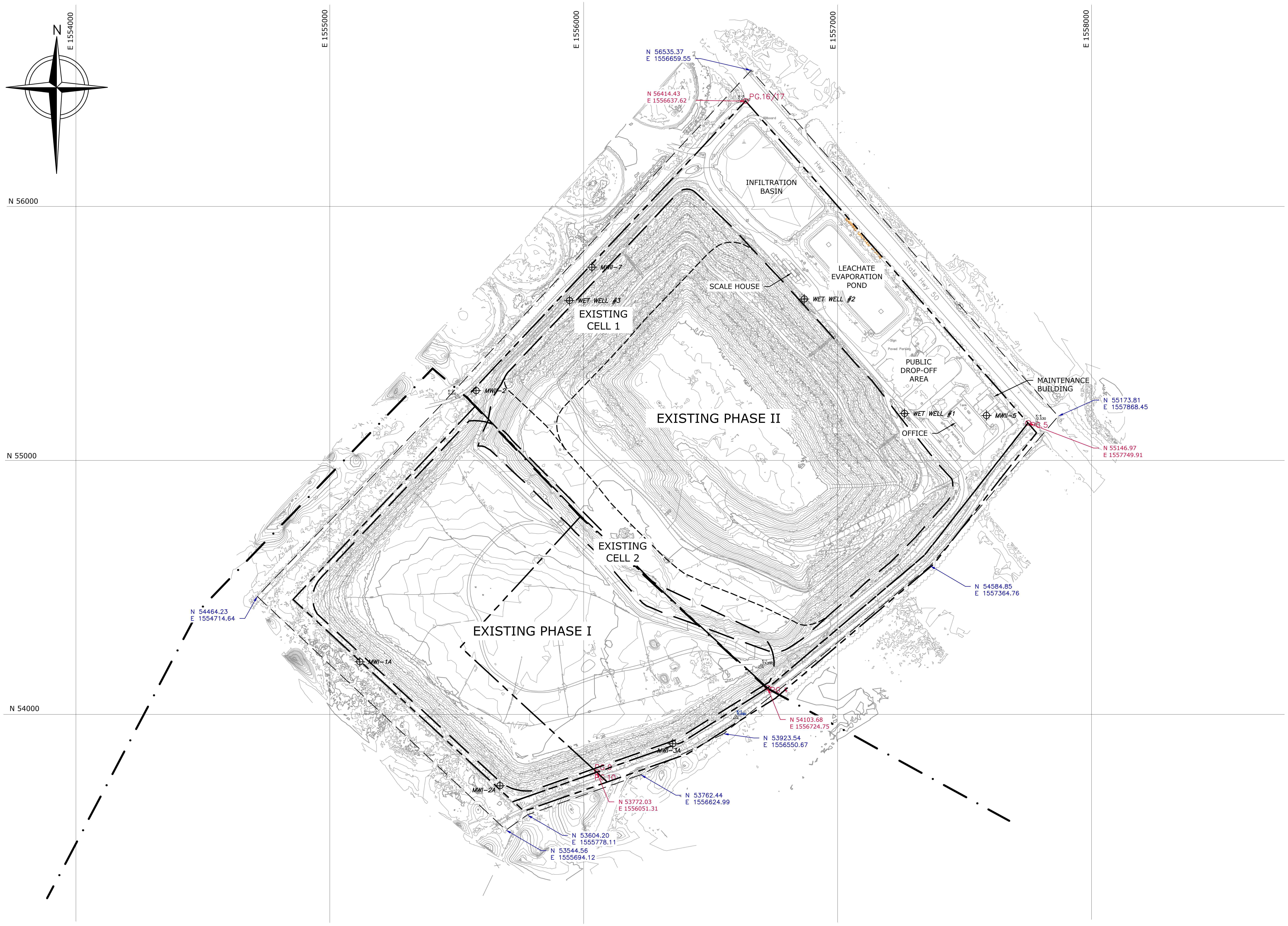

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LEGEND:

PROPERTY LINE

EASEMENT

PHASE LIMIT

CELL LIMIT

50 EXISTING INDEX CONTOUR (10FT INTERVAL)

EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)

⌖ MWI-3A GROUNDWATER MONITORING WELL

⌖ WET WELL #2 WET WELL

SPECIAL MANAGEMENT AREA (SMA) / CONSERVATION DISTRICT BOUNDARY

NOTES:

1. TOPOGRAPHIC CONTOURS PREPARED BY WALKER ASSOCIATES. DATE OF PHOTOGRAPHY: OCTOBER 2022
2. HORIZONTAL DATUM IS BASED ON NAD83 (1986) HAWAII STATE PLANE ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL, WHICH IS SITE-SPECIFIC AND CORRELATES TO DESIGNATED USGS BRASS MONUMENT G1000 PLUS 1.21 FEET (AECOM, 2018).

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11/29/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

EXISTING CONDITIONS

DESIGNED BY : GRB	CHECKED BY : CHM	DATE : NOV 2023
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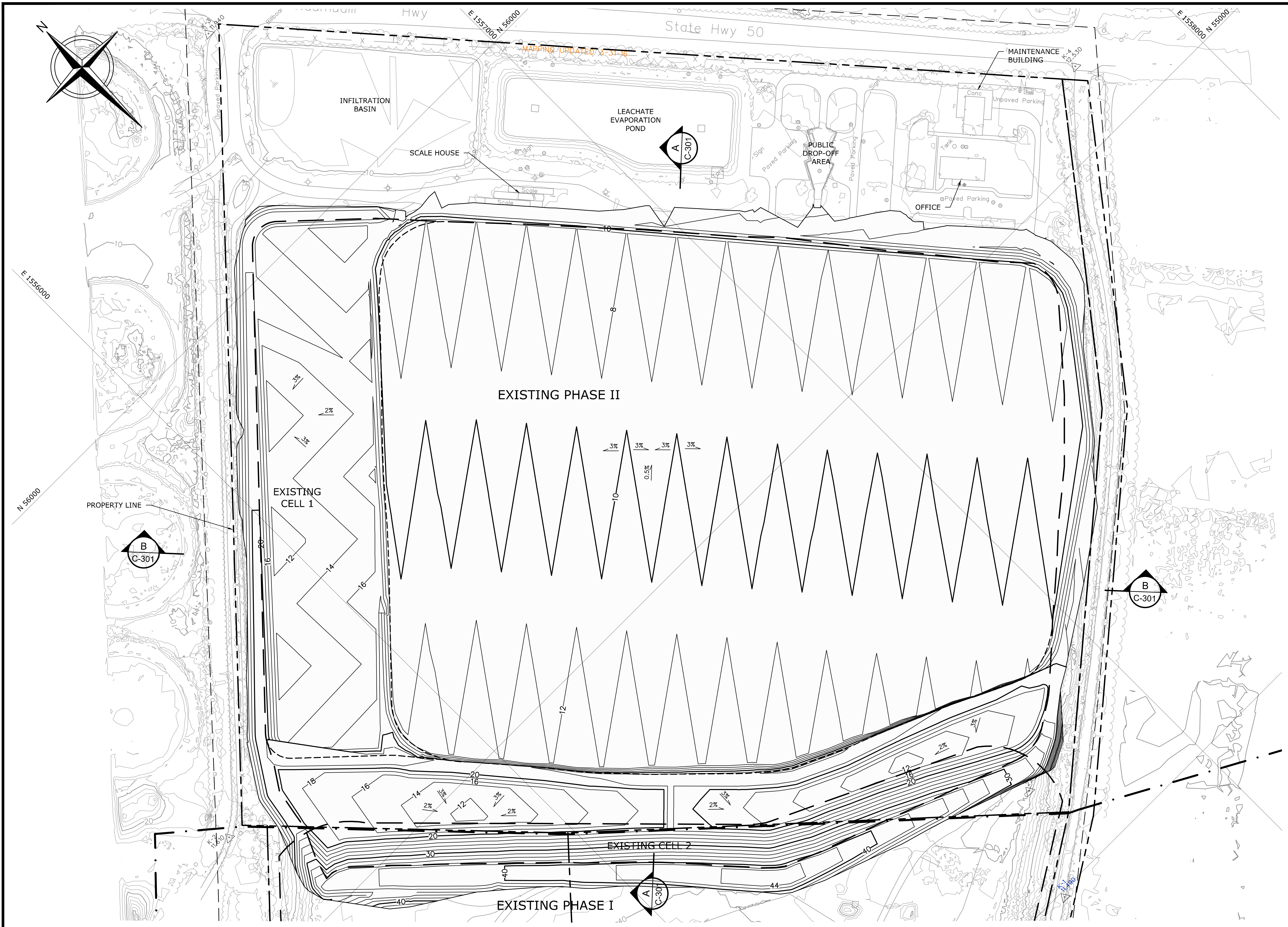
SHEET
C-100



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SCALE IN FEET

LEGEND:

— — — —	PROPERTY LINE
– – – – –	EASEMENT
— — —	PHASE LIMIT
- - - - - -	CELL LIMIT
— · — · —	PROJECT LIMIT
—— 20 ——	EXISTING INDEX CONTOUR (10FT INTERVAL)
————	EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
—— 20 ——	PERMITTED SUBGRADE CONTOUR (10FT INTERVAL)
————	PERMITTED FSUBGRADE CONTOUR (5FT INTERVAL)
— · —	SPECIAL MAINTENANCE AREA (SMA) / CONSERVATION DISTRICT BOUNDARY

NOTES:

1. TOPOGRAPHIC CONTOURS PREPARED BY WALKER ASSOCIATES. DATE OF PHOTOGRAPHY: OCTOBER 22, 2022
2. HORIZONTAL DATUM IS BASED ON NAD83 (1986) HAWAII STATE PLANE ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL, WHICH IS SITE SPECIFIC AND CORRELATES TO DESIGNATED USGS BRASS MONUMENT G1000 PLUS 1.21 FEET (AECOM, 2018).
3. LINER SUBGRADE TOPO FROM GEOSYNTEC (2022), PREPARED FROM BEST AVAILABLE RECORD DATA FOR PHASE II (1993); PHASE II, CELL 1 (2013); AND PHASE II, CELL 2 (2019)

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KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

SUBBASE GRADING PLAN

SHEET
C-101

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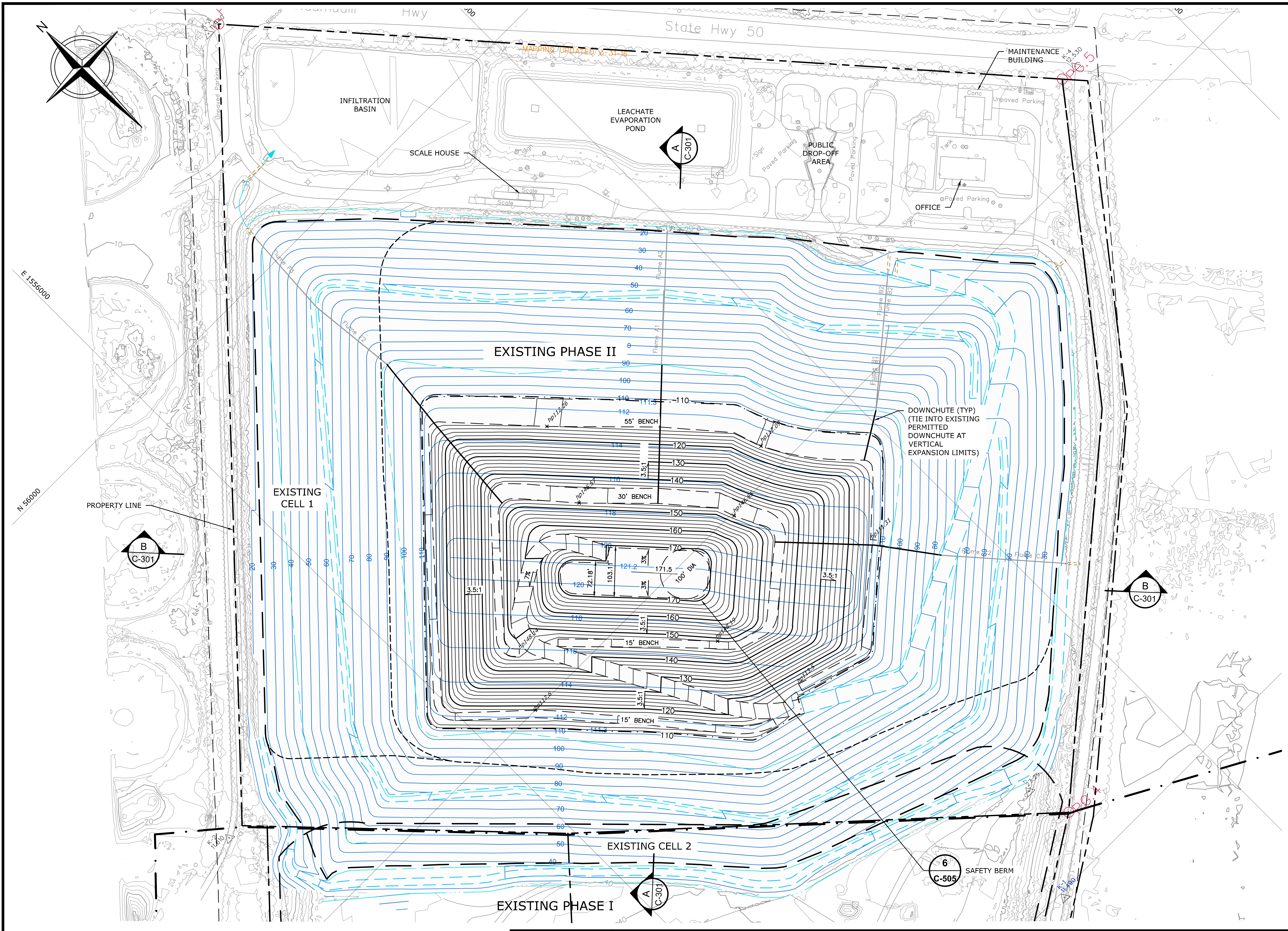

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SCALE IN FEET

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LEGEND:

PROPERTY LINE
EASEMENT
PHASE LIMIT
CELL LIMIT
PROJECT LIMIT
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EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
50 PERMITTED FINAL COVER CONTOUR (10FT INTERVAL) (BY OTHERS)
PERMITTED FINAL COVER CONTOUR (5FT INTERVAL) (BY OTHERS)
PERMITTED EDGE OF ACCESS ROAD/BENCH
PERMITTED STORMWATER FLOW
50 PROPOSED FINAL COVER CONTOUR (10FT INTERVAL)
PROPOSED FINAL COVER CONTOUR (2FT INTERVAL)
SPECIAL MAINTENANCE AREA (SMA) / CONSERVATION DISTRICT BOUNDARY

PH2 PERMIT FC vs VERT EXPAN:
NET = 407,700 CY (FILL)

NOTES:

1. TOPOGRAPHIC CONTOURS PREPARED BY WALKER ASSOCIATES. DATE OF PHOTOGRAPHY: OCTOBER 2022.
2. HORIZONTAL DATUM IS BASED ON NAD83 (1986) HAWAII STATE PLANE ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL, WHICH IS SITE-SPECIFIC AND CORRELATES TO DESIGNATED USGS BRASS MONUMENT G1000 PLUS 1.21 FEET (AECOM, 2018).

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KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

FINAL COVER GRADING PLAN

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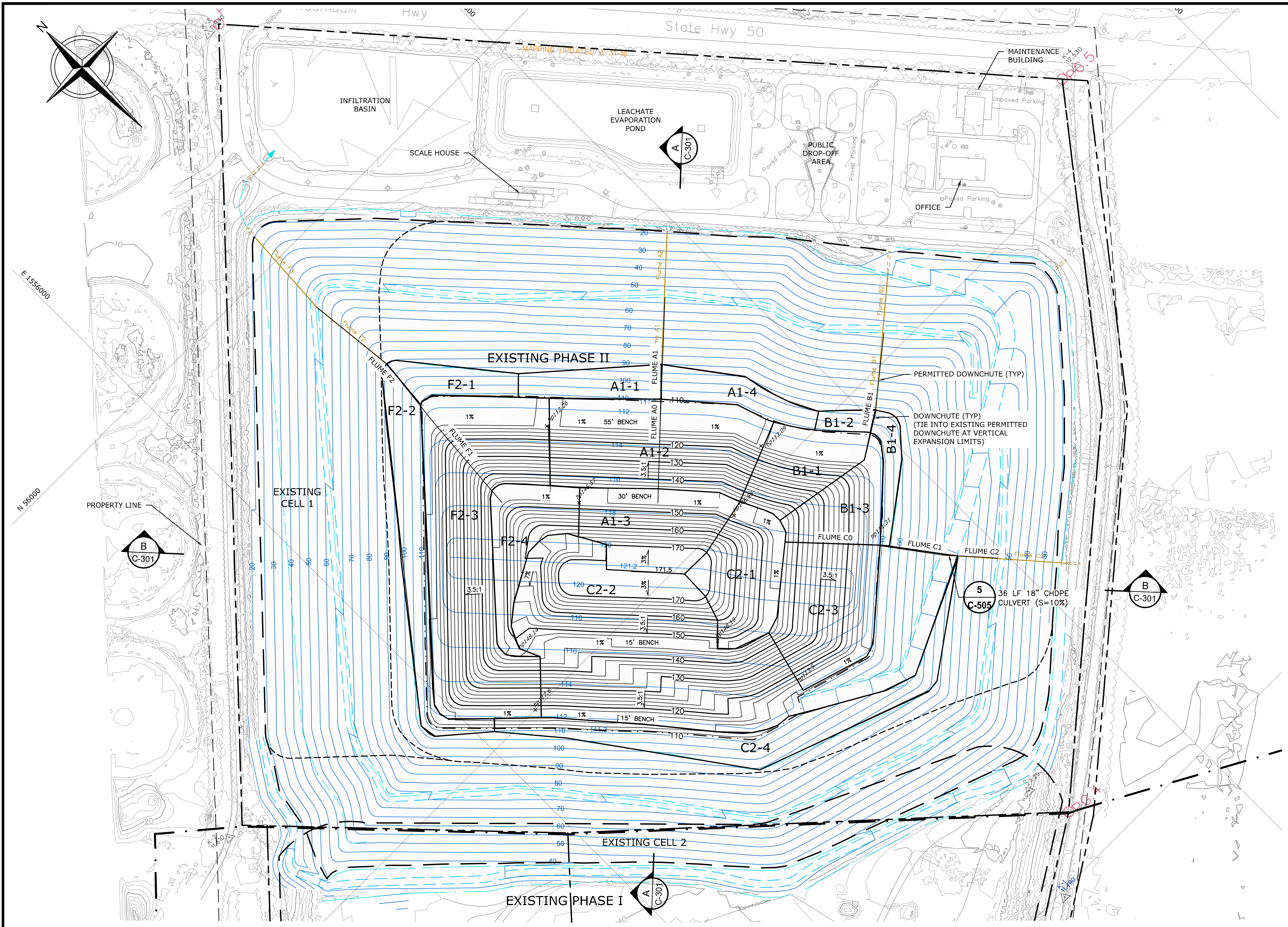
APPROVED BY : GRB
FILE : 220048-C-102_FIN COV PLAN.dwg

SHEET
C-102



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SCALE IN FEET

LEGEND:

PROPERTY LINE
EASEMENT
PHASE LIMIT
CELL LIMIT
PROJECT LIMIT
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EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
50 PERMITTED FINAL COVER CONTOUR (10FT INTERVAL) (BY OTHERS)
PERMITTED FINAL COVER CONTOUR (5FT INTERVAL) (BY OTHERS)
PERMITTED EDGE OF ACCESS ROAD/BENCH
PERMITTED STORMWATER FLOW
50 PROPOSED FINAL COVER CONTOUR (10FT INTERVAL)
PROPOSED FINAL COVER CONTOUR (2FT INTERVAL)
SPECIAL MAINTENANCE AREA (SMA) / CONSERVATION DISTRICT BOUNDARY

NOTES:

1. TOPOGRAPHIC CONTOURS PREPARED BY WALKER ASSOCIATES. DATE OF PHOTOGRAPHY: OCTOBER 2022.
2. PHASE II AREA TOPOGRAPHY UPDATED BY AIRFRAME LLC , MAY 5, 2021.
3. HORIZONTAL DATUM IS BASED ON NAD83 (1986) HAWAII STATE PLANE ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL,WHICH IS SITE-SPECIFIC AND CORRELATES TO DESIGNATED USGS BRASS MONUMENT G1000 PLUS 1.21 FEET (AECOM, 2018).

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KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION
SURFACE WATER MANAGEMENT PLAN

SHEET
C-103

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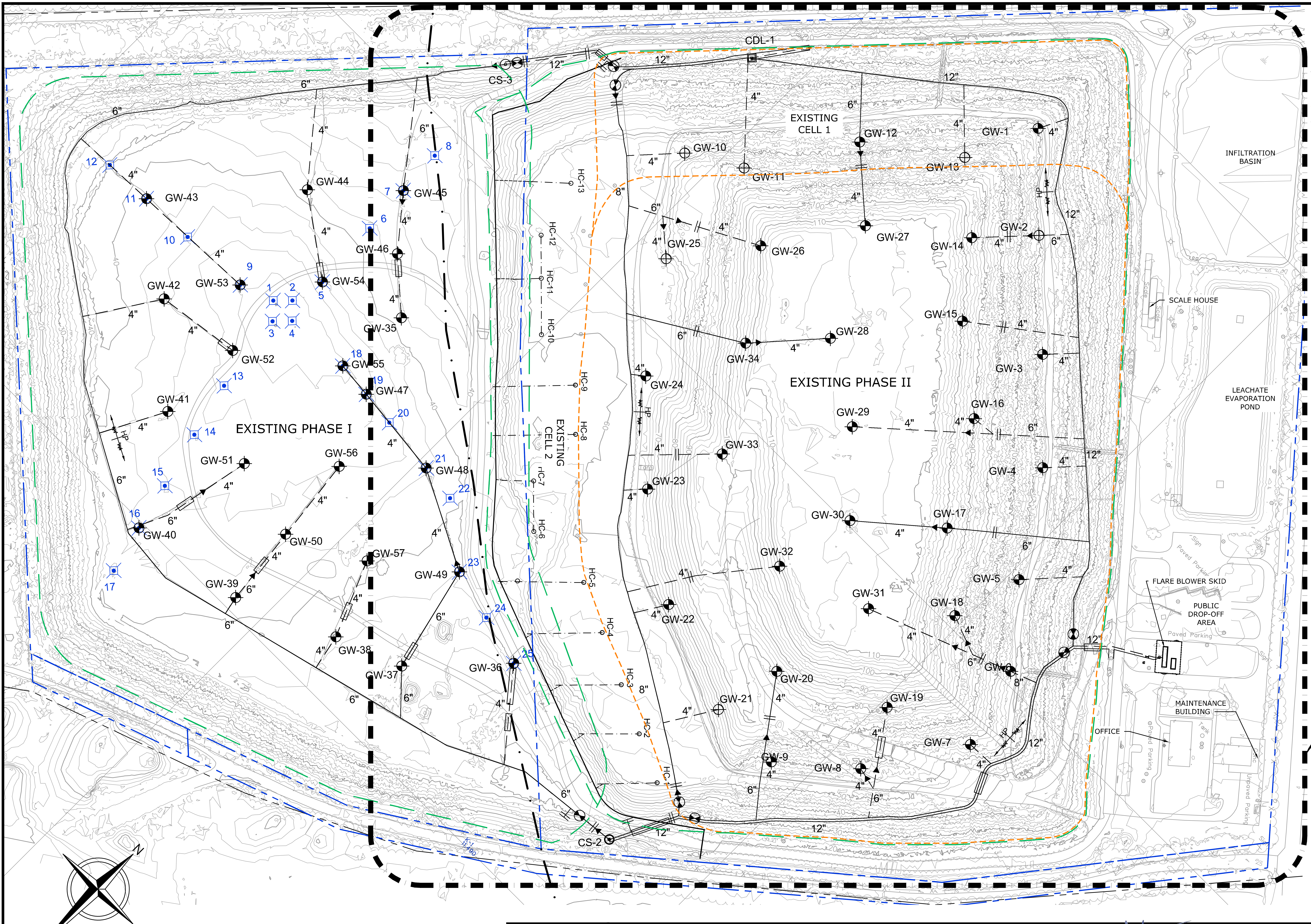

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LEGEND:

— — —	PROPERTY LINE (APPROXIMATE)
— — —	EASEMENT PROPERTY LINE
— — —	LANDFILL WASTE PHASE LIMIT
- - - -	EXISTING CELL LIMIT
50	EXISTING INDEX CONTOUR (10FT INTERVAL)
——	EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
⊕ MWI-3A 4.48	GROUNDWATER MONITORING WELL & WSEL
⊕ WET WELL #2	WET WELL
HP	HIGH POINT IN HEADER
— · — · —○	LANDFILL HORIZONTAL COLLECTOR WITH CLEANOUT RISER
— — — —	LANDFILL GAS COLLECTION BELOW GRADE HEADER/LATERAL
——	CONDENSATE LINE
⊙	CONDENSATE SUMP
—‖	BLIND FLANGE
‖	FLANGE
GW-30	GAS EXTRACTION WELL
●	VALVE
—▶—	REDUCER
18 GW-55	EXISTING LANDFILL GAS VENT WITH WELLHEAD
▣	DRIPLEG
▭	EXISTING ROAD CROSSING
24	EXISTING GAS VENT

SEE SHEETS C-111 TO C-113 FOR ENLARGED AREA

NOTES:

1. TOPOGRAPHIC CONTOURS PROVIDED BY KAUAI COUNTY. DATE OF PHOTOGRAPHY: OCTOBER 22, 2022
2. PHASE II AREA TOPOGRAPHY UPDATED BY AIRFRAME LLC , MAY 5, 2021.
3. HORIZONTAL DATUM IS BASED ON NAD83 (1986). HAWAII ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL.
4. THE AS-BUILT GCCS WAS PROVIDED BY KAUAI COUNTY DATED MAY 15, 2015.
5. THE LOCATIONS OF THE HORIZONTAL COLLECTORS ARE DRAWN IN APPROXIMATELY ACCORDING TO THE AS BUILT SURVEY COMPLETED BY ESAKI SURVEYING AND MAPPING, INC. ON SEPTEMBER 29, 2021.

ISSUED FOR PERMITTING - NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE

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TEL 909.860.7777 FAX 909.860.8017

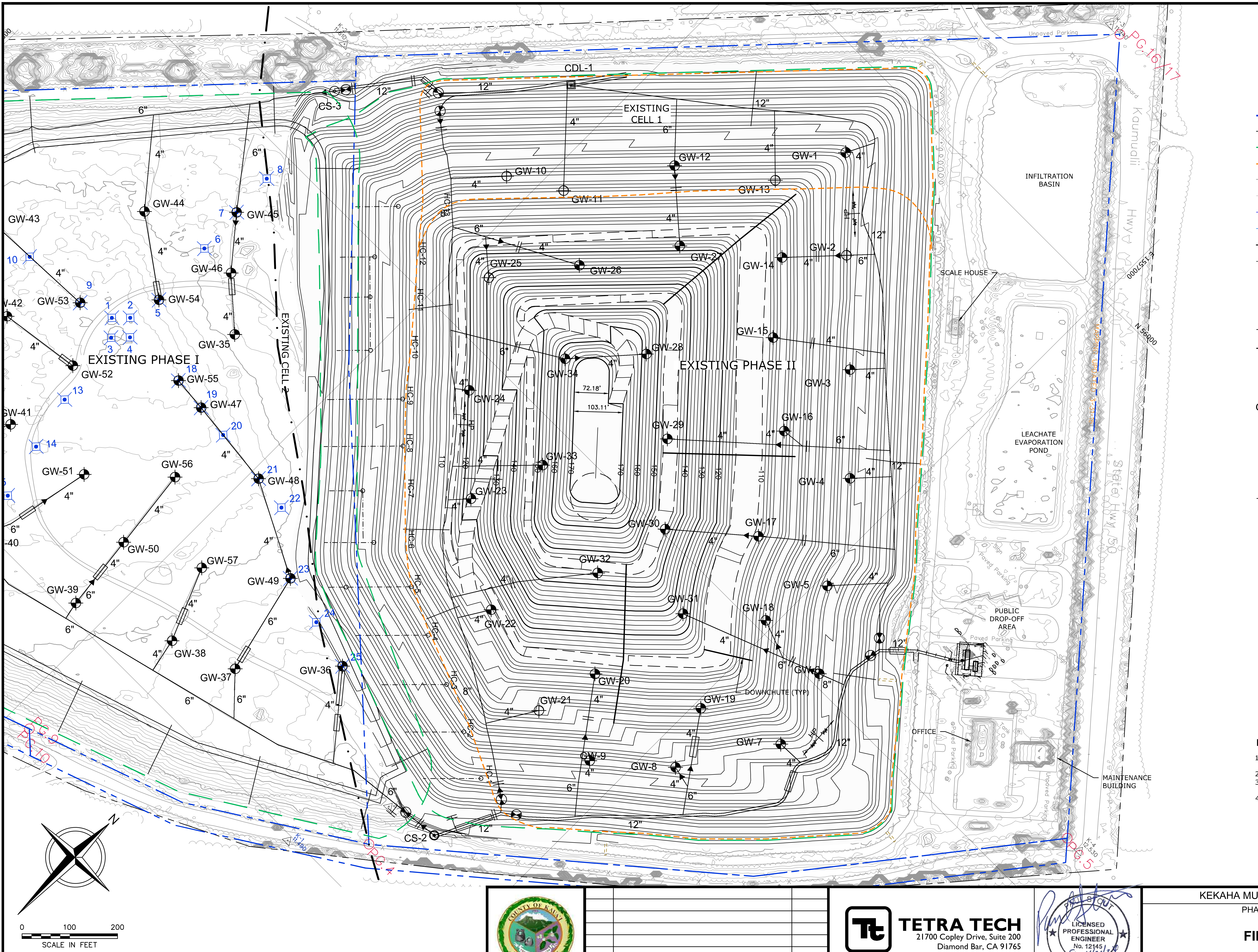
PAUL STOUT
LICENSED PROFESSIONAL ENGINEER
No. 12145
Exp 4/30/24
HAWAII U.S.A.
11/28/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

EXISTING GCCS CONDITIONS

SHEET
C-110

DESIGNED BY : GRB/CME	CHECKED BY : AMN	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB/PJS	FILE : 220048-C-110_EXIST COND PLAN_221122.dwg



LEGEND:

	PROPERTY LINE
	EASEMENT PROPERTY LINE
	LANDFILL WASTE PHASE LIMIT
	EXISTING CELL LIMIT
50	EXISTING INDEX CONTOUR (10FT INTERVAL)
	EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
50	PERMITTED FINAL COVER CONTOUR (10FT INTERVAL)
	PERMITTED FINAL COVER CONTOUR (5FT INTERVAL)
50	PROPOSED FINAL COVER CONTOUR (10FT INTERVAL)
	PROPOSED FINAL COVER CONTOUR (2FT INTERVAL)
MWI-3A 4.48	GROUNDWATER MONITORING WELL & WSEL
WET WELL #2	WET WELL
HP	HIGH POINT IN HEADER
	LANDFILL GAS COLLECTION HEADER/LATERAL
	CONDENSATE LINE
⊙	CONDENSATE SUMP
	BLIND FLANGE
	FLANGE
GW-30	GAS EXTRACTION WELL
	VALVE
	REDUCER
18 GW-55	EXISTING LANDFILL GAS VENT WITH WELLHEAD
	DRIPLEG
	EXISTING ROAD CROSSING
24	EXISTING GAS VENT

NOTES:

1. TOPOGRAPHIC CONTOURS PREPARED BY WALKER ASSOCIATES. DATE OF PHOTOGRAPHY: FEBRUARY 24, 2019
2. PHASE II AREA TOPOGRAPHY UPDATED BY AIRFRAME LLC , MAY 5, 2021.
3. HORIZONTAL DATUM IS BASED ON NAD83 (1986). HAWAII ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL.
4. THE AS-BUILT GCCS WAS PROVIDED BY KAUAI COUNTY DATED MAY 15, 2015.

ISSUED FOR PERMITTING - NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE

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HAWAII U.S.A.
Exp 4/30/24
11/28/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

FINAL COVER PLAN

SHEET
C-111

DESIGNED BY : GRB/CME
CHECKED BY : AMN
DATE : NOV 2023
DRAWN BY : MDC/GVP
APPROVED BY : GRB/PJS
FILE : 220048-C-111_FINAL COVER PLAN_221031.dwg

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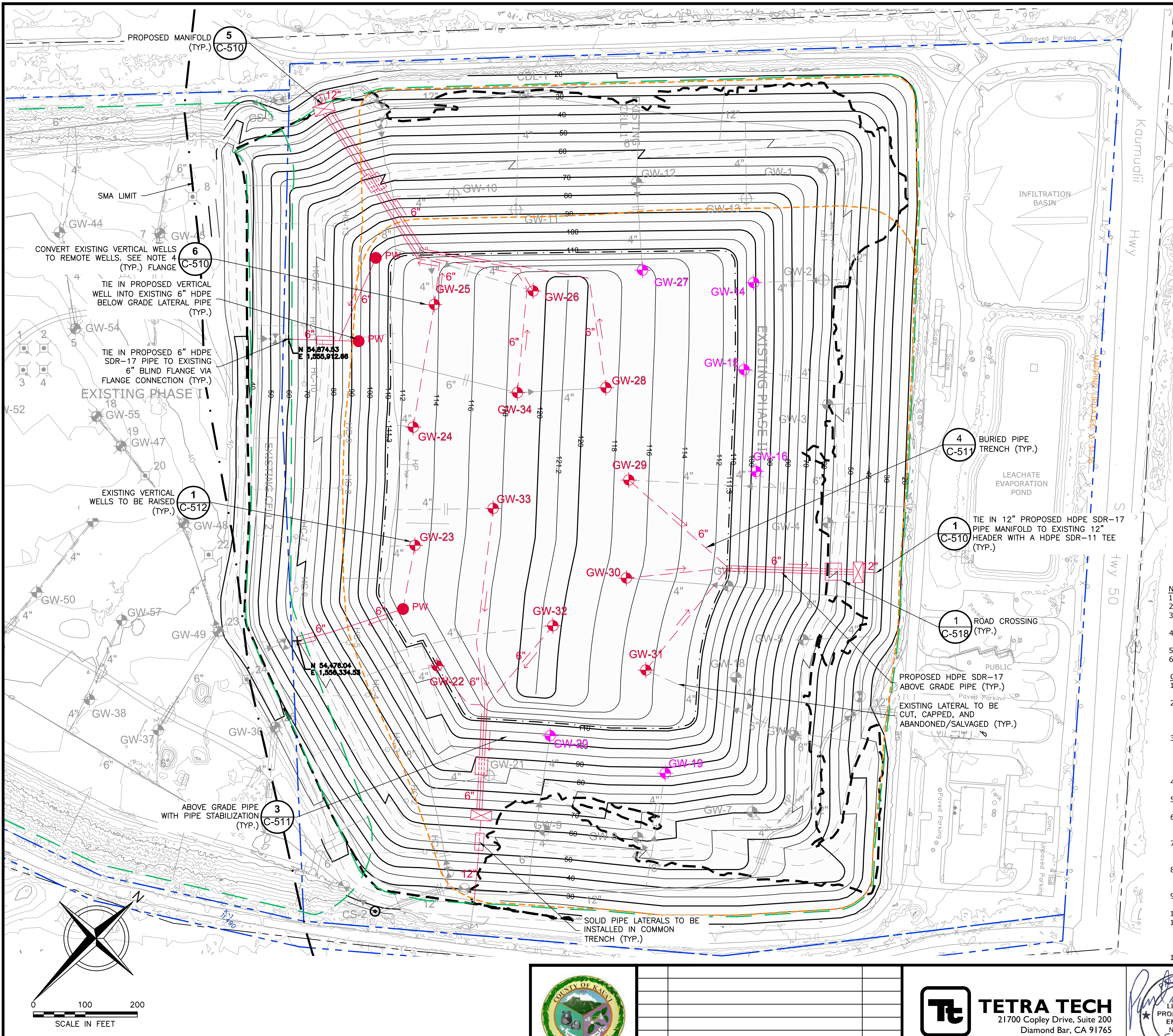

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LEGEND:

- PROPERTY LINE
- EASEMENT PROPERTY LINE
- LANDFILL WASTE PHASE LIMIT
- EXISTING CELL LIMIT
- 50 EXISTING INDEX CONTOUR (10FT INTERVAL)
- EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
- 50 CURRENT PERMITTED FINAL COVER CONTOUR (10FT INTERVAL)
- CURRENT PERMITTED FINAL COVER CONTOUR (2FT INTERVAL)
- CURRENT LIMIT OF AREA BELOW FINAL COVER GRADE
- MWI-3A 4.48 GROUNDWATER MONITORING WELL & WSEL
- WET WELL #2 WET WELL
- HP HIGH POINT IN HEADER
- LANDFILL HORIZONTAL COLLECTOR WITH CLEANOUT RISER
- LANDFILL GAS COLLECTION BELOW GRADE HEADER/LATERAL
- CONDENSATE LINE
- CONDENSATE SUMP
- BLIND FLANGE
- FLANGE
- GW-30 GAS EXTRACTION WELL
- VALVE
- REDUCER
- 18 GW-55 EXISTING LANDFILL GAS VENT WITH WELLHEAD
- DRIPLEG
- HEADER CASING
- 24 EXISTING GAS VENT
- PROPOSED ABOVE GRADE HDPE SDR-17 PIPE
- PROPOSED BELOW GRADE HDPE SDR-17 PIPE
- GW-22 EXISTING WELL TO BE RAISED
- GW-22 EXISTING WELL TO BE REMOTED
- ● PW PROPOSED VERTICAL EXTRACTION WELL
- ☒ PROPOSED MANIFOLD
- PROPOSED ROAD CROSSING
- ← SLOPE OF PIPE

EXISTING WELLS TO BE RAISED		
GW-14	GW-15	GW-16
GW-19	GW-20	GW-27

EXISTING WELLS TO BE REMOTED		
GW-22	GW-23	GW-24
GW-25	GW-26	GW-28
GW-29	GW-30	GW-31
GW-32	GW-33	

NOTES

1. TOPOGRAPHIC CONTOURS PROVIDED BY KAUAI COUNTY. DATE OF PHOTOGRAPHY: OCTOBER 22, 2022
2. PHASE II AREA TOPOGRAPHY UPDATED BY AIRFRAME LLC , MAY 5, 2021.
3. HORIZONTAL DATUM IS BASED ON NAD83 (1986). HAWAII ZONE 4. VERTICAL DATUM BASED ON LOCAL TIDAL, WHICH IS SITE-SPECIFIC AND CORRELATES TO DESIGNATED USGS BRASS MONUMENT G1000 PLUS 1.21 FEET (AECOM, 2018).
4. WELLHEADS TO BE LOCATED ON EDGE OF TOP DECK NEXT TO SIDE SLOPE. LOCATIONS MAY REQUIRE FIELD MODIFICATIONS BASED ON TOPOGRAPHY AT TIME OF CONSTRUCTION.
5. THE AS-BUILT GCCS WAS PROVIDED BY KAUAI COUNTY DATED MAY 15, 2015.
6. THE LOCATIONS OF THE HORIZONTAL COLLECTORS ARE DRAWN IN APPROXIMATELY ACCORDING TO THE AS BUILT SURVEY COMPLETED BY ESAKI SURVEYING AND MAPPING, INC. ON SEPTEMBER 29, 2021.

CONSTRUCTION NOTES:

1. CONTRACTOR TO SURVEY AND STAKE PIPING ALIGNMENTS WITH GRADES AND OBTAIN APPROVAL FROM THE ENGINEER AND OWNER PRIOR TO PROCEEDING.
2. THE CONTRACTOR SHALL LAY OUT THE PIPE TO CONFORM TO FIELD CONDITIONS. PROVIDE 36" MINIMUM COVER AND 5% MINIMUM SLOPE CROSSING BELOW PERIMETER AND MAIN HAUL ROADS. PROVIDE MINIMUM PIPE DRAINAGE SLOPES OF 3% WITHIN WASTE LIMIT AND 0.5% OUTSIDE OF WASTE LIMIT. CONTRACTOR RESPONSIBLE FOR CUT (12" MAX, UNLESS OTHERWISE NOTED PER PLAN) AND FILL BENEATH PIPE TO ENSURE PROPER DRAINAGE, AS APPROVED BY THE ENGINEER AND OWNER.
3. FEATURES, CONTOURS, AND ELEVATIONS OF THESE BASE MAPS ARE APPROXIMATE INDICATIONS OF CURRENT AND FUTURE CONDITIONS. CONTRACTOR IS RESPONSIBLE FOR INSPECTING WORK AREAS AT PRE-BID SITE WALK AS CURRENT CONDITIONS FOR BIDDING PURPOSES. CONTRACTOR SHALL VERIFY THE ACTUAL LOCATIONS OF THESE ELEMENTS PRIOR TO, AND DURING CONSTRUCTION, AND SHALL FINALIZE THE GAS SYSTEM LOCATIONS TO ACCOMMODATE FINAL FIELD CONDITIONS, AS APPROVED BY THE ENGINEER AND OWNER.
4. ALL CONNECTIONS TO EXISTING PIPING SHALL BE CONFIRMED BY THE CONTRACTOR PRIOR TO BIDDING. SOME CONNECTIONS MAY REQUIRE EXCAVATION.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR MAKING ALL DISCONNECTIONS AND RECONNECTIONS FOR INSTALLATION OF NEW PIPING WHERE NECESSARY.
6. WORK SHALL NOT VARY FROM DESIGN WITHOUT APPROVAL OF THE ENGINEER. WORK THAT VARIES FROM DESIGN WITHOUT APPROVAL WILL BE SUBJECT TO REWORK TO MAINTAIN ADHERENCE TO THE APPROVED DESIGN. ANY REWORK AS A RESULT WILL NOT BE PAID FOR.
7. ALL PIPING GREATER THAN 6 INCHES IN DIAMETER SHALL BE PRESSURE TESTED FOR 1 HOUR AT 10 PSIG. GREATER THAN 10% DROP IN PRESSURE OVER 1 HOUR SHALL INDICATE A LEAK EXISTS AND SHALL BE REPAIRED AND RETESTED. PIPE SHALL BE TESTED IN SEGMENTS NO LONGER THAN 2,000 FEET UNLESS APPROVED BY THE ENGINEER.
8. CONTRACTOR TO REMOVE AND REUSE EXISTING WELLHEADS, PUMPS, PIPING AND FITTINGS WHERE APPLICABLE. CAP ALL ABANDONED PIPE. IF ABANDONED PIPE IS HDPE, USE FUSED ON HDPE CAP. IF ABANDONED PIPE IS PVC, USE PVC SCH 40 CAP SECURED WITH SET SCREWS AT 90° AND CEMENT.
9. ALL EXISTING PIPING THAT IS NOT IN USE, AS DIRECTED BY THE ENGINEER, SHALL BE RELOCATED BY THE CONTRACTOR TO THE ON-SITE STORAGE FACILITY.
10. CONTRACTOR TO USE FACTORY MOLDED/FABRICATED CONCENTRIC REDUCER FITTINGS AS NECESSARY.
11. CONTRACTOR TO PROTECT IN PLACE THE EXISTING ABOVE AND BELOW GRADE LATERALS DURING CONSTRUCTION. IF EXISTING PIPING NEEDS TO BE RELOCATED TEMPORARILY DURING CONSTRUCTION, THE CONTRACTOR WILL ENSURE CONSTANT SLOPE IS MAINTAINED ON THE PIPE AND THE LATERALS WILL BE RETURNED TO THEIR EXISTING CONDITION FOLLOWING CONSTRUCTION ACTIVITIES.
12. ELECTROFUSION COUPLERS SHALL NOT BE USED UNLESS APPROVED BY THE ENGINEER AND OWNER.

REV	REVISION DESCRIPTION	DATE

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PAUL STOUT
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Exp 4/30/24
HAWAII U.S.A.
11/28/23

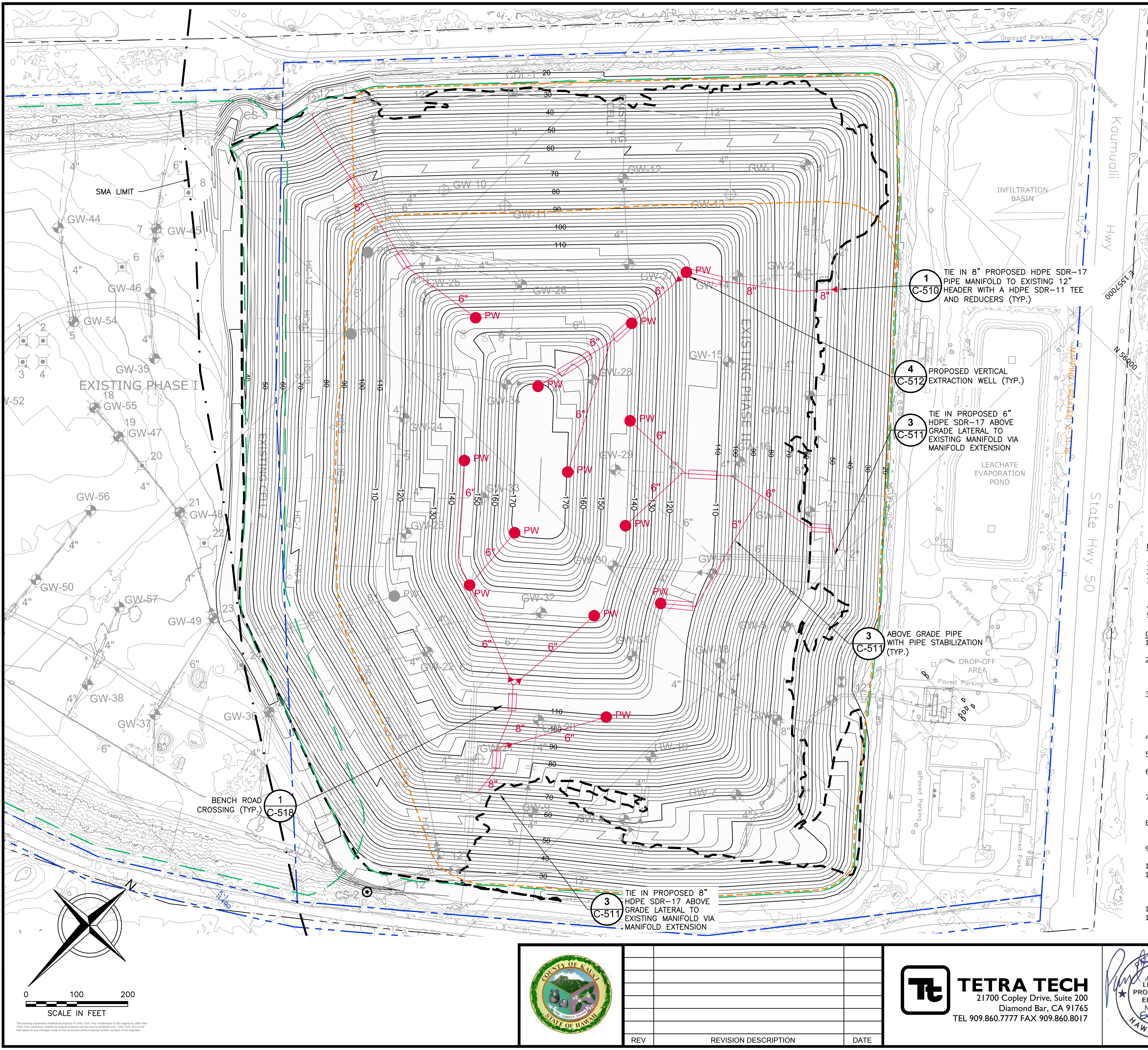
KEKAHA MUNICIPAL SOLID WASTE LANDFILL

PHASE II - VERTICAL EXPANSION

GCCS CONSTRUCTION SITE PLAN - PHASE I

SHEET
C-112

DESIGNED BY : GRB/CME	CHECKED BY : AMN	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB/PJS	FILE : 220048-C-112-113_SITE GCCS PLAN_220315.dwg



LEGEND:

— - - —	PROPERTY LINE
— - - —	EASEMENT PROPERTY LINE
- - - -	LANDFILL WASTE PHASE LIMIT
- - - -	EXISTING CELL LIMIT
— 50 —	EXISTING INDEX CONTOUR (10FT INTERVAL)
——	EXISTING INTERMEDIATE CONTOUR (2FT INTERVAL)
— 50 —	PROPOSED FINAL COVER CONTOUR (10FT INTERVAL)
——	PROPOSED FINAL COVER CONTOUR (2FT INTERVAL)
■ ■ ■ ■	CURRENT LIMIT OF AREA BELOW FINAL COVER GRADE
⊕ MWI–3A 4.48	GROUNDWATER MONITORING WELL & WSEL
⊕ WET WELL #2	WET WELL
HP	HIGH POINT IN HEADER
— · — · —○	LANDFILL HORIZONTAL COLLECTOR WITH CLEANOUT RISER
— — — —	LANDFILL GAS COLLECTION BELOW GRADE HEADER/LATERAL
——	CONDENSATE LINE
⊙	CONDENSATE SUMP
⊣‖	BLIND FLANGE
GW-30 ⊕	GAS EXTRACTION WELL
⊗	VALVE
→▶	REDUCER
18 GW-55	EXISTING LANDFILL GAS VENT WITH WELLHEAD
⊡	DRIPLEG
—▭—	HEADER CASING
24 ⊠	EXISTING GAS VENT
● PW	PROPOSED VERTICAL EXTRACTION WELL
——	PROPOSED ABOVE GRADE HDPE SDR-17 PIPE
☒	PROPOSED MANIFOLD
—▭—	PROPOSED ROAD CROSSING
→▶	PROPOSED REDUCER

NOTES:

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12. ELECTROFUSION COUPLERS SHALL NOT BE USED UNLESS APPROVED BY THE ENGINEER AND OWNER.
13. CONTRACTOR SHALL PREPARE BID ASSUMING THAT THE WELLS WILL BE INSTALLED PRIOR TO LATERAL PIPING. LATERAL PIPING ALIGNMENTS AND ROUTES SUBJECT TO CHANGE PENDING INSTALLED WELL GAS QUALITY AND ASSOCIATED SCOPE ADJUSTMENTS WILL BE ASSESSED VIA THE PROVIDED UNIT PRICE VALUES IN THE BID.

ISSUED FOR PERMITTING - NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE

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No. 12145
Exp 4/30/24
HAWAII U.S.A.
11/28/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL

PHASE II - VERTICAL EXPANSION

GCCS FINAL FILL PLAN - PHASE II

SHEET
C-113

DESIGNED BY : GRB/CME	CHECKED BY : AMN	DATE : NOV 2023	
DRAWN BY : MDC/GVP	APPROVED BY : GRB/PJS	FILE : 220048-C-112-113_SITE GCCS PLAN_220315.dwg	

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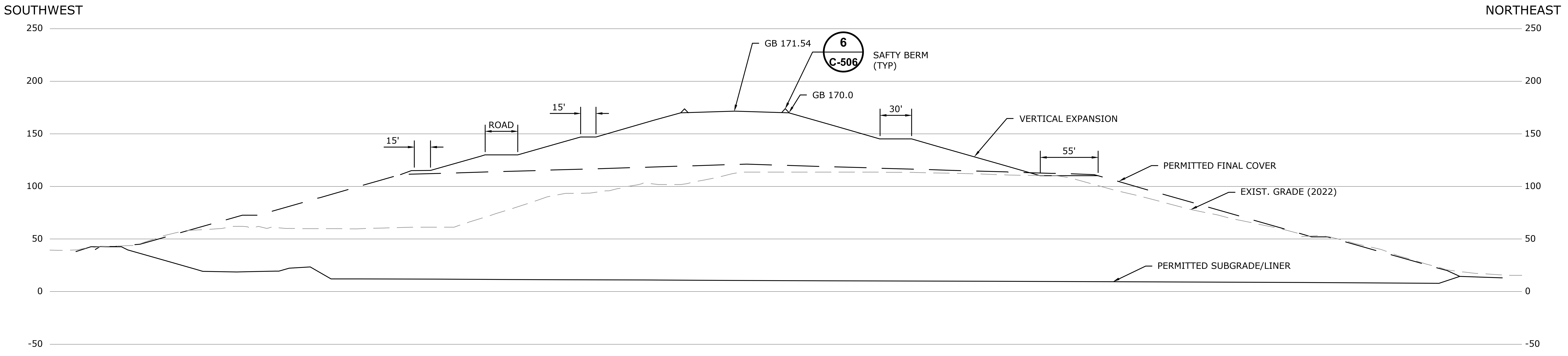
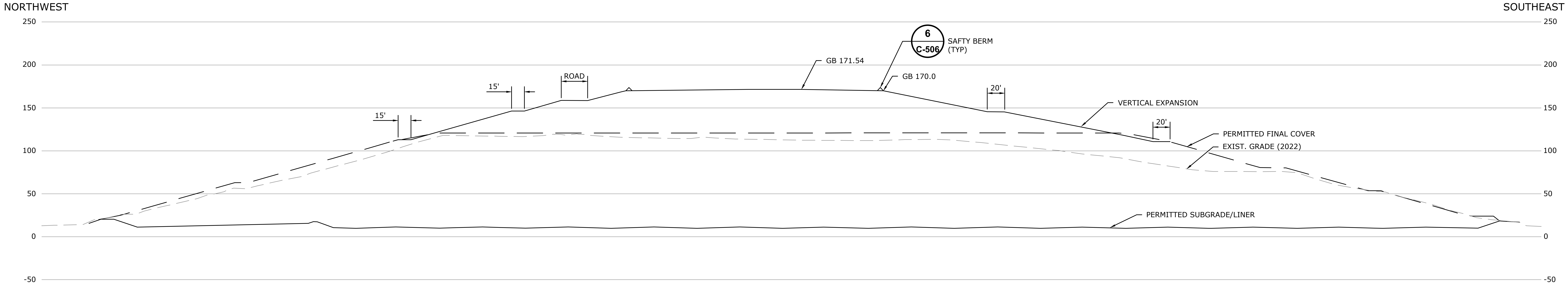


SOUTHWEST-NORTHEAST

SECTION A / C-301

SCALE: 1"=60'



NORTHWEST-SOUTHEAST

SECTION B / C-301

SCALE: 1"=60'

ISSUED FOR PERMITTING - NOT FOR CONSTRUCTION

X:\PROJECTS\KAUAI COUNTY\197-220048 - Kekaha Vertical Expansion_Project Drawings\220048-C-301_LF SECTIONS.dwg 11/28/2023 3:57 PM

REV	REVISION DESCRIPTION	DATE

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No. 20139-C
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11/29/23

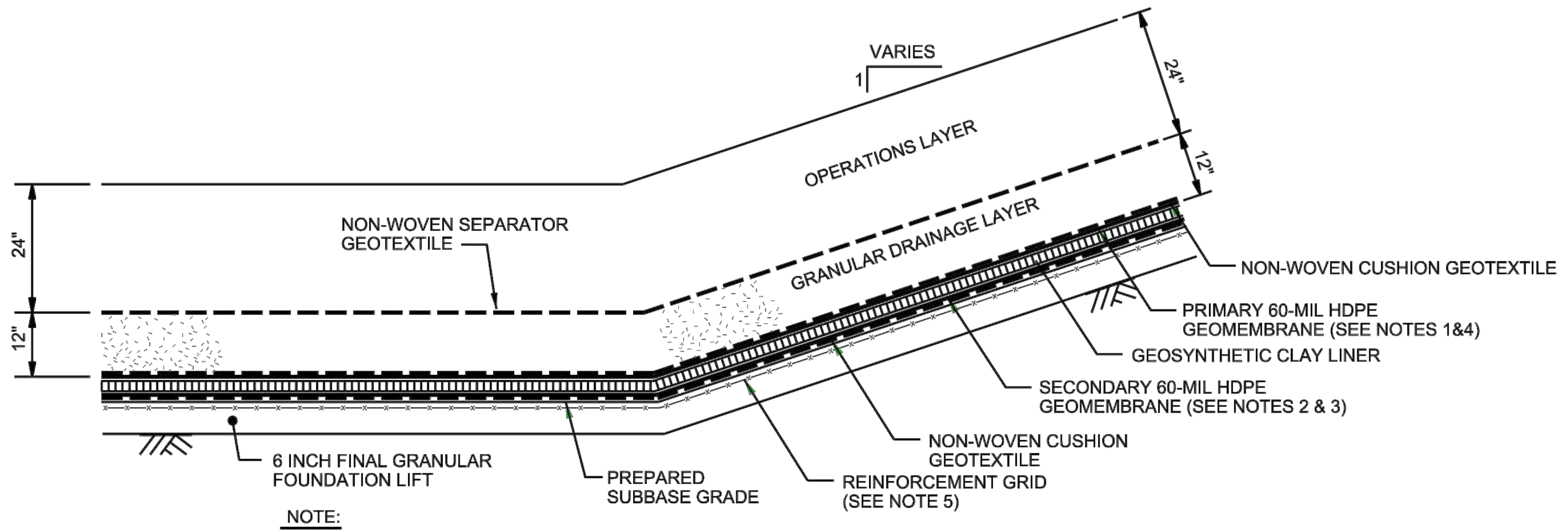
KEKAHA MUNICIPAL SOLID WASTE LANDFILL

PHASE II - VERTICAL EXPANSION

LANDFILL CROSS-SECTIONS

DESIGNED BY : GRB
CHECKED BY : CHM
DATE : NOV 2023
DRAWN BY : MDC/GVP
APPROVED BY : GRB
FILE : 220048-C-301_LF SECTIONS.dwg

SHEET
C-301

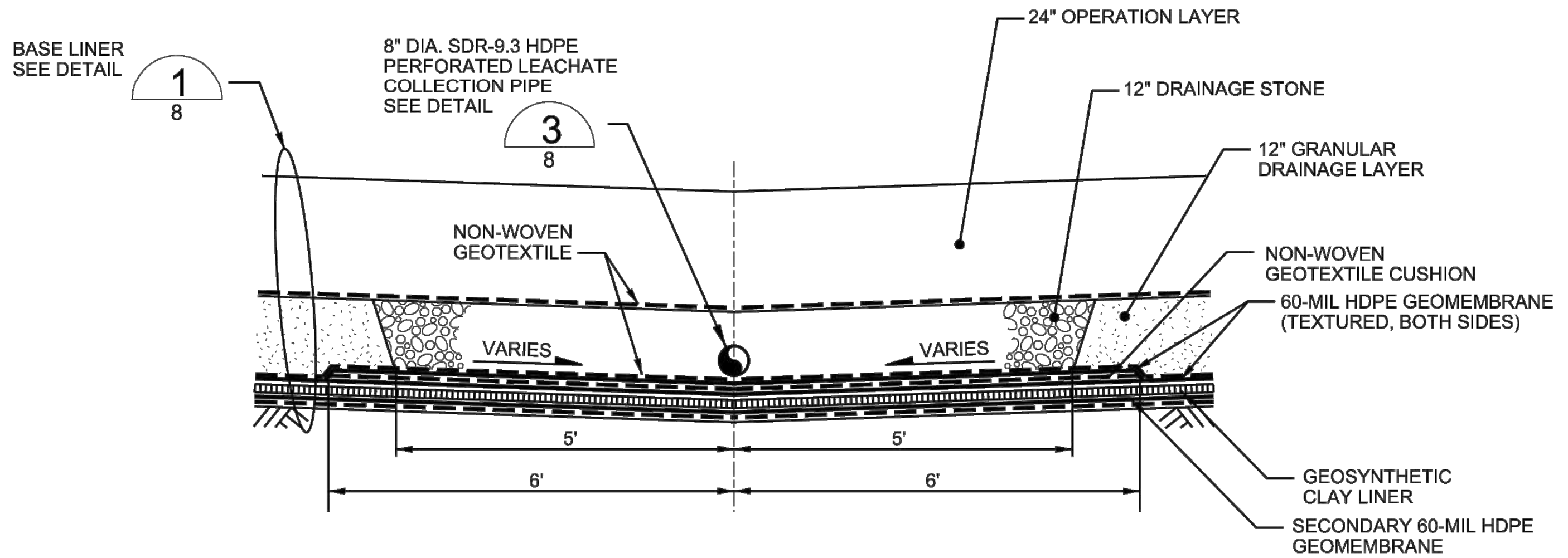


NOTE:

1. PRIMARY 60-MIL HDPE GEOMEMBRANE OVER PHASE I SIDESLOPE IS SINGLE-SIDED TEXTURED. SMOOTH SIDE OF GEOMEMBRANE IS UP AND IN DIRECT CONTACT WITH NON-WOVEN CUSHION GEOTEXTILE FOR THE GRANULAR DRAINAGE LAYER. EXTEND PRIMARY SINGLE-SIDED TEXTURED GEOMEMBRANE 5 FEET PAST TOE OF SLOPE WHERE EXTRUSION WELDED TO PRIMARY DOUBLE-SIDED TEXTURED GEOMEMBRANE.
2. SECONDARY 60-MIL HDPE GEOMEMBRANE OVER PHASE 1 SIDESLOPE IS SINGLE-SIDED TEXTURED. SMOOTH SIDE OF GEOMEMBRANE IS DOWN AND IN CONTACT WITH NON-WOVEN CUSHION GEOTEXTILE. EXTEND SECONDARY SINGLE-SIDED TEXTURED GEOMEMBRANE 5 FEET PAST TOE OF SLOPE WHERE EXTRUSION WELDED TO SECONDARY DOUBLE-SIDED TEXTURED GEOMEMBRANE.
3. SECONDARY 60-MIL HDPE GEOMEMBRANE ON PHASE II SIDESLOPE AND CELL 2 BASE IS TEXTURED ON BOTH SIDES.
4. PRIMARY 60-MIL HDPE GEOMEMBRANE ON PHASE II SIDESLOPE AND CELL 2 BASE IS TEXTURED ON BOTH SIDES.
5. REINFORCEMENT GRID TO BE INSTALLED ON PHASE I SIDESLOPES IN SUBCELLS A AND D. REFER TO APPENDIX F OF ENGINEERING REPORT FOR MATERIAL PROPERTIES. REFER TO DRAWING NO. 2 FOR LOCATIONS.

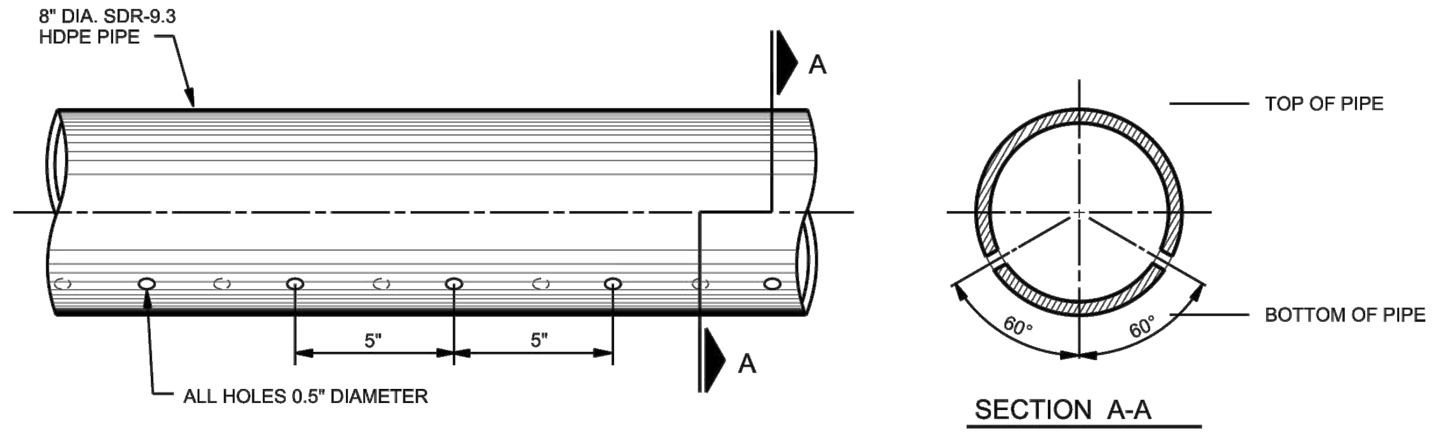
BASE LINER DETAIL 1

NTS



LEACHATE COLLECTION SYSTEM 2

NTS

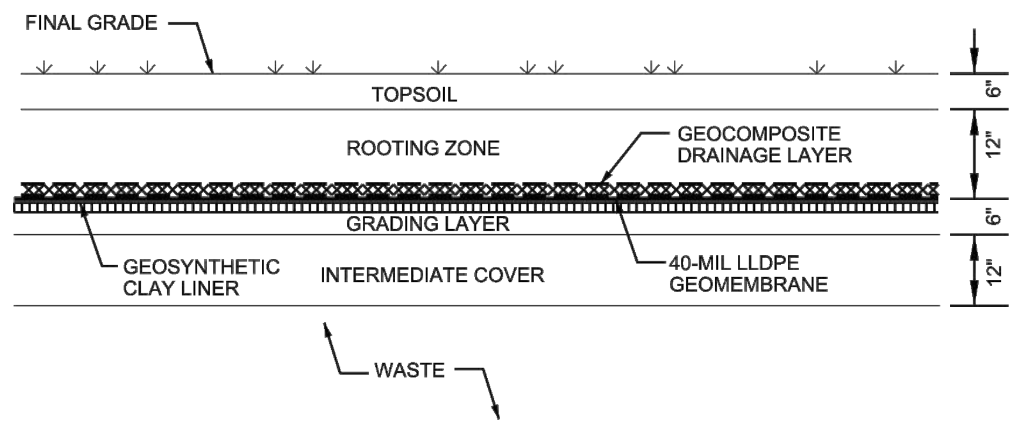


NOTE:

1. ALL HOLES TO BE ALTERNATELY STAGGERED.

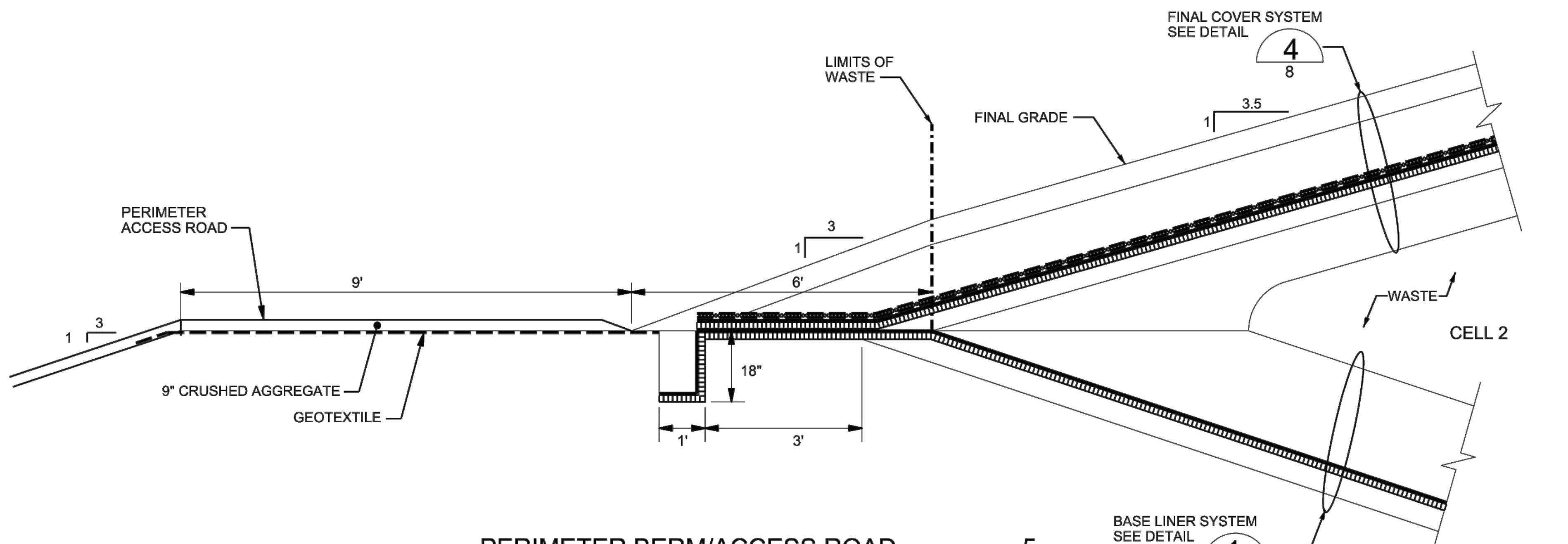
PERFORATED LEACHATE COLLECTION PIPE 3

NTS



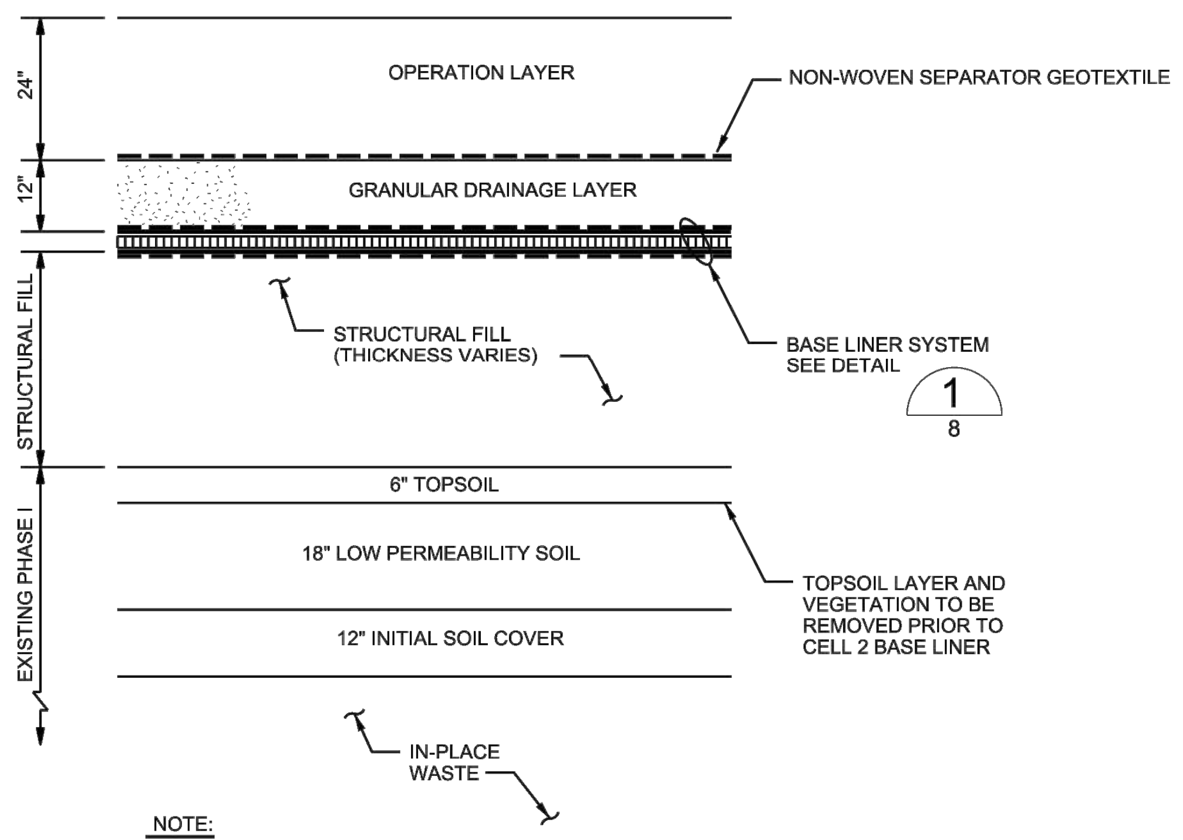
FINAL COVER SYSTEM 4

NTS



PERIMETER BERM/ACCESS ROAD 5

NTS

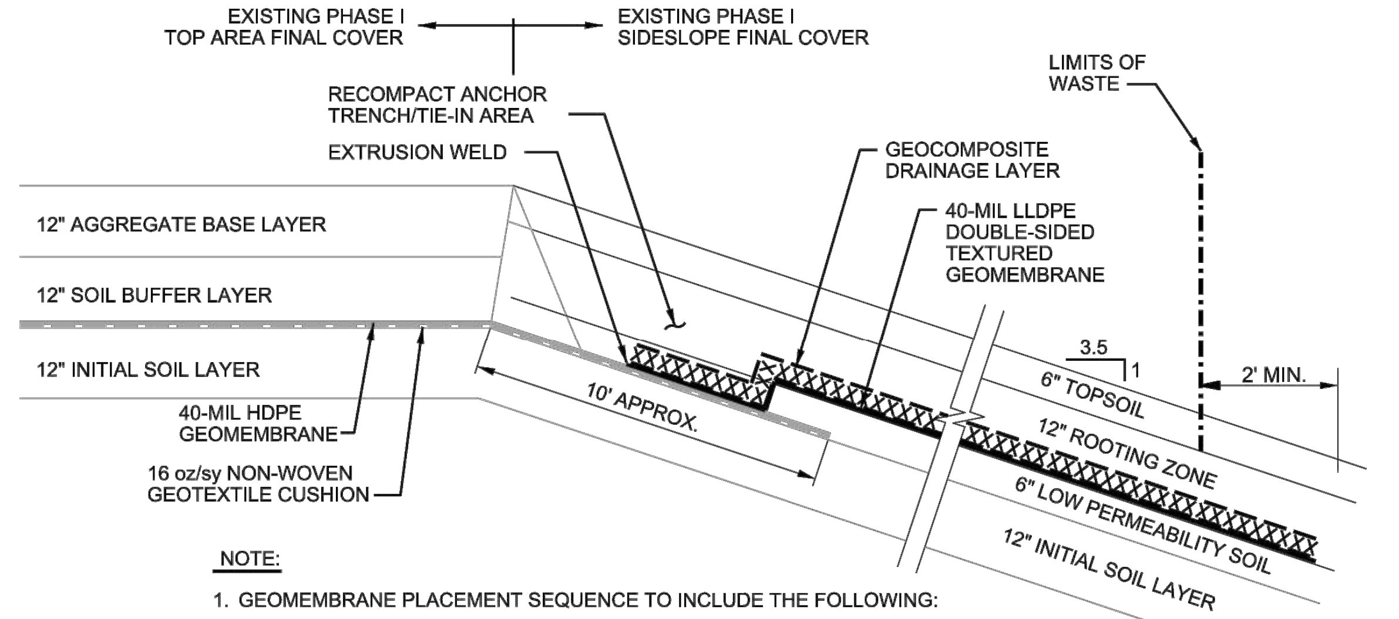


NOTE:

1. EXISTING PHASE 1 SIDESLOPE FINAL COVER CONFIGURATION TAKEN FROM DRAWING C-10 "POST CONSTRUCTION REPORT, KEKAHA SANITARY LANDFILL, PHASE I CLOSURE, KEKAHA, KAUAI, HAWAII". DATED FEBRUARY 16, 1996 BY HARDING LAWSON ASSOCIATES.

OVERLAY BASE LINER DETAIL (ONTO PHASE I) 6

NTS

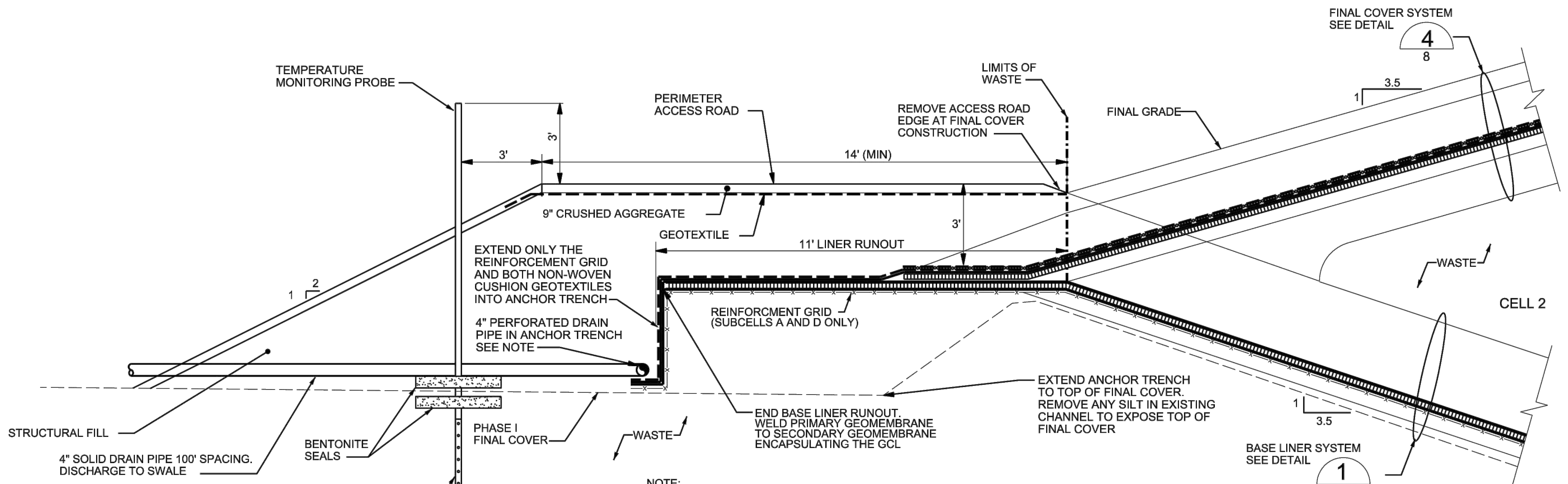


NOTE:

1. GEOMEMBRANE PLACEMENT SEQUENCE TO INCLUDE THE FOLLOWING:
   A. STRIP AND STOCKPILE TOPSOIL.
   B. STRIP AND STOCKPILE TOP 12" OF 18" LOW PERMEABILITY LAYER.
   C. SMOOTH DRUM ROLL REMAINING LOW PERMEABILITY SOIL SURFACE
   D. EXCAVATE ANCHOR TRENCH TAKING CARE TO PROTECT EXISTING GEOMEMBRANE AND GEOTEXTILE.
   E. REMOVE ROCKS AND OTHER DELETERIOUS MATERIAL LARGER THAN 1 INCH IN DIAMETER FROM EXISTING LOW PERMEABILITY SOIL SURFACE AND TOPSOIL.
   F. PLACE GEOMEMBRANE AND WELD TO EXISTING GEOMEMBRANE.
   G. PLACE NEW GEOCOMPOSITE DRAINAGE LAYER.
   H. PLACE 12" ROOTING ZONE USING LOW GROUND PRESSURE EQUIPMENT.
   I. REPLACE TOPSOIL USING LOW GROUND PRESSURE EQUIPMENT.
2. WHEN DEPLOYING GEOCOMPOSITE DRAINAGE LAYER OVER TEXTURED GEOMEMBRANE, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.
3. LIMITS OF EXISTING GEOMEMBRANE TO BE FIELD LOCATED AND VERIFIED.
4. PLACEMENT SEQUENCE, LIMITS, AND CONFIGURATION MAY BE MODIFIED AT TIME OF CONSTRUCTION BASED ON FIELD CONDITIONS AND ENGINEER'S APPROVAL.

PHASE I GEOMEMBRANE EXTENSION 8

NTS



NOTE:

1. SLOPE PERFORATED COLLECTION DRAIN TO BOTH EDGES OF LANDFILL FROM HIGH POINT.

OVERLAY BASE LINER TERMINATION ON PHASE I 7

NTS

NO	REVISIONS	DRN	CHK	DATE
4	MODIFIED DETAIL 1 NOTES, MODIFIED DETAILS 7 AND 8	CFF	NKW	12/2015
3	MODIFIED DETAIL 1 NOTES, ADDED DETAIL 8 AND MODIFIED DETAIL 6	DRB	KJB	03/2013
2	ADDED GCL TO COVER CROSS-SECTION ON DETAILS 4,5, AND 7	DRB	KJB	01/2013
1	UPDATED DETAILS, NOTES, MATERIAL SELECTION AND ANCHOR TRENCHING.	DRB	KJB	12/2012

NANCY K. WRIGHT
LICENSED PROFESSIONAL ENGINEER
No. 16394-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

Nancy K. Wright
SIGNATURE

APRIL 30, 2018
EXPIRATION DATE OF THE LICENSE

DRN	DRB
DES	NKW/TCR
CHK	FLC/MRH
APP	KJB

PREPARED BY
AECOM

ENGINEERING REPORT
KEKAHA LANDFILL PHASE II-CELL 2 LATERAL EXPANSION KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

DETAILS

DATE DECEMBER 2015
PROJECT NO 60197394
FILENAME
SHEET NO
DRAWING NO 8

10/19/2017 9:59:05 AM
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ISSUED FOR PERMITTING - NOT FOR CONSTRUCTION

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REV	REVISION DESCRIPTION	DATE

TETRA TECH
21700 Copley Drive, Suite 200
Diamond Bar, CA 91765
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KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION
LINER AND LCRS DETAILS
(FROM AECOM, 2017)

DESIGNED BY : GRB
CHECKED BY : CHM
DATE : NOV 2023
DRAWN BY : MDC/GVP
APPROVED BY : GRB
FILE : 220048-C-501_LF DETAILS.dwg

SHEET
C-501

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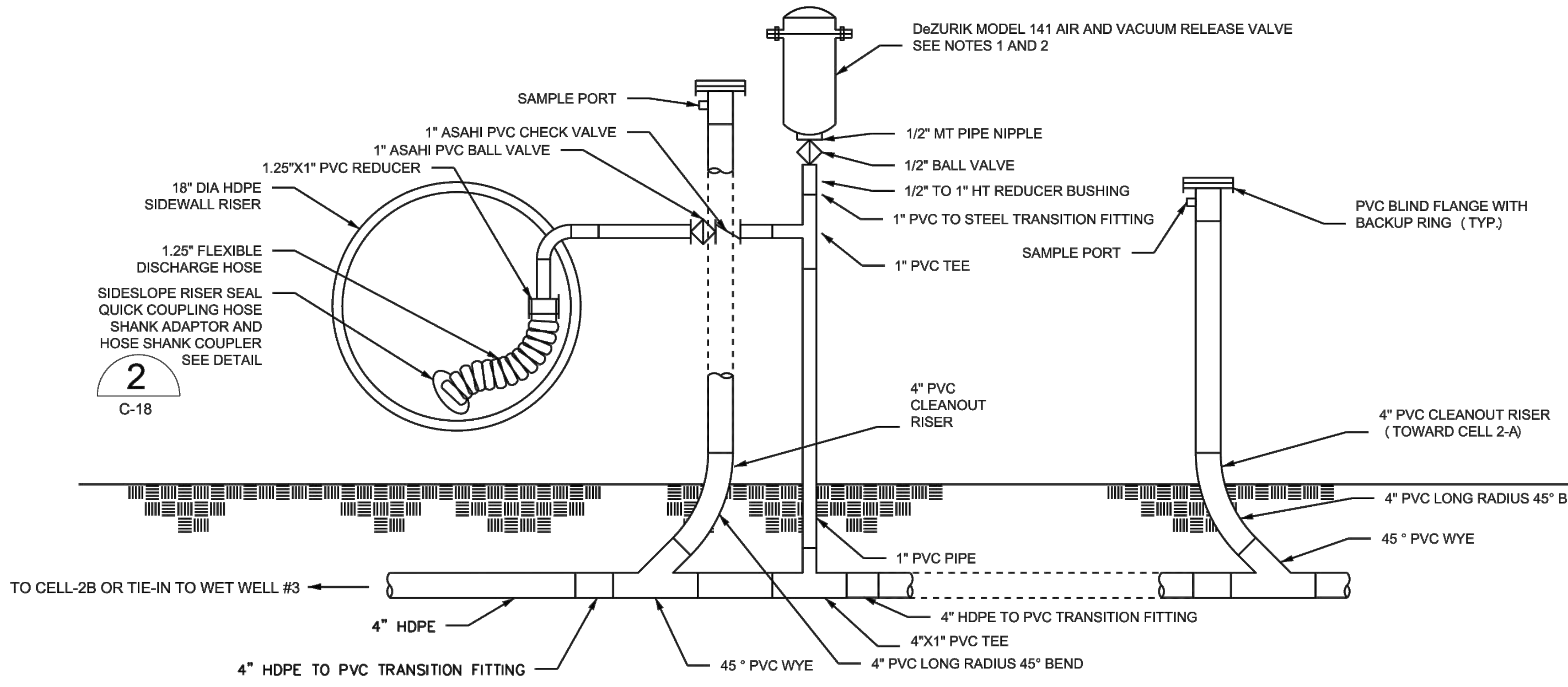
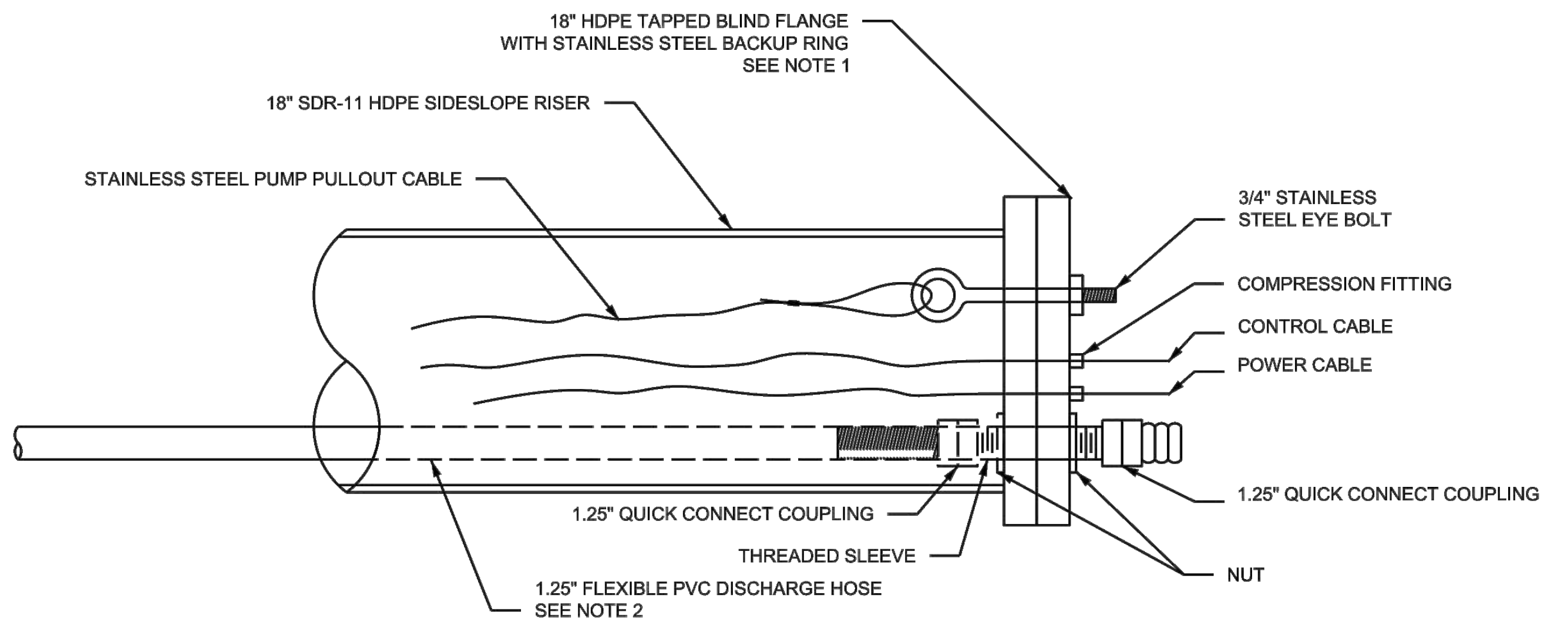


NOTE:
1. DeZURIK/APCO AIR/VACUUM RELIEF VALVE MODEL 141, STAINLESS STEEL FLOAT, BUNA N SEAT, 1/2" THREADED NPT INLET AND 1/2" THREADED NPT OUTLET WITH MUSHROOM CAP.
2. CONTRACTOR TO PROVIDE SUPPORT STRUCTURE TO HOLD DISCHARGE PIPING, AIR/VACUUM RELEASE VALVE, AND CLEANOUT RISERS IN PLACE WITHOUT DAMAGING UNDERLYING GEOMEMBRANE LINER OR FINAL COVER. (TYPICAL, ALL PIPE RISER LOCATIONS)
3. CONTRACTOR TO PROVIDE SUPPORT STRUCTURE TO HOLD PUMP POWER AND CONTROL PANELS.
4. ALL PVC PIPING SHALL BE SCHEDULE 80 PVC.

UPSLOPE DETAIL (LOOKING AT TOP OF SIDESLOPE RISER WITH TRANSFER PIPING)(TYPICAL) 1

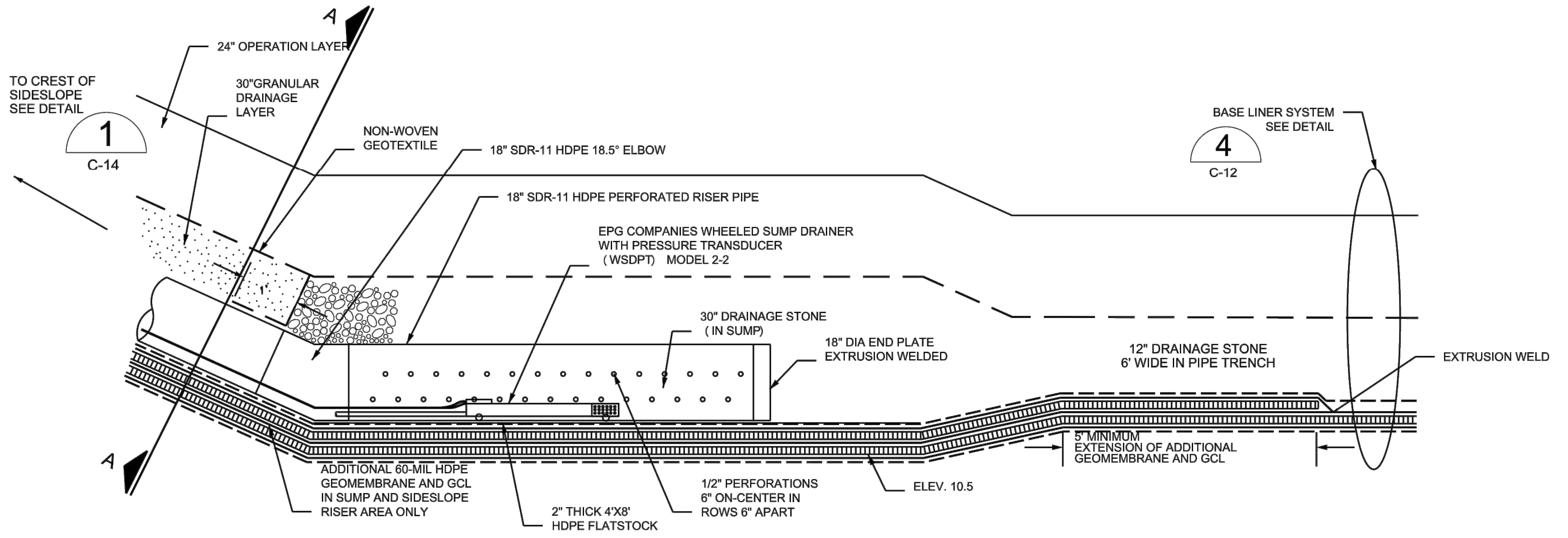
NTS



NOTE:
1. TWO TAPPED BLIND FLANGES REQUIRED WITH ATTACHED FITTINGS AT EACH SUMP RISER LOCATION. ONE PUMP AND HOOKUPS TO BE INSTALLED. OTHER RISER AND (PLUGGED) TAPPED BLIND FLANGE READY FOR USE WHEN NEEDED IN FUTURE.
2. PROVIDE 1/4" WEEPHOLE IN DISCHARGE HOSE 25' FROM PUMP. PUT PAINT MARK AT WEEPHOLE.

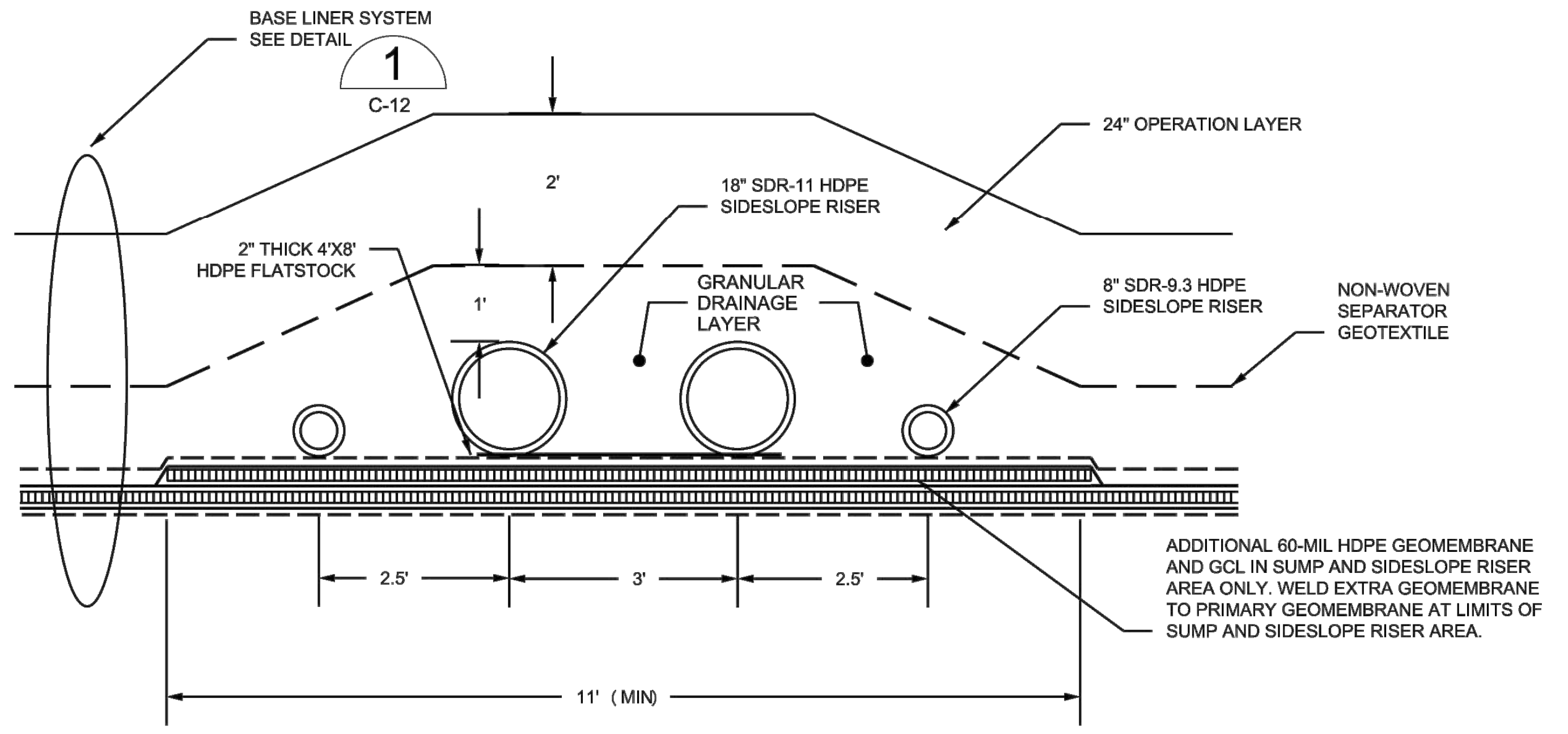
TOP OF SIDESLOPE RISER SEAL 2

NTS

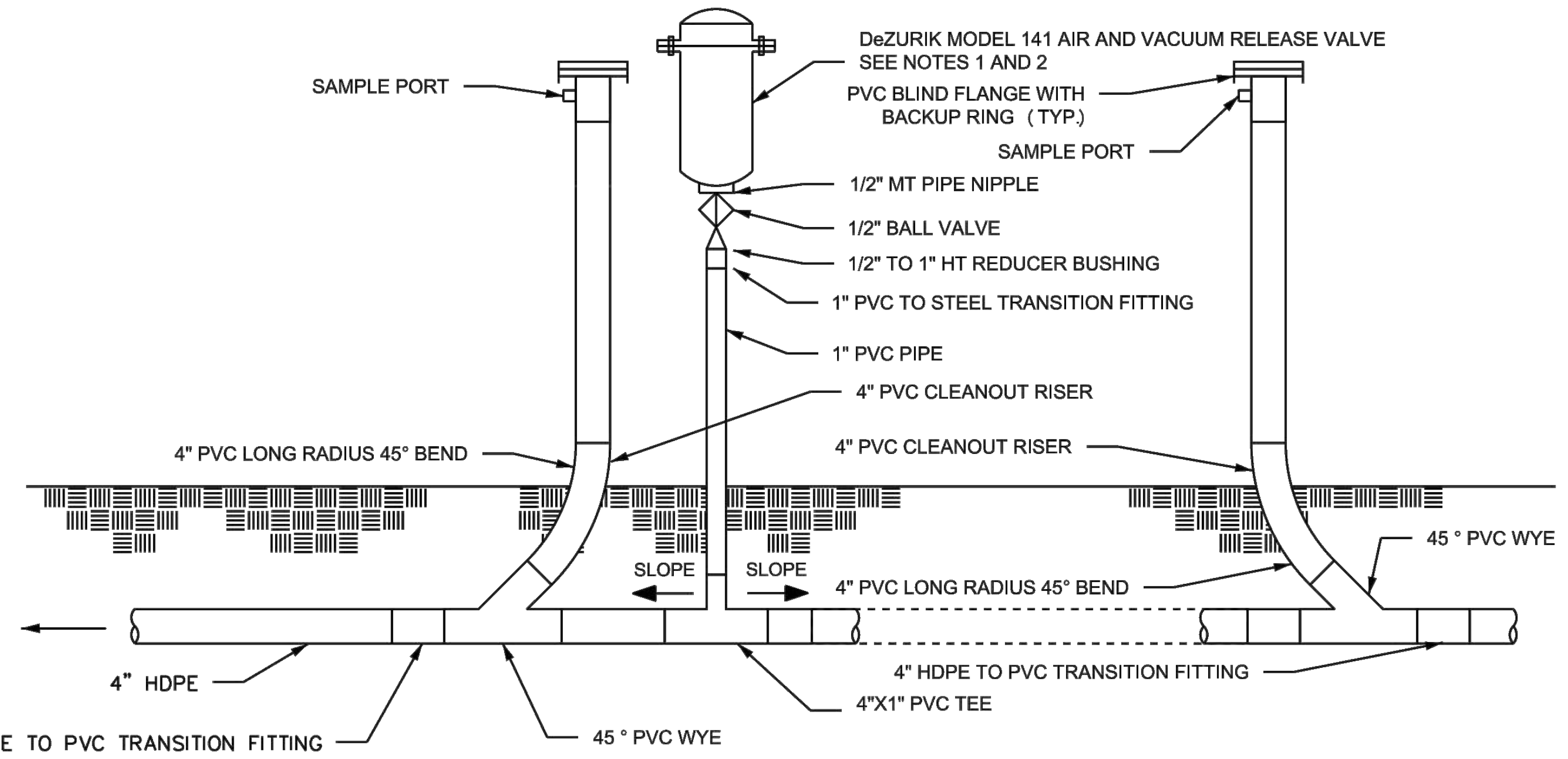


TYPICAL LEACHATE COLLECTION SUMP 3

NTS

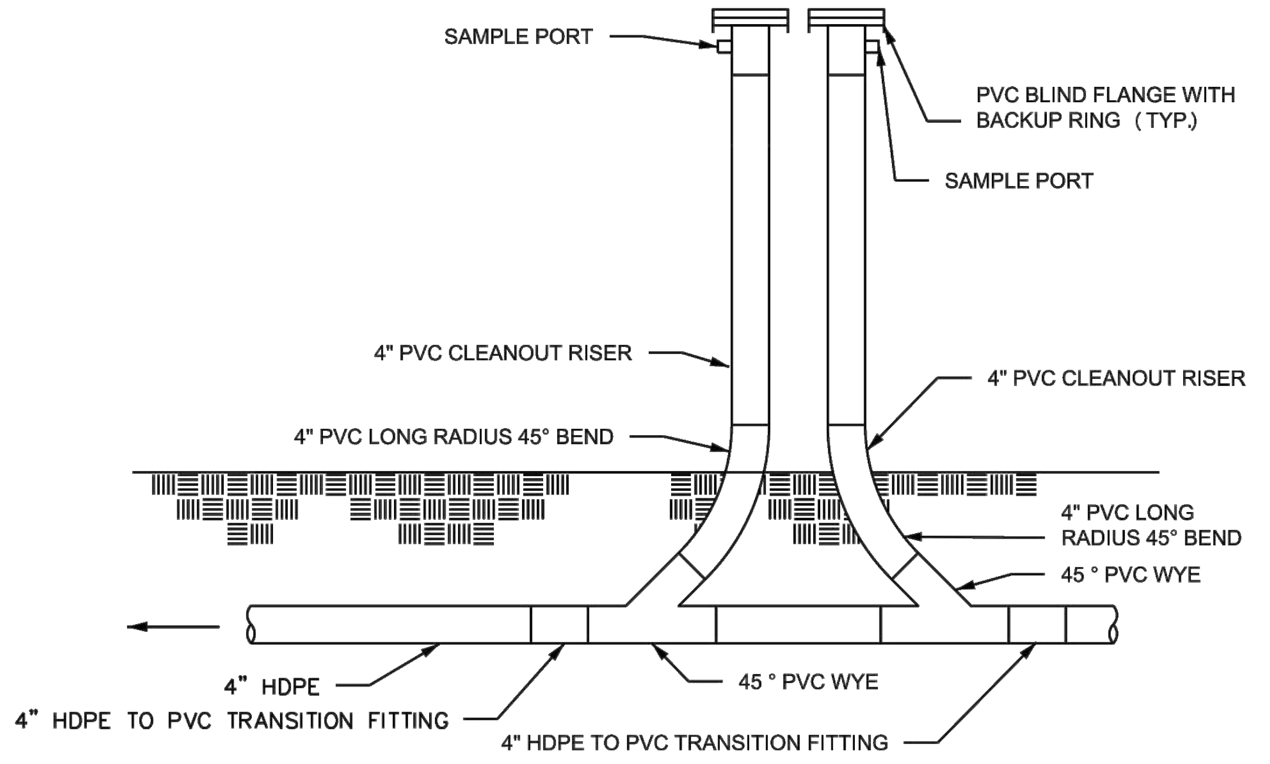


SECTION A-A



LEACHATE TRANSMISSION PIPE HIGH POINT 4

NTS



LEACHATE TRANSMISSION PIPE CLEANOUT RISERS 5

NTS

NO	REVISIONS	DRN	CHK	DATE
1	ISSUED FOR CONSTRUCTION	TPB	NKW	09/04/2018

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Nancy K. Wright

SIGNATURE

APRIL 30, 2020

EXPIRATION DATE OF THE LICENSE

DRN	TPB
DES	NKW
CHK	MRH
APP	NKW

PREPARED BY AECOM

CELL 2 BASE LINER
CONSTRUCTION DRAWINGS
PHASE II LATERAL EXPANSION
KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

LEACHATE COLLECTION DETAILS

DATE SEPTEMBER, 2018

PROJECT NO 60558519

FILENAME

SHEET NO

DRAWING NO C-15

NOTE:
THE DETAILS ON THIS SHEET ARE INCORPORATED WITHOUT CHANGE FROM AECOM (2017) FOR REFERENCE PURPOSES ONLY AND ARE INTENDED TO PROVIDE INFORMATION ON EXISTING PERMITTED FEATURES OF THE SITE THAT ARE NOT PROPOSED TO BE REVISED AS PART OF THIS VERTICAL EXPANSION.

REV	REVISION DESCRIPTION	DATE

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KEKAHA MUNICIPAL SOLID WASTE LANDFILL

PHASE II - VERTICAL EXPANSION

PHASE II, CELL 2 LEACHATE COLLECTION DETAILS (FROM AECOM, 2020)

DESIGNED BY : GRB	CHECKED BY : CHM	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB	FILE : 220048-C-502_LF DETAILS.dwg

SHEET
C-502

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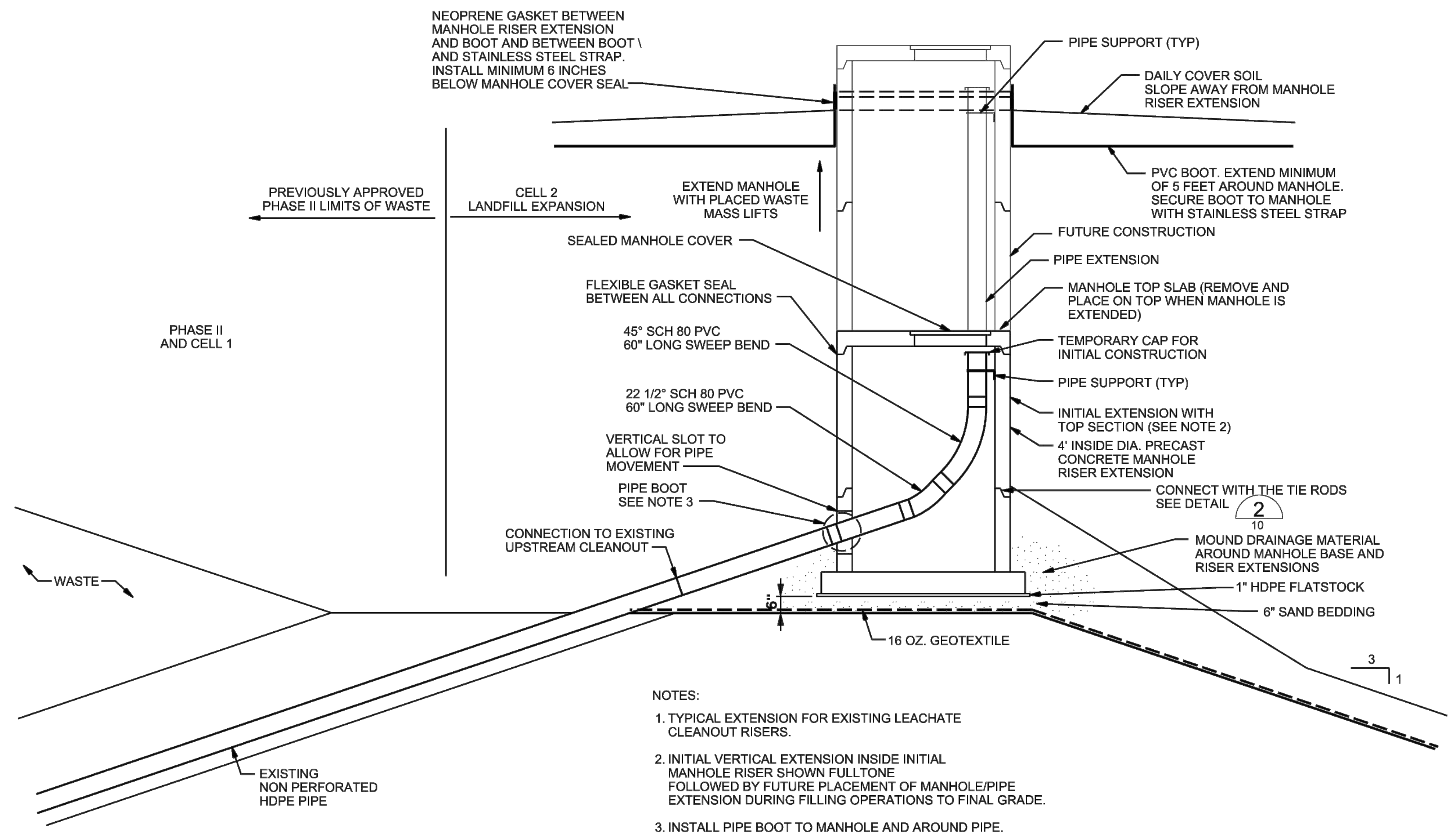
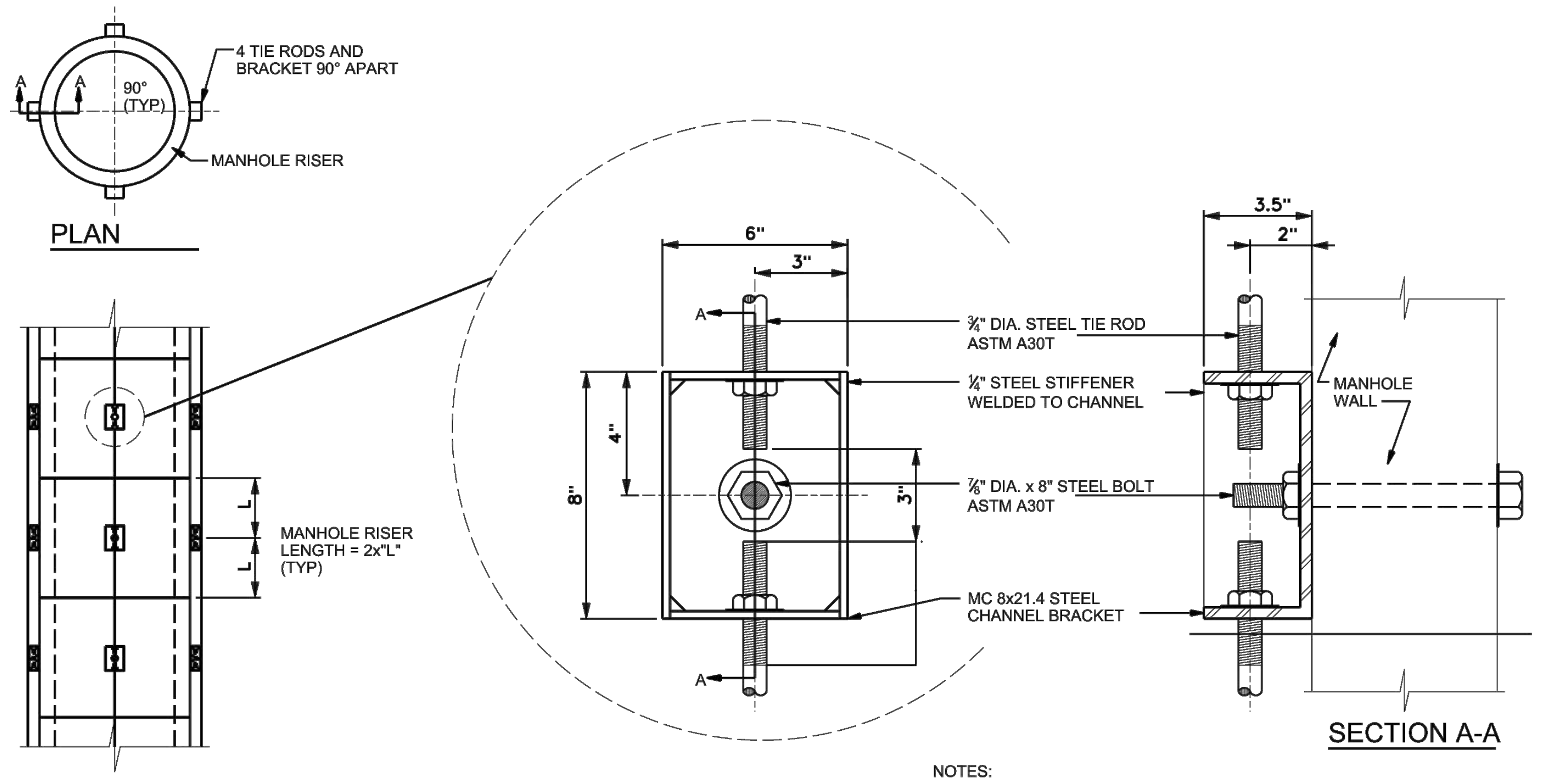


NOTES:

1. TYPICAL EXTENSION FOR EXISTING LEACHATE CLEANOUT RISERS.
2. INITIAL VERTICAL EXTENSION INSIDE INITIAL MANHOLE RISER SHOWN FULLTONE FOLLOWED BY FUTURE PLACEMENT OF MANHOLE/PIPE EXTENSION DURING FILLING OPERATIONS TO FINAL GRADE.
3. INSTALL PIPE BOOT TO MANHOLE AND AROUND PIPE. BOOT MAY BE LOCATED INSIDE OR ON OUTSIDE OF MANHOLE.

VERTICAL LEACHATE CLEANOUT AND MANHOLE RISER EXTENSIONS 1

NTS

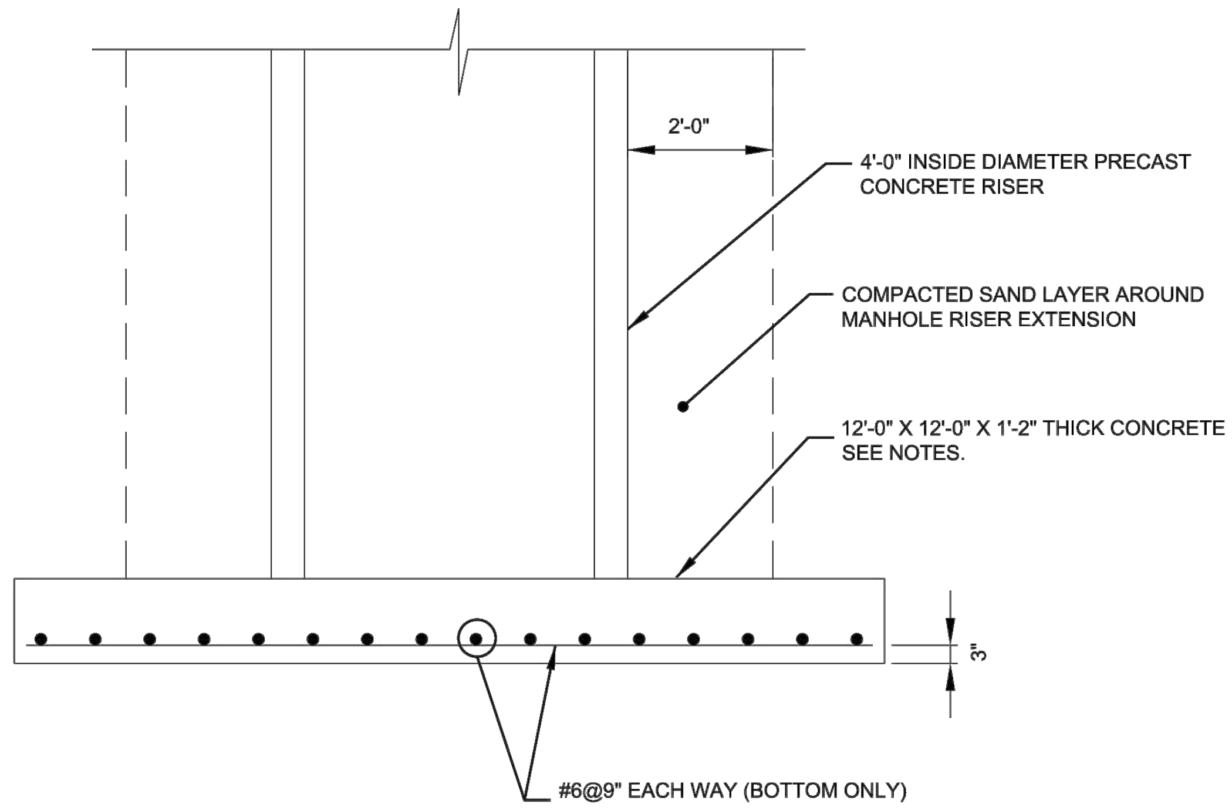


NOTES:

1. MAINTAIN ALL MANHOLE RISER SECTIONS LEVEL AND PLUMB. PROVIDE CAST IRON SPACERS BETWEEN RISER SECTIONS IF NECESSARY TO ADJUST TO LEVEL CONDITIONS.
2. EPOXY COAT ALL EXPOSED METAL SURFACES AND BOLTS IMMEDIATELY FOLLOWING INSTALLATION .
3. STAINLESS STEEL CAN BE SUBSTITUTED FOR ALL COMPONENTS.

MANHOLE TIE ROD AND BRACKET 2

NTS



MANHOLE BASE DETAIL 3

NTS

NOTES:

1. CONCRETE PAD
   - A. ACTUAL PAD DIMENSIONS AND REINFORCEMENT MAY VARY AT TIME OF CONSTRUCTION DUE TO FIELD CONDITIONS.

2. CONCRETE MIX
   - A. CLASS A:
     - 1. MINIMUM 6 BAGS OF CEMENT PER CUBIC YARD OF CONCRETE.
     - 2. MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 4000 PSI.
   - B. FURNISH AND DELIVER CONCRETE IN ACCORDANCE WITH ASTM C94.
   - C. AIR CONTENT 6 +/- 1 %, ASTM C260.
   - D. SLUMP: 4 +/- 1 IN.
   - E. WATER/CEMENT RATIO: 0.45 MAXIMUM, MIXING WATER TO BE POTABLE.
   - F. CEMENT: ASTM C150 TYPE 1.
   - G. AGGREGATES: FINE TO BE NATURAL SAND, COARSE TO BE CRUSHED GRAVEL ASTM C33, SIZE (3/4 INCH MAXIMUM).
   - H. APPLY ASTM C309 TYPE 1 OR 1-D CURING COMPOUND IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, CURE AND SEAL J-20 BY DAYTON SUPERIOR OR EQUAL.
   - I. EXPOSED CONCRETE SURFACES TO HAVE SURFACE DEFECTS PATCHED AND PROJECTING FINS KNOCKED OFF.
   - J. PATCH HONEYCOMBING, STONE POCKETS, SPALLS, AND OTHER IRREGULARITIES WITH PATCHING MORTAR, SIKATOP BY SIKA CORPORATION OR EQUAL.
   - K. EXTERIOR EXPOSED SLAB TO HAVE A FLOAT AND BROOM FINISH.

3. REINFORCEMENT
   - A. DEFORMED BARS CONFORMING TO ASTM A615, GRADE 60.
   - B. DO NOT WELD OR FIELD BEND REINFORCING BARS.
   - C. #6 REINFORCING BAR:
     - 1. LAPPED SPLICE LENGTH = 30 INCHES
     - 2. EMBEDMENT LENGTH = 24 INCHES.

NO	REVISIONS	DRN	CHK	DATE
2	REMOVED DETAIL 5 LEACHATE TRANSFER PIPE TIE-IN TO LCM-1	CFF	NKW	12/2015
1	ADD PVC PIPE BOOT TO MANHOLE, DETAIL 1	DRB	KJB	10-23-12

NANCY K. WRIGHT
LICENSED PROFESSIONAL ENGINEER
No. 16394-C

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

Nancy K Wright
SIGNATURE

APRIL 30, 2018
EXPIRATION DATE OF THE LICENSE

DRN	DRB
DES	NKW/TCR
CHK	FLC/MRH
APP	KJB

PREPARED BY
AECOM

ENGINEERING REPORT
KEKAHA LANDFILL PHASE II-CELL 2 LATERAL
EXPANSION KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

DETAILS

DATE DECEMBER 2015
PROJECT NO 60197394
FILENAME
SHEET NO
DRAWING NO 10

NOTE:
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REV	REVISION DESCRIPTION	DATE

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KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

LCRS RISER DETAILS (FROM AECOM, 2017)

DESIGNED BY : GRB	CHECKED BY : CHM	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB	FILE : 220048-C-503_LF DETAILS.dwg

SHEET
C-503

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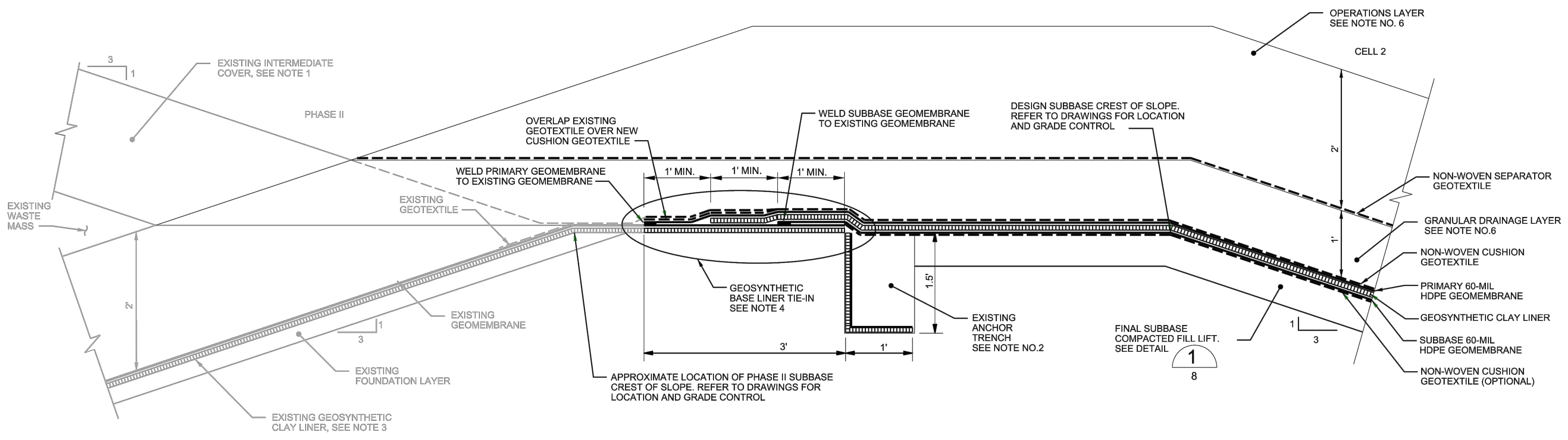

NOTES:

1. CONTRACTOR TO EXPOSE EXISTING ANCHOR TRENCH, GEOSYNTHETIC BASE LINER AND DRAINAGE LAYER OF PHASE II. COORDINATE WITH OWNER ACCESS TO TIE-IN AREA TO AVOID CONFLICT WITH SITE OPERATION. EXPOSURE ACTIVITIES WILL INCLUDE AT A MINIMUM REMOVAL OF EXISTING INTERMEDIATE COVER, EXISTING SOILS OVERLYING THE ANCHOR TRENCH AND BERM. CARE IS TO BE TAKEN DURING REMOVAL OF SOILS DIRECTLY IN CONTACT GEOSYNTHETICS. EXPOSURE ACTIVITIES TO BE CONSTANTLY MONITORED BY QUALITY ASSURANCE CONSULTANT AND DOCUMENTED. EXCESS DAMAGE AND RESULTING REPAIRS CAUSED FROM EXPOSING TIE-IN AREA WILL BE RESPONSIBILITY OF CONTRACTOR. CONTRACTOR TO MAINTAIN SURFACE WATER CONTROL FROM TIE-IN AREA.

2. CUT GEOSYNTHETICS ENTERING ANCHORING TRENCH AT ANCHOR TRENCH EDGE. PROTECT EXPOSED EDGE FROM DRYING AND MOISTURE. REMOVE ALL REMAINING PORTIONS OF GEOSYNTHETICS FROM ANCHOR TRENCH. BACKFILL ANCHOR TRENCH WITH STRUCTURAL FILL AND COMPACT PER PROJECT SPECIFICATIONS.

3. EXISTING GEOSYNTHETIC CLAY LINER (GCL) OF PHASE II IS COMPRISED OF A BENTONITE LAYER WITH A GEOMEMBRANE CARRIER. THE GEOMEMBRANE IS IN DIRECT CONTACT WITH THE SUBBASE. CARE TO BE TAKEN NOT TO PULL GCL FROM OVERLYING GEOMEMBRANE DURING TIE-IN CONSTRUCTION.

4. CONSTRUCT GEOSYNTHETIC BASE LINER TIE-IN IN THE FOLLOWING ORDER:

   A. INSTALL NEW SUBBASE GEOMEMBRANE AND WELD TO EXISTING GEOMEMBRANE WITH A MINIMUM 1-FOOT OVERLAP.

   B. INSTALL NEW GEOSYNTHETIC CLAY LINER (GCL) ON TOP OF SUBBASE GEOMEMBRANE WITH MINIMUM 2-FOOT OVERLAP ONTO EXISTING GEOMEMBRANE.

   C. INSTALL NEW PRIMARY GEOMEMBRANE OVER NEW GCL AND WELD TO EXISTING GEOMEMBRANE MINIMUM 1-FOOT PAST NEW GCL OVERLAP.

   D. INSTALL NEW NON-WOVEN CUSHION GEOTEXTILE OVER PRIMARY GEOMEMBRANE. OVERLAP EXISTING GEOTEXTILE ON NEW NON-WOVEN GEOTEXTILE A MINIMUM OF 2 FEET AND HEAT BURNISH FIELD OVERLAP SEAM. REPAIR THINNED OR TORN PORTIONS OF THE EXISTING GEOTEXTILE WITH NEW NON-WOVEN GEOTEXTILE AS NEEDED.

   E. INSTALL GRANULAR DRAINAGE LAYER.

   F. INSTALL NEW NON-WOVEN SEPARATOR GEOTEXTILE.

   G. INSTALL OPERATIONS LAYER.

5. WHEN DEPLOYING GCL OR GEOTEXTILES OVER TEXTURED GEOMEMBRANE OR WHEN DEPLOYING TEXTURED GEOMEMBRANE OVER GCL OR GEOTEXTILES, A RUBSHEET SHALL BE USED BETWEEN THE TWO MATERIALS AND REMOVED AFTER FINAL MATERIAL POSITIONING.

6. INSTALL GRANULAR DRAINAGE LAYER AND OPERATIONS LAYER OVER TIE-IN AREA PRIOR TO PLACEMENT OF MATERIALS ON SIDESLOPES. PLACEMENT OF MATERIALS ON SIDESLOPES TO OCCUR FROM TOE OF SLOPE UP SIDESLOPE.

7. ALL NEW GEOMEMBRANE IS TEXTURED ON BOTH SIDES.

PHASE II / CELL I TO CELL 2 BASE LINER TIE-IN DETAIL 1
NTS

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NO	REVISIONS	DRN	CHK	DATE
2	REMOVED DETAIL 2	CFF	NKW	12/2015
1	NEW DRAWING, DETAIL 1 MOVED FROM DRAWING 9	DRB	KJB	03/2013

NANCY K. WRIGHT
No. 16394-C

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

Nancy K. Wright
SIGNATURE

APRIL 30, 2018
EXPIRATION DATE OF THE LICENSE

DRN	DRB
DES	NKW/TCR
CHK	FLC/MRH
APP	KJB

PREPARED BY
AECOM

ENGINEERING REPORT
KEKAHA LANDFILL PHASE II-CELL 2 LATERAL
EXPANSION KEKAHA SANITARY LANDFILL
KAUAI, HAWAII

DETAILS

DATE DECEMBER 2015
PROJECT NO 60197394
FILENAME
SHEET NO
DRAWING NO 14

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REV	REVISION DESCRIPTION	DATE

TETRA TECH
21700 Copley Drive, Suite 200
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KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

PHASE II, CELL 1 TO CELL 2 BASE LINER TIE-IN-DETAIL (FROM AECOM, 2017)

DESIGNED BY : GRB
CHECKED BY : CHM
DATE : NOV 2023
DRAWN BY : MDC/GVP
APPROVED BY : GRB
FILE : 220048-C-505_LF DETAILS.dwg

SHEET
C-504

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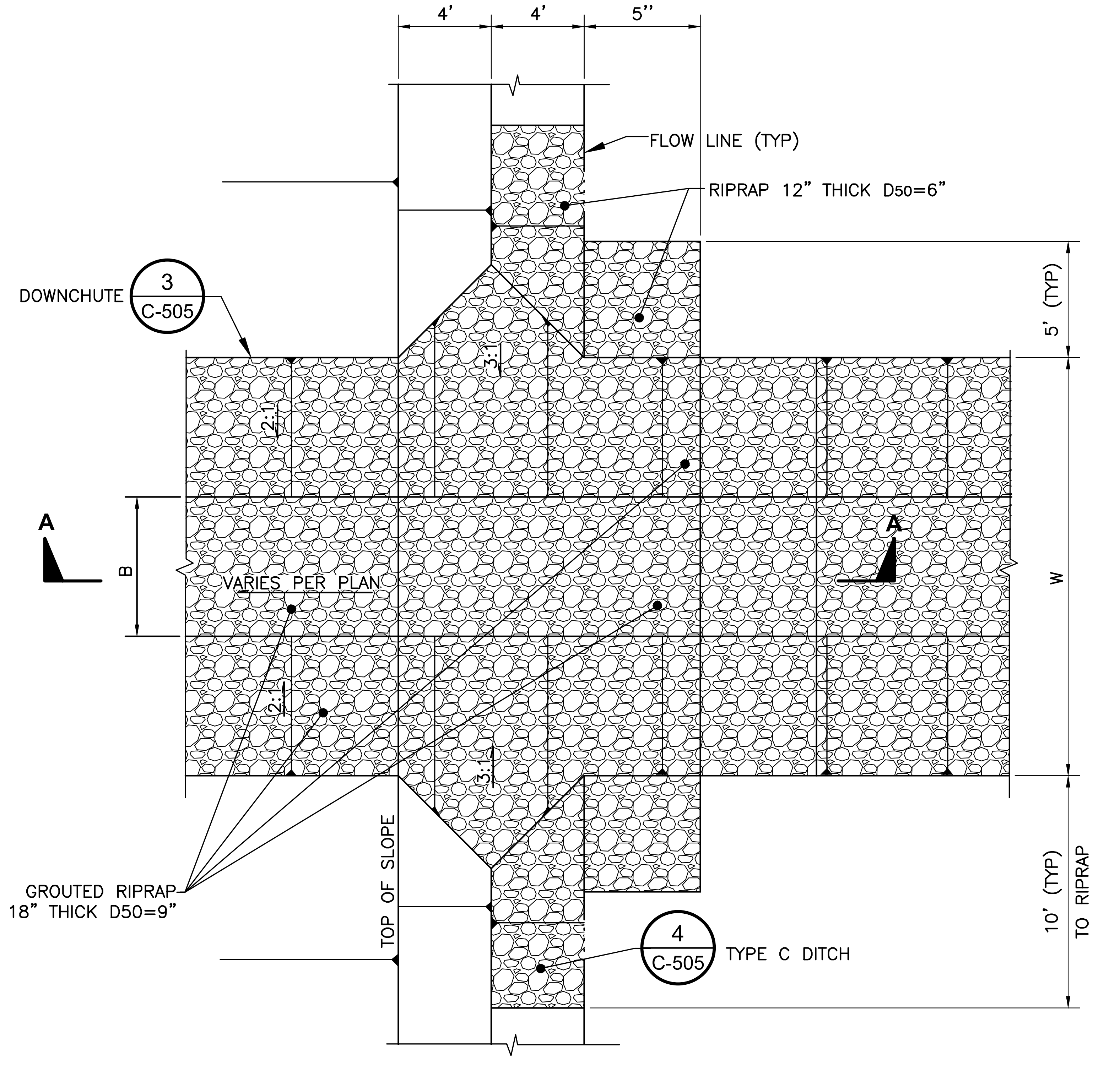

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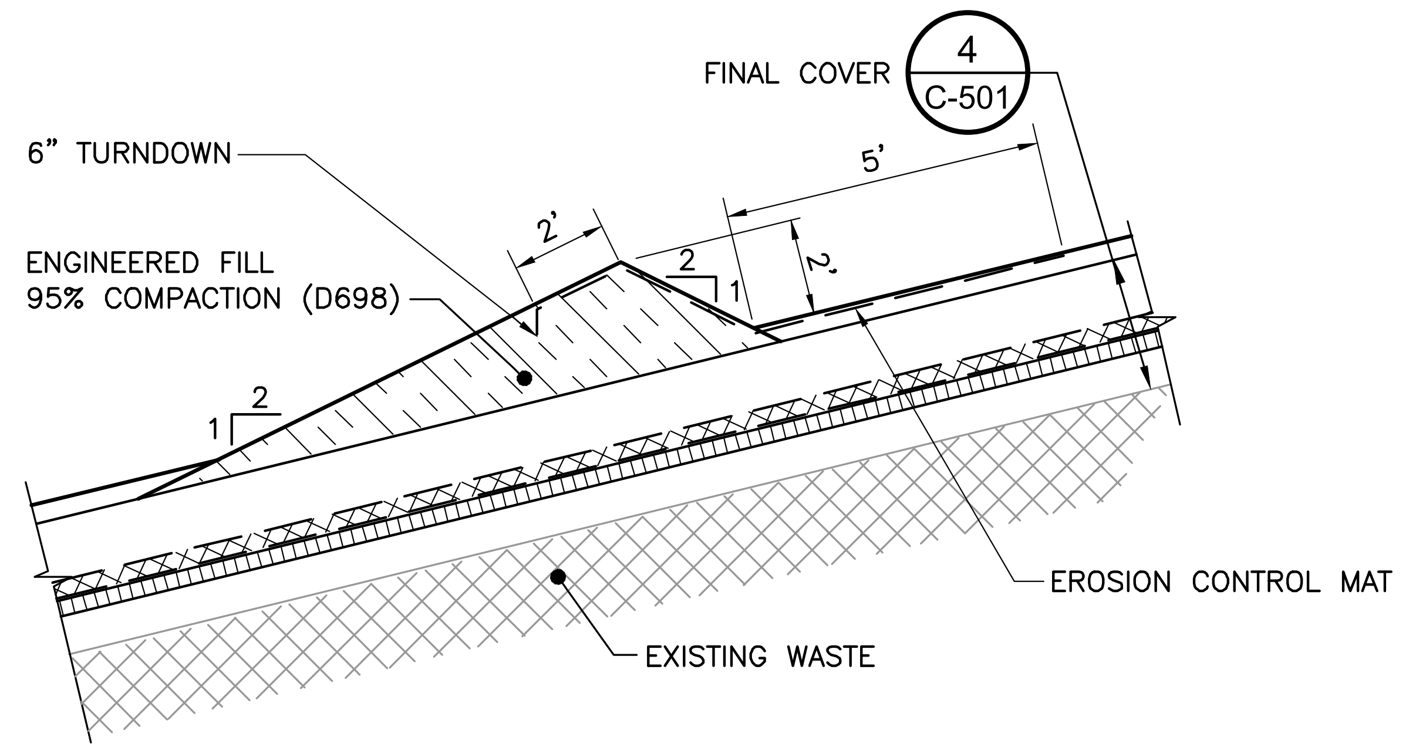
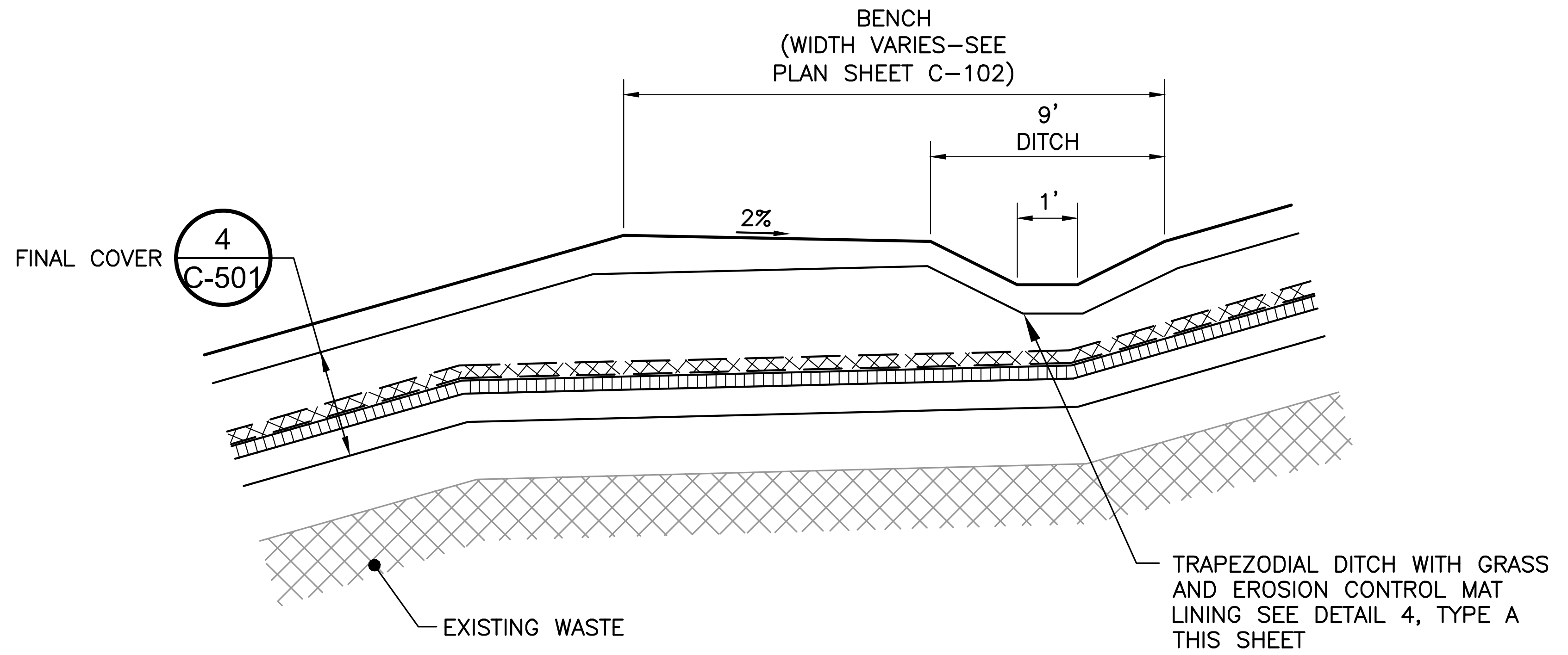


SECTION A-A

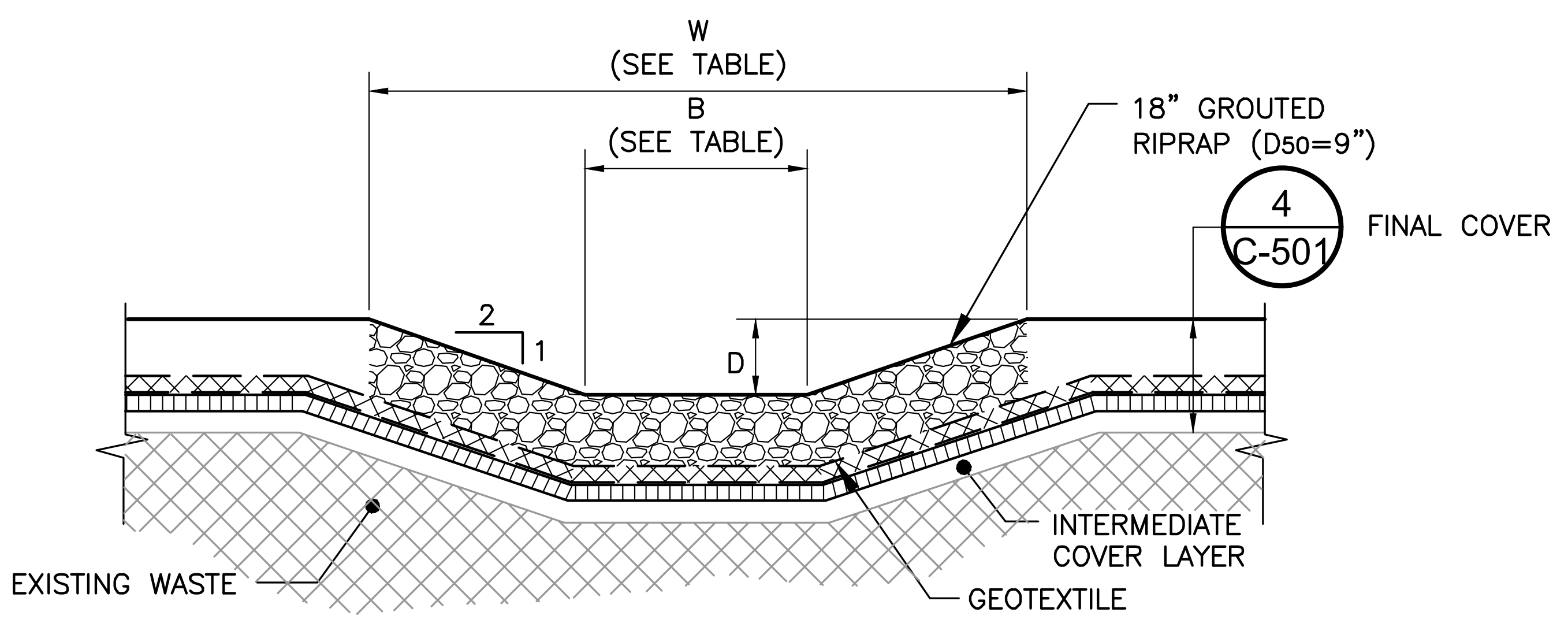
DOWNCHUTE FLUME/DIVERSION BERM JUNCTION

DETAIL 1/C-505
SCALE: NOT TO SCALE



FINAL COVER BENCH PROFILE

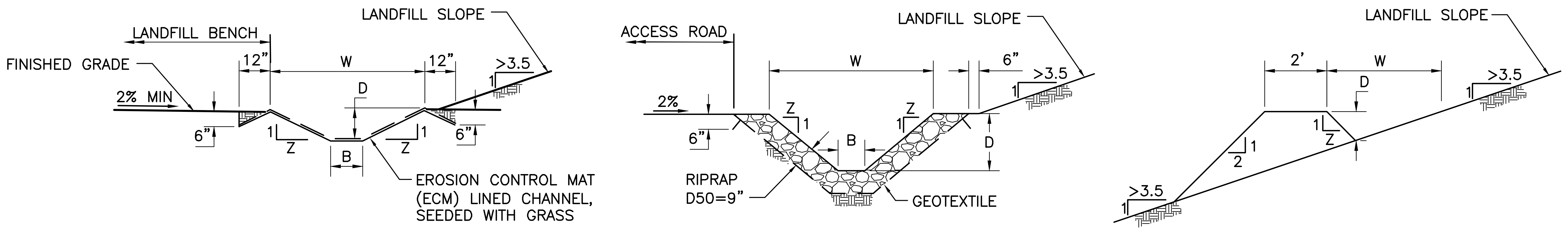
DETAIL 2/C-505
SCALE: NOT TO SCALE



	DIMENSION		
DOWNCHUTE/FLUME ID	TOP WIDTH W (FT)	BOTTOM WIDTH B (FT)	DEPTH D (FT)
A0	7	1	1.5
A1	9	1	2
B1	7	1	1.5
C0	7	1	1.5
C1	7	1	1.5
C2	10	2	2
F1	7	1	1.5
F2	10	2	2

DOWNCHUTE

DETAIL 3/C-505
SCALE: NOT TO SCALE



TYPE A DITCH, BENCH/TERRACE

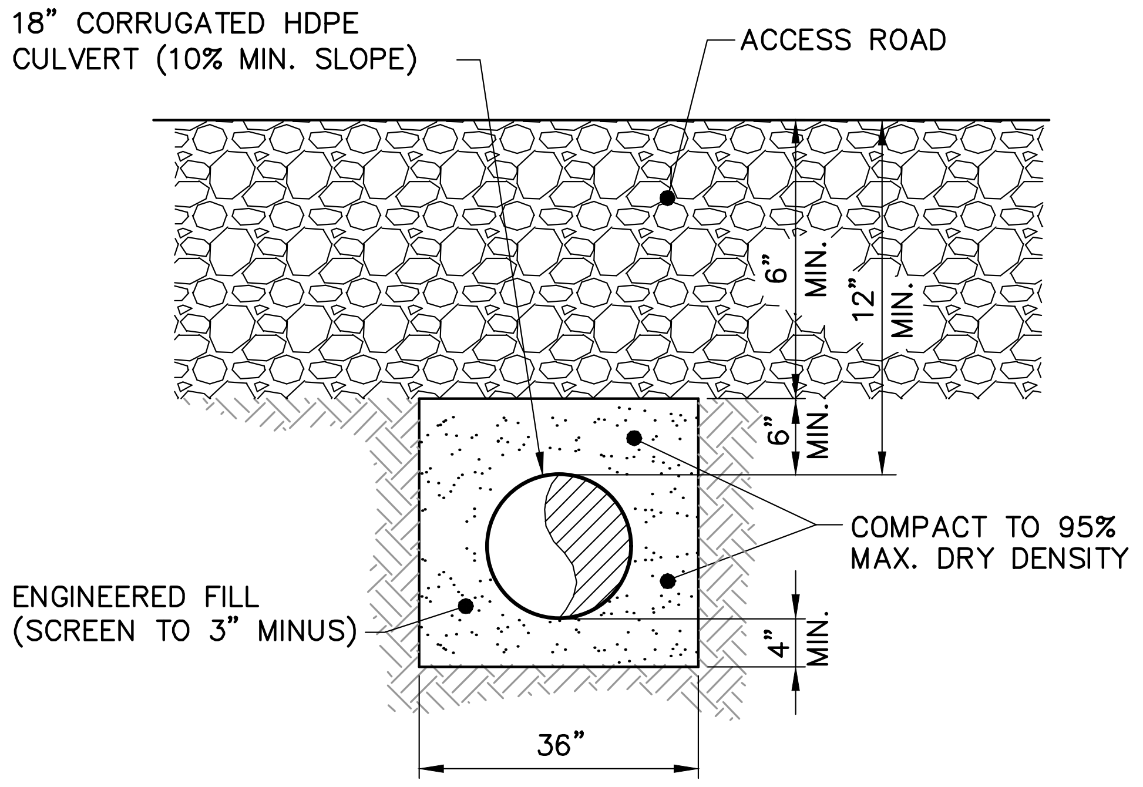
TYPE B DITCH, ACCESS ROAD

TYPE C DITCH, SIDESLOPE DIVERSION BERM

	DIMENSION			SIDE SLOPE		
TYPE	W (FT)	B (FT)	D (FT)	Z	SHAPE	LINING
A	9	1	2	2.0	TRAPEZOIDAL	GRASS LINED WITH ECM
B	8	2	1.5	2.0	TRAPEZOIDAL	ROCK RIPRAP
C	11	0	2	2.0	V–SHAPED	GRASS LINED WITH ECM

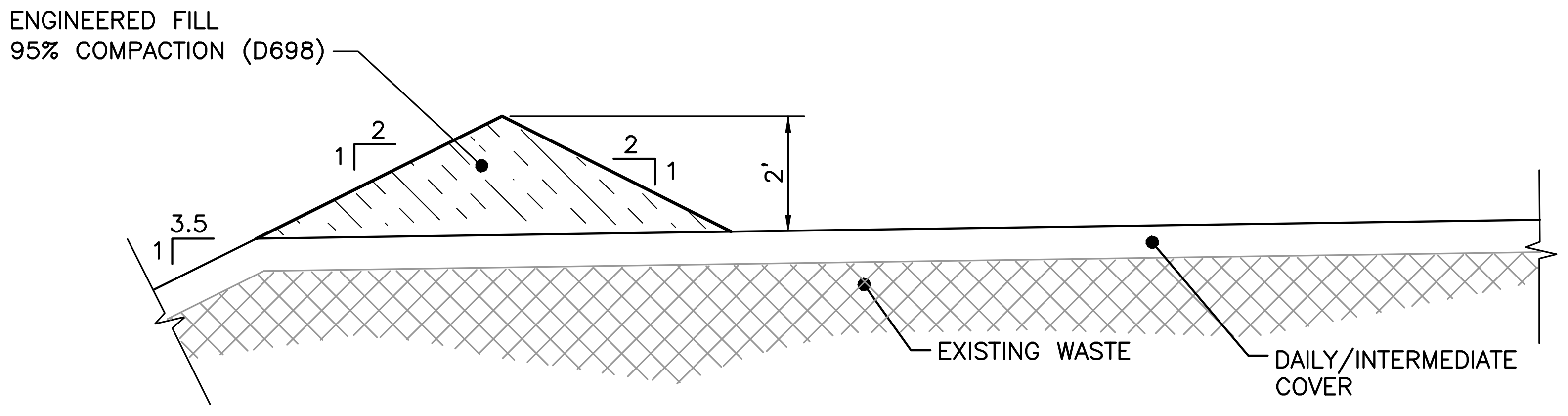
DRAINAGE DITCH DETAIL

DETAIL 4/C-505
SCALE: NOT TO SCALE



CULVERT TRENCH

DETAIL 5/C-505
SCALE: NOT TO SCALE



SAFETY BERM

DETAIL 6/C-505
SCALE: NOT TO SCALE

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REV	REVISION DESCRIPTION	DATE

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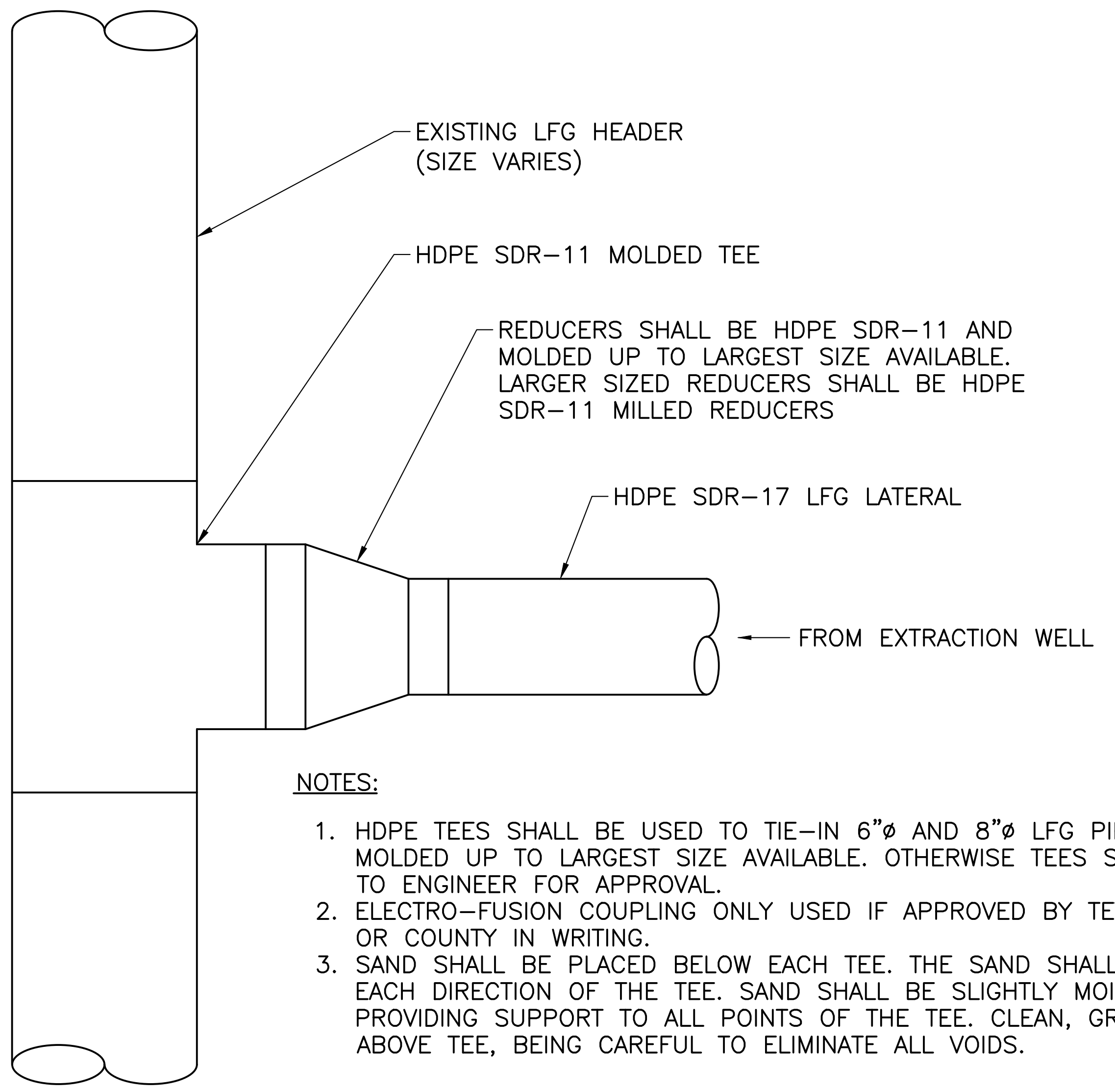
GARTH R. BOWERS
LICENSED PROFESSIONAL ENGINEER
No. 20139-C
Exp 4/3-/24
HAWAII U.S.A.
11/29/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION
STORMWATER DETAILS

DESIGNED BY : GRB	CHECKED BY : CHM	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB	FILE : 220048-C-506_LF DETAILS.dwg

SHEET
C-505



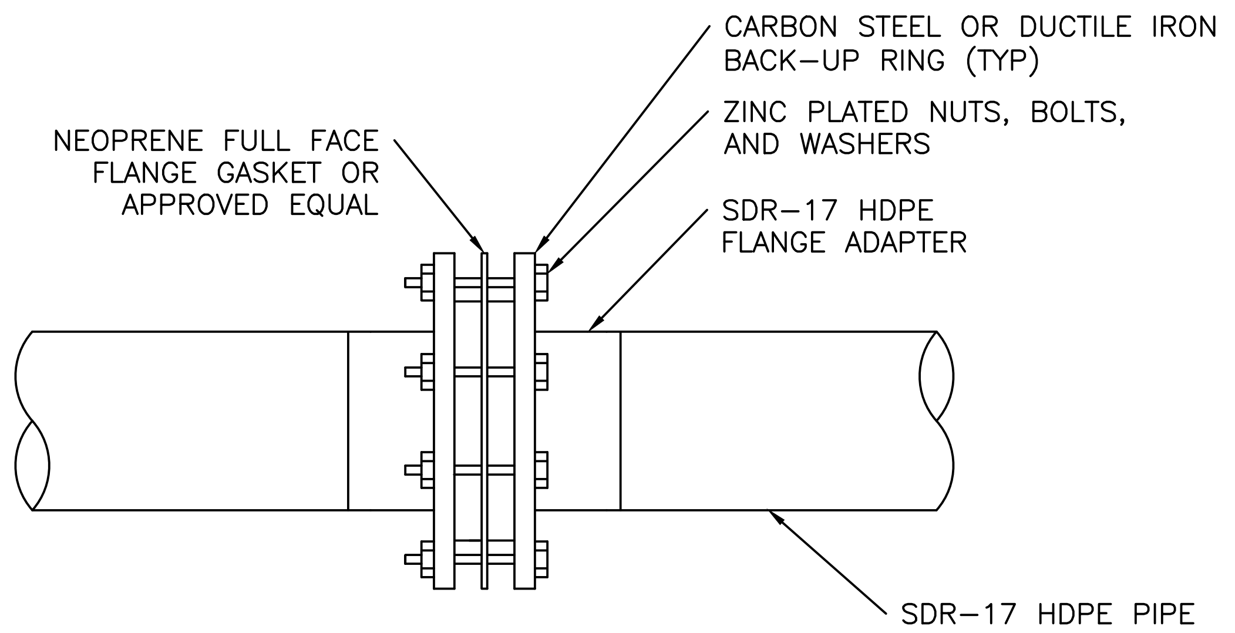
NOTES:

1. HDPE TEES SHALL BE USED TO TIE-IN 6"ø AND 8"ø LFG PIPE OR HEADER. TEES SHALL BE MOLDED UP TO LARGEST SIZE AVAILABLE. OTHERWISE TEES SHALL BE FABRICATED AND SUBMITTED TO ENGINEER FOR APPROVAL.
2. ELECTRO-FUSION COUPLING ONLY USED IF APPROVED BY TETRA TECH OR THE COUNTY OF KAUAI OR COUNTY IN WRITING.
3. SAND SHALL BE PLACED BELOW EACH TEE. THE SAND SHALL BE INSTALLED SO IT EXTENDS IN EACH DIRECTION OF THE TEE. SAND SHALL BE SLIGHTLY MOISTENED AND HAND-TAMPED PROVIDING SUPPORT TO ALL POINTS OF THE TEE. CLEAN, GRADED SOIL SHALL BE HAND-TAMPED ABOVE TEE, BEING CAREFUL TO ELIMINATE ALL VOIDS.

LANDFILL GAS LATERAL CONNECTION WITH TEE

DETAIL 1 / C-510

SCALE: NOT TO SCALE



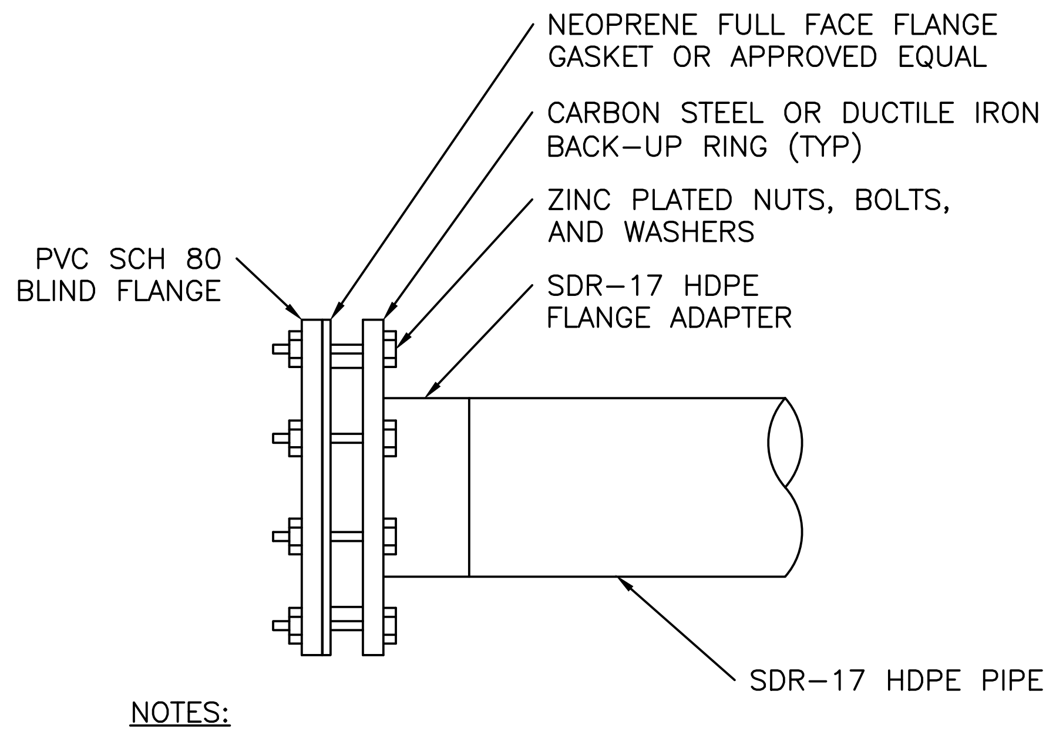
NOTES:

1. 5 MIL PLASTIC SHALL BE TAPED AROUND ALL BURIED FLANGE CONNECTIONS.
2. VALVE LOCATED BETWEEN FLANGES WITH APPROPRIATE SPACERS.
3. IF USING VALVE, EVERY OTHER BOLT INSTALLED THROUGH BOTH FLANGES, AND EVERY OTHER BOLT THROUGH FLANGE ON HEADER SIDE THROUGH VALVE ONLY. VALVE IS ASAHI TYPE 57 (2"-14"), TYPE 56 (16"), TYPE 75 (18"-24"), OR PDCPD (28"-40") BUTTERFLY VALVE. GEAR OPERATED, PVC BODY PPDISK, NITRILE OR VITON SEATS AND SEALS.
4. VALVE INCLUDES HDPE FLANGE ADAPTER, D.I. BACKUP RING, AND GALVANIZED OR ZINC PLATED NUTS, BOLTS AND WASHERS, HDPE VALVE SPACER OR ROUTER FLANGE ADAPTER TO ALLOW VALVE TO FULLY OPEN.

FLANGE ASSEMBLY

DETAIL 2 / C-510

SCALE: NOT TO SCALE



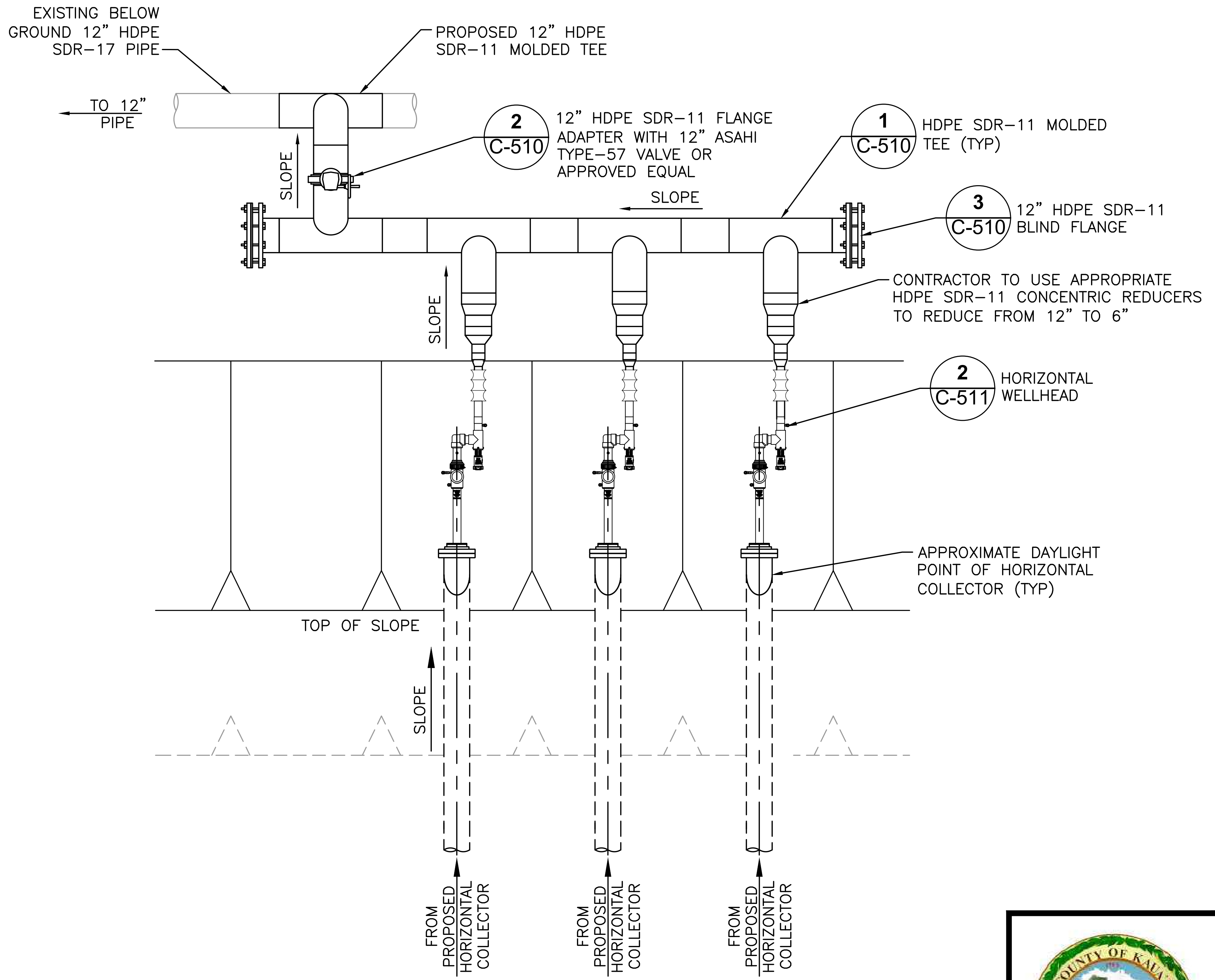
NOTES:

1. TAPE 5 MIL PLASTIC AROUND ALL BLIND FLANGES.

BLIND FLANGE ASSEMBLY

DETAIL 3 / C-510

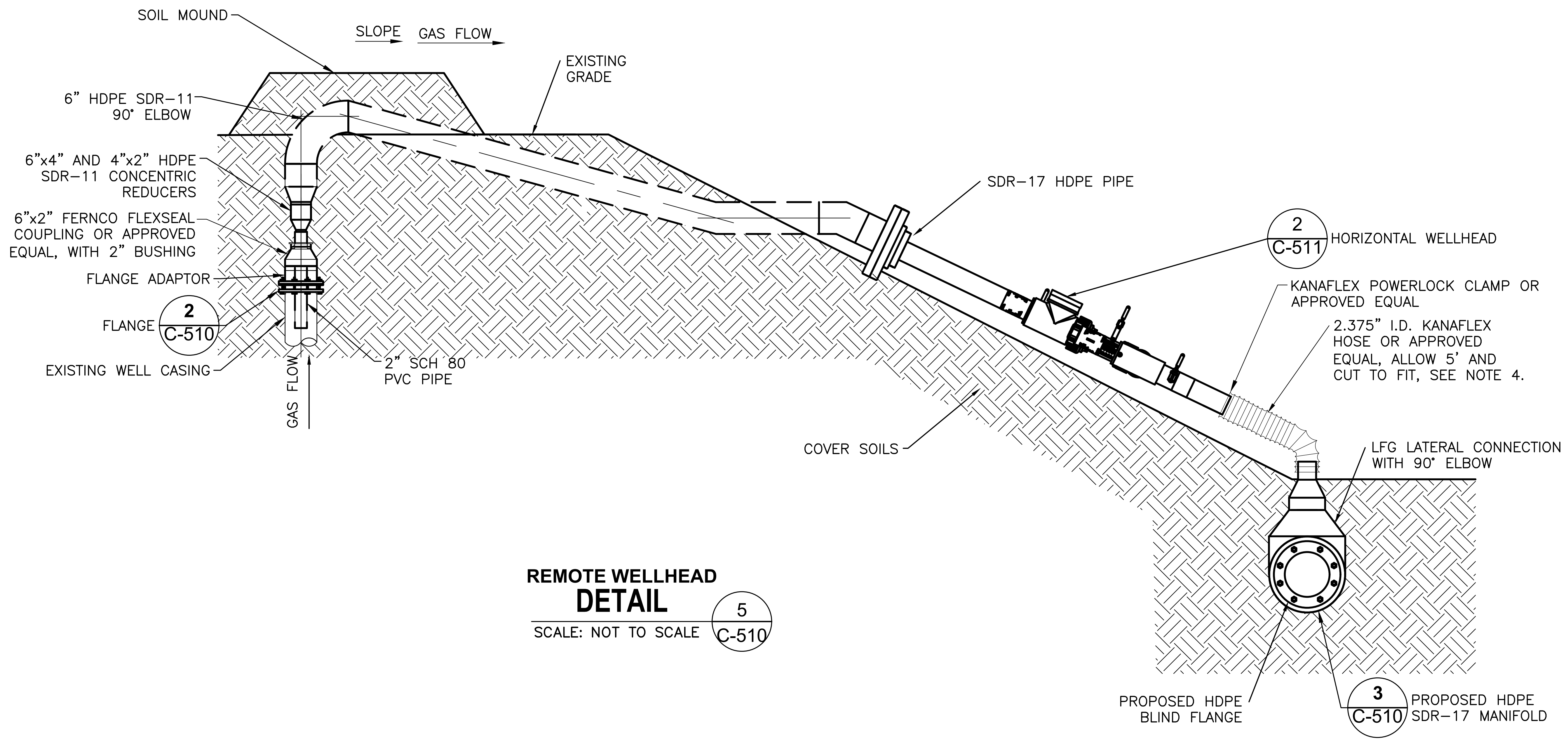
SCALE: NOT TO SCALE



WELLHEAD MANIFOLD FOR HORIZONTAL COLLECTORS

DETAIL 4 / C-510

SCALE: NOT TO SCALE



REMOTE WELLHEAD

DETAIL 5 / C-510

SCALE: NOT TO SCALE

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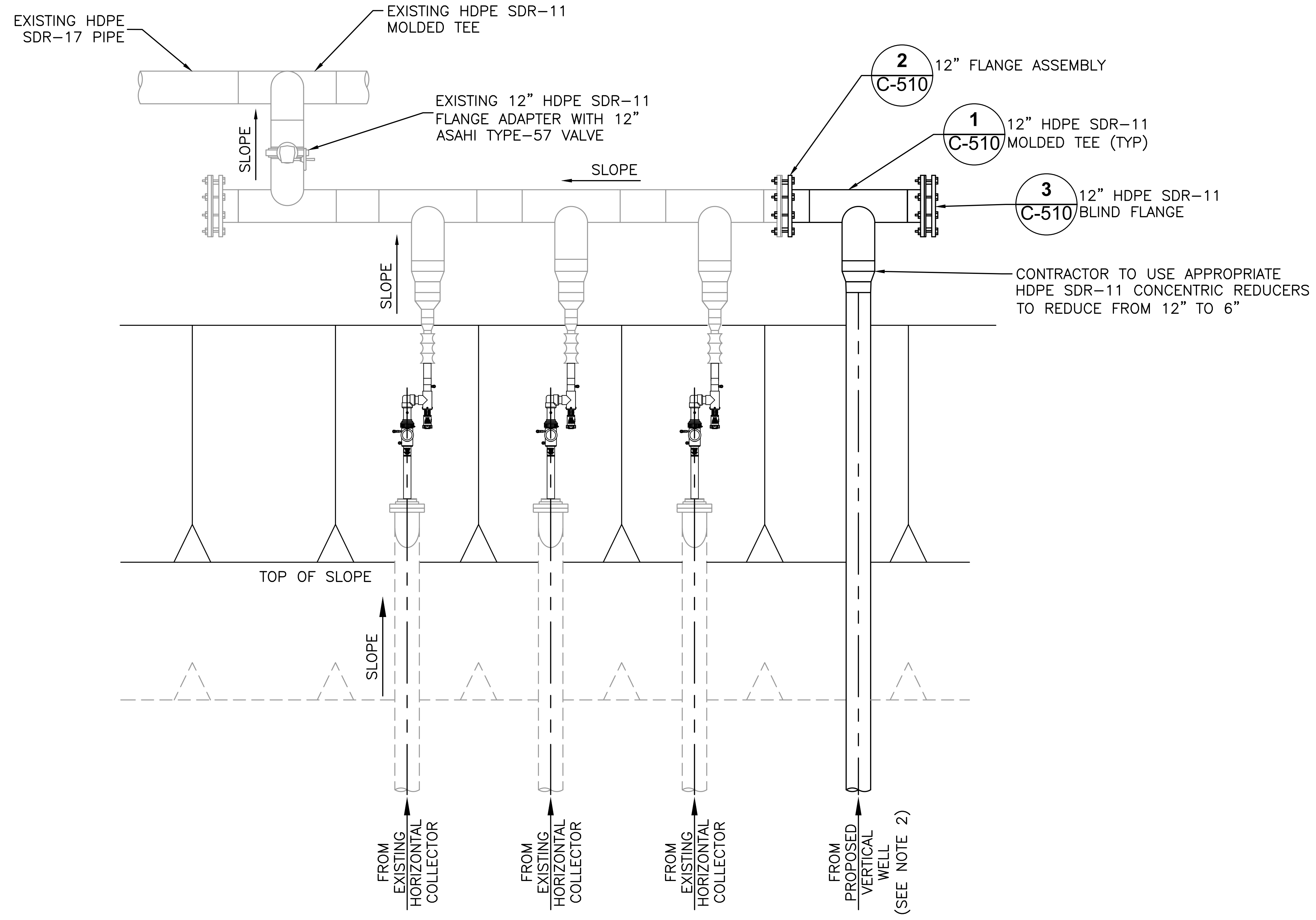
No. 12145
11/28/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION

GCCS DETAILS

DESIGNED BY : GRB/CME	CHECKED BY : AMN	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB/PJS	FILE : 220048-C-510_LF DETAILS.dwg

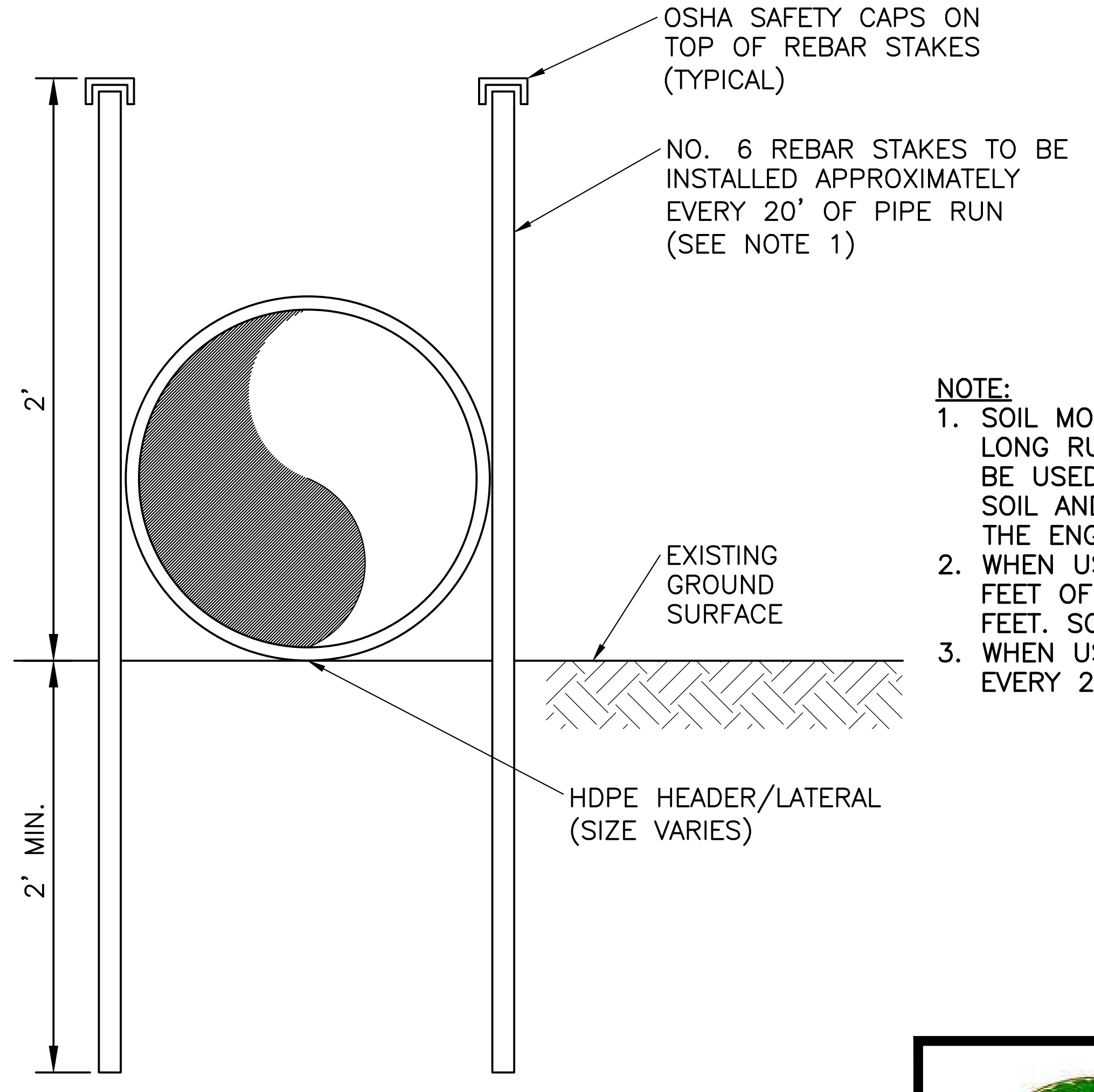
SHEET
C-510



NOTE:
1. CONTRACTOR TO BED WITH CLEAN SOILS OR SAND TO PROVIDE APPROPRIATE SLOPE.
2. CONTRACTOR TO CHECK DRAINAGE SLOPE OF ALL WELLS AND PIPING BEING CONNECTED TO CONNECTION MANIFOLD TO ASSURE DRAINAGE IS MAINTAINED.

MANIFOLD EXTENSION

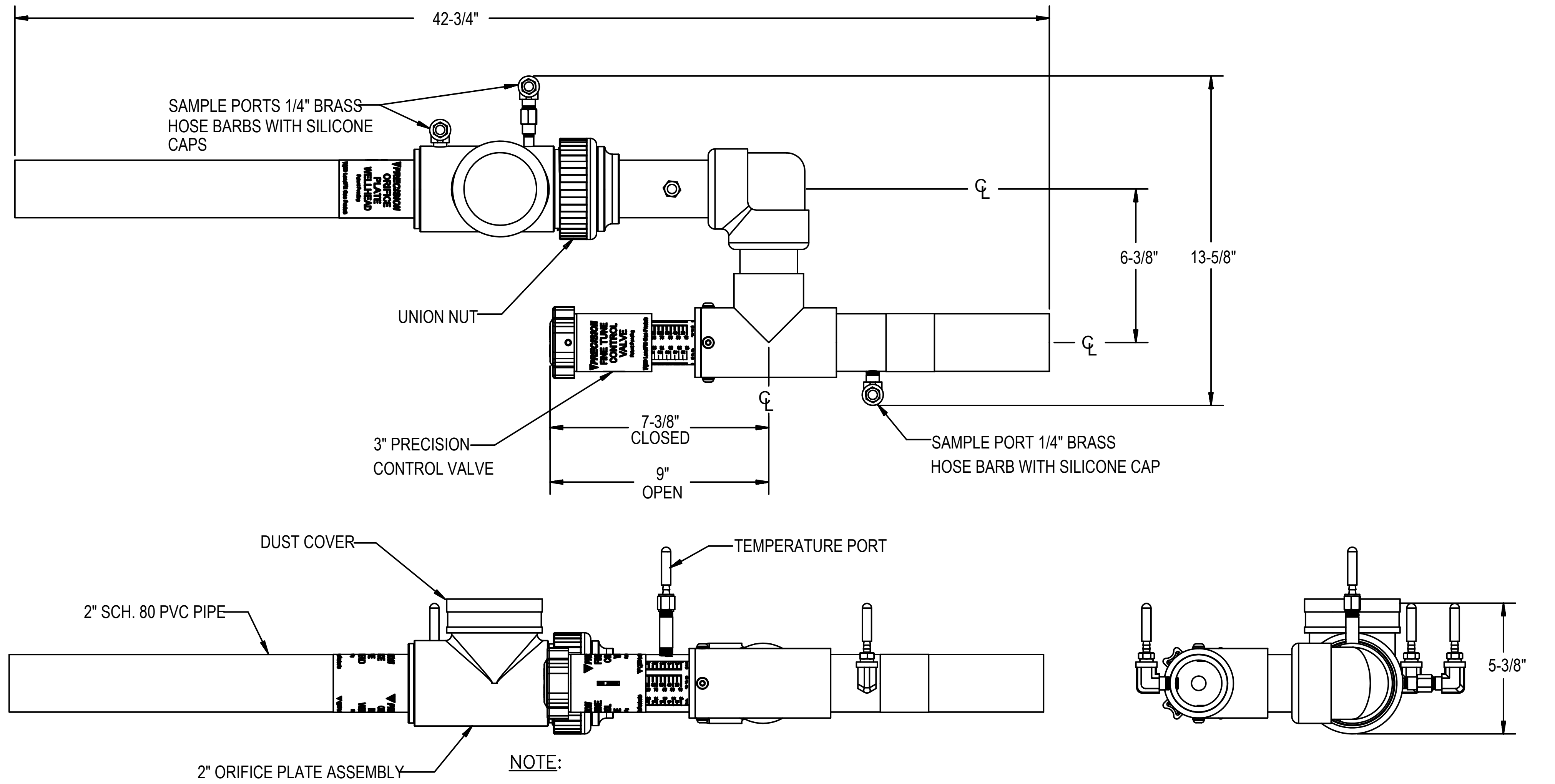
DETAIL 1 C-511
SCALE: NTS



NOTE:
1. SOIL MOUNDS MAY BE USED FOR STABILIZATION ON LONG RUNS WITH LITTLE ELEVATION CHANGE. REBAR TO BE USED ON SIDE SLOPES. SOME PIPES MAY REQUIRE SOIL AND REBAR FOR STABILIZATION AS DIRECTED BY THE ENGINEER.
2. WHEN USE OF SOIL MOUNDS IS APPROPRIATE, TWO FEET OF SOIL SHALL BE PLACED OVER PIPE FOR FIVE FEET. SOIL MOUND SPACING EVERY 50' OF PIPE RUN.
3. WHEN USE OF REBAR IS APPROPRIATE, REBAR SPACED EVERY 20' OF PIPE RUN.

ABOVE GRADE HEADER/LATERAL

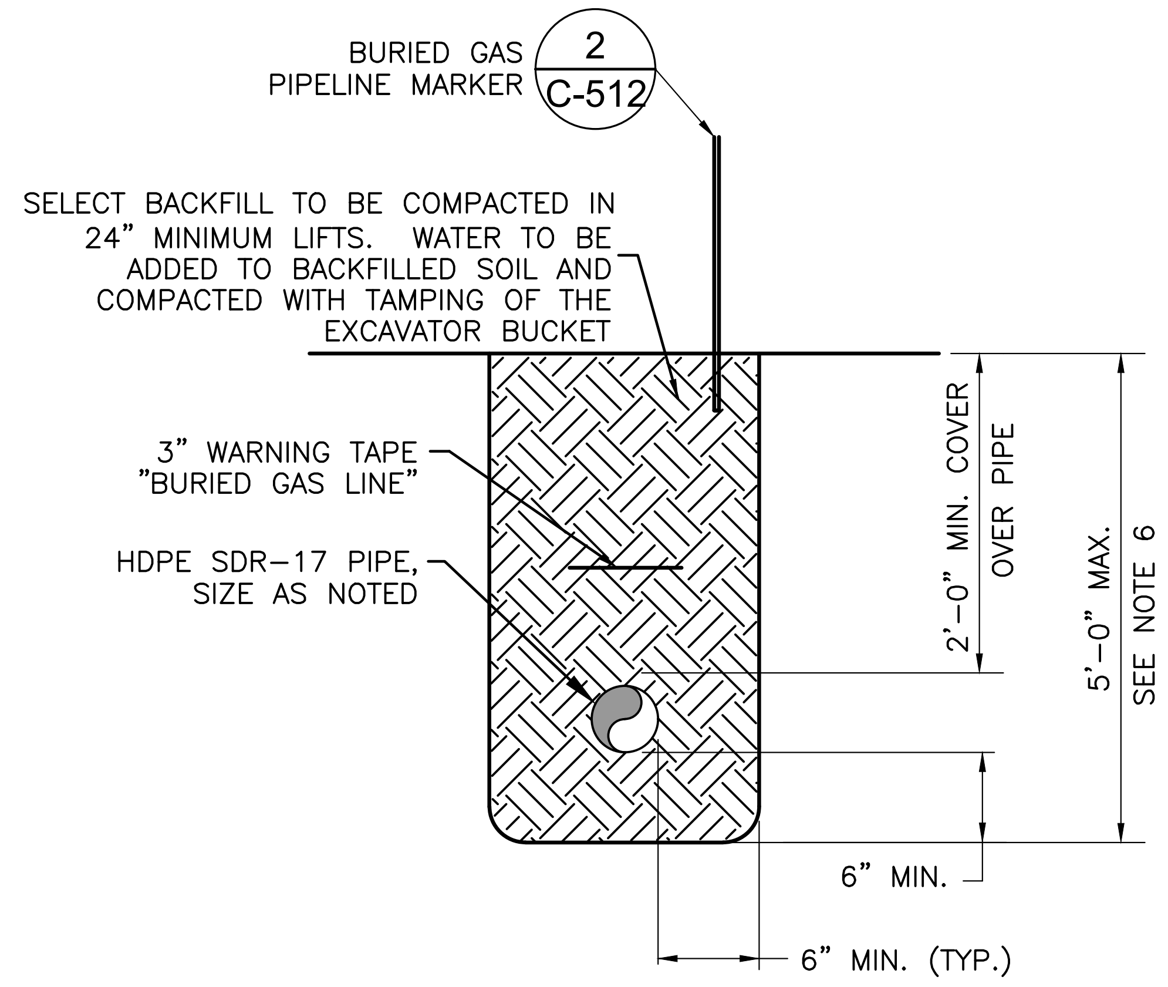
DETAIL 3 C-511
SCALE: NOT TO SCALE



NOTE:
1. WELLHEAD ASSEMBLY TO BE QED ORP315HL 2-INCH WELLHEAD OR APPROVED EQUAL.

2-INCH HORIZONTAL WELLHEAD

DETAIL 2 C-511
SCALE: NOT TO SCALE



NOTES:
1. PROVIDE MINIMUM PIPE DRAINAGE SLOPES OF 3% WITHIN WASTE LIMIT AND 1% OUTSIDE THE WASTE LIMIT, AS APPROVED BY THE OWNER/ENGINEER.
2. SLOPE PIPE THROUGH BENCH CROSSING TO MAXIMUM EXTENT POSSIBLE BUT NOT LESS THAN 5%.
3. PROVIDE BURIED GAS PIPELINE MARKER, SEE DETAIL 6 SHEET DS3 WHICH STATES "CAUTION BURIED GAS PIPING" OR APPROVED EQUAL.
4. BURIED GAS PIPELINE MARKERS TO BE SPACED AT A MAXIMUM OF 50' APART ON LANDFILL AND MAXIMUM AT 20' SPACING NEAR FLARE (SHEET 3B AND 3C).
5. BURIED PIPING 12" IN DIAMETER OR GRADER TO HAVE 6" MIN OF BEDDING UP TO CENTERLINE OF PIPE.
6. CONTRACTOR SHALL NOT TRENCH DEEPER THAN 5' BELOW GROUND SURFACE WITHOUT OBTAINING PERMISSION FROM ENGINEER PRIOR. ADDITIONAL FEES ASSOCIATED WITH TRENCHING DEEPER THAN 5' WITHOUT PRIOR APPROVAL WILL NOT BE PAID.

BURIED PIPE TRENCH

DETAIL 4 C-511
SCALE: NOT TO SCALE

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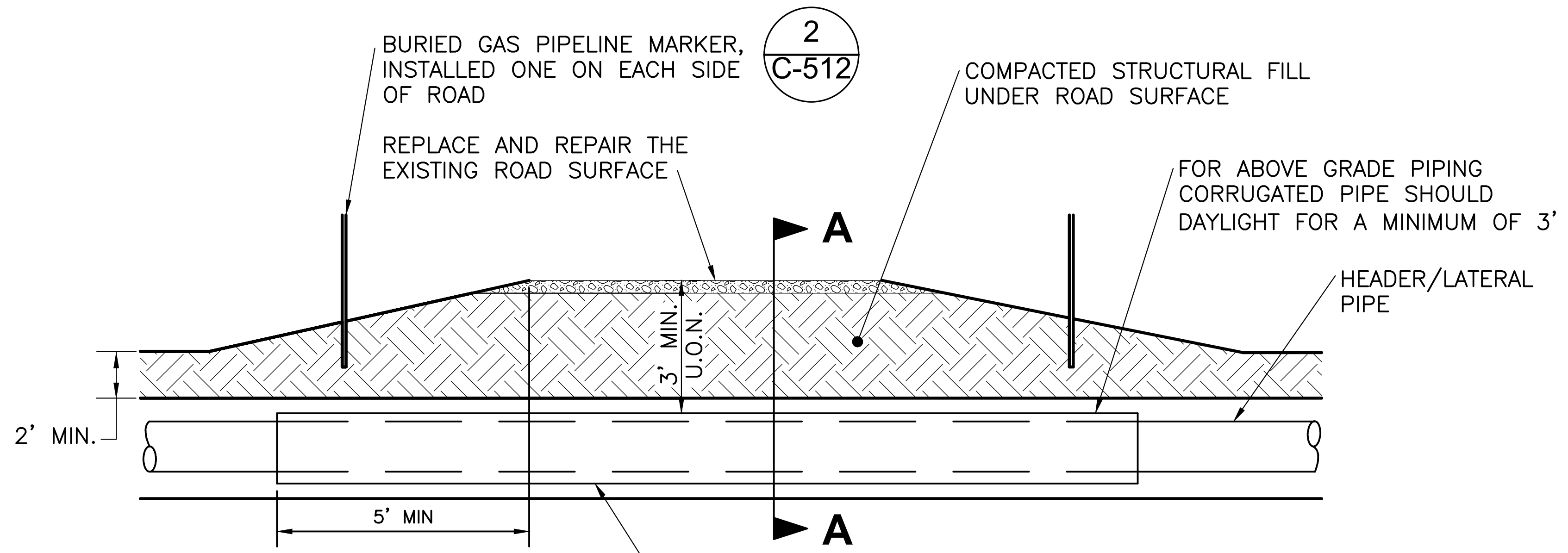
C-511



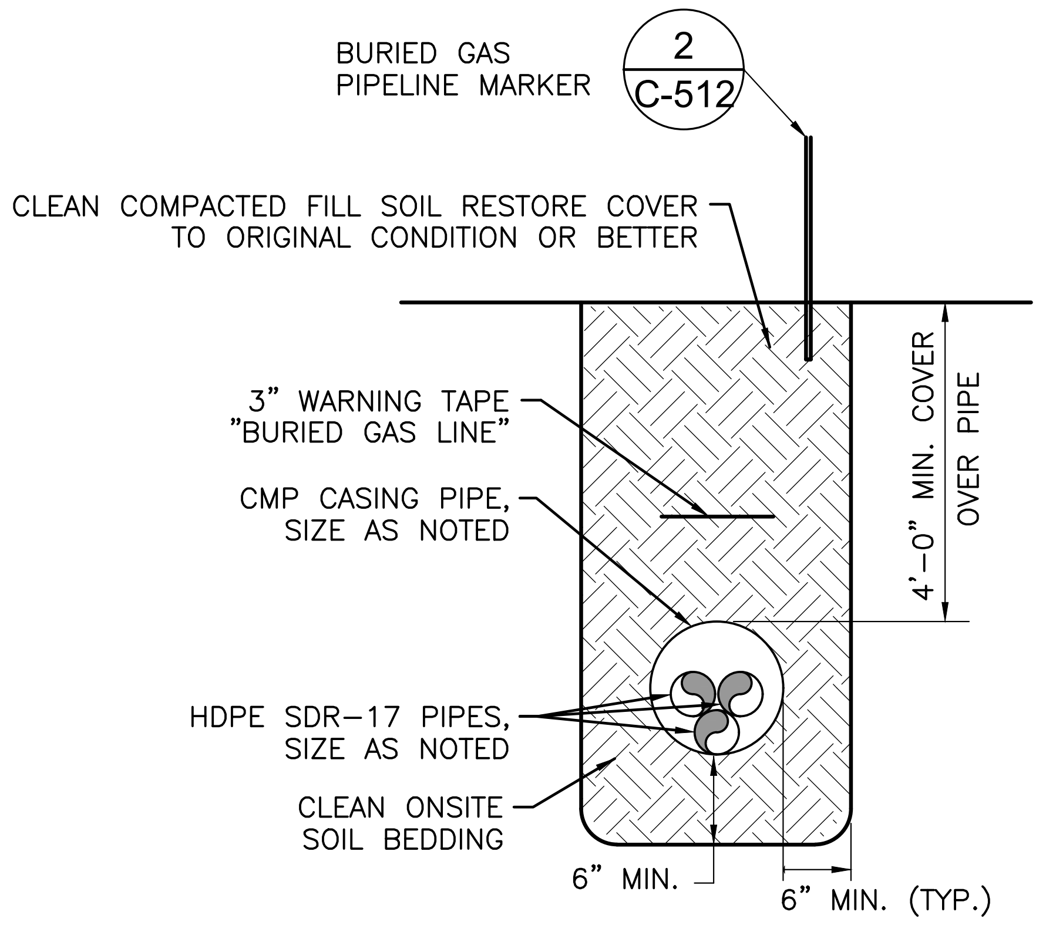
PIPE SCHEDULE	
6" LATERAL PIPE	12" CASING PIPE OR APPROVED EQUAL
8" LATERAL PIPE	12" CASING PIPE OR APPROVED EQUAL
12" LATERAL PIPE OR 2"x6" LATERAL PIPE	18" CASING PIPE OR APPROVED EQUAL
3"x6" LATERAL PIPE	24" CASING PIPE OR APPROVED EQUAL

NOTE:

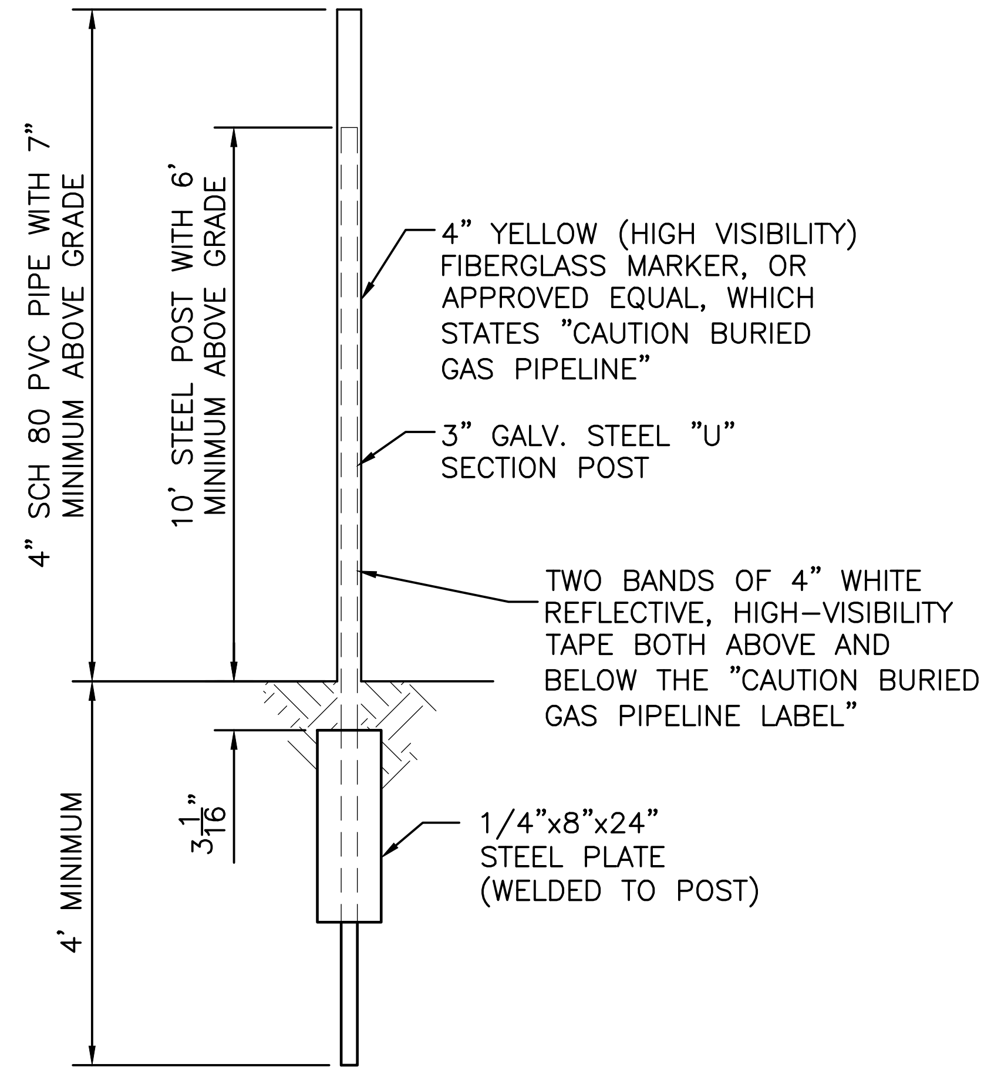
1. CONTRACTOR TO LAY OUT THE PIPE TO CONFORM TO FIELD CONDITIONS. PROVIDE 4' MINIMUM COVER AND 5% MINIMUM PIPE SLOPE CROSSING BELOW PERIMETER AND MAIN HAUL ROADS.
2. PROVIDE BURIED GAS PIPELINE MARKER, SEE DETAIL 6 SHEET DS3 WHICH STATES "CAUTION BURIED GAS PIPING" OR APPROVED EQUAL AT BOTH SIDES OF ROAD CROSSING.

TYPICAL ROAD CROSSING

DETAIL
1 C-512
SCALE: NOT TO SCALE



SECTION A-A



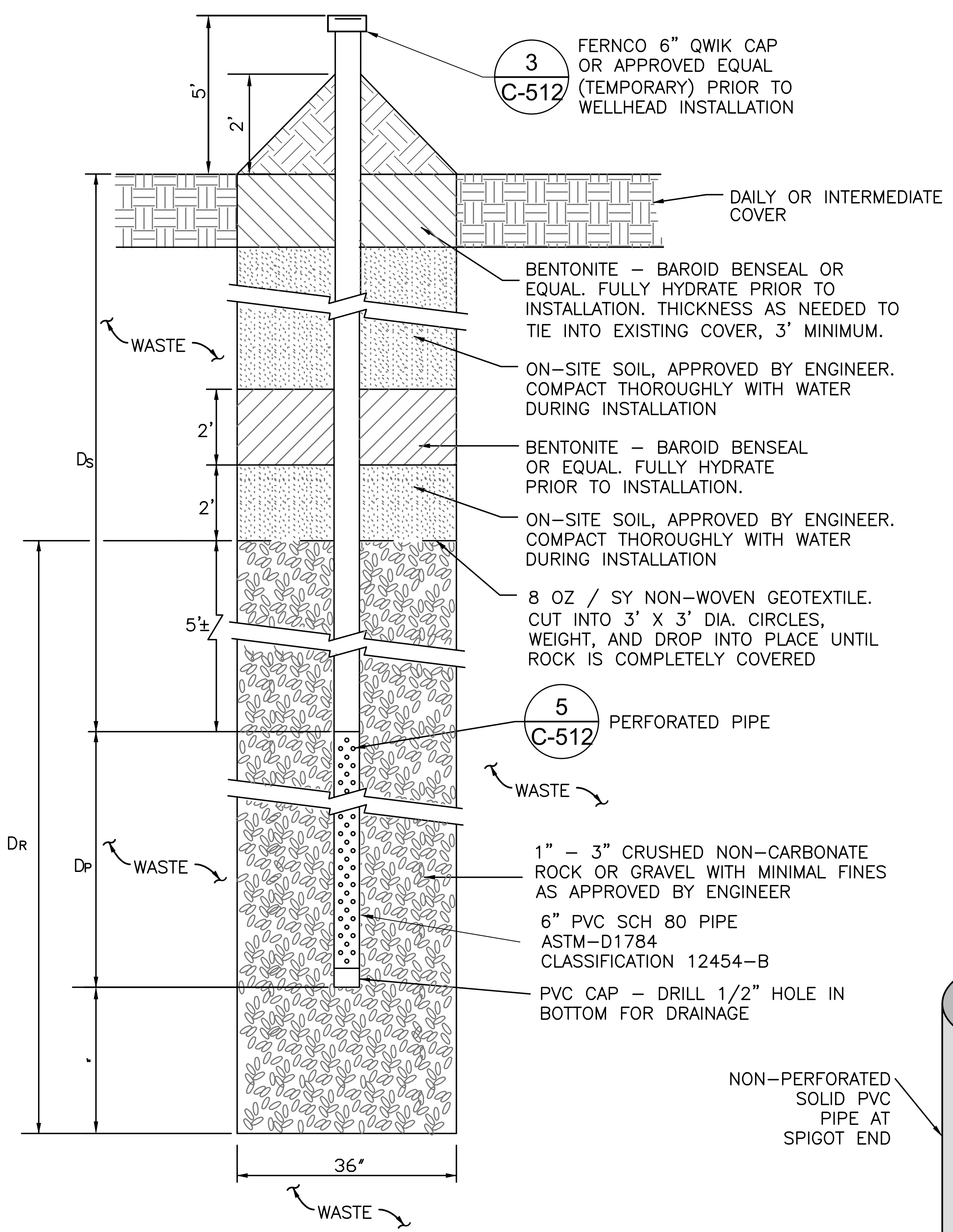
NOTE:

1. TYPICAL BURIED GAS PIPELINE MARKER OR EQUIVALENT HIGH VISIBILITY MARKERS TO BE USED.

BURIED GAS PIPELINE MARKER

DETAIL
2 C-512
SCALE: NOT TO SCALE

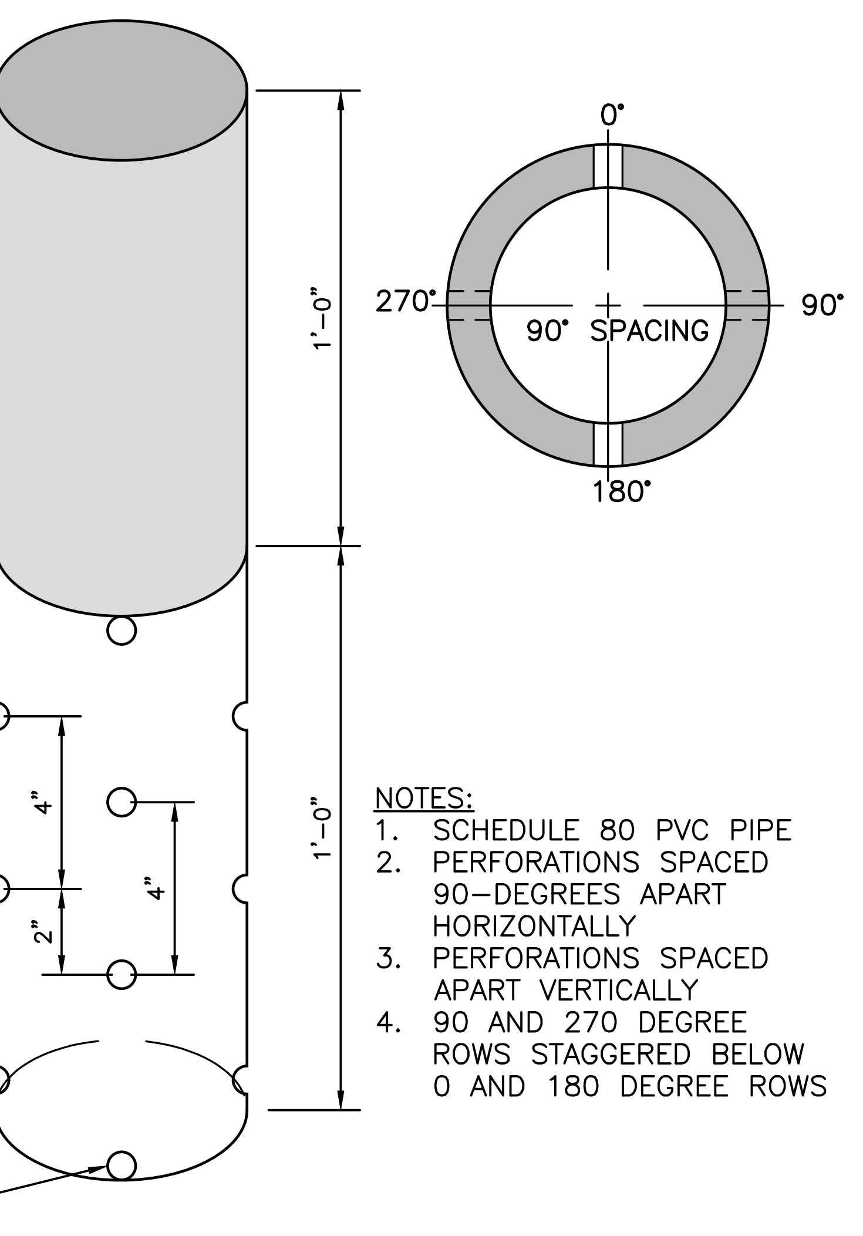
TYPICAL LFG EXTRACTION WELL



DETAIL
4 C-512
SCALE: NOT TO SCALE

NOTES:

1. WELL PIPE TO BE BELL AND SPIGOT OR JOINED WITH PVC SCH 80 COUPLINGS.
2. PVC SOLVENT WELD AND INSTALL FOUR 1/4" BY 1" LONG GALVANIZED LAG BOLTS @ 90° ON CENTER ON EACH JOINT.
3. PVC WITH MINIMUM ASTM D-1784 CELL CLASSIFICATION OF 12454-B.
4. D_R = DEPTH OF ROCK
   D_S = DEPTH OF SOLID PIPE (BELOW GRADE) – 25 FEET MINIMUM
   D_P = LENGTH OF PERFORATED PIPE
5. MINIMUM 15 FEET SEPARATION BETWEEN BASE OF BORING AND TOP OF LINER SYSTEM, PROVIDE MINIMUM 20 FEET SEPARATION BETWEEN BASE OF BORING AND TOP OF LINER SIDE SLOPES.
6. 1"-3" NON-CARBONATE GRAVEL WITH MINIMAL FINES.
7. WELL DRILLING WILL NOT COMMENCE UNTIL BOTTOM LINER ELEVATIONS ARE IDENTIFIED AND VERIFIED BY PROJECT SURVEYOR, DESIGN ENGINEER, AND CQA REPRESENTATIVE.
8. WELL DRILLING TABLE WILL BE MANAGED BY THE CLIENT OR A DESIGNATED REPRESENTATIVE TO ENSURE ONLY THE VERIFIED WELL DEPTHS ARE PRESENT, AND THAT DRILLER AND CQA REPRESENTATIVE HAVE THE IDENTICAL INFORMATION PRIOR TO DRILLING.

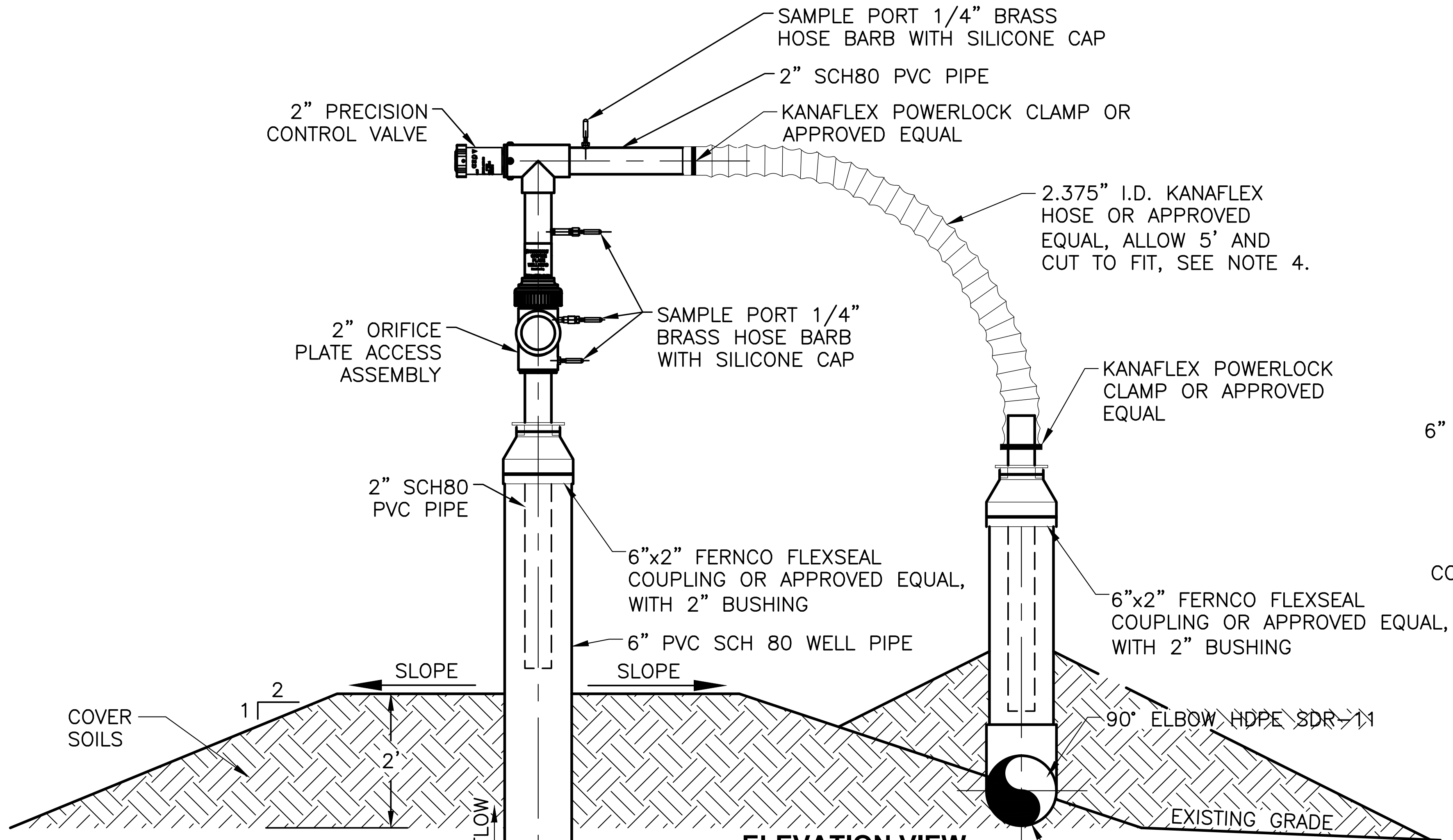


NOTES:

1. SCHEDULE 80 PVC PIPE
2. PERFORATIONS SPACED 90-DEGREES APART HORIZONTALLY
3. PERFORATIONS SPACED APART VERTICALLY
4. 90 AND 270 DEGREE ROWS STAGGERED BELOW 0 AND 180 DEGREE ROWS

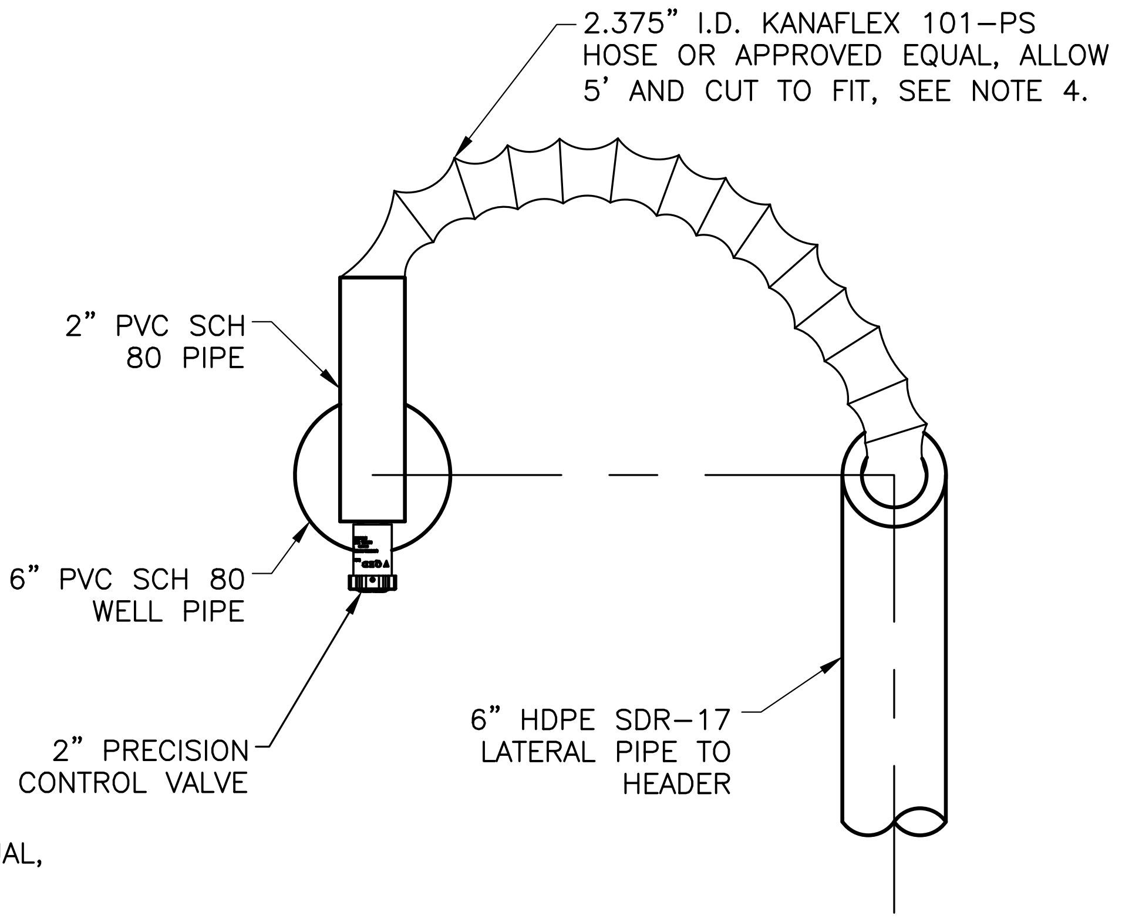
PERFORATED PIPE

DETAIL
5 C-512
SCALE: NOT TO SCALE



ELEVATION VIEW

WELLHEAD ROTATED FOR CLARITY
SEE PLAN VIEW BELOW FOR
ACTUAL ALIGNMENT OF WELLHEAD



PLAN VIEW

NOTES:

1. WELLHEAD ASSEMBLY QED ENVIRONMENTAL SYSTEMS 2-INCH WELLHEAD OR APPROVED EQUAL.
2. PROVIDE HIGH VISIBILITY REFLECTIVE TAPE AROUND TOP 1-FOOT OF WELL CASING AND LATERAL PIPE.
3. INSTALL FLEX HOSE WITH EXCESS HOSE TO ALLOW MOVEMENT OF LATERAL BUT CONFIGURED AS NECESSARY TO PREVENT SAG AND WATER ACCUMULATION. ALL INSTALLATIONS SHALL BE INSPECTED BY ENGINEER PRIOR TO APPROVAL.
4. WELLHEAD SHALL BE INSTALLED 90° FROM LATERAL PIPE, SEE PLAN VIEW DETAIL.

VERTICAL WELLHEAD

DETAIL
3 C-512
SCALE: NOT TO SCALE

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SHEET
C-512

INSTRUCTIONS:

PREPARE AND ORGANIZE REQUIRED SUPPLIES AT THE VERTICAL LANDFILL GAS EXTRACTION WELL LOCATION PRIOR TO PERFORMING ANY WORK.

SUPPLIES INCLUDE:

- CORDLESS DRILL
- CHOP SAW / RECIPROCATING SAW
- GENERATOR
- HEX-HEAD STYLE BIT FOR DRILL
- HEX-HEAD STYLE HAND SCREWDRIVER
- SIX-INCH DIAMETER STEEL SHEET METAL PLATE OR EQUIVALENT (TO BLOCK FLOW INTO VACUUM RISER DURING FUSION)
- 4-GAS METER (TO WEAR FOR SAFETY)
- FLAME IONIZATION DETECTOR (FID) (TO MEASURE SURFACE EMISSIONS)

FOR PVC/CPVC PIPE

- LAG SCREWS – 3/8" DIAMETER X 3/4" LENGTH
- OATEY→ PVC HEAVY DUTY ORANGE CEMENT (TO JOIN PLASTIC PIPE AND FITTINGS) WHICH COMPLIES WITH ASTM F493. (SEE SPECIFICATIONS SECTION 33 51 16.23)
- OATEY→ PVC INDUSTRIAL GRADE PURPLE PRIMER (TO REMOVE GLOSS AND PREPARE PIPE FOR SOLVENT WELDING) WHICH COMPLIES WITH ASTM F656. (SEE SPECIFICATIONS SECTION 33 51 16.23)
- OATEY→ CPVC HEAVY DUTY ORANGE CEMENT (TO JOIN PLASTIC PIPE AND FITTINGS) WHICH COMPLIES WITH ASTM F493. (SEE SPECIFICATIONS SECTION 33 51 16.23)
- OATEY→ CPVC INDUSTRIAL GRADE PURPLE PRIMER (TO REMOVE GLOSS AND PREPARE PIPE FOR SOLVENT WELDING) WHICH COMPLIES WITH ASTM F656. (SEE SPECIFICATIONS SECTION 33 51 16.23)
- CLEAR CLEANER (TO QUICKLY REMOVE DIRT, GREASE, AND MOISTURE FROM PIPES AND FITTINGS BEFORE SOLVENT WELDING). (SEE SPECIFICATIONS SECTION 33 51 16.23)
- APPLICATION SWABS
- PVC/CPVC BELL AND SPIGOT STYLE PIPING – MATERIAL AND SIZE TO MATCH EXISTING WELL CASING (SEE SPECIFICATIONS SECTION 33 51 16.23)
- PVC/CPVC CONNECTION COUPLERS (SEE SPECIFICATIONS SECTION 33 51 16.23)
- BENTONITE – 8-MESH OR FINER (SEE SPECIFICATIONS SECTION 31 23 23.14)

FOR HDPE PIPE / ELECTRO-FUSION WELDING

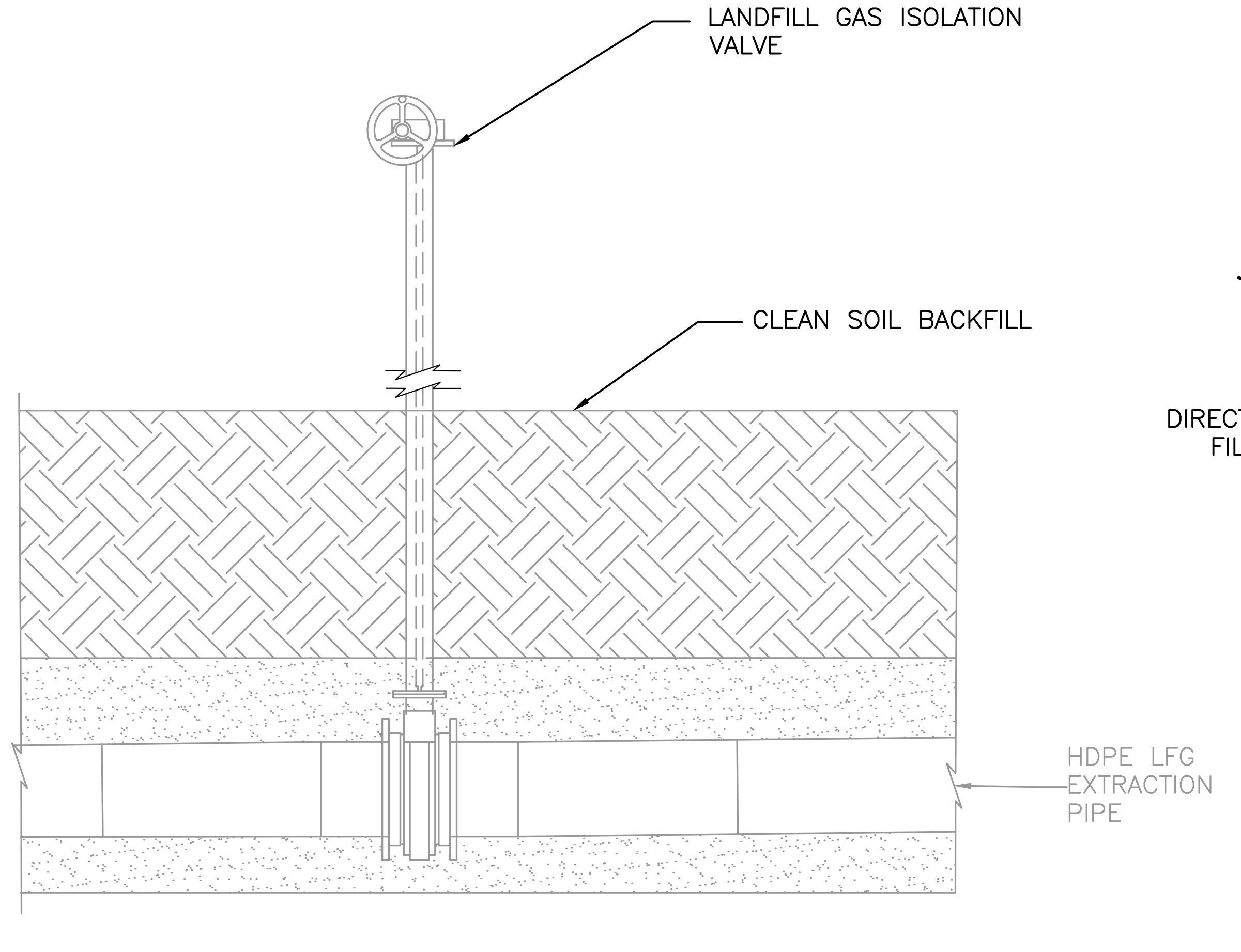
- GENERATOR OF SUFFICIENT POWER TO SERVICE ELECTRO-FUSION EQUIPMENT.
- MCELROY PIT BULL OR EQUIVALENT ELECTRO-FUSION MACHINERY – FOUR-INCH/SIX-INCH (IF ELECTRO-FUSION COUPLERS ARE APPROVED BY THE SITE ENGINEER).
- ELECTRO-FUSION COUPLER(S) (IF ALLOWED BY SITE ENGINEER).
- PIPE SCRAPING EQUIPMENT CAPABLE OF SCRAPING PIPE ENDS OR TAPPING TEE SURFACES, EXTENDING BEYOND THE AREA TO BE COVERED BY THE FITTING.
- ANCILLARY EQUIPMENT: WELDING TENT, SOLVENT BASED MARKER AND CLEAN, DRY LINT-FREE CLOTH OR PAPER TOWEL.

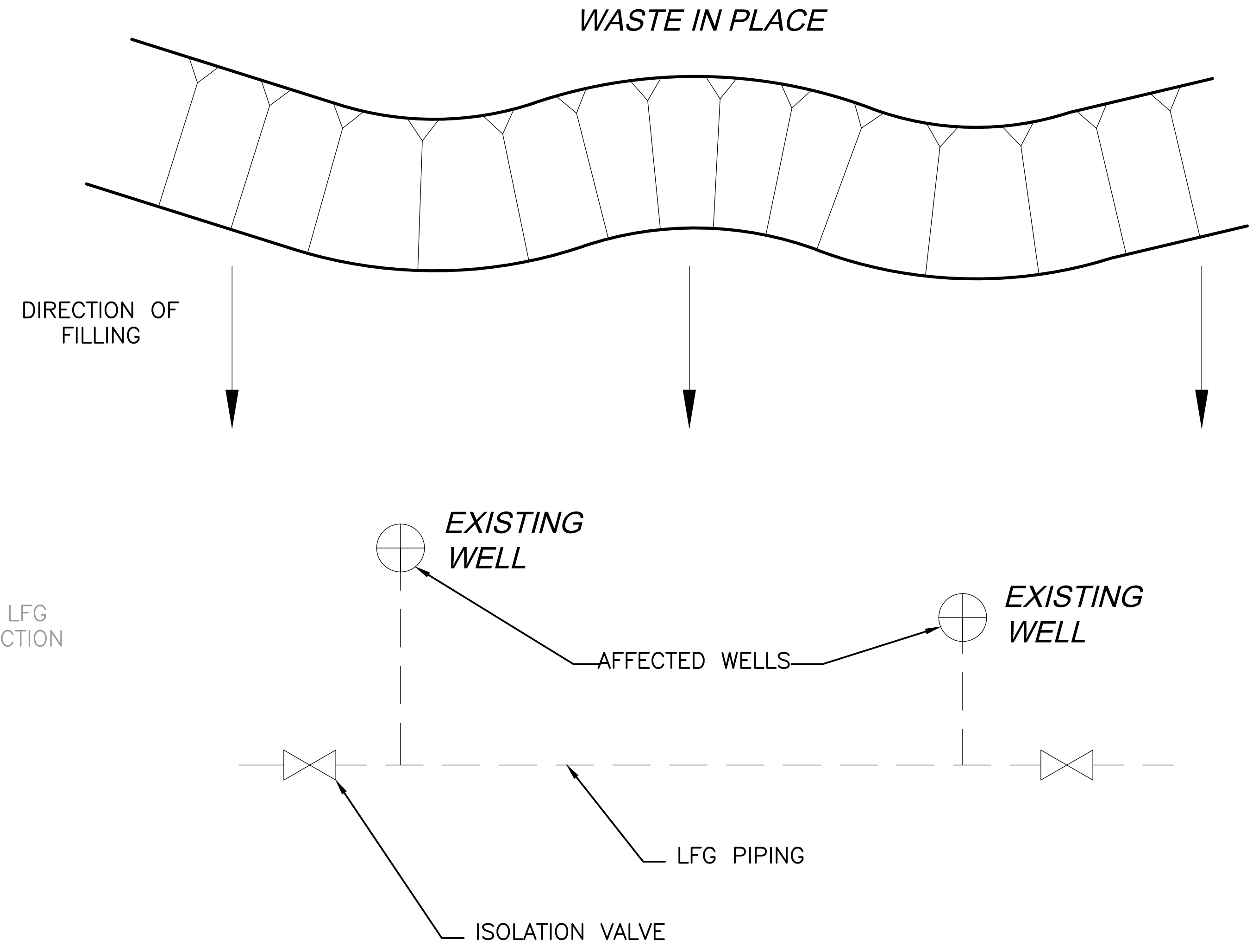
FOR HDPE PIPE / BUTT FUSION WELDING

- GENERATOR OF SUFFICIENT POWER TO SERVICE BUTT FUSION EQUIPMENT.
- MCELROY PIT BULL OR EQUIVALENT ELECTRO-FUSION MACHINERY – FOUR-INCH/SIX-INCH
- ANCILLARY EQUIPMENT: WELDING TENT, SOLVENT BASED MARKER AND CLEAN, DRY LINT-FREE CLOTH OR PAPER TOWEL.

STEP 1
ORGANIZE SUPPLIES

NOTE: WELL RAISING SOP INCLUDES STEPS 1-11 IN SHEETS C-513 THROUGH C-518





INSTRUCTIONS:

- THE FIELD TECHNICIAN SHOULD DETERMINE FROM THE OPERATIONS MANAGER THE EXTENT OF THE WASTE FILLING OPERATIONS AND THE DESIRED FINAL ELEVATION OF THE SUBJECT AREA IN ORDER TO DETERMINE THE QUANTITY AND LOCATION(S) OF AFFECTED WELLS, THE IDEAL METHOD(S) AND LOCATION(S) TO ISOLATE THE SYSTEM VACUUM PIPING, AND TO PROPERLY PREPARE THE NECESSARY QUANTITY OF RISER MATERIALS AND LFG PIPING ADDITIONS OR CHANGES.
- THE FIELD TECHNICIAN SHOULD LOCATE (IF APPLICABLE) ISOLATION VALVES ON ADJACENT HEADER/LATERAL PIPING TO ISOLATE THE AFFECTED WELL(S) FROM THE SYSTEM VACUUM AND DETERMINE THE QUANTITY OF WELLS AFFECTED BY CLOSING THE VALVE(S). THE FIELD TECHNICIAN SHOULD CONSULT THE SITE ENVIRONMENTAL MANAGER/ENGINEER PRIOR TO CLOSING THE ISOLATION VALVES, SHOULD THE FLARE/ENGINE FACILITY (IF APPLICABLE) BE AFFECTED. WHEN THE WELL RAISING PROCESS IS COMPLETE, THE FIELD TECHNICIAN SHOULD OPEN ISOLATION VALVES THAT WERE CLOSED.
- THE FIELD TECHNICIAN SHOULD COMMUNICATE ALL WELL RAISING PLANS TO THE OPERATIONS MANAGER SO THAT PRECAUTIONARY MEASURES MAY BE EXPLAINED TO OPERATIONS PERSONNEL.
- FILLING OPERATIONS SHOULD AVOID THE SUBJECT AREA(S) UNTIL THE FIELD TECHNICIAN HAS PROPERLY PREPARED THE WELL(S) AND RISER(S) FOR RAISING.
- IF SITE OPERATIONS REMOVES SURFACE SOIL PRIOR TO WASTE PLACEMENT, THE FIELD TECHNICIAN SHOULD INFORM THE OPERATIONS MANAGER TO LEAVE A MINIMUM FIVE-FOOT OFFSET OF UNTOUCHED SURFACE SOIL AROUND THE WELL CASING TO AVOID POTENTIAL DAMAGE TO THE WELL CASING(S) AND LATERAL RISER(S).

STEP 2
FIELD COMMUNICATION ON OPERATIONS AND WELL RAISING PLANS

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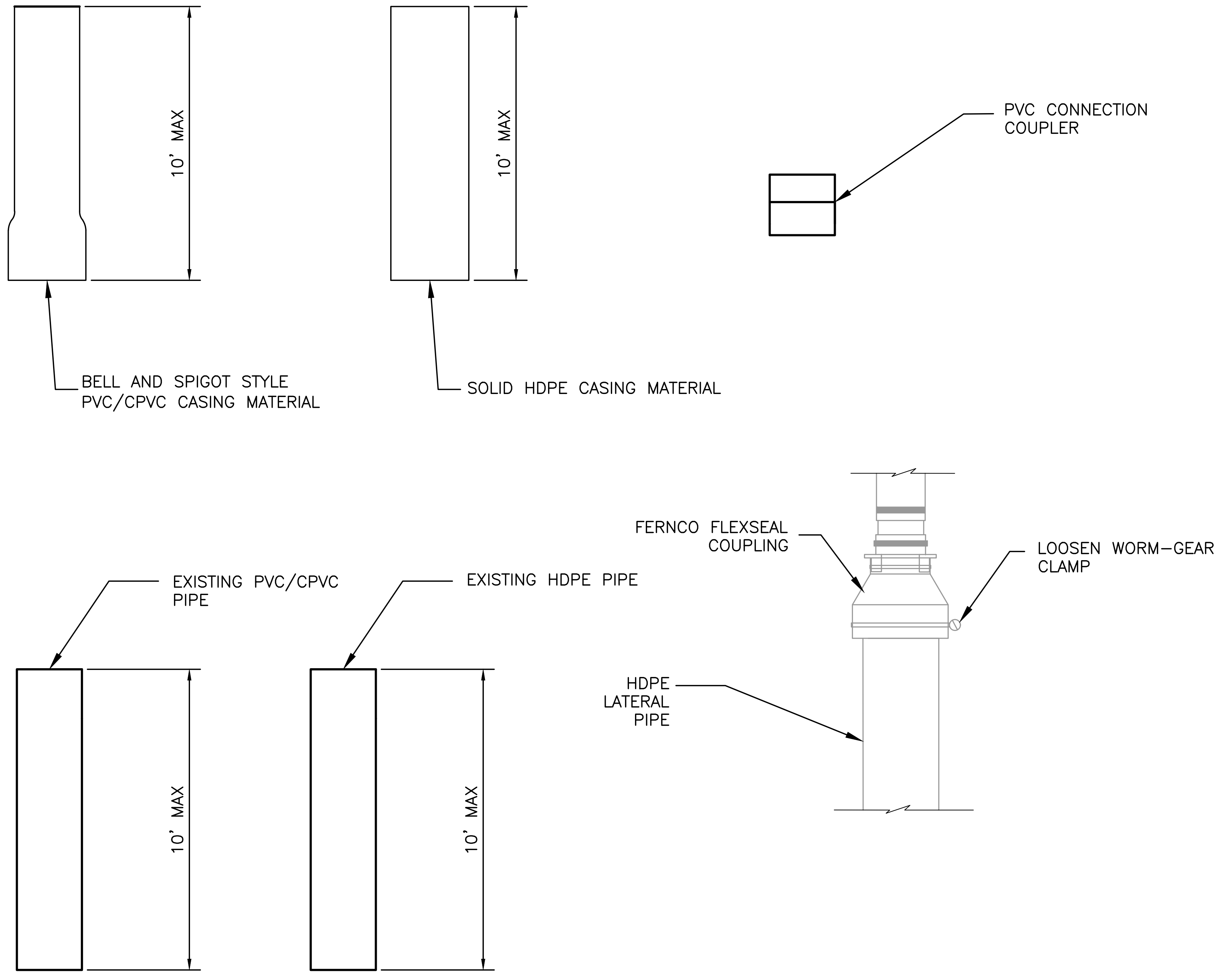

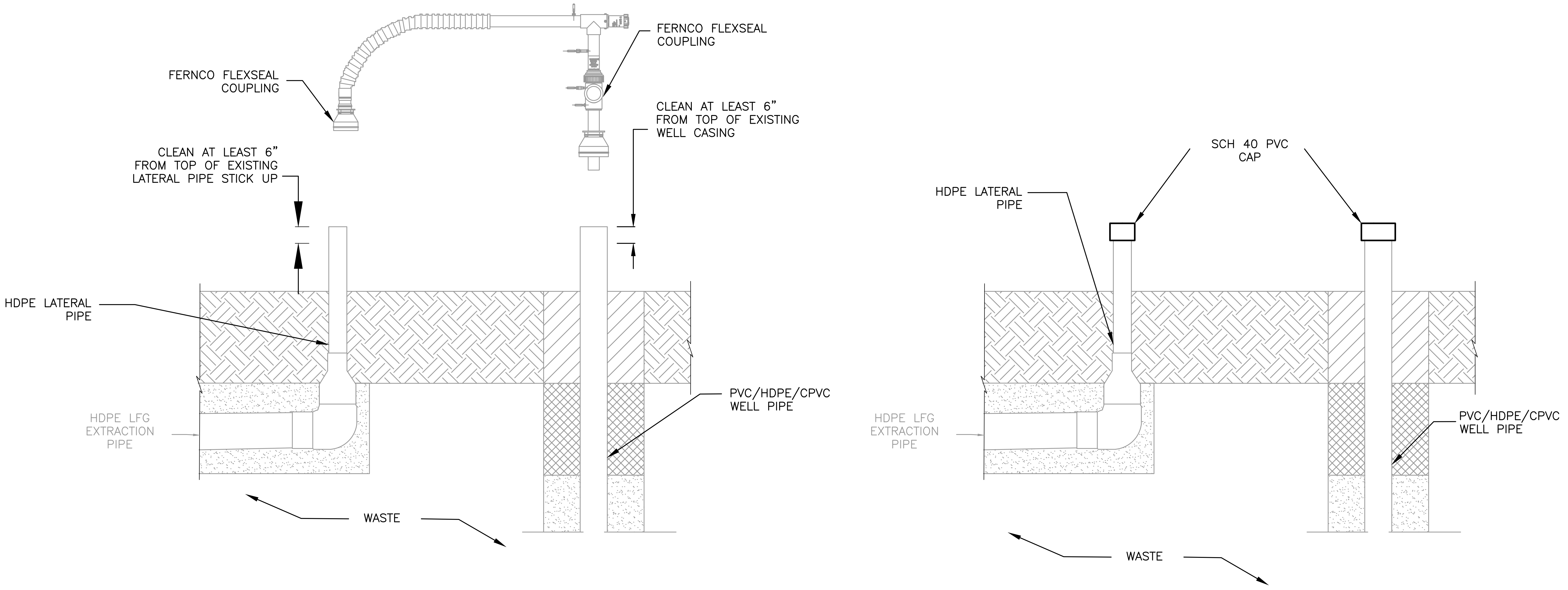

INSTRUCTIONS:

- UPON DETERMINING THE LOCATION OF THE SUBJECT WELL(S) AND QUANTITY OF MATERIALS REQUIRED TO COMPLETE THE RAISING OF THE WELL(S), THE FIELD TECHNICIAN SHOULD LOAD ALL NECESSARY MATERIALS FOR THE SUBJECT WELL(S) INTO THE SITE VEHICLE.
- WELL CASING RISER SEGMENTS SHOULD BE CUT INTO LENGTHS NOT EXCEEDING 10 FEET FOR EASE OF INSTALLATION, AND TO AVOID DAMAGE TO THE WELL CASING CAUSED BY THE STRESSES FROM WIND AND MATERIAL WEIGHT. MULTIPLE SEGMENTS OF RISER PIPING MAY BE REQUIRED AT EACH WELL DURING A FILLING OPERATION. USE BELL AND SPIGOT TYPE PIPING FOR EASE OF INSTALLATION FOR PVC/CPVC WELL CASING.
- TO CONNECT SHORTER SEGMENTS OF CASING RISER MATERIALS, USE PVC/CPVC CONNECTION COUPLERS INSTEAD OF BELL AND SPIGOT TYPE PIPING. IF SMALL SEGMENTS WITH CONNECTION COUPLERS ARE USED, THE TECHNICIAN SHOULD PREPARE THE SEGMENT BY ATTACHING THE CONNECTION COUPLER TO THE END OF THE RISER SEGMENT WITH PRIMER, GLUE, AND FOUR LAG SCREWS.
- PLEASE SEE DRAWING ABOVE FOR DETAILED REPRESENTATION OF WELL RAISING PREPARATION.

STEP 3
PREPARATION FOR WELL RAISING PROCEDURE

INSTRUCTIONS:

- THE RELEVANT ISOLATION VALVE(S) SHOULD BE CLOSED PRIOR TO REMOVING THE WELLHEAD, IN ORDER TO MINIMIZE AIR INTRUSION INTO THE GCCS. THE FIELD TECHNICIAN SHOULD NOT CLOSE ANY ISOLATION VALVE WITHOUT CONSULTING THE SITE ENVIRONMENTAL MANAGER/ENGINEER.
- THE TECHNICIAN SHOULD REMOVE THE WELLHEAD, FIRST BY LOOSENING THE LOWEST STAINLESS STEEL WORM–GEAR CLAMP ON THE FERNCO FLEXSEAL COUPLING OF THE WELLHEAD TO THE WELL CASING USING A HEX–HEAD STYLE HAND SCREWDRIVER, AND THEN LOOSENING THE LOWEST WORM–GEAR CLAMP ON THE FERNCO FLEXSEAL COUPLING OF THE FLEX–HOSE TO THE HDPE LFG EXTRACTION PIPE. REMOVE THE WELLHEAD AND FLEX–HOSE SIMULTANEOUSLY TO AVOID DAMAGE TO THE WELLHEAD AND PLACE ON A CLEAN SURFACE.
- PLACE A SCH40 PVC CAP ONTO THE HDPE EXTRACTION PIPE RISER AND WELL CASING RISER IMMEDIATELY FOLLOWING DISCONNECTION OF THE FLEX–HOSE IN ORDER TO MINIMIZE AIR INTRUSION INTO THE GCCS.
- PLEASE SEE DRAWING ABOVE FOR DETAILED REPRESENTATION OF WELLHEAD REMOVAL.

STEP 4
REMOVE WELLHEAD

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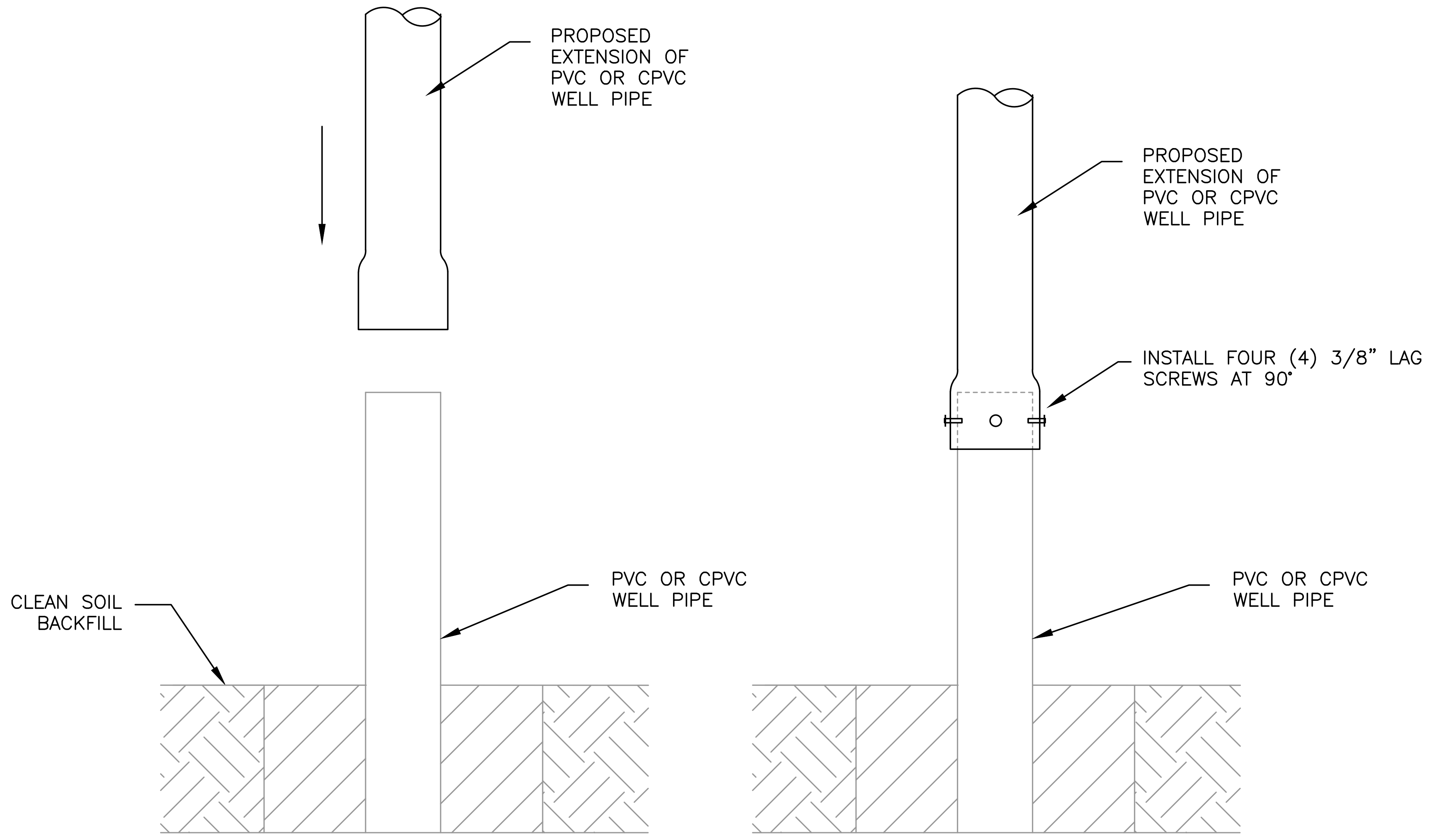
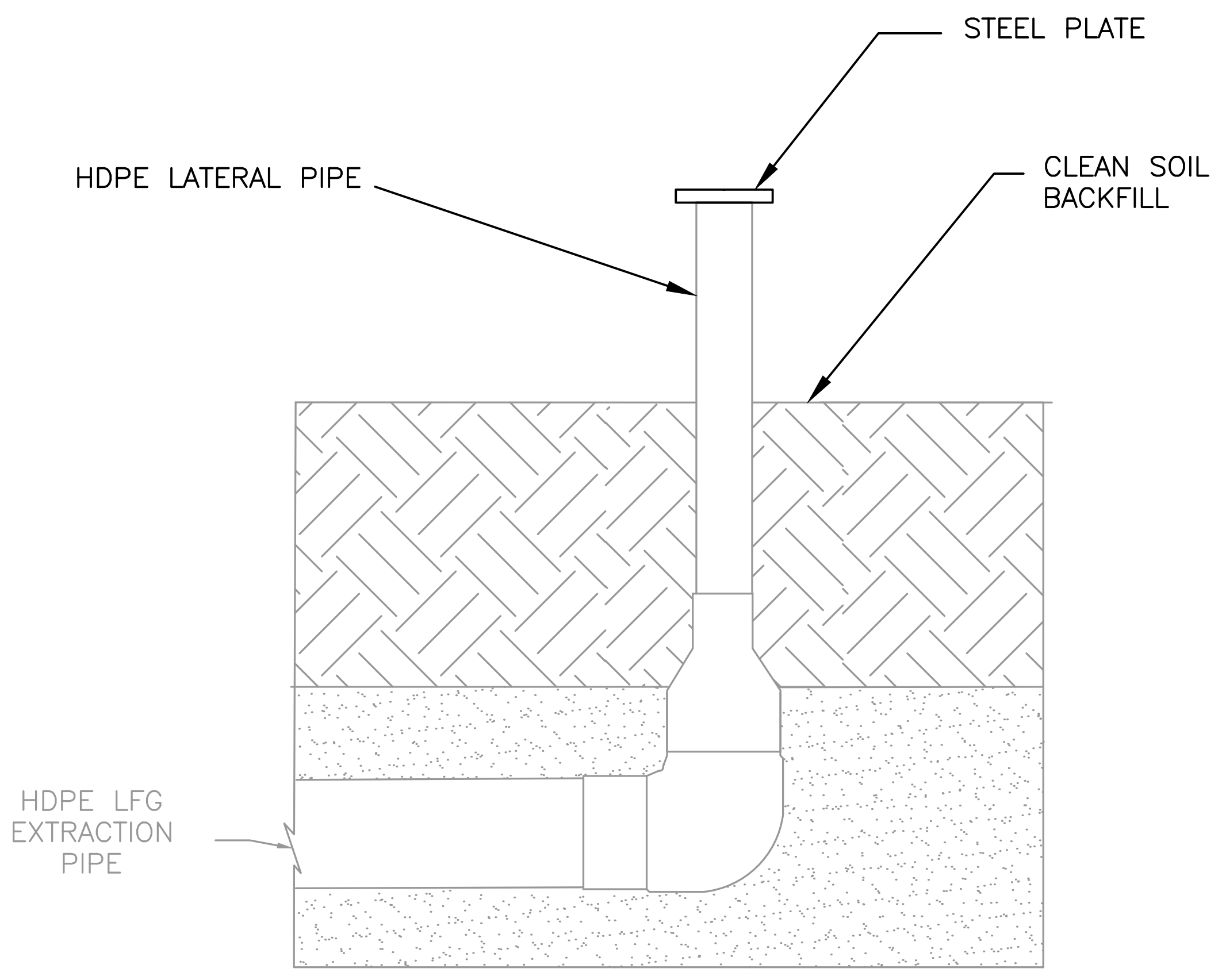
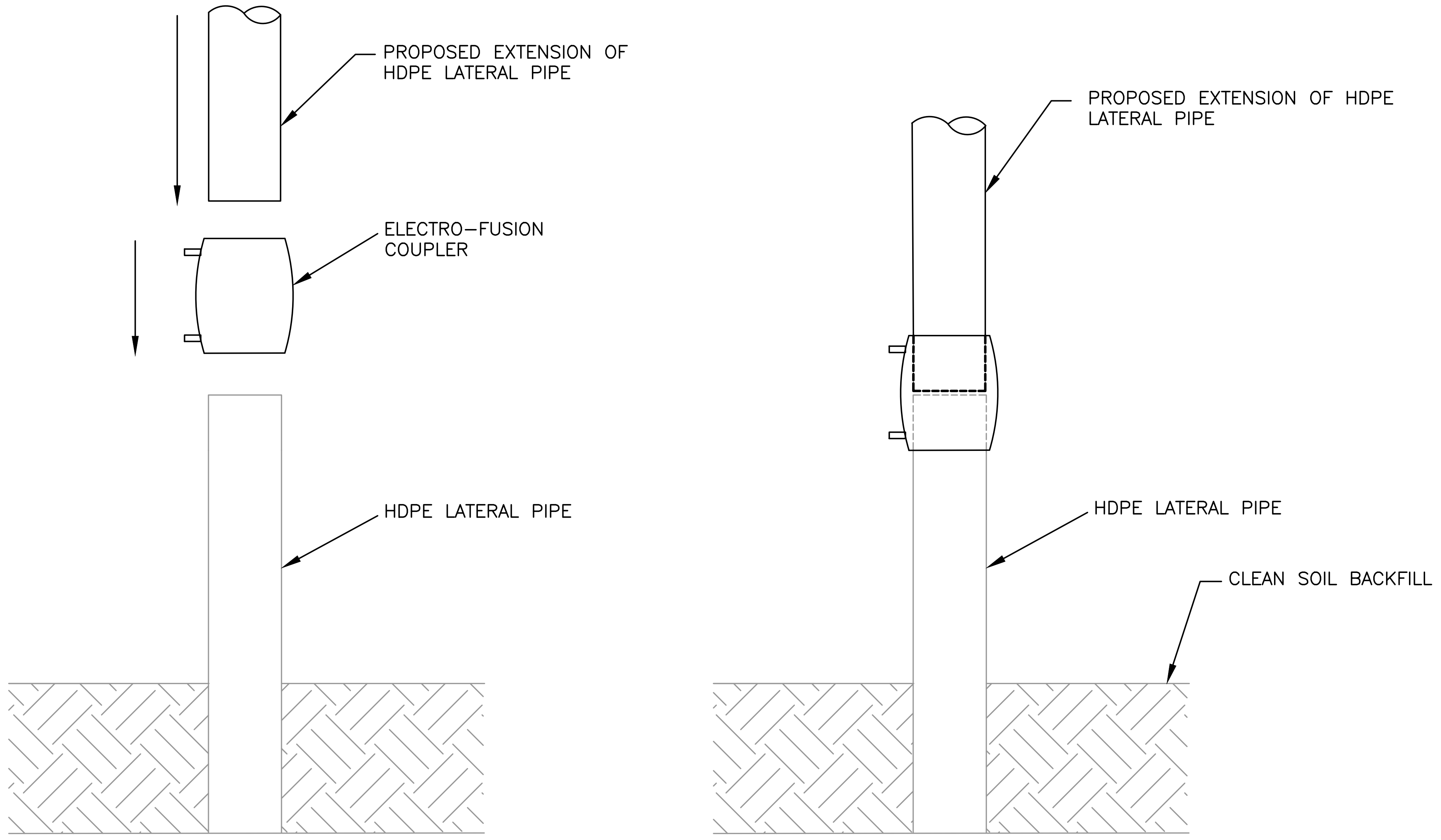




OPTION 1



OPTION 2

INSTRUCTIONS:

- ONCE THE DESIRED LENGTH OF RISER PIPING HAS BEEN ASSEMBLED, ATTACH A SCH40 PVC CAP TO THE TOP END OF THE RISER PIPING, TO MINIMIZE LFG EMISSIONS DURING FILLING OPERATIONS, USING A SINGLE SCREW. ADDITIONALLY, A HIGHLY VISIBLE FLAG SHOULD BE TAPED TO THE TOP OF EACH RISER SEGMENT IN ORDER TO INCREASE THE VISIBILITY OF THE MATERIALS TO THE OPERATORS.

FOR PVC/CPVC

- INSPECT THE EXISTING WELL CASING FOR HOLES, DAMAGE, OR EXCESS FOREIGN MATERIAL BUILD–UP. CLEAN OFF THE OUTER PORTION OF THE TOP OF THE WELL CASING AS NEEDED.
- APPLY PCV/CPVC PRIMER TO OUTER PORTION OF THE TOP OF THE EXISTING WELL CASING, WITH A MINIMUM VERTICAL APPLICATION LENGTH EQUAL TO THE LENGTH OF THE BELL/COUPLER OVERLAP, AND APPLY PRIMER TO THE INNER SURFACE OF THE BELL/COUPLER PORTION OF THE RISER SEGMENT.
- SWIFTLY APPLY PCV/CPVC GLUE TO THE SURFACES APPLIED WITH PRIMER, AVOIDING DRYING OF THE GLUE PRIOR TO CONNECTION.
- SLIDE THE BELL/COUPLER PORTION OF THE RISER PIPE OVER THE EXISTING WELL CASING, ENSURING THE FULL LENGTH OF THE BELL OR HALF OF THE LENGTH OF THE COUPLER OVERLAPS THE EXISTING WELL CASING.
- INSTALL FOUR LAG SCREWS AT A 90–DEGREE OFFSET AT THE MIDPOINT OF THE BELL/COUPLER.

FOR HDPE

- FOLLOW PROCEDURE IN STEP 6.

STEP 5
INSTALL WELL CASING RISER SEGMENT

INSTRUCTIONS:

- ONCE THE DESIRED LENGTH OF HDPE RISER PIPING HAS BEEN ASSEMBLED, ATTACH A SCH40 PVC CAP TO THE TOP END OF THE RISER PIPING TO MINIMIZE AIR INTRUSION INTO THE GCCS. ALSO, A HIGHLY VISIBLE FLAG SHOULD BE TAPED TO THE TOP OF EACH RISER SEGMENT IN ORDER TO INCREASE THE VISIBILITY OF THE MATERIALS TO THE OPERATORS.

OPTION 1: BUTT FUSION WELDING (NOT SHOWN)

- REMOVE THE SCH40 PVC CAP FROM THE EXISTING RISER AND COVER WITH A STEEL PLATE TO MINIMIZE AIR INTRUSION INTO THE GAS COLLECTION SYSTEM.
- PLACE THE HDPE FUSION MACHINE ONTO THE EXISTING RISER PIPE, SECURING THE MACHINE TO THE EXISTING PIPE.
- PLACE THE RISER SEGMENT ONTO THE HDPE FUSION MACHINE AND SECURE.
- PERFORM FUSION, PER THE FUSION MACHINE'S MANUFACTURER'S INSTRUCTIONS.

OPTION 2: ELECTRO–FUSION WELDING (WHEN APPROVED BY SITE ENGINEER)

- REMOVE THE SCH40 PVC CAP FROM THE HDPE LFG EXTRACTION PIPE RISER AND SLIDE THE ELECTRO–FUSION COUPLER OVER THE RISER, ENSURING HALF OF THE LENGTH OF THE COUPLER OVERLAPS THE RISER.
- QUICKLY PLACE THE RISER SEGMENT INTO THE CONNECTION OF THE ELECTRO–FUSION COUPLER AND THE LFG EXTRACTION PIPE RISER, MINIMIZING AIR INTRUSION INTO THE GCCS, SHOULD ISOLATION OF THE LATERAL PIPING NOT APPLY.
- PERFORM FUSION, PER THE ELECTRO–FUSION MACHINE'S MANUFACTURER'S INSTRUCTIONS.

STEP 6
INSTALL VACUUM LATERAL RISER SEGMENT

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No. 12145
Exp 4/30/24
HAWAII U.S.A.
11/28/23

KEKAHA MUNICIPAL SOLID WASTE LANDFILL
PHASE II - VERTICAL EXPANSION
GCCS DETAILS

DESIGNED BY : GRB/CME	CHECKED BY : AMN	DATE : NOV 2023
DRAWN BY : MDC/GVP	APPROVED BY : GRB/PJS	FILE : 220048-C-510_LF DETAILS.dwg

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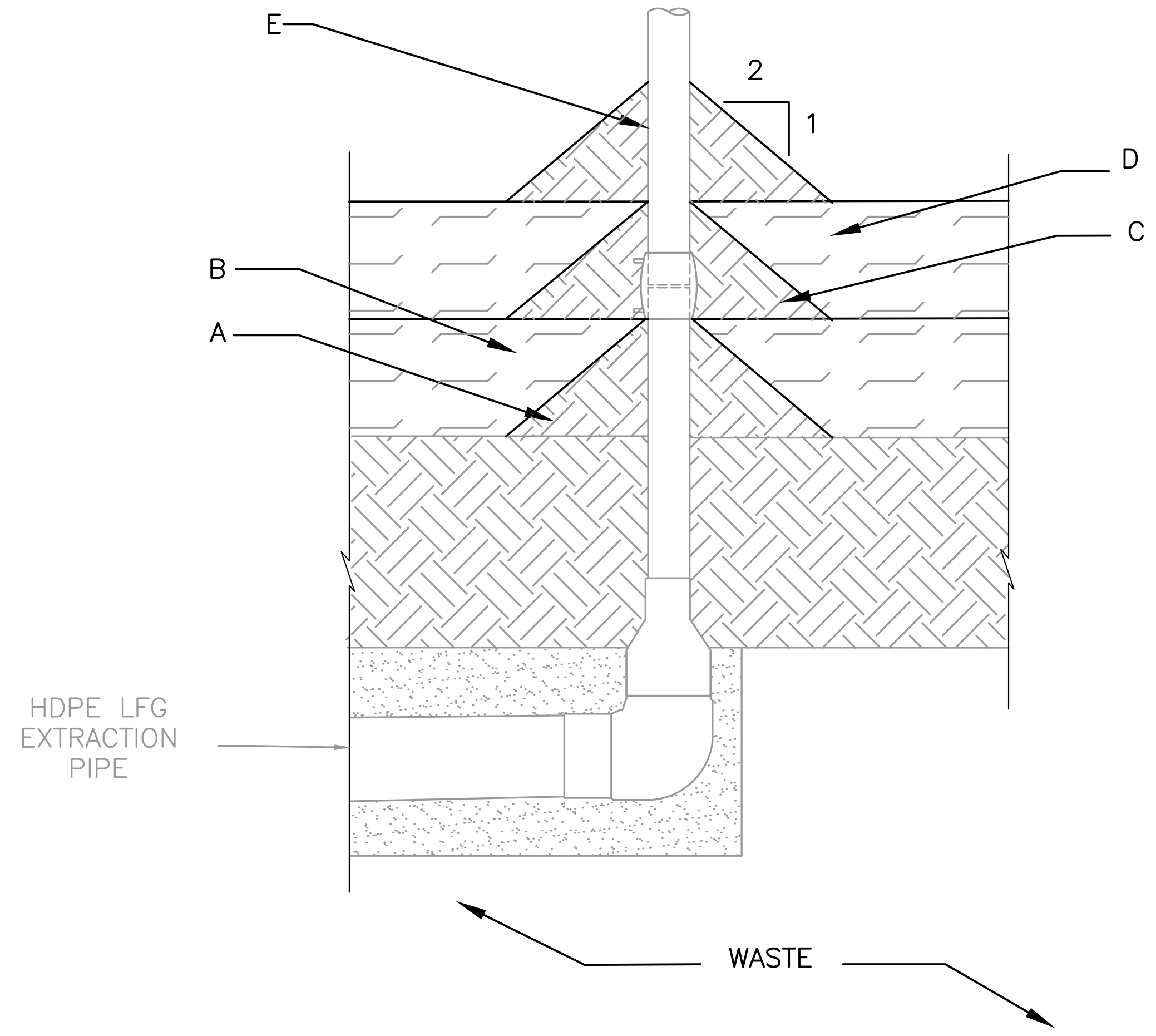
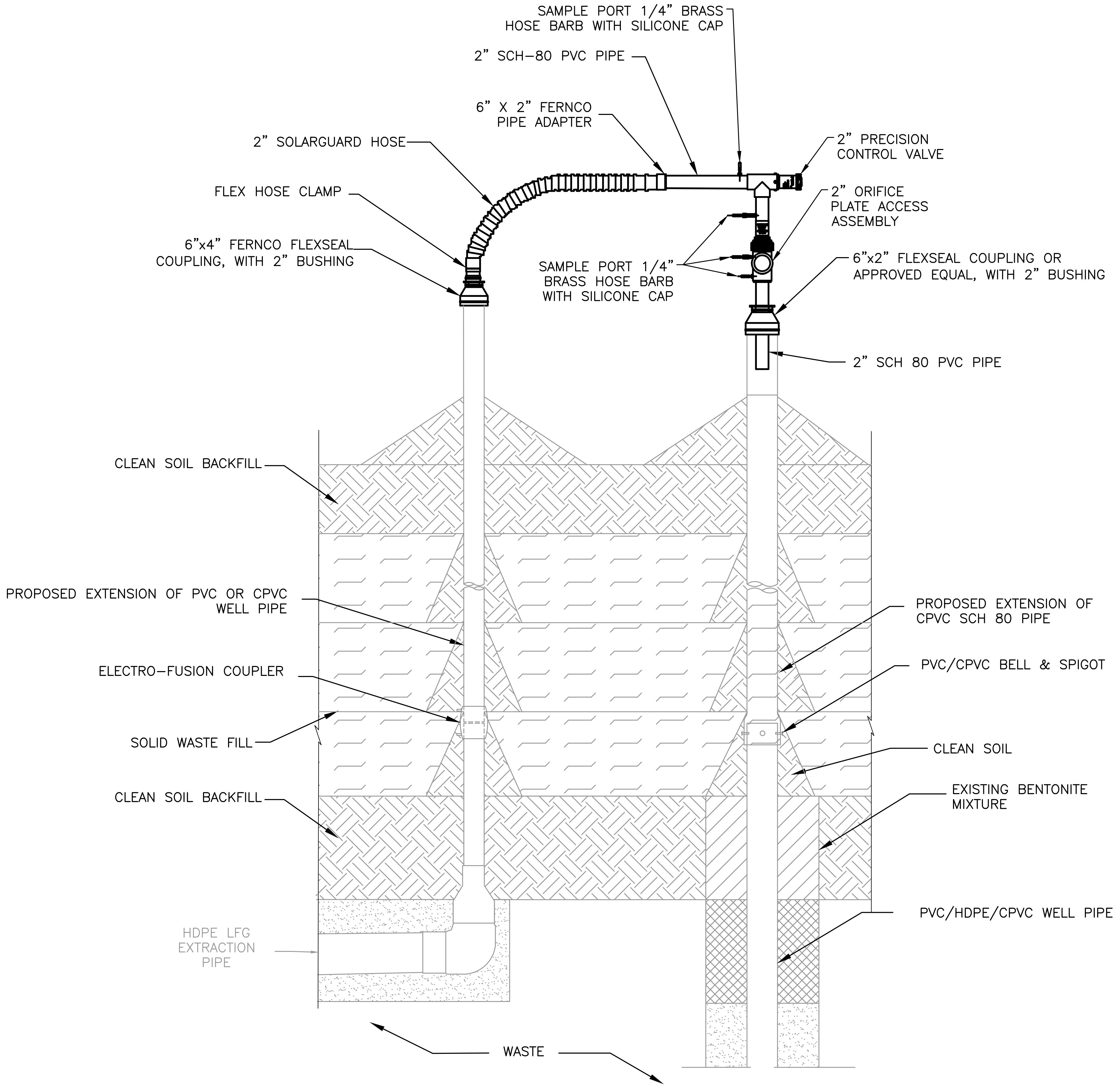


INSTRUCTIONS:

- GENTLY PLACE SOIL AROUND THE WELL CASING AND LATERAL RISER WITH AN EXCAVATOR OR BACKHOE BUCKET, FREQUENTLY HYDRATING THE SOIL AROUND THE WELL CASING AS SOIL IS PLACED.
  - A. INITIAL SOIL MOUND
  - B. FIRST LIFT OF SOLID WASTE FILL
  - C. SECOND SOIL MOUND
  - D. SECOND LIFT OF SOLID WASTE FILL
  - E. REPEAT AS NEEDED
- THE FIELD TECHNICIAN SHOULD COMMUNICATE FREQUENTLY WITH THE OPERATIONS MANAGER AND FIELD PERSONNEL TO COORDINATE THE APPLICATION OF SOIL AROUND THE RISERS AS NEEDED AT VARIOUS ELEVATIONS OF THE WASTE COMPACTION PROCESS.
- DO NOT PUSH THE SOIL TOWARD THE CASING OR LATERAL RISER AS THIS MAY CAUSE HDPE PIPE TO PINCH AND PVC OR CPVC MATERIALS TO BREAK OR CRACK. THIS COULD POTENTIALLY BLOCK SYSTEM VACUUM FROM REACHING THE WELLHEAD OR LEAD TO AIR LEAKING INTO THE GCCS.
- THE FIELD TECHNICIAN SHOULD FREQUENTLY INSPECT THE ORIENTATION OF THE RISER MATERIALS TO ENSURE BOTH RISERS ARE VERTICAL. RISER MATERIALS INSTALLED AT AN ANGLE ARE AT GREATER RISK OF DAMAGE DUE TO THE WEIGHT OF THE WASTE ABOVE AND FORCES FROM LANDFILL SETTLEMENT. PHYSICAL BARRIERS, SUCH AS K-RAILS, MAY BE PLACED AROUND THE SOIL MOUNDS TO FURTHER PROTECT THE WELLS DURING WASTE PLACEMENT.
- THE FIELD TECHNICIAN SHOULD BE PRESENT AS WASTE IS PLACED AND COMPACTED AROUND THE WELL CASING TO ENSURE THE RISERS ARE NOT STRUCK, PUSHED, OR DAMAGED BY THE OPERATIONS EQUIPMENT.
- ALL OPERATIONS PERSONNEL SHOULD BE MADE AWARE OF THE WELL CASING AND LATERAL RISER PIPE, AND BE CAUTIOUS WHILE MANEUVERING HEAVY MACHINERY IN THE VICINITY OF THE SUBJECT PIPES.
- OPERATORS MUST AVOID PUSHING WASTE AGAINST THE VERTICAL PIPES AND SOIL MOUND AS DOING SO MAY RESULT IN DAMAGE TO PIPING MATERIALS.
- REPEAT THE HYDRATED SOIL PLACEMENT PROCESS WITH AN EXCAVATOR OR BACKHOE BUCKET AS NEEDED THROUGHOUT THE WASTE PLACEMENT PROCESS, ENSURING UNIFORMLY HYDRATED SOIL SURROUNDS THE WELL CASING AND LATERAL RISER PIPING, UNTIL THE DESIRED SURFACE ELEVATION IS ATTAINED.
- DO NOT REMOVE THE PVC CAP FROM THE TOP OF THE RISER SEGMENTS UNLESS ADDITIONAL RISER MATERIALS ARE NEEDED.
- IF ADDITIONAL RISER SEGMENTS ARE NEEDED, REPEAT STEPS 5 AND 6.

STEP 7
SOIL AND WASTE PLACEMENT OPERATIONS



INSTRUCTIONS:

- UPON COMPLETION OF THE FINAL SURFACE BY SITE OPERATIONS, REMOVE THE CAPS FROM THE RISER MATERIALS, AND REINSTALL THE WELLHEAD, WORM-GEAR CLAMPS, AND FLEX HOSE WHICH WERE REMOVED FROM THE SUBJECT WELL.
- BUTT FUSION WELDING NOT SHOWN.

STEP 8
WELLHEAD INSTALLATION

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PHASE II - VERTICAL EXPANSION

GCCS DETAILS

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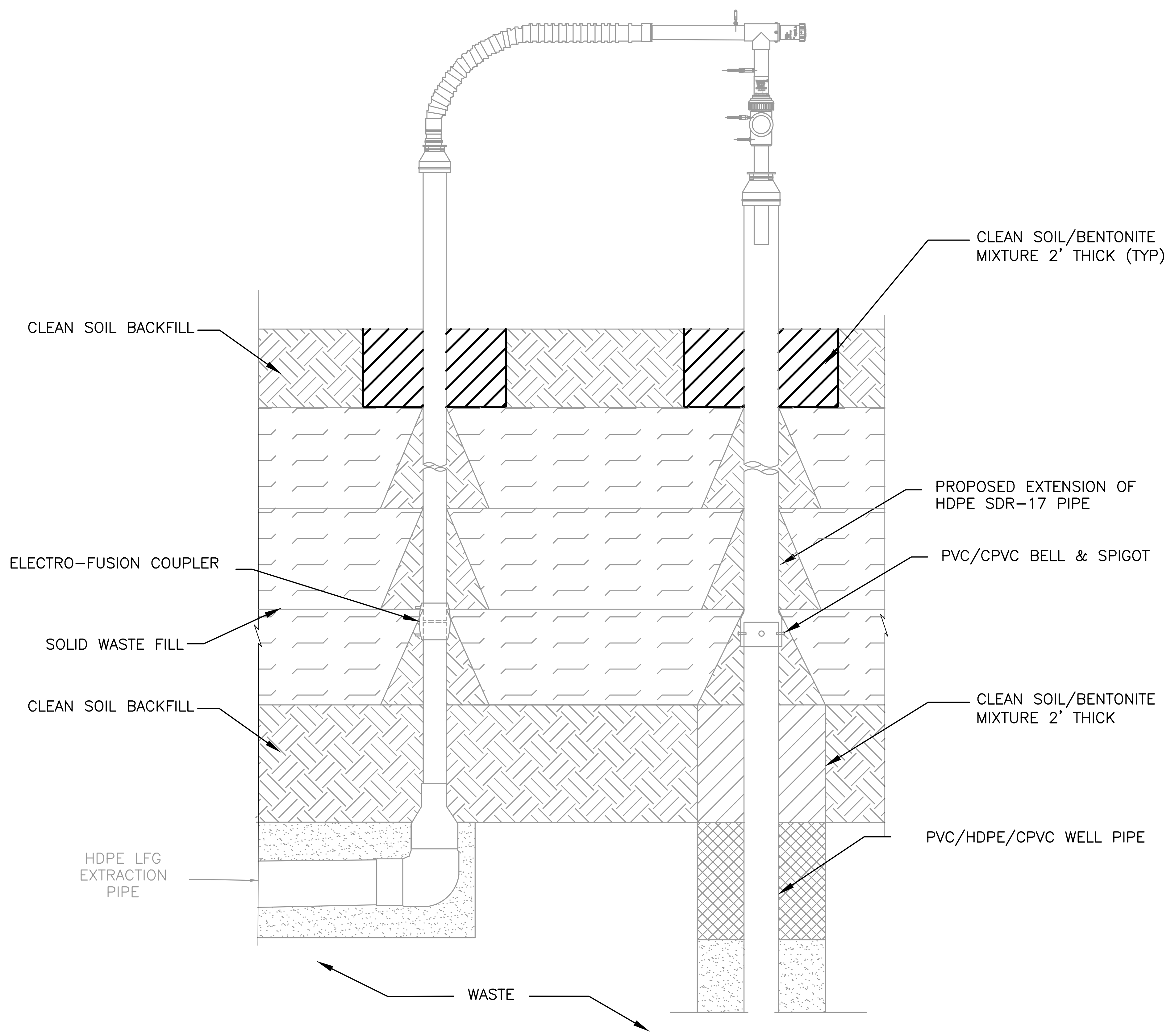

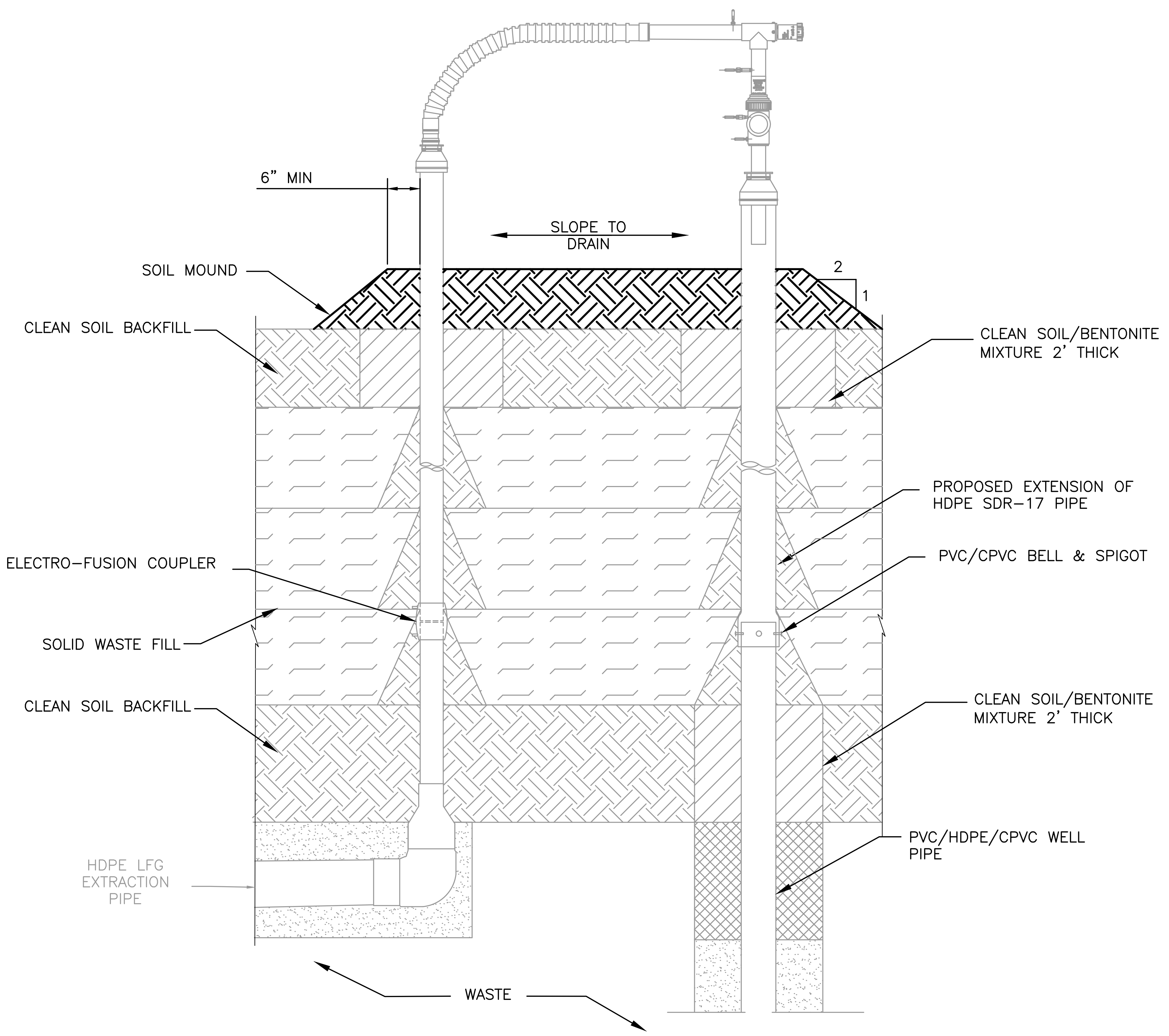

INSTRUCTIONS

- PREMIX BENTONITE ABOVE GROUND. MIX 8 BAGS OF BAROID BENSEAL 8-MESH BENTONITE OR EQUIVALENT WITH MANUFACTURERS RECOMMENDED AMOUNT OF WATER FOR EACH BORE SEAL. ENSURE MIXTURE IS COMPLETELY BLENDED ABOVE GRADE PRIOR TO APPLICATION.
- EXCAVATE A ONE TO TWO-FOOT DEEP HOLE IN A 2-FOOT RADIUS AROUND THE WELL CASING WITH A BACKHOE, EXCAVATOR, OR SHOVEL.
- POUR PRE-MIXED BENTONITE INTO EXCAVATION.
- BENTONITE SEALS SHOULD BE INSTALLED TO THE GROUND SURFACE AND ALLOWED TO SIT UNCOVERED FOR 24-HOURS.
- A FIELD TECHNICIAN SHOULD TEST FOR SURFACE EMISSIONS AROUND THE WELL CASING WITH AN FID. SHOULD THE FID REVEAL SURFACE EMISSIONS OF GREATER THAN OR EQUAL TO 200 PARTS PER MILLION, ADDITIONAL HYDRATED BENTONITE MATERIALS SHOULD BE PLACED AND THE SEAL RETESTED.

STEP 9
BENTONITE SEAL

INSTRUCTIONS:

- UPON APPROVAL OF THE BENTONITE SEAL BY THE FIELD TECHNICIAN, A TWO-FOOT TALL SOIL MOUND SHOULD BE GENTLY PLACED AROUND THE WELL CASING, ONE FOOT IN RADIUS BEYOND THE EXCAVATION.
- THE SOIL MATERIALS SHOULD BE POURED FROM THE BUCKET JUST ABOVE THE GROUND SURFACE TO AVOID HIGH VELOCITY SOIL MATERIALS DAMAGING THE INTEGRITY OF THE BENTONITE SEAL.
- THE SOIL MOUND SHOULD BE GENTLY COMPACTED AT THE TOP TO ALLOW FOR A STABLE SURFACE FOR THE FIELD TECHNICIAN TO STAND UPON.

STEP 10
SOIL MOUND

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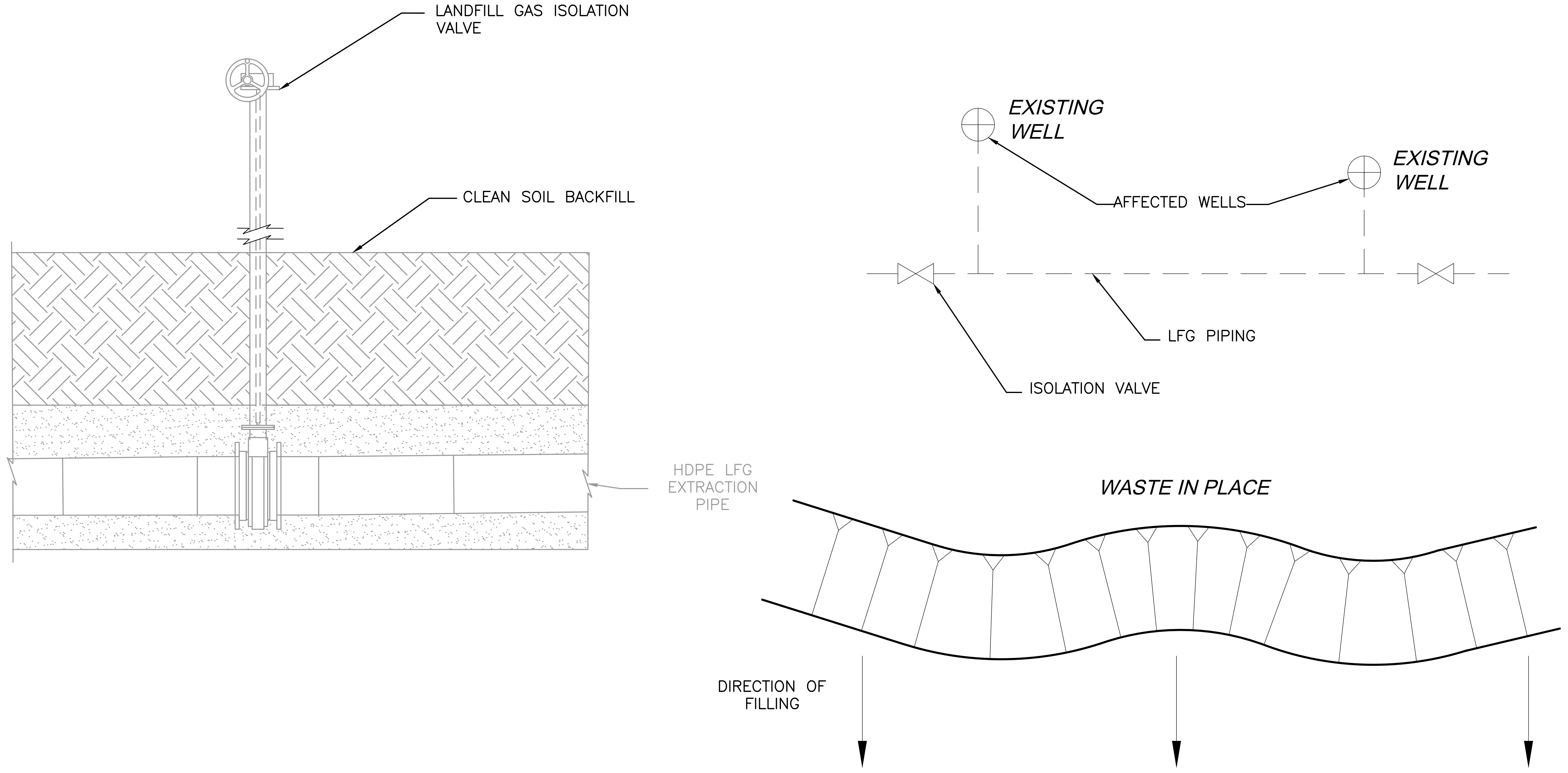

INSTRUCTIONS:

- UPON COMPLETION OF FILLING OPERATIONS IN THE VICINITY OF THE AFFECTED WELLS, THE TECHNICIAN SHOULD COORDINATE WITH THE ENVIRONMENTAL MANAGER/ENGINEER TO ALLOW FOR COMPLIANCE RECORDING DURING THE RE–APPLICATION OF THE SYSTEM VACUUM TO THE SUBJECT WELLS, AS WELL AS THE STARTUP OF THE FLARE/ENGINE FACILITY (IF APPLICABLE).

STEP 11
OPEN ISOLATION VALVES

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Appendix A
Landfill Gas Collection and Control System Design Plan

KEKAHA LANDFILL
COUNTY OF KAUAI
KEKAHA, KAUAI, HAWAII

LANDFILL GAS COLLECTION AND CONTROL SYSTEM DESIGN PLAN

Prepared for

County of Kauai
Department of Public Works
Lihue, Kauai, Hawaii

March 2015

ENVIRONMENTAL INFORMATION LOGISTICS, LLC

Prepared By:

Environmental Information Logistics, LLC
130 E. Main Street
Caledonia, Michigan 49316
(616) 891 2591

ANDREW J. QUERIO
LICENSED PROFESSIONAL ENGINEER
No. 15174-C

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION

Andrew J. Querio 4/30/16

Signature 3/19/15 Expiration Date of License

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
CFR	Code of Federal Regulations
CO	carbon monoxide
DOH	Department of Health, State of Hawaii
GCCS	Gas Collection and Control System
HDPE	high-density polyethylene
LandGEM	Landfill Air Emissions Estimation Model
LFG	landfill gas
Mg/yr	megagrams per year
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMOC	non-methane organic compound
NSPS	New Source Performance Standards
ppm	part per million
PVC	polyvinyl chloride
scfm	standard cubic feet per minute
SEM	surface emission monitoring
SSM	Start-up, Shutdown and Malfunction
U.S. EPA	United States Environmental Protection Agency
w.c.	water column
ZOI	zone of influence
%	percent
40 CFR §	Section
°C	degree Celsius
°F	degree Fahrenheit

1 INTRODUCTION

1.1 Purpose

This document serves as the Gas Collection and Control System (GCCS) Design Plan for Kekaha Landfill including Phase I (a closed area) and Phase II (an active area with a 2014 permitted vertical expansion) in accordance with requirements of 40 Code of Federal Regulations (CFR), New Source Performance Standards (NSPS) Part 60, Subpart WWW, for Municipal Solid Waste Landfills. The purpose of this document is to provide a design plan that meets the requirements of the NSPS and to provide the Administrator the design standards and calculations used to prepare this GCCS Design Plan.

1.2 Applicability/Background

> **40 CFR §60.752(b)(2)** If the calculated NMOC emission rate is equal to or greater than 50 megagrams per year, the owner or operator shall: ...

Pursuant to 40 CFR 60, Subpart WWW, promulgated on March 12, 1996, those facilities that commence construction, reconstruction, or modification after May 30, 1991, are subject to the applicable provisions of the rule.

The permitting of the Phase II-Cell 1 vertical expansion on March 5, 2014 (a modification under the NSPS rules) increased the design capacity of Kekaha Landfill to greater than 2.5 million megagrams (Mg) *and* 2.5 million cubic meters (m^3) making Kekaha Landfill subject to Tier 1 calculations of the Landfill NSPS because it exceeded the applicability provisions of 40 CFR §60.752(a)(2). That rule specifies that both volume and mass after a landfill modification must exceed both 2.5 million Mg *and* 2.5 million m^3 to trigger Tier 1. The County of Kauai (County) submitted an Amended Design Capacity report reflecting the modification to greater than 2.5 million Mg *and* 2.5 million cubic meters (m^3) to the United States Environmental Protection Agency (U.S. EPA) and State of Hawaii Department of Health (DOH) on June 2, 2014 (within 90 days of the permitted increase in design capacity as required by rule).

The County submitted a Tier 1 calculation on June 2, 2014 in accordance with 40 CFR §60.752(b) demonstrating that the NMOC emission rate exceeded 50 Mg/yr making the facility subject to the gas collection and control requirements of the Landfill NSPS.

This initial GCCS Design Plan complies with the timeline established by 40 CFR §60.752(b)(2)(i) – *submit a collection and control system design plan prepared by a professional engineer to the Administrator within 1 year* (i.e., one year after submittal of the Tier 1 calculation demonstrating that the NMOC emission rate exceeded 50 Mg/yr which occurred on June 2, 2014). Future compliance dates will be based on June 2, 2015, the due date for the GCCS Design Plan.

As stated in this design plan, the GCCS at Kekaha Landfill complies with the specifications for active collection systems as stipulated in 40 CFR §60.759 of the NSPS. If future expansions of the GCCS are necessary, they will be designed to comply with the NSPS requirements, accommodate existing site conditions, or any approved alternatives.

The submittal of this document fulfills the requirement for the Facility to prepare a GCCS Design Plan in accordance with 40 CFR §60.752(b)(2). In addition, a surface emissions monitoring plan has been prepared and is included in Appendix C.

The GCCS Design Plan outlines the methodology employed to design a landfill gas collection and control system that will collect, transport, and dispose of the landfill gas generated by the entire permitted landfill at final grades. The facility will comply with the monitoring, record keeping, and reporting requirements of the NSPS as specified within the rule with alternatives and variance requests to these requirements included in Section 6. Furthermore, the NSPS specifically requires the gas collection system to be designed in accordance with general conditions that are contained within the NSPS. These regulations will be found throughout this document in addition to the means to how the landfill is meeting or plans on meeting these regulations.

1.3 Certification

This GCCS Design Plan for Kekaha Landfill has been prepared by Environmental Information Logistics, LLC (EIL) under contract with AECOM as authorized by the County of Kauai.

I certify that the GCCS as described in this Plan meets the design requirements specified in 40 CFR 40 CFR §60.759 and any alternatives pursuant to 40 CFR §60.752(b)(2). I further certify that this report was prepared by me or under my direct supervision, and that I am a duly registered Professional Engineer under the laws of the State of Hawaii.

Andrew J. Querio

Andrew J. Querio, P.E.
Senior Engineer 3/19/15

No. 15174-C

2 DESIGN CRITERIA

The GCCS (Gas Collection and Control System) has been designed and is to be constructed to conform to NSPS requirements.

2.1 Landfill Gas Collection Design

The following listed NSPS regulations describe when landfill gas has to be collected from municipal solid waste (MSW) that has been deposited in the landfill.

> **40 CFR §60.752(b)(2)(ii)(A)(2)** Collect gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of:
>
> **40 CFR §60.752(b)(2)(ii)(A)(2)(i)** 5 years or more if active; or
>
> **40 CFR §60.752(b)(2)(ii)(A)(2)(ii)** 2 years or more if closed or at final grade;

These above regulations are commonly known as the 5/2 yr rule, and will be called such when referenced in this design plan.

In accordance with these requirements, gas extraction devices and the installation/expansion of the pipe network to connect the devices into the gas collection system, has been designed and are to be installed to collect gas from all areas with waste that have reached the age of 5 years or older if active; and in waste that has reached the age of 2 years or more if closed or at final grade. At Kekaha Landfill, Phase I meets the requirements of 40 CFR §60.752(b)(2)(ii)(A)(2)(ii) and all current permitted cells of Phase II meet the requirements of 40 CFR §60.752(b)(2)(ii)(A)(2)(i) and will have a GCCS installed. Furthermore, the surface emission monitoring (SEM) performed in accordance with 40 CFR §60.753, and addressed below in the Gas Collection Density, Section 2.1.1, will demonstrate compliance with this requirement in addition to the certification of the design by a professional engineer.

Additionally, the GCCS has been designed to be in compliance with the following regulations:

> **40 CFR §60.752(b)(2)(ii)(A)(3)** Collect gas at a sufficient extraction rate;
>
> **40 CFR §60.752(b)(2)(ii)(A)(4)** Be designed to minimize off-site migration of gas.

The GCCS has been designed, as demonstrated by this plan, to extract LFG at a sufficient rate to minimize subsurface lateral migration from the solid waste boundaries of the facility and surface emissions. This is achieved by sizing, installing, and operating collection elements (which are discussed in the sections below) that sufficiently collect the landfill gas, which include, adequately sized transmission headers and laterals (pipe network), gas moving equipment (blower(s)), and controlled in a manner that is expected to handle the estimated LFG flow rate. According to the definition in 40 CFR §60.751, collecting at sufficient rate can be determined by maintaining negative (gauge) pressure at all wellheads.

These design attributes are discussed below and the calculations and drawings for the designs are in the Appendices. Furthermore, existing, and future planned control devices will also be examined in the Design Section of this plan.

The USEPA's Landfill Gas Emissions Model (LandGEM) is a design 'tool' that incorporates the information available to project future operating conditions. In addition to the site-specific characteristics (waste acceptance rate, type, liner/cap configuration, etc.), for sites that have a GCCS, the existing LFG extraction rate is also used to calibrate LandGEM. Actual operating parameters may dictate changes in the system flow characteristics and process equipment as the system is expanded. These changes will be made in accordance with 40 CFR §60.752 as dictated by actual site conditions at the time of construction.

The GCCS header/lateral pipe network at final build-out is designed to accommodate the anticipated maximum flows; however, there may be interim site conditions that require the temporary installation of a sacrificial pipe network sized to convey interim gas flows.

The portions of the pipe network that are installed prior to maximum gas generation and are planned for use as part of the final grade design specified in this plan will be appropriately sized to handle that maximum.

2.1.1 Gas Collection Density

One of the requirements of the NSPS for designing a gas collection system is to ensure sufficient density of the LFG extraction points, as stated below:

> **40 CFR §60.759(a)(2)** The sufficient density of gas collection devices determined in paragraph (a)(1) of this section shall address landfill gas migration issues and augmentation of the collection system through the use of active or passive systems at the landfill perimeter or exterior.

Per the definition stated in 40 CFR §60.759, "sufficient density" means "any number, spacing, and combination of collection system components. . .

necessary to maintain emission and migration control as determined by measures of performance set forth in this part."[1]

The well spacing required to achieve comprehensive control of LFG is a function of many parameters including liner type, cover type, surrounding geology/hydrogeology, landfill geometry, well depth, waste composition and age, and the presence of liquids within the landfill.

All of these factors were used to space the extraction wells including an analysis of the zone of influence from each extraction well using Darcy's equation. The spacing should effectively control surface emissions and subsurface migration of LFG in accordance with NSPS requirements especially in light of the geosynthetic cap that will be used on Phase II and which currently covers Phase I except for the side slopes. Based on extensive industry experience, the LFG collector spacing determined by the Darcy equation is adequate to provide comprehensive control of the LFG as required. In the event that this spacing is not adequate to meet the required operating standards, additional collectors will be installed as necessary.

Additionally, properly designed, installed, and operated gas collection element density can be demonstrated in the field by use of the Surface Emission Monitoring (SEM) requirements contained in 40 CFR §60.753 of the NSPS.

2.1.2 Landfill Gas Collection System Expandability

Expandability of the GCCS is achieved by installing in-line valves, flange adapters with blind flanges or HDPE butt caps along the header and lateral piping. This allows the GCCS to be modified/expanded in the future.

2.1.3 Fill Settlement

Settlement will occur over time due to decomposition of the in-place refuse. To accommodate this condition, the GCCS components were designed with several features to account for this settlement including:

- LFG extraction devices will be connected to the LFG transmission piping via a flexible pipe or hose connection. This allows the LFG piping to accommodate changes in the orientation of the LFG transmission piping or LFG extraction well.

- LFG transmission piping was sloped at sufficient grades so that reasonable amounts of differential and total settlement may occur without causing pipe

---

[1] *"this part" pertains to the landfill NSPS*

breakage or disrupting the overall flow gradient of the LFG transmission piping.

- Adequate piping will be used for the construction of the header and lateral transmission system. Piping materials will be determined as needed during construction. Typically, piping that is flexible and absorbs differential settlement without breaking or cracking will be used i.e. high density polyethylene pipe (HDPE).

2.1.4 LFG Collection and Connection Components

This section details how the collection devices are connected to the GCCS.

> **40 CFR §60.759(b)(3)** Collection devices may be connected to the collection header pipes below or above the landfill surface. The connector assembly shall include a positive closing throttle valve, any necessary seals and couplings, access couplings and at least one sampling port. The collection devices shall be constructed of PVC, HDPE, fiberglass, stainless steel, or other non-porous material of suitable thickness.

The collection devices are connected to the collection header pipes via lateral piping. The lateral piping will be connected to the header above the landfill surface to provide easy access. The piping is routed below grade for short intervals to allow for proper surface drainage or to prevent damage from landfill operations. Road crossings will be sleeved to ensure that equipment does not damage the piping.

The connector assemblies (extraction wellheads) will be located above grade. These assemblies include a positive closing throttle valve, necessary seals and couplings, access couplings, and sampling ports.

At times, vertical LFG wells may collect water. During these times, it may be necessary to install water pumps to remove liquid from the wells. When pumps are installed to lower liquid levels in an effort to enhance extraction efficiency, this installation and operation may be considered expansion of the GCCS as per 40 CFR §60.755.

2.1.5 GCCS Materials

In accordance with 40 CFR §60.759 collector materials must be constructed of PVC, HDPE, fiberglass, stainless steel, or other non-porous corrosion resistant material of suitable thickness. These materials are designed and installed to:

- Withstand the stresses induced during installation (limited pipe bending);
- Withstand static load and settlement;

- Withstand traffic loads;
- Be extended to comply with emission and migration control standards;
- Be resistant to decomposition heat; and
- Be perforated adequately.

The GCCS at Kekaha Landfill consists of HDPE pipe and CPVC extraction wells both of which fulfill the requirements specified by US EPA. As an alternative, HDPE pipe may be used in place of CPVC for extraction wells as directed by the County Engineer and the Design Engineer.

2.1.6 Well, Collection Device, & Pipe Network Loading

The pipe network is designed to withstand the estimated static, settlement, overburden, and traffic loads. Static loads from the vacuum applied to the GCCS components and applied loads on the GCCS were both evaluated. Vacuum loads required for the GCCS operation (<40 inches water column) were compared to, and found to be less than, the allowable vacuum loads for the GCCS components (108 inches water column at 120 deg. F – Chevron Phillips HDPE Pipe Performance Bulletin PP 501, January 2015).

Foundations used for GCCS components (flare system concrete pad) were designed to handle the applied loads. The applied loads on GCCS components within the landfill (truck traffic on road crossings), as well as settlement forces, cannot accurately be predicted due to the non-homogeneous nature of the refuse within the landfill. However, the road crossing pipe loads will be distributed by using a pipe sleeve and the settlement forces will be minimized since most of the system will be above grade. Should various sections of the header or laterals settle and collect condensate, the piping will be moved to eliminate the problem.
Further, the GCCS components within the landfill are consistent with those at other landfills, which have been in-place for extended periods of time and verified to be capable of withstanding applied static and settlement forces.

2.1.7 Nonproductive Areas

Nonproductive areas may be excluded from the requirements to have a NSPS compliant control device(s) in the area, as stated below:

> **40 CFR §60.759(a)(3)(ii)** Any nonproductive area of the landfill may be excluded from control, provided that the total of all excluded areas can be shown to contribute less than 1 percent of the total amount of NMOC emissions from the landfill. The amount, location, and age of the material shall be documented and provided to the Administrator upon request. A separate NMOC emissions estimate shall be made for each section proposed for exclusion, and the sum of all such sections shall be compared to the NMOC emissions estimate for the entire landfill.

As areas of the landfill are determined to be nonproductive, these areas will be excluded in accordance with the requirement stated above. Copies of required documentation, including calculations on proving the nonproductive area exemption, will be on file at the landfill. The nonproductive areas at the landfill may change over time and therefore, records of these areas will be kept on file at the site. Nonproductive areas may occur over all parts of the landfill timeline, which include existing, interim, and final conditions.

2.1.8 Asbestos and Non-degradable materials

Any areas of the landfill that contain only asbestos and/or non-degradable materials are not required to be controlled in accordance with the NSPS, as stated below:

> **40 CFR §60.759(a)(3)(i)** Any segregated area of asbestos or non-degradable material may be excluded from collection if documented as provided under 40 CFR §60.758(d). The documentation shall provide the nature, date of deposition, location and amount of asbestos or non-degradable material deposited in the area, and shall be provided to the Administrator upon request.

No such areas are known to currently exist. However, if the landfill excludes degradable material from non-degradable material in the future, these segregated areas will be excluded from the requirement of collecting LFG from it. Any areas or planned areas containing these types of waste will be included in the appropriate section of a revised Design Plan.

2.1.9 Landfill Gas Extraction System Design

The landfill gas extraction is normally implemented using gas collection devices that are connected to a vacuum source. This section describes design considerations for these gas collection devices. There are some specific requirements included in the following NSPS sections that apply to the gas collection and extraction components:

> **40 CFR §60.759(a)(1)** - The collection devices within the interior and along the perimeter areas shall be certified to achieve comprehensive control of surface gas emissions by a professional engineer. The following issues shall be addressed in the design: depths of refuse, refuse gas generation rates and flow characteristics, cover properties, gas system expandability, leachate and condensate management, accessibility, compatibility with filling operations, integration with closure end use, air intrusion control, corrosion resistance, fill settlement, and resistance to the refuse decomposition heat.
>
> **40 CFR §60.759(b)(1)** The landfill gas extraction components shall be constructed of polyvinyl chloride (PVC), high density polyethylene (HDPE) pipe, fiberglass, stainless steel, or other non-porous corrosion resistant material of suitable dimensions to: convey projected amounts of gases; withstand installation, static, and settlement forces; and withstand planned overburden or traffic loads. The collection system shall extend as necessary to comply with emission and migration standards. Collection devices such as

> wells and horizontal collectors shall be perforated to allow gas entry without head loss sufficient to impair performance across the intended extent of control. Perforations shall be situated with regard to the need to prevent excessive air infiltration.
>
> **40 CFR §60.759(b)(2)** Vertical wells shall be placed so as not to endanger underlying liners and shall address the occurrence of water within the landfill. Holes and trenches constructed for piped wells and horizontal collectors shall be of sufficient cross-section so as to allow for their proper construction and completion including, for example, centering of pipes and placement of gravel backfill. Collection devices shall be designed so as not to allow indirect short-circuiting of air into the cover or refuse into the collection system or gas into the air. Any gravel used around pipe perforations should be of a dimension so as not to penetrate or block perforations.
>
> **40 CFR §60.759(b)(3)** Collection devices may be connected to the collection header pipes below or above the landfill surface. The connector assembly shall include a positive closing throttle valve, any necessary seals and couplings, access couplings and at least one sampling port. The collection devices shall be constructed of PVC, HDPE, fiberglass, stainless steel, or other non-porous material of suitable thickness.

At Kekaha Landfill, the collection devices are connected to the collection system via HDPE header and lateral piping. The lateral piping is connected to the header above the landfill surface except for short intervals where it is installed below grade to ensure surface water drainage or protection from equipment and so as not to interfere with site landfill operations. These collection devices are called, “gas wells,” which include extraction wellheads (connector assemblies) that are located above grade. These wellheads include a positive closing throttle valve, necessary seals and couplings, access couplings, and a minimum of two sampling ports; all which aid in the prevention of air intrusion, allow for proper operation of the wellheads, and allow the wellheads to be sampled and monitored.

2.1.10 Depths of Extraction Wells

The vertical wells are designed to protect the landfill underlying liner system by terminating the well boreholes 10 feet above documented liner system elevations. Bore depths will be checked periodically during installation to ensure that the design depth is not exceeded.

If documented liner system elevations are not known, the bore will be extended to depths 10 feet above those approximating the base of the landfill established by inquiry of site personnel. Bore depths will be checked periodically during installation to ensure that the design depth is not exceeded.

In addition, the proposed vertical wells depths will be adjusted based on surveyed elevations to account for differences between the design and actual measurements. The well screen is designed in such a manner so that it captures as much landfill gas as is practicable, without pulling air into the landfill. This well screen is also adequately sized to allow any liquid to enter the well casing without compromising gas flow and the casing is sized to allow for the installation of a pump if necessary to remove that liquid.

Practical site-specific factors that were addressed during the design include:

- Availability of accurate liner construction records (boreholes must not be advanced far enough to risk penetrating the liner);
- Proximity to liner side-slopes or other areas in which the liner elevation changes rapidly; and
- Obstructions or other technical difficulties that may impact the drilling operations.

2.1.10.1 Vertical LFG Wells

To a large extent, a well's zone of influence is dictated by the amount of vacuum that can be applied without causing an excessive amount of air intrusion into the landfill. Typically, to reduce air intrusion and thereby increase the zone of influence (ZOI), the upper part of the final well depth is not slotted or backfilled with gravel (Drawing No. 4 in Appendix B shows the design details of the proposed extraction wells). Experience has shown that a minimum of 10 feet and a maximum of 40 feet of solid pipe below grade provides a good balance between air intrusion control and LFG collection efficiency. Air intrusion is also minimized by using soil backfill in the upper zone of the vertical wells and hydrated bentonite plugs just above the well screen and where the pipe penetrates the landfill soil cover.

LFG enters the extraction well through perforations in the portion of the well backfilled with gravel. The designed minimum open area of the perforations is 12 in^2/foot, which will provide sufficient open area for free gas flow while minimizing the impact on pipe strength.

Further, air intrusion and LFG emissions will be controlled through periodic monitoring and adjustment of the GCCS in coordination with appropriate maintenance of the landfill cover system. The Kekaha closure plan calls for a soil cap with geomembrane on Phase II. The existing Phase I cap does not include a geomembrane on the side slopes. Areas where geomembranes are present will include a boot around the well casing.

Vertical collection wells will be installed in the approximate locations shown on the GCCS Plan included in Appendix B. A typical well design detail is also provided on the GCCS Details included in Appendix B.

2.1.11 Extraction Well Perforations & Backfill

Extraction wells must be perforated to allow LFG entry without excessive head loss and the surrounding gravel sized to prevent blocking of perforations. The designed minimum open area of the perforations is 12 in^2/foot and the gravel is to be 1.5 – 2.5 inch with less than 5% passing a 1.25" sieve.

There are many site-specific factors that were examined to determine the length of the slotted portion of the gas well. These are shown on the drawing details in Appendix B. Due to the costs associated with new well installation, it is in the best interest of the landfill to choose the optimal slot depth to collect as much gas from the well; yet, maintain compliance with the NSPS well parameters.

The design considered the following conditions:

- Mitigation of odor potential by keeping the well screen as near to the surface as practical; and
- Installation of deeper slots to extend ZOI because of the use of a geomembrane in the caps.
- Air infiltration through the cover, refuse contamination of the collection elements, and direct venting of LFG to the atmosphere.

The designed screen length balance these two concerns favoring deeper screen because of the potential for beneficial use of the gas in the future.

2.1.12 Well/Collection Device Backfill

Gravel, washed aggregate, or other acceptable crushed stone with low carbonate content and of sufficient size, or inert non-calcareous material, will be used to prevent penetration or blockages of the LFG collector pipe perforations/slots. Also, note that an acceptable substitute may be used in lieu of the aforementioned rock as long as it prevents blockage/penetration of the extraction well pipe perforations/slots.

2.1.13 Accessibility

At a minimum, the system is designed to provide accessibility to the GCCS components by persons on foot. The gas piping is above grade and the extraction wellheads are all accessible above grade as well.

2.1.14 Landfill Gas Well – Installation Requirements

LFG vertical gas extraction wells installed in waste and any future wells constructed for LFG collection, will have sufficient cross-section to allow for their proper construction and completion, including centering of the pipes and placement of gravel or other approved backfill material. Similarly, any horizontal gas collectors that may be installed in the future would have a similar cross-sectional area.

2.2 Leachate and Condensate Management

In accordance with the leachate and condensate management requirement included in 40 CFR §60.759(a)(1), leachate management is accomplished through the use of a leachate collection and management system. A leachate collection and recovery system (LCRS) is incorporated above the Kekaha Landfill Phase II base liner containment system. The LCRS is designed to allow no more than 12-inches of leachate to accumulate over the liner and consists of a gravel layer connected to perforated pipes that drain to leachate sumps. An automated pumping system pumps the leachate out of the sumps to the leachate evaporation pond. The older Phase I portion of the Kekaha Landfill does not have a base liner or LCRS.

Condensate management is to be accomplished by sloping the LFG transmission piping to low points in the GCCS piping for collection of the condensate. The perimeter header system drains by gravity to low spots along the gas collection system. This includes a sump at the flare station. Condensate collection sumps/drains are located at these low points, to collect the condensate and remove it from the transmission piping. Condensate collected in drains/sumps is designed to be re-introduced into the leachate management system and ultimately managed with the leachate at the facility.

Connections of the leachate collection system to the GCCS may be completed in the future but they would be for odor control and to meet other landfill operating needs beyond regulatory compliance with the rule.

2.3 Control Systems

The NSPS specifically requires that LFG collected by a NSPS compliant gas collection system be sent to NSPS compliant control device(s). These regulations contained in the NSPS are listed below:

> **40 CFR §60.752(b)(2)(iii)** Route all the collected gas to a control system that complies with the requirements in either paragraph (b)(2)(iii)(A), (B) or (C) of this section.

Since the Kekaha Landfill plans to utilizes an enclosed LFG flare as a control system, the required operational performance of the control devices is stipulated by 40 CFR §60.752(b)(2)(iii)(B), which states:

> **40 CFR §60.752(b)(2)(iii)(B)** A control system designed and operated to reduce NMOC by 98 weight-percent, or, when an enclosed combustion device is used for control, to either reduce NMOC by 98 weight percent or reduce the outlet NMOC

> concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen. The reduction efficiency or parts per million by volume shall be established by an initial performance test, required under 40 CFR §60.8 using the test methods specified in 40 CFR §60.754(d).
>
> **40 CFR §60.752(b)(2)(iii)(C)** Route all collected gas to a treatment system that processes the collected gas for subsequent sale or use. All emissions from any atmospheric vent from the gas treatment system shall be subject to the requirements of paragraph (b)(2)(iii)(A) or (B) of this section.

The enclosed LFG flare at Kekaha Landfill is designed to reduce the concentration of NMOCs present in the LFG delivered to the flare by at least 98 percent (by weight) or reduce outlet NMOC concentrations to less than 20 parts per million by volume (ppmv).

Per 40 CFR §60.752(b)(2)(iii)(B)(2), the enclosed LFG flare will operate within the performance ranges established during the source performance tests and is operated in such a manner as to meet the emission requirements of the NSPS.

The County of Kauai is contemplating energy recovery from the landfill which may include a compressed natural gas facility or other similar type project beneficially using landfill gas generated at the site. Any future LFG control device, devices, and/or treatment system will be designed to adequately comply with the above NSPS requirements. Control device(s) at the landfill will be adequately sized to handle all the gas collected by the GCCS. The selected control system may change over time; therefore, all chosen control devices will be designed, installed, and operated in compliance with the required regulations.

The capacity of the control system may increase/decrease over time as the amount and quality of LFG produced by the landfill changes. Therefore, the control device, devices, or system chosen for the existing, interim, and future timeframes may vary depending on the site specific LFG characteristics including the quantities produced, which are collected by the gas collection system. All changes to the control system will be reviewed by a professional engineer to determine if an air permit is necessary.

2.3.1 Enclosed Flare – Fail Safe Operations

In accordance with 40 CFR §60.756 of the NSPS, the flare exhaust temperatures are monitored continuously. Continuous flame presence is also monitored using an ultraviolet (UV) flame sensor. The flare exhaust temperature is monitored continuously using thermocouples installed at three stack elevations.

The enclosed flare will be continuously monitored for the presence of a flame, indicating that combustion is occurring. In the event that a flame is not detected, indicating that the combustion process has been disrupted, the monitoring system will automatically:

a. Cut power to the LFG mover(s), and;

b. Initiate the closure of either an electric or pneumatic-activated valve at the inlet to the mover(s).

Stopping the mover(s) will cause the LFG extraction process to cease. As previously mentioned, closing the inlet valve will eliminate the potential for direct venting of raw LFG through the control system. This process will be initiated automatically, in the event of flame failure, without the need for operator intervention. There is no LFG flow bypass around the control device.

3 EXISTING SITE CONDITIONS

3.1 Landfill Description

The Kekaha Landfill is in the southwestern portion of the island of Kauai, approximately 1.3 miles northwest of the town of Kekaha, between Kaumualii Highway (Highway 50) and Laeo Kokole Lighthouse site. The closed Phase I of the Kekaha Landfill is on property granted to the County by the State of Hawaii by executive order and is owned/maintained by the County of Kauai. The adjacent parcels are owned by the State of Hawaii, the National Guard, the US Coast Guard, and the US Navy. Phase II of the Kekaha Landfill is located on these adjacent parcels. The Kekaha Landfill is operated by Waste Management of Hawaii (WMH), a wholly owned subsidiary of Waste Management, Inc.

The Kekaha Landfill has been in operation since 1953. The original boundaries of the Phase I landfill are defined by Tax Map Key (TMK) (4):1-2-02 Plat 9, providing approximately 33 acres.

As summarized in the Kekaha Landfill, Phase I, Closure/Post-Closure Plan prepared by Harding Lawson Associates (dated January 1994), the Kekaha Landfill site has served as a disposal site for municipal, agricultural, commercial, demolition and industrial solid waste for Kauai since 1953. From July 1991 until October 1993, Phase I of the Kekaha Landfill was the only municipal solid waste landfill operating on Kauai. In October 1993, all waste disposal activities ceased at Phase I of the Kekaha Landfill. Due to impending implementation of EPA's Subtitle D regulations, at that time, it was determined that emergency conditions warranted closure of the Phase I Landfill and construction of a new Phase II Landfill on adjoining property began. Closure of Phase I was undertaken at that time and accomplished as documented in the Kekaha Landfill, Phase I Closure, Post-Construction Report prepared by Harding Lawson Associates (dated February 1996). In October 1993, the County began disposing of all municipal solid waste at Phase II of the Kekaha Landfill. Phase II of the Kekaha Landfill consists of approximately 39 acres.

The only LFG collection and control system features in place at the landfill at this time include a passive gas venting system in Phase I. The conceptual collection network and vent detail were provided in the 1994 Closure/Post-Closure Plan referenced previously and consisted of a geotextile blanket collector and a geosynthetic edge drain pipe network to gather the gas and move it to vents that penetrate the cover. The gas venting system was installed as part of the closure referenced previously and, as documented in the 1996 Post-Construction Report, includes approximately 25 vents and associated piping. No LFG collection features exist in Phase II at this time.

The existing gas venting system components on Phase I will be capped, and the new GCCS will be installed on Phase I and Phase II of the Kekaha Landfill as described herein. However, portions of the existing gas vent system may be connected to the proposed gas collection system as described in Section 4 (interim gas collection).

4 INTERIM DESIGN CONDITIONS

This section of the GCCS Design Plan addresses interim conditions. Interim conditions are those that occur while the landfill is in its active state, accepting waste, and before it is closed or at final grades. The gas extraction system will be installed during these interim conditions and will be operated in compliance with the NSPS, while also balancing the requirements placed upon the gas collection system by the day-to-day activities of an active landfill. Interim conditions can hinder the effectiveness of the GCCS because it may be inadvertently damaged by landfill personnel operating heavy equipment, or water-in of header and lateral pipes because of bellies resulting from heavy traffic or differential settlement. In these cases, the design accommodates header relocation and the installation of interim extraction wells if necessary. In addition, interim conditions are situations where the existing landfill elevations have not reached final landfill design grades.

Interim gas extraction wells at the landfill will be in installed per the design in compliance with NSPS requirements and raised if necessary. However, in some cases the location of extraction wells installed during interim conditions cannot be accurately predicted due to shifting refuse fill patterns that may change based on the weather (significant area events such as hurricanes, tropical storms, earthquakes, floods, etc.), waste type, and waste volumes. In these instances, wells not installed in the design locations will be replaced or a new well added per the design at final grades. Lastly, interim well spacing’s may change from the final design because the final design relies upon a geomembrane which minimizes air intrusion. The surface emissions monitoring will be used to assess performance of interim systems and the GCCS modified accordingly if necessary.

4.1 Gas Collection System Expansion during Interim Conditions

During interim conditions, compliance with the NSPS requirements that specify additional gas collection devices and the corresponding expansion of the overall gas collection system will be maintained. Furthermore, expansions made to the collection system during interim conditions will ensure that LFG will be collected at sufficient rates that may change over the interim time frame, and will be designed and installed properly to minimize off-site migration of gas. Some of these requirements are specifically stated below:

> **40 CFR §60.751** *Sufficient density* means any number, spacing, and combination of collection system components, including vertical wells, horizontal collectors, and surface collectors, necessary to maintain emission and migration control as determined by measures of performance set forth in this part.
>
> **40 CFR §60.759(a)(3)** The placement of gas collection devices determined in paragraph (a)(1) of this section shall control all gas producing areas, except as provided by paragraphs (a)(3)(i) and (a)(3)(ii) of this section.
>
> **40 CFR §60.759(a)(2)** The sufficient density of gas collection devices determined in paragraph (a)(1) of this section shall address landfill gas migration issues and augmentation of the collection system through the use of active or passive systems at the landfill perimeter or exterior.
>
> **40 CFR §60.755(b)** For purposes of compliance with 40 CFR §60.753(a), each owner or operator of a controlled landfill shall place each well or design component as specified in the approved design plan as provided in 40 CFR §60.752(b)(2)(i). Each well shall be installed no later than 60 days after the date on which the initial solid waste has been in place for a period of:
>
> > **40 CFR §60.755(b) (1)** 5 years or more if active; or
> >
> > **40 CFR §60.755(b) (2)** 2 years or more if closed or at final grade.
>
> **40 CFR §60.759(c)** Each owner or operator seeking to comply with 40 CFR §60.752(b)(2)(i)(A) shall convey the landfill gas to a control system in compliance with 40 CFR §60.752(b)(2)(iii) through the collection header pipe(s). The gas mover equipment shall be sized to handle the maximum gas generation flow rate expected over the intended use period of the gas moving equipment using the following procedures:

In compliance with these regulations, the GCCS has been designed and will be further expanded as necessary during interim conditions, to extract LFG at a sufficient rate so as to minimize the subsurface lateral migration and surface emissions of LFG. This is achieved, in part by, appropriately sizing and installing sufficient collection elements, transmission piping, gas moving equipment, and control device(s) for the estimated maximum flow rate of LFG. Kekaha Landfill has been designed to achieve this.

A professional engineer will certify expansions of the GCCS and the measures of system performance will be verified as set forth in the NSPS. Based upon the outcome of the system performance metrics contained in the NSPS, such as the SEM and monthly collection device monitoring requirements, the GCCS will be adjusted or modified accordingly. This information will be used as an additional tool to evaluate the need for future expansion of the GCCS.

Per the definition stated in 40 CFR §60.751, “sufficient density” means “any number, spacing, and combination of collection system components . . .

necessary to maintain emission and migration control as determined by measures of performance set forth in this part." Well spacing at the Kekaha Landfill is established based on site-specific conditions (waste age, waste density, moisture content, etc.), ZOI estimates, past operational experience, and engineering judgment (See Appendix A-1). This is consistent with spacing criteria used at other landfills and should effectively control surface emissions and subsurface migration of LFG in accordance with NSPS requirements.

In the event that the actual LFG generation rate exceeds the capacity of the system, additional GCCS components will be designed and installed in accordance with NSPS requirements as dictated by actual site conditions at the time of construction. Therefore, actual operating parameters may dictate changes in the system flow characteristics and process equipment as the system is expanded.

Furthermore, the header and lateral piping systems is sized to accommodate the peak flows of the landfill. The existing Phase I vents will be capped and abandoned, however, one or more of these vents may be used in the future if necessary to address odors, gas migration or other similar situation.

4.1.1.1 Horizontal Gas Collectors:

Horizontal gas collectors may be installed in areas where waste placement activities interfere with the installation of a vertical well. In these cases, a horizontal trench collector with gravel and perforated piping will be installed and connected to the main header system. To limit air intrusion, these horizontal collectors will be installed only in areas where at least 20 feet of additional waste is to be landfilled above them. However, since horizontal collectors are often installed relatively close to the surface of the landfill, atmospheric air can be pulled into them, resulting in oxygen content greater than the NSPS limit of 5%. Should this occur, a higher operating limit for oxygen may be established in accordance with the NSPS, as discussed in Section 6.1.4 of this Design Plan.

4.1.2 Compatibility with Refuse Filling Operations

One of the key factors in constructing and operating a gas collection system during interim conditions, is how to design it so it is compatible with the refuse filling operations of an active landfill. As refuse filling operations proceed and portions of the site reach final or near final grades, additional GCCS components may be installed to comply with the 5-year/2-year requirements of NSPS, which are specifically discussed in Section 2, Design Criteria. Using this method allows GCCS components to be installed in accordance with 40 CFR §60.752(b)(2)(ii)(A)(2)(i) and (ii) while minimizing interference of the GCCS with ongoing filling operations.

During the process of refuse filling operations, vertical gas extraction wells may be “raised” periodically so the new refuse is not placed over the top of an existing well. Vertical wells are raised in anticipation of a new lift of refuse, or in advance of the refuse to be added to the area in order to maintain worker safety in the active area during these well raising construction activities. However, in performing the well raising in a safe area, this may require the well to be raised more than 30 days before refuse can be placed around the well during which the well is temporarily offline. A variance request for monitoring these raised wells is contained in Section 6.1.7 of this Plan.

4.1.3 Landfill Cover Properties

The purpose of the interim cover system is to provide a barrier to LFG emissions, as well as, water and air infiltration, and comply with State of Hawaii solid waste regulations and the landfill’s operating permit. The lateral extent of the interim cover system will vary depending on when the landfill plans to place additional waste in the area. If the landfill municipal solid waste sequencing plan defers filling to final grade in certain area(s), the County may decide to hydroseed or install some kind of a temporary cap over this portion of the landfill to improve performance of the GCCS.

5 FINAL DESIGN CONDITIONS

Final Design conditions are for the closed landfill or areas of the active landfill, which have ceased to accept waste and has a certified closed cap in place. Final Design conditions also apply to the closed landfill or closed portions of an active landfill that achieved final waste grades.

5.1 Landfill Gas Collection

This section addresses the location of the GCCS components after the landfill is no longer operating under interim conditions. The GCCS will be operated in accordance with the requirements of the NSPS for a closed landfill.

> **40 CFR §60.755(b)** For purposes of compliance with 40 CFR §60.753(a), each owner or operator of a controlled landfill shall place each well or design component as specified in the approved design plan as provided in 40 CFR §60.752(b)(2)(i). Each well shall be installed no later than 60 days after the date on which the initial solid waste has been in place for a period of:
>
> **40 CFR §60.755(b) (2)** 2 years or more if closed or at final grade.

In accordance with this requirement, a GCCS must be installed in all areas with waste that is 5 years or older if open and 2 years or more if closed or at final grade.

> **40 CFR §60.752(b)(2)(ii)(A)(3)** Collect gas at a sufficient extraction rate;
>
> **40 CFR §60.752(b)(2)(ii)(A)(4)** Be designed to minimize off-site migration of gas.
>
> **40 CFR §60.759(a)(2)** The sufficient density of gas collection devices determined in paragraph (a)(1) of this section shall address landfill gas migration issues and augmentation of the collection system through the use of active or passive systems at the landfill perimeter or exterior.

In compliance with 40 CFR §60.752(b)(2)(ii)(A)(3) and (4), the GCCS is designed to extract LFG at a sufficient rate so as to minimize the subsurface lateral migration and surface emissions of LFG. This is achieved by sizing and installing sufficient collection elements, transmission piping, blower(s), and control device(s) for the estimated maximum flow rate of LFG.

The GCCS is designed to collect LFG at a sufficient rate, which per the definition in 40 CFR §60.751 means to maintain a negative [gauge] pressure at all wellheads. Application of a negative pressure and minimization of air infiltration (oxygen) will be verified by monitoring each LFG wellhead.

Per the definition stated in 40 CFR §60.751, “sufficient density” means “any number, spacing, and combination of collection system components. . . necessary to maintain emission and migration control as determined by measures of performance set forth in this part.” Well spacing at the Kekaha Landfill was established based on site-specific conditions (waste age, waste density, moisture content, etc.), ZOI estimates, past experience, and engineering judgment (See Appendix A-1). This is consistent with spacing criteria used at other landfills and should effectively control surface emissions and subsurface migration of LFG in accordance with NSPS requirements.

Wells may have to be replaced over time due to liquids, fouling, siltation or other similar impacts or well casing damage, or relocated due to the conditions found during installation (obstructions). If this happens, the location of the well may vary from the original designed location, but will remain within the original zone of influence. As-builts of the gas collection system will be updated and a copy of the as-built drawing will be kept on-site. The design criteria discussed in Section 2 of this Plan was incorporated into the planned GCCS (Appendix B).

Kekaha Landfill will conduct SEM events as specified in 40 CFR 60.755(b) in all accessible areas that have waste in-place for 2 years and are closed or at final grade to ensure that the gas collection system was designed, installed, and is being operated properly. If the GCCS at the Kekaha Landfill does not meet the measures of performance set forth in the NSPS, the GCCS will be adjusted or modified in accordance with the NSPS requirements. Possible adjustments or modifications are detailed in Section 6 of this Plan.

5.1.1 Landfill Gas Generation Rates and Flow Characteristics

This portion of the design plan is to address the peak value flow rates used in determining the final build out of the GCCS, as described in this section and in Appendix A-2.

> **40 CFR §60.752(b)(2)(ii)(A)(1)** An active collection system shall be designed to handle the maximum expected gas flow rate from the entire landfill that warrants control over the intended use period of the gas control or treatment system equipment

In compliance with 40 CFR §60.752(b)(2)(ii)(A), the maximum expected LFG flow rate for the site was used for sizing the GCCS. LFG generation based on the United States Environmental Protection Agency (USEPA) Landfill Gas Estimation Model (LandGEM) yielded a peak value of 521 scfm in 2020 for total landfill gas. This value is based on the currently permitted volume (including the most recently permitted expansion which is included in this design plan submittal) in the solid waste disposal permits. Copies of the results of the LFG generation rate modeling are included in Appendix A-2. The corresponding sizing of the system may change based on actual gas flows obtained from the landfill as the site nears closure. Additionally, the sizing of the GCCS may be changed to incorporate a factor of safety.

5.1.2 Landfill Cover Properties

The purpose of the final cover system is to provide a barrier to LFG emissions, as well as, water and air infiltration. At the time of the submittal of this Design Plan, the landfill final cover properties consist of a final cover system pursuant to RCRA Subtitle D, 40 CFR § 258.60(a), designed to:

(a) Have permeability less than or equal to the permeability of any bottom liner system or natural subsoil present, or a permeability no greater than 1 x 10^{-5} cm/sec, whichever is less, and

(b) Minimize infiltration through the closed MSWLF unit by an infiltration layer that contains a minimum of 18-inches of an earthen soil material, and

(c) Minimize erosion of the final cover by an erosion layer that contains a minimum of 6-inches of earthen material that could sustain native plant growth.

The final cover at Kekaha Landfill will be designed and installed in accordance with applicable regulatory requirements. Closure of Phase I was accomplished as documented in the Kekaha Landfill, Phase I Closure, Post-Construction Report prepared by Harding Lawson Associates (dated February 1996). Final cover placement for Phase II will proceed in phases as fill elevations reach final grades. Integration of GCCS with specific cover components (including provisions for low permeability soils or geosynthetic membranes) will be addressed in the approved Final Closure Plan.

5.1.3 Integration with Closure End Use

Currently, the closure end-use for the site is unspecified. Any modifications to the closure end use will be reviewed by Kekaha Landfill to evaluate compatibility with the GCCS. Items of concern will be mitigated by either altering the proposed closure end-use or by adjusting or modifying the GCCS in accordance with NSPS requirements.

5.1.4 Operation of GCCS After Closure

The landfill is not required to operate the GCCS indefinitely after closure of the landfill. The requirements that allow for removal of the GCCS are listed below:

40 CFR §60.752(b)(2)(v) The collection and control system may be capped or removed provided that all the conditions of paragraphs (b)(2)(v) (A), (B), and (C) of this section are met:

40 CFR §60.752(b)(2)(v)(A) The landfill shall be a closed landfill as defined in 40 CFR §60.751 of this subpart. A closure report shall be submitted to the Administrator as provided in 40 CFR §60.757(d);

40 CFR §60.752(b)(2)(v)(B) The collection and control system shall have been in operation a minimum of 15 years; and

40 CFR §60.752(b)(2)(v)(C) Following the procedures specified in 40 CFR §60.754(b) of this subpart, the calculated NMOC gas produced by the landfill shall be less than 50 megagrams per year on three successive test dates. The test dates shall be no less than 90 days apart, and no more than 180 days apart.

The GCCS will be operated in accordance with the above regulations of the NSPS. After the GCCS is allowed to be removed according to the NSPS, the GCCS may remain in place and functional, but it will no longer be required to operate in accordance with the NSPS operational requirements. If these above regulations regarding GCCS removal change, the landfill will comply with the new/revised regulations.

6 NSPS VARIANCE SECTION

The following requirement allows for alternatives to the operational standards, test methods, procedures, compliance requirements, monitoring, record-keeping, and reporting provisions to be requested in the design plan.

> **40 CFR §60.752(b)(2)(i)(B)** The collection and control system design plan shall include any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, record keeping or reporting provisions of §60.753 through §60.758 proposed by the owner or operator.

The following are variances to the NSPS, arranged by general topic, and comply with the intent of the NSPS requirements.

6.1 Collection Device Monitoring

The following variances to the NSPS relate to collection system monitoring requirements.

6.1.1 Monthly Well Monitoring Device

The requirements of 40 CFR §60.755 (a)(5) allows for the monitoring of temperature and either nitrogen or oxygen to establish whether excess air infiltration is occurring. Unless an alternative test method is approved, 40 CFR §60.753 (c)(1) and (2), allow for the use of EPA Method 3C to measure the nitrogen levels and the use of either EPA Method 3A or EPA Method 3C to establish the oxygen content. In accordance with the general state-of-the-practice procedures, Kekaha Landfill proposes to use a portable monitoring instrument such as an Envision meter, Landtec GEM 2000 or 5000, LMS, or equivalent. The monitoring equipment will be verified and calibrated in accordance with manufacturer's recommendations to ensure accurate measurement of all parameters for which it is used to monitor.

6.1.2 Operational Change to Accommodate Declining Flows

The primary objective of the NSPS regulations is to minimize surface emissions into the atmosphere, while mitigating conditions within the landfill that could foster subsurface oxidation. Kekaha Landfill requests the following alternative to standard operating procedures for LFG extraction wells where gas flow rates are so low that applying even minimal vacuum results in an exceedance of the applicable oxygen concentration limit. Shutting such wells down is likely to cause positive pressure in the wellhead as landfill gas builds up. Therefore, simultaneously complying with both the negative pressure and oxygen concentration limits in 40 CFR §60.753 can be difficult for the wells where gas flow rates have declined over time.

Under provisions in 40 CFR §60.753(b)(3), wells that experience positive pressure after being shutdown to accommodate declining LFG flow rates can be decommissioned if permission is granted by the Administrator. As an alternative to decommissioning wells under the provisions, the Kekaha Landfill has proposed to make the following changes to its standard operating procedure for wells where persistent oxygen exceedances are not the result of operations and/or maintenance issues:

a. To ensure a representative sample is obtained, LFG should be flowing. The wellhead and / or well casing should be purged of poor stagnant gas prior to sampling.

b. Wells where oxygen concentrations do not decline to acceptable levels after more than one hour of reduced vacuum will be shut off until the gas quality recovers.

c. The monthly monitoring required by 40 CFR §60.755 will be conducted for wells that have been shut down, but positive pressure or elevated oxygen concentrations will not be considered exceedances of the operating limits in 40 CFR §60.753.

d. If monthly monitoring indicates that pressure has built up in the well and the oxygen concentration still exceeds five percent, the well will be opened to relieve the pressure and will be shut down until it is monitored the following month.

e. If monthly monitoring indicates that the gas quality has improved (i.e. the oxygen concentration has dropped below five percent), the well will be brought back on line until the gas quality declines again.

f. The quarterly surface emissions monitoring (SEM) required under 40 CFR §60.755 will be conducted for wells that have been shut down. Standard remediation steps, including evaluating the need to return wells to full-time service, will be followed if exceedances of the 500 ppm methane surface concentration limit are detected.

The foregoing procedures are consistent with the alternative operating scenario detailed in an EPA clarification letter dated February 9, 2005 and is also consistent with the determination dated 02/09/2005 (Appendix D-

56). Furthermore, Kekaha Landfill will document these operational changes in the Semi-Annual Monitoring Reports required under NSPS.

6.1.3 Collection devices added to the GCCS/ Expanding the system to address Pressure, Temperature, and/or Oxygen or Nitrogen Exceedances

Subsequent to initial gas system installation, gas system expansion and / or modification may be implemented, which could include the installation of new extraction wells, pipes, or other GCCS components. Pursuant to 40 CFR §60.755(a)(4) the landfill is not required to expand the system during the first 180 days after gas collection system start-up where pressure exceedances were recorded at one or more wells.

Based on the November 10, 2005 meeting between USEPA and waste industry representatives (See Appendix D-116), the exemption from system expansion can be requested for any individual well/collector or series of collectors installed during initial system installation or subsequent to initial installation as part of system expansion or modification; however, such exemption must be approved in the Design Plan. Therefore, the Kekaha Landfill is requesting 180 days from the date that each well or collector is installed to achieve the NSPS operating parameters for pressure, oxygen and/or temperature without having to expand the GCCS due to a monitored exceedance. During the 180 day period, monthly monitoring of the well/collector and attempted corrective actions are still required.

6.1.4 Monthly Monitoring and Associated Corrective Actions

Sections 40 CFR §60.755(a)(3) and 40 CFR §60.755(a)(5) of the NSPS requires the landfill owner or operator to take corrective action to remedy GCCS operating and compliance monitoring exceedances within 5 calendar days. If the condition cannot be corrected within 15 days of the initial exceedance, the GCCS must be expanded within 120 days of the initial reported exceedance, or an alternate remedy to correct the exceedance(s) and a corresponding timeline for implementation may be submitted for agency approval. In many instances expansion of the GCCS will not alleviate the source of the exceedance found during the 5/15 day remonitoring events.

For this reason, Kekaha Landfill is seeking approval for an alternative to this corrective measure protocol. If the condition cannot be corrected within 15 days of the initial exceedance, the Kekaha Landfill is proposing to implement assessment monitoring procedures. These assessment monitoring procedures will be implemented to ascertain the best approach for enhancing the effectiveness of the GCCS. Assessment monitoring procedures will include evaluation/troubleshooting of existing GCCS components (i.e. investigation for damaged components, checking water levels in wells, investigation of sump pump operability etc.). Assessment monitoring procedures in addition to corrective actions (as discussed below) will be performed as soon as possible, but will not exceed more than 120 days after the initial exceedance. Based on the data gathered during assessment monitoring, the Kekaha Landfill will implement the deemed appropriate corrective action measures to modify/expand/repair the GCCS. If the exceedance(s) can be corrected during the 120-day period, no further action will be taken until the next monthly well monitoring event.

Note that if the Kekaha Landfill is not able to correct for the exceedance(s) within the 120-day period using the corrective action measures deemed appropriate prior to completion of the 120-day assessment period, a letter requesting an extended timeline for implementation of corrective measures will be submitted to the Administrator on or before the 120th day of the aforementioned assessment period. If the well cannot be brought back into compliance during assessment monitoring, the data obtained during the 120-day assessment monitoring period will be used to determine if the GCCS is in need of expansion/enhancement or the extraction well has become a low-producing extraction well. If the extraction well is determined to be low-producing, the Kekaha Landfill proposes to implement the alternative operating scenario presented in variance request 6.1.2 of this Design Plan for low-producing extraction wells.

Solutions to any extraction well exceedances may include corrective actions to the GCCS other than the installation of additional collection devices. These corrective actions could include one or more of the following measures:

a. Installation/upgrades to the blower/flare skid equipment (bigger blowers, larger flare, additional blowers, etc.).
b. Installation of a liquid management system in the extraction wells or sumps.
c. Installation/modification of other ancillary equipment (larger air compressor, additional air and condensate force main lines, etc.)
d. Redrilling and/or installation of additional/replacement collection devices.
e. Repair of landfill cap to lessen the chance of encountering ambient air.

f. Repair/Replace header valves.

Please note that the foregoing list is not intended to be exhaustive. Other actions that result in the remediation of an exceedance within the 120-day time frame would also be covered under this alternative. Any enhancements made to the existing GCCS will be documented in the SEM-Annual Reports prepared for compliance with NSPS/Title V requirements. In the event that, the GCCS cannot be brought back into compliance during the 120-day period, the Kekaha Landfill will prepare and submit an alternative compliance schedule for review and approval by the Administrator before the expiration of the 120-day period.

6.1.5 Well Abandonment

A notice will be submitted to the Administrator when a well is decommissioned. In addition if a well is replaced, the existing well can be abandoned/removed by the landfill without notification or prior approval by the Administrator. The new well will be renamed to an alternative name.

6.1.6 Early Installation of Collection Devices

The requirements of 40 CFR §60.755(b) states that each extraction well shall be installed no later than 60 days after the date on which the initial solid waste has been in place for a period of 5 years or more in active areas or 2 years or more if closed or at final grade. However, there may be occasions when Kekaha Landfill will decide to install extraction wells included in the Design Plan prior to the onset of NSPS requirements. Based on the foregoing regulatory citation, any extraction wells installed prior to the requirements of NSPS will not be subject to the operational and/or record-keeping requirements of NSPS until the age of the initial waste placed reaches 5 years old if in an active area or 2 years old if closed or at final grade. To make certain that the Administrator is made fully aware of these special circumstances, Kekaha Landfill will include information in the semi-annual report required by NSPS and Title V indicating the date of initial extraction well installation and the NSPS compliance date of the “early extraction well”. Appendix D-21.

6.1.7 Monitoring of Collection Device during Well Raising

During the process of refuse filling operations, installed vertical extraction wells have to be “raised” periodically so the new refuse is not placed over the top of an existing vertical well. If the well cannot be accessed, then monthly measurements would not be possible. A well is raised in advance of placing waste around it in order to keep people safe and out of the active area during these well raising construction activities. However, in performing the well raising in a safe area, this may require the well to be raised more than 30 days before refuse can be placed around the well during which time the well is offline.

Therefore the site may have a well extending up into the air that may be near an active refuse placement area, and cannot have monthly monitoring performed on it. Furthermore, as refuse is placed around the well in the active face, access for landfill gas technicians is very limited and typically unsafe due to all the heavy equipment being operated in a small area.

Due to the potential dangers associated with well raising, Kekaha Landfill is requesting that raised wells be exempt from the monthly NSPS monitoring for a period not greater than 60 days. Wells that were not monitored due to well raising activities will be noted on the semi-annual NSPS reports. Records will be maintained of the period wells are offline. Appendix D-26.

6.1.8 Monitoring of Leachate Clean-out Risers

During the operating life of the landfill, Kekaha Landfill may decide to connect the Phase II leachate collection system to the GCCS to help control odors, to increase the quantity of LFG available for beneficial use, or to meet other landfill operating needs beyond regulatory compliance with the rule. This Plan has been prepared to meet the required level of LFG control without the use of the aforementioned connections. For this reason, Kekaha Landfill does not believe that the operating requirements of the rule should be applied to voluntarily added collectors because these collectors only act to enhance the performance of the system beyond that required by the rule. Further, because these devices are installed for purposes other than to meet the requirements of the rule, their design may preclude their ability to meet the stipulated operational requirements.

Additionally, these leachate collection risers often operate with oxygen at atmospheric level (approximately 21%), which is far greater than the 5% oxygen limit for gas collection wells contained in the NSPS. Furthermore, these leachate collection risers that are connected to the gas collection system are not always operated under a negative pressure because they are sometimes closed off for operational purposes. If Kekaha Landfill is required to operate any gas connection points to the leachate collection system, then the Kekaha Landfill will need to operate those points at a variance of 21% and at times be allowed to be operated under a positive pressure. Therefore, Kekaha Landfill is requesting that connections to the leachate risers not be required to be operated and monitored in compliance with the NSPS. If the Administrator feels that any leachate risers connected to the GCCS must be operated and monitored in accordance with the NSPS, then the Kekaha Landfill would need to establish an oxygen variance of less than twenty-one percent and be allowed to operate them at positive pressures as well.

6.2 Surface Emission Monitoring

The following variances are related to Surface Emission Monitoring (SEM) events.

6.2.1 Exclusion of dangerous areas from SEM requirements

40 CFR §**60.753(d) Operational Standards for Collection and Control Systems:** "...A surface monitoring design plan shall be developed...Areas with steep slopes or other dangerous areas may be excluded from surface testing.

Kekaha Landfill is proposing to exclude the following steep slopes and dangerous areas from SEM:

a. Roads;
b. Active areas or working face;
c. Truck traffic areas;
d. Slopes steeper than or equal to 4:1; and
e. Areas where the landfill cover material has been exposed for the express purpose of installing, expanding, replacing, or repairing components of the LFG, leachate, or gas condensate collection and removal systems

6.2.2 10-day SEM Re-monitoring Event

Kekaha Landfill is requesting a variance to the 10-day Surface Emissions Remonitoring Event (REM) window allotted for adjustments to the cover and/or GCCS. Industry experience with NSPS facilities suggests that this 10-day time frame may not be reasonable to effect comprehensive repairs during all quarters of a typical year. For example, if the facility experiences precipitation events following a surface scan, it may take several days or even weeks for the sideslopes of the landfill to dry out enough to support construction equipment cover repairs. If the sideslopes are not completely dry, the repair equipment could cause greater damage to the final cap (and subsequently higher emissions) than the original erosion or crack. Poor weather conditions can prevent cover maintenance, causing the follow-up Surface Emissions REM events 10 days later to automatically fail. This can ultimately force a facility to install an unnecessary LFG collection device when all that was really required was enough time to effect a cover repair.

For this reason, the Kekaha Landfill is requesting that the 10-day REM event time frame be extended by an additional two (2) weeks, in the event of bad weather conditions after a quarterly SEM event. Kekaha Landfill is proposing to obtain this two-week extension automatically upon providing the EPA with the following written information:

- The date of the Initial Quarterly SEM event
- The date of the inclement weather event
- Description of inclement weather event
- The name of the responsible sampling technician (Print and Signature)

Please note that a copy of this information will also be maintained in the Kekaha Landfill NSPS files. (See Iowa Determination Letter dated March 15, 2006 shown in Appendix D-21.)

6.2.3 Alternative Remedy for SEM Events

Sections 40 CFR §60.755(a)(4) of the NSPS requires the landfill owner or operator to take corrective action to remedy any methane surface emissions of greater than or equal to 500 ppm. Kekaha Landfill plans to perform the initial SEM Events and 10-day/30-day SEM events in accordance with the NSPS and 6.2.2 of this variance request section. Additionally, SEM exceedance corrective measures may include corrective actions to the GCCS other than the installation of additional LFG collection devices. Therefore, Kekaha Landfill is proposing to implement these alternative remedies to correct SEM exceedances. These corrective actions could include one or more of the following measures:

a. Installation/upgrades to the blower/flare skid equipment (bigger blowers, larger flare, additional blowers, etc.).
b. Installation of a liquid management system in the extraction wells or sumps.
c. Installation/modification of other ancillary equipment (larger air compressor, additional air and condensate force main lines, etc.)
d. Redrilling or installation of additional/replacement LFG collection devices.

e. Repair of landfill cap or intermediate soil cover to lessen the chance of landfill gas emissions.
f. Repair/Replace header valves.

Please note that the foregoing list is not intended to be exhaustive. Other actions that result in the remediation of an exceedance within the 120-day time frame would also be covered under this alternative. Any enhancements made to the existing GCCS will be documented in the Semi-Annual Reports prepared for compliance with NSPS/Title V requirements. Please note that Kekaha Landfill will be proactively implementing this variance to make certain that exceedances are addressed as expeditiously as possible. In the event that, the GCCS cannot be brought back into compliance during the 120-day assessment period, Kekaha Landfill will prepare an alternative compliance schedule for review and approval by the Administrator.

6.2.4 SEM for Closed Portions of the Landfill

Kekaha Landfill is requesting that any portions of the landfill that have been certified closed or have been closed and capped in accordance with the cover conditions contained in this Design Plan be treated as a closed landfill for SEM events. These closed portions of the landfill would be monitored in accordance with 40 CFR §60.756(f), which states the following:

> "…Any closed landfill that has no monitored exceedances of the operational standard in three consecutive quarterly monitoring periods may skip to annual monitoring. Any reading of 500 ppm or more above background detected during the annual monitoring returns the frequency for the landfill to quarterly monitoring."

Therefore, Kekaha Landfill is requesting that all closed areas of the landfill (i.e., Phase I of the existing Kekaha Landfill) have SEM performed on it in accordance with the requirements of 40 CFR §60.756(f).

6.3 Control Device

The following variances have to do with Control Devices.

6.3.1 1-hour and 5-day Standards

Section 60.755(e) states that the compliance provisions apply at all times, except during periods of startup, shutdown or malfunction provided that the duration of the start-up, shutdown or malfunction shall not exceed 5 days for collection systems and shall not exceed 1 hour for treatment or control devices. The collection and control systems are designed so that when the control system is off-line the gas moving equipment is shutdown as well preventing gas from being vented to the atmosphere. Therefore, the entire collection system is off-line when the control system is shutdown. It is the understanding of Kekaha Landfill that the 1-hour and 5-day downtime provisions mean that the collection system cannot be down for more than 5 days at a time. Further, the treatment and/or control system (i.e., flare) cannot be down for more than 1 hour at a time while the collection system is running, in a manner that allows uncontrolled LFG to vent to the atmosphere. For this reason Kekaha Landfill will operate the GCCS such that control system downtime in excess of 5 days, assuming no uncontrolled LFG emissions into the atmosphere in excess of 1 hour, is not considered an exceedance of the standard. This type of operational procedure is understood to meet the intent of the regulation. Furthermore, the EPA appears to agree with this understanding of the regulation, because the proposed NSPS revision does not include the 1-hour rule as part of the regulation. This information is shown in the EPA-SWANA Meeting Summary of Responses, which can be found in Appendix D-116.

6.3.2 Flow meters when no bypass is present

The Municipal Solid Waste Landfill NSPS/EG-- Questions and Answers (Q&A) document indicates that LFG flow measurement or lock and key requirements would not apply to a GCCS that is designed such that there is no physical means to bypass the LFG flow before it reaches the control device. In the event that a malfunction occurs with the GCCS equipment, an electric or pneumatically operated valve has been designed to close to prevent the direct venting of raw LFG into the atmosphere. The existing GCCS design satisfies the foregoing LFG flow measurement/lock-and-key waiver criteria; therefore, Kekaha Landfill is requesting to not be required to install and operate flow-measuring device in accordance with the requirements of the NSPS. If Kekaha Landfill decides to install a flow measuring device, it will not be required to monitor or record flow in accordance with NSPS. A copy of the Q&A Document is shown in Appendix D-61.

6.3.3 Intermittent operation and shutdown of extraction wells and control devices

The site is located in a relatively dry area of the island, therefore gas generation is expected to be very limited. This may necessitate intermittent operation or the operation of wells with positive pressure to prevent a landfill fire as provided for in the NSPS. Kekaha Landfill is requesting approval to operate wells intermittently to avoid conditions that would be conducive to the formation of a fire consistent with the NSPS. It may be necessary to turn off this control device periodically to ensure that air does not get introduced into the landfill.

APPENDIX A

GCCS DESIGN CALCULATIONS

Appendix A-1: Discussion of the Darcy Zone of Influence for Landfill Gas Extraction Systems

Purpose: To present a design procedure for determination of gas extraction well locations and relative placement/spacing.

Method: Utilization of an individual gas extraction well's Darcy zone of influence to determine optimal well spacing sufficient to induce vacuum uniformly throughout the waste disposal area.

Objective: As a standard design method, landfill gas extraction well spacing by means of the Darcy zone of influence provides a reasonable effective extraction area coverage over the waste disposal area, with minimum overlap or open spaces. Placement of gas extraction wells on side slopes should be minimized to reduce air intrusion.

Definition: The zone of influence (ZOI) is the radial distance from an extraction well from which the migration direction of landfill gas will be influenced by an application of vacuum. Since gas is influenced by convection forces (pressure gradient), the zone of influence is established where the measured pressure/vacuum at extreme zone (r_1) of influence is zero.

Darcy Zone of Influence for Radial Compressible Fluid Flow

Discussion: Darcy equation, for radial fluid flow

$$v = \left(\frac{g_C \ K}{\mu} \right) \left(\frac{dP}{dr} \right) \quad equation\,(\,1\,)$$

Where:

g_c = acceleration of gravity constant = 32.2 ($lb_M \cdot ft/lb_F \cdot sec^2$)

v = apparent flow velocity in (ft/sec) units

μ = absolute viscosity of the flowing fluid (landfill gas) in ($lb_M/ft \cdot sec$) units

K = absolute permeability of the porous media (refuse) in (ft^2) units

dP = pressure gradient in the direction of radial flow in (lb_F/ft^2) units

dr = radial distance gradient in (ft) units

Definition: Permeability is defined as a measure of a porous media's ability to transmit fluids.

Assumptions necessary to develop the basic flow equations:

(1) steady-state flow conditions exist.

(2) the pore space of the refuse is 100 percent saturated with the flowing fluid (landfill gas).

(3) the viscosity of the flowing fluid is constant.

(4) isothermal conditions in the refuse prevail.

(5) flow is laminar, horizontal, and linear since refuse grain size is relatively small and the velocity of the fluid flow is low.

Please refer to the ideal radial flow system diagram (Figure 1). With these assumptions in mind, let

$$v = \frac{q}{A}$$

Where:

v = the apparent velocity of the flowing fluid (gas)

q = volumetric rate of fluid (gas) flow

A = total cross-sectional area perpendicular to flow direction

= $2\pi r h_s$

h_s = total extraction well length of slotted pipe

Substitute in equation (1):

$$q \ / \ A = \left(\frac{g_C \ K}{\mu} \right) \left(\frac{dP}{dr} \right) \quad equation(\ 2\ )$$

with $A = 2\pi r h_s$ and rearranging

$$q = \left(\frac{2\pi \, r \, h_S \ \ g_C \ \ K}{\mu} \right) \left(\frac{dP}{dr} \right) \quad equation(\ 3\ )$$

Since landfill gas is a compressible fluid, its viscosity and flow characteristics must be corrected to standard conditions.

When a flowing fluid is compressible, then q is not constant, but is a function of pressure and temperature $f(P,T)$. An expression for the standard flow rate of a gas (q_s) is obtained from Charles' law, assuming ideal gas behavior at standard conditions:

$$\frac{P_1 \; q_1}{T_1} = \frac{P_2 \; q_2}{T_2} = constant = \frac{P_S \; q_S}{T_S} \quad \_ \quad at\ standard\ conditions$$

Substitution in equation (3):

$$\frac{P_S \; q_S}{T_S} = \frac{Pq}{T} = \left(\frac{2\pi\, rh_S \; g_C \; K}{\mu \; T} \right) \left(\frac{PdP}{dr} \right) = constant$$

Where:

T_s = standard temperature = 60(degF) = 520(degR) constant

P_s = standard pressure = 14.7 (psia) = 2,116.8 (lb_F/ft^2) constant

T = flowing temperature of the fluid (landfill gas)

Therefore:

$$\frac{P_S \, q_S}{T_S} = \left(\frac{2\pi \, r \, h_S \, g_C \, K}{\mu \, T} \right) \left(\frac{PdP}{dr} \right) \qquad equation\,(\,4\,)$$

let q_s = standard volumetric rate of fluid flow

$$q_S = (\,dG \;/\; dt\,)\, V\rho = (\,dG \;/\; dt\,)\, \pi\, r^2 \; h_T \;\; \rho$$

Where:

(dG/dt) = landfill gas generation rate

V = volume of well influence, assuming uniform cylindrical geometry

= $\pi r^2 h_T$

ρ = density of refuse; assume ρ = 1,300 (lb_M/yd^3) = 48.15 (lb_M/ft^3)

h_T = total extraction well length (total well depth)

This approach assumes that all conditions are uniform, and that all gas generated at radius r_1 is extracted. Actually, only a fraction of the gas generated at some distance “r” from the well would be extracted, and this fraction would decrease as the radius increases.
Please refer to the ideal radial flow system diagram (Figure 1).

$$\frac{P_S\ (dG/dt)\ \pi r^2\ h_T\ \rho}{T_S} = \left(\frac{2\pi r h_S\ g_C K}{\mu T}\right)\left(\frac{PdP}{dr}\right) \quad equation\,(5)$$

Substitution in equation (4):
Simplification, separation of variables, and insertion of system limits in equation (5):

$$\int_{r_0}^{r_1} rdr = \frac{2 g_C\ K T_S (h_S\ /\ h_T)}{P_S (dG\ /\ dT)\ \rho\mu T} \int_{P_0}^{P_1} PdP$$

Where:

r_o = radius of the extraction well pipe

r₁ = the Darcy zone of influence

Which when integrated:

$$\frac{(r_1^2 - r_0^2)}{2} = \left[\frac{g_C\ K T_S (h_S / h_T)}{P_S (dG\ /\ dt)\rho\mu T}\ x\ (P_1^2 - P_0^2)\right]$$

Solving for zone of influence *(r_1)*:

$$r_1 = \left[\frac{2 g_C\ K T_S (h_S\ /\ h_T)}{P_S (dG\ /\ dt)\rho\mu T}(P_1^2 - P_0^2) + r_0^2\right]^{1/2} \quad equation\,(6)$$

This is the Darcy zone of influence equation.

Since a concentric cylindrical surface at distances r_1 and r_0 are assumed, perpendicular gas flow across the surface at r_1 must be much greater than that across the surface at r_0 and since r_0 <<< r_1, then r_0 is negligible and:

$$r_1 = \left[\frac{2 g_C\ K T_S (h_S\ /\ h_T)}{P_S (dG\ /\ dt)\rho\mu T}(P_1^2 - P_0^2)\right]^{1/2} \quad equation\,(7)$$

The maximum vacuum that can be applied in a gas extraction well is usually dependent on the length of solid pipe section specified. The relationship is that as the length of solid pipe section increases, the potential of air intrusion through the cover or side slopes decreases, therefore allowing more vacuum to be applied to the gas extraction well to maximize its effective zone of well influence. The average reasonable applied vacuum at the wellhead *(P_0)* for an active gas extraction system must be anticipated by the designer to calculate the Darcy zone of influence.

The following table is a guideline of reasonable applied vacuum values to be utilized in equation (7):

Length of Solid Pipe (ft)	**Applied Vacuum (in. W.C.)**	**Applied Vacuum (lb/ft) absolute**
15	0.25	2,115.5
20	0.75	2,112.9
25	2.0	2,106.4
30	2.5	2,103.8
35	3.0	2,101.2
40	3.5	2,098.61

Note:

ft	foot/feet
in. w.c.	inches water column pressure
lb/ft	pounds per foot

The following calculation demonstrates how the Darcy zone of influence can be determined for a conceptual gas extraction well location plan.

Assumptions:

Landfill gas composition based on EPA model:

percent methane (CH_4) = 50 %

percent carbon dioxide (CO_2) = 50 %

Total = 100 %

Average flowing landfill gas temperature *(T)* = 100(deg F) = 560(deg R)

Gas generation rate *(dG/dt)* = $k*L_o * 2 = 0.02*100*2 = 4$ m^3/Mg-yr =

0.065(ft^3/lb_M-yr)

or *(dG/dt)* = 2.06×10^{-9}(ft^3/lb_M-sec)

k and L_o are based on EPA's AP-42 emissions factors for dry sites.

Average reasonable applied vacuum at the wellhead *(P_o)* for an active gas extraction system with a 20-foot length of solid pipe:

P_o = 1.51 (inches of water column)

= 0.0547 (psig)

= 2,108.9 (lb_F/ft^2) absolute

Conversion: 1.0 (psig) = 27.7 (inches of water column)

Average reasonable absolute permeability of refuse *(K)* based on HELP model for determining leachate heads within a landfill.

K = $2.681 \times 10^{-11} (ft^2)$

Typical gas absolute viscosity at standard temperature conditions (60°F)

<u>Absolute Viscosity Reference Values</u>

methane (CH_4) = 7.1×10^{-6} (lb_M/ft.sec)

carbon dioxide (CO_2) = 9.8×10^{-6} (lb_M/ft.sec)

Standard landfill gas viscosity *(μ)* at 60°F:

μ = $(0.5)(7.1 \times 10^{-6}) + (0.50)(9.8 \times 10^{-6})$

μ = 8.45×10^{-6} (lb_M/ft.sec)

Determine the ratio of slotted pipe to total pipe section for typical gas extraction wells as specified by the designer.

Calculated average ratio value (h_s / h_T) = 0.59 for Kekaha Landfill, approximately two-thirds slotted length per total length.

Constants utilized in the Darcy zone of well influence, equation (7):

g_c = acceleration of gravity constant = 32.2 (lb_M.ft / lb_F .sec ^{2})

T_s = standard temperature = 520 (°R)

P_s = standard pressure = 2,116.8 (lb_F /ft ^{2})

ρ = density of refuse = 48.15 (lb_M /ft^3)

P_1 = pressure/vacuum at extreme zone (r_1) of influence convention pressure gradient

P_1 = 0 (inches of water column)

P_1 = 0 (psig) = 14.7 (psia) absolute

P_1 = 2,116.8 (lb_F /ft^2) absolute

Note that $P_1 = P_s$ = 2,116.8 (lb_F /ft^2) absolute atmospheric pressure.

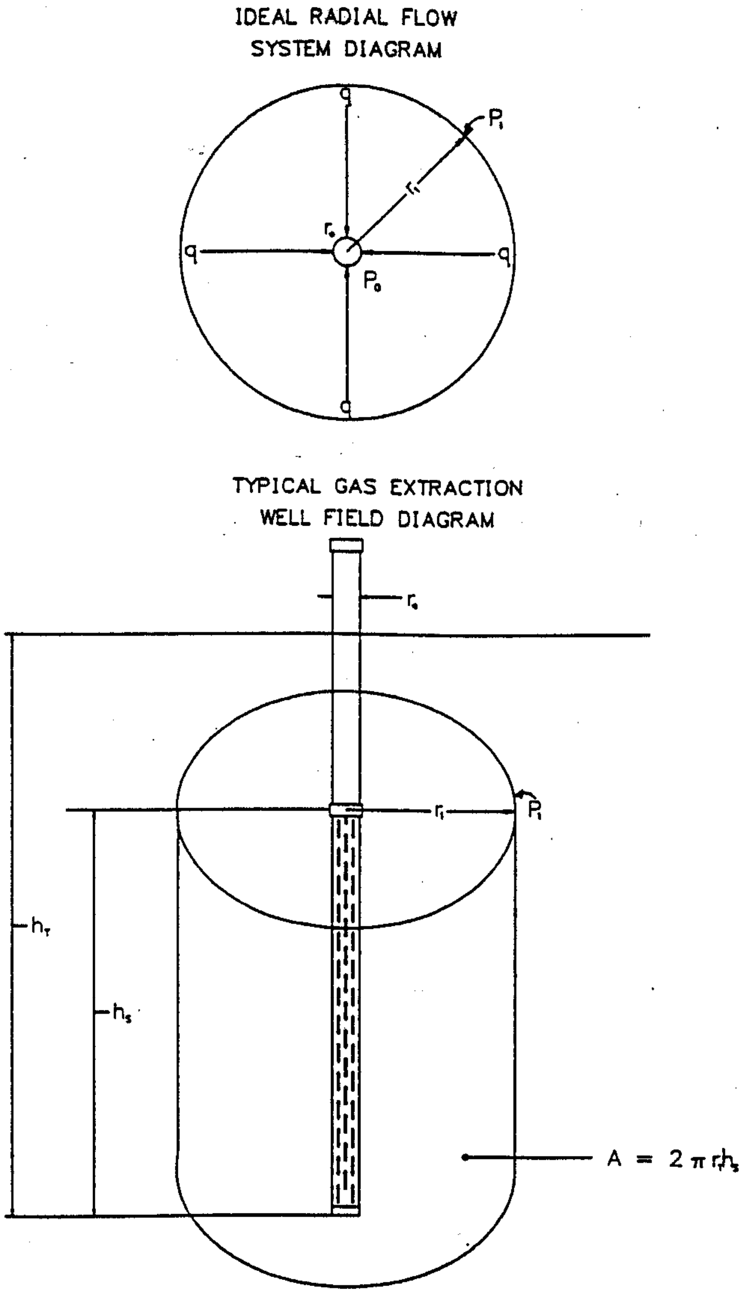
$$r_1 = \left[\frac{(2 x 32.2)(2.681 x 10^{-11})(520)(0.59)[(2{,}116.8)^2 - (2{,}108.9)^2]}{(2{,}116.8)(2.06 x 10^{-9})(48.15)(8.45 x 10^{-6})(560)} \right]^{1/2}$$

Substitute in equation (7) to derive the Darcy zone of influence for a typical gas extraction well.

$$r_1 = \left[1.78 x 10^4 (ft^2) \right]^{1/2}$$

Therefore: r_1 = 133 (ft) = zone of well influence.

Figure 1 shows the geometry of a typical zone of influence for a landfill gas well. Table A-1 shows the calculated ZOI for all of the extraction wells. The maximum ZOI was determined to be 164 feet. The design, however, is limited to 150 feet to provide conservative spacing of the extraction wells.



IDEAL RADIAL FLOW SYSTEM DIAGRAM

TYPICAL GAS EXTRACTION WELL FIELD DIAGRAM

FIGURE 1: DARCY RADIUS OF INFLUENCE CONCEPTS

TABLE A-1: Zone of Influence Calculation Table

AVERAGE ASSUMPTIONS

GAS GENERATION RATE:	0.064	FT3/LBm*YR
PERMEABILITY FACTOR:	2.681	x 10E-11, FT2
REFUSE DENSITY:	48.15	LBm/FT3
GAS TEMPERATURE:	110	DEG. F
DESIGN MAX. ZOI:	150	FT

Assumes standard conditions are 14.7 psia, 60 Deg. F.

WELL NO.	Well COORDINATES		SURFACE ELEVATION (FASL)	BASE ELEVATION (FASL)	DEPTH OFF BASE (FT)	WELL DEPTH (FT)	LENGTH OF PIPE		(Hs/Ht) RATIO	APPLIED VACUUM (in WC)	ZOI (FT)	GAS FLOW (SCFM)
	NORTH	EAST					SOLID (FT)	SLOTTED (FT)				
1	55,833	1,556,407	65.0	16.0	10	39.0	25	14	0.36	2.29	128	6.4
2	55,683	1,556,560	65.0	7.4	10	47.6	25	23	0.47	2.29	147	10.6
3	55,519	1,556,734	60.0	8.5	10	41.5	25	17	0.40	2.29	134	7.9
4	55,358	1,556,896	57.0	8.3	10	38.7	25	14	0.35	2.29	127	6.7
5	55,165	1,557,021	58.0	7.5	10	40.5	25	16	0.38	2.29	132	7.5
6	55,023	1,557,139	55.0	8.3	10	36.7	25	12	0.32	2.29	120	5.8
7	54,862	1,557,186	60.0	8.5	10	41.5	25	17	0.40	2.29	134	7.9
8	54,672	1,557,065	61.2	9.7	10	41.5	25	17	0.40	2.29	134	7.9
9	54,555	1,556,928	60.5	11.1	10	39.4	25	14	0.37	2.29	129	7.0
10	55,297	1,555,940	71.0	15.0	10	46.0	25	21	0.46	2.29	144	9.9
11	55,395	1,556,026	76.0	15.0	10	51.0	25	26	0.51	2.29	150	11.8
12	55,561	1,556,173	72.9	16.0	10	46.9	25	22	0.47	2.29	145	10.3
13	55,710	1,556,310	71.3	16.0	10	45.3	25	20	0.45	2.29	142	9.6
14	55,584	1,556,468	103.7	8.2	10	85.4	25	60	0.71	2.29	150	18.2
15	55,452	1,556,573	106.3	9.0	10	87.3	25	62	0.71	2.29	150	18.6
16	55,330	1,556,728	97.3	9.0	10	78.3	25	53	0.68	2.29	150	16.8
17	55,166	1,556,880	96.5	8.2	10	78.3	25	53	0.68	2.29	150	16.8
18	55,023	1,556,981	90.0	9.5	10	70.5	25	46	0.65	2.29	150	15.3
19	54,796	1,557,015	86.7	10.0	10	66.7	25	42	0.63	2.29	150	14.5
20	54,691	1,556,807	93.7	10.5	10	73.2	25	48	0.66	2.29	150	15.8

TABLE A-1: Zone of Influence Calculation Table

AVERAGE ASSUMPTIONS

GAS GENERATION RATE:	0.064	FT3/LBm*YR
PERMEABILITY FACTOR:	2.681	x 10E-11, FT2
REFUSE DENSITY:	48.15	LBm/FT3
GAS TEMPERATURE:	110	DEG. F
DESIGN MAX. ZOI:	150	FT

Assumes standard conditions are 14.7 psia, 60 Deg. F.

WELL NO.	Well COORDINATES		SURFACE ELEVATION (FASL)	BASE ELEVATION (FASL)	DEPTH OFF BASE (FT)	WELL DEPTH (FT)	LENGTH OF PIPE		(Hs/Ht) RATIO	APPLIED VACUUM (in WC)	ZOI (FT)	GAS FLOW (SCFM)
	NORTH	EAST					SOLID (FT)	SLOTTED (FT)				
21	54,554	1,556,779	63.8	11.7	10	42.1	25	17	0.41	2.29	136	8.2
22	54,632	1,556,559	60.6	12.1	10	38.5	25	13	0.35	2.29	126	6.6
23	54,766	1,556,364	60.8	11.5	10	39.4	25	14	0.37	2.29	129	7.0
24	54,924	1,556,201	59.1	11.8	10	37.2	25	12	0.33	2.29	122	6.0
25	55,120	1,556,064	63.3	12.5	10	40.8	25	16	0.39	2.29	132	7.6
26	55,273	1,556,179	114.4	10.8	10	93.6	20	74	0.79	1.70	150	21.2
27	55,432	1,556,320	119.1	9.3	10	99.7	20	80	0.80	1.70	150	22.6
28	55,264	1,556,432	119.7	9.4	10	100.3	20	80	0.80	1.70	150	22.7
29	55,146	1,556,567	120.0	9.7	10	100.3	20	80	0.80	1.70	150	22.7
30	55,009	1,556,697	119.9	10.0	10	99.9	20	80	0.80	1.70	150	22.6
31	54,910	1,556,848	119.1	10.3	10	98.8	20	79	0.80	1.70	150	22.4
32	54,793	1,556,606	102.7	11.4	10	81.3	20	61	0.75	1.70	150	18.5
33	54,957	1,556,455	113.2	11.3	10	91.9	20	72	0.78	1.70	150	20.8
34	55,113	1,556,296	112.7	10.8	10	91.9	20	72	0.78	1.70	150	20.8
35	54,708	1,555,929	38.2	5.0	10	23.2	10	13	0.57	0.53	77	2.8
36	54,291	1,556,402	33.0	5.0	10	18.0	10	8	0.44	0.53	68	1.9
37	54,166	1,556,267	33.9	5.0	10	18.9	10	9	0.47	0.53	70	2.1
38	54,113	1,556,132	37.6	5.0	10	22.6	10	13	0.56	0.53	76	2.7
39	54,027	1,555,934	39.9	5.0	10	24.9	10	15	0.60	0.53	79	3.2
40	54,047	1,555,720	42.1	5.0	10	27.1	20	7	0.26	1.70	94	4.7
41	54,195	1,555,573	43.2	5.0	10	28.2	20	8	0.29	1.70	99	5.4
42	54,350	1,555,408	42.5	5.0	10	27.5	20	7	0.27	1.70	96	5.0

TABLE A-1: Zone of Influence Calculation Table

AVERAGE ASSUMPTIONS

GAS GENERATION RATE: 0.064 FT3/LBm*YR

PERMEABILITY FACTOR: 2.681 x 10E-11, FT2

REFUSE DENSITY: 48.15 LBm/FT3

GAS TEMPERATURE: 110 DEG. F

DESIGN MAX. ZOI: 150 FT

Assumes standard conditions are 14.7 psia, 60 Deg. F.

WELL NO.	Well COORDINATES		SURFACE ELEVATION (FASL)	BASE ELEVATION (FASL)	DEPTH OFF BASE (FT)	WELL DEPTH (FT)	LENGTH OF PIPE		(Hs/Ht) RATIO	APPLIED VACUUM (in WC)	ZOI (FT)	GAS FLOW (SCFM)
	NORTH	EAST					SOLID (FT)	SLOTTED (FT)				
43	54,543	1,555,316	42.5	5.0	10	27.5	20	7	0.27	1.70	96	5.0
44	54,708	1,555,456	38.3	5.0	10	23.3	10	13	0.57	0.53	77	2.9
45	54,868	1,555,611	34.1	5.0	10	19.1	10	9	0.48	0.53	71	2.1
46	54,745	1,555,675	36.7	5.0	10	21.7	10	12	0.54	0.53	75	2.6
47	54,538	1,555,845	44.4	5.0	10	29.4	20	9	0.32	1.70	104	6.1
48	54,467	1,555,982	42.0	5.0	10	27.0	20	7	0.26	1.70	93	4.7
49	54,475	1,556,002	37.4	5.0	10	22.4	10	12	0.55	0.53	76	2.7
50	54,188	1,555,914	41.9	5.0	10	26.9	20	7	0.26	1.70	93	4.6
51	54,230	1,555,756	44.0	5.0	10	29.0	20	9	0.31	1.70	102	5.9
52	54,374	1,555,578	46.1	5.0	10	31.1	20	11	0.36	1.70	110	7.2
53	54,537	1,555,475	46.4	5.0	10	31.4	20	11	0.36	1.70	111	7.3
54	54,616	1,555,600	43.4	5.0	10	28.4	20	8	0.30	1.70	100	5.5
55	54,461	1,555,735	47.2	5.0	10	32.2	20	12	0.38	1.70	113	7.8
56	54,360	1,555,894	43.5	5.0	10	28.5	20	8	0.30	1.70	100	5.6
57	54,266	1,556,068	39.7	5.0	10	24.7	10	15	0.59	0.53	79	3.1

General Assumptions for Zone of Influence Calculation

The careful formulation of assumptions is critical and requires some knowledge of the landfill's characteristics.

Gas Generation Rate:

Landfill gas is the by-product of the anaerobic decomposition of organic material disposed of in a landfill, by methanogenic (methane producing) bacteria. Landfill gas production is assumed to have a first order reaction rate and is dependent upon the following:

- age of the landfill
- types of waste received
- location (i.e., climate and precipitation)
- moisture conditions within the refuse
- landfill cover materials and thicknesses

An AP-42 “k” value of 0.02 $year^{-1}$ will be used. To convert this to English units for use in the ZOI calculation program, the k value must be multiplied by the theoretical yield. The theoretical yield from AP-42 is assumed to be 100 m^3 methane/Mg waste, which converts to 3.2 ft^3/lb waste. The gas generation rate is therefore 0.064 ft^3 LFG/lb refuse/year.

Permeability Factor:

Permeability is defined as a measure of the ability of a porous media to transmit fluids. While the permeability of refuse within a landfill can vary greatly, it is assumed to be a constant for ease of calculation. A reasonable absolute permeability value for refuse is 2.68×10^{-11} square feet (ft^2) based on the EPA’s Landfill Hydrologic Evaluation Landfill Performance (HELP) model. This number was calculated by applying Darcy's Law for Linear Compressible Fluid Flow to the movement of landfill gas through refuse and assuming the following:

1. Steady state flow conditions exist.
2. The pore space of the refuse is 100 percent saturated with the flowing fluid (landfill gas).
3. The viscosity of the flowing fluid is constant.
4. Isothermal conditions in the refuse prevail.
5. Flow is laminar, horizontal and linear since refuse grain size is relatively small and the velocity of fluid flow is low.

Refuse Density:

Refuse density is a function of the types of waste received and the degree of compaction at the landfill site. A refuse density of 1300 lbs/yd^3 will be used for the calculations for the facility based on average historical densities measured at the site.

Gas Temperature:

The temperatures within a landfill can influence the movement of landfill gas in two ways. First, since landfill gas is a compressible fluid, its viscosity and flow characteristics must be corrected to standard temperature and pressure conditions prior to using the Darcy Equation for radial fluid flow.

Secondly, a landfill's interior temperature can affect the rate at which landfill gas is generated since different types of bacteria are present at different temperatures. Methanogens (or methane producing bacteria) that generate landfill gas at temperatures below 110^{o}F are known as mesophilic bacteria, while those that generate gas at temperatures in excess of 110^{o}F are called thermophilic bacteria. Although both types of bacteria produce approximately the same quality of gas, the gas generation rate is optimized in the thermophilic range.

Average Cover Depth:

The average thickness of final cover is subtracted from the refuse depth available for gas production. Soil is inert and will not contribute to the generation of landfill gas.

Maximum Zone of Influence:

As noted in the prior discussion of the Darcy ZOI, a maximum of 150 feet was utilized in the design of the gas extraction system. This provides a conservative spacing and ensures that all new extraction wells are placed no more than 300 feet apart.

Average Overlap Factor:

It is desirable to achieve a certain degree of overlap of the circular ZOIs. The overlap provides a factor of safety to the gas control system design. If field conditions prevent gas from moving towards a particular well, an overlap helps ensure that the gas can travel to more than one collection point.

The target range of overlap values is approximately 10 to 15 percent, unless the designer requires a denser well spacing. The overlap value used for the facility’s proposed well spacing is approximately 10%.

Appendix A-2: LandGEM Modeling Results

LandGEM

Landfill Gas Emissions Model

Version 3.02

U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory (NRMRL)
and
Clean Air Technology Center (CATC)
Research Triangle Park, North Carolina

May 2005

Summary Report

Landfill Name or Identifier: Kekaha Landfill

Date: Thursday, February 5, 2015

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^{n} \sum_{j=0.1}^{1} kL_o \left(\frac{M_i}{10} \right) e^{-kt_{ij}}$$

Where,

Q_{CH4} = annual methane generation in the year of the calculation (*m^3/year*)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate (*$year^{-1}$*)

L_o = potential methane generation capacity (*m^3/Mg*)

M_i = mass of waste accepted in the i^{th} year (*Mg*)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at http://www.epa.gov/ttnatw01/landfill/landflpg.html.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for convential landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	**1985**
Landfill Closure Year (with 80-year limit)	**2019**

Actual Closure Year (without limit)	***2019***	
Have Model Calculate Closure Year?	**No**	
Waste Design Capacity		*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.020**	*year^{-1}*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**595**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	**Waste Accepted**		**Waste-In-Place**	
	(Mg/year)	***(short tons/year)***	***(Mg)***	***(short tons)***
1985	35,533	39,086	0	0
1986	72,959	80,255	35,533	39,086
1987	72,959	80,255	108,492	119,341
1988	72,959	80,255	181,451	199,596
1989	72,959	80,255	254,410	279,851
1990	72,959	80,255	327,369	360,106
1991	72,959	80,255	400,328	440,361
1992	72,959	80,255	473,287	520,616
1993	100,492	110,541	546,246	600,871
1994	78,035	85,838	646,738	711,412

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	***(short tons/year)***	***(Mg)***	***(short tons)***
1995	114,275	125,703	724,773	797,250
1996	196,973	216,670	839,048	922,953
1997	84,825	93,307	1,036,021	1,139,623
1998	58,409	64,250	1,120,845	1,232,930
1999	61,445	67,590	1,179,255	1,297,180
2000	66,207	72,828	1,240,700	1,364,770
2001	70,147	77,162	1,306,907	1,437,598
2002	67,908	74,699	1,377,055	1,514,760
2003	73,693	81,062	1,444,962	1,589,459
2004	78,605	86,465	1,518,656	1,670,521
2005	81,054	89,160	1,597,260	1,756,986
2006	82,043	90,247	1,678,314	1,846,146
2007	81,922	90,114	1,760,357	1,936,393
2008	79,307	87,237	1,842,279	2,026,507
2009	71,343	78,477	1,921,586	2,113,744
2010	63,404	69,744	1,992,928	2,192,221
2011	64,543	70,997	2,056,332	2,261,965
2012	64,080	70,488	2,120,875	2,332,962
2013	74,545	82,000	2,184,955	2,403,450
2014	74,545	82,000	2,259,500	2,485,450
2015	74,545	82,000	2,334,046	2,567,450
2016	74,545	82,000	2,408,591	2,649,450
2017	74,545	82,000	2,483,136	2,731,450
2018	74,545	82,000	2,557,682	2,813,450
2019	73,423	80,765	2,632,227	2,895,450
2020	0	0	2,705,650	2,976,215

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1985	0	0	0	0	0	0
1986	1.759E+02	1.409E+05	9.464E+00	4.699E+01	7.043E+04	4.732E+00
1987	5.336E+02	4.273E+05	2.871E+01	1.425E+02	2.136E+05	1.436E+01
1988	8.842E+02	7.081E+05	4.757E+01	2.362E+02	3.540E+05	2.379E+01
1989	1.228E+03	9.833E+05	6.607E+01	3.280E+02	4.916E+05	3.303E+01
1990	1.565E+03	1.253E+06	8.419E+01	4.180E+02	6.265E+05	4.210E+01
1991	1.895E+03	1.517E+06	1.020E+02	5.062E+02	7.587E+05	5.098E+01
1992	2.219E+03	1.777E+06	1.194E+02	5.926E+02	8.883E+05	5.969E+01
1993	2.536E+03	2.031E+06	1.364E+02	6.774E+02	1.015E+06	6.822E+01
1994	2.983E+03	2.389E+06	1.605E+02	7.969E+02	1.194E+06	8.025E+01
1995	3.310E+03	2.651E+06	1.781E+02	8.843E+02	1.325E+06	8.906E+01
1996	3.811E+03	3.051E+06	2.050E+02	1.018E+03	1.526E+06	1.025E+02
1997	4.710E+03	3.772E+06	2.534E+02	1.258E+03	1.886E+06	1.267E+02
1998	5.037E+03	4.033E+06	2.710E+02	1.345E+03	2.017E+06	1.355E+02
1999	5.226E+03	4.185E+06	2.812E+02	1.396E+03	2.093E+06	1.406E+02
2000	5.427E+03	4.346E+06	2.920E+02	1.450E+03	2.173E+06	1.460E+02
2001	5.647E+03	4.522E+06	3.038E+02	1.508E+03	2.261E+06	1.519E+02
2002	5.883E+03	4.711E+06	3.165E+02	1.571E+03	2.355E+06	1.583E+02
2003	6.103E+03	4.887E+06	3.283E+02	1.630E+03	2.443E+06	1.642E+02
2004	6.347E+03	5.082E+06	3.415E+02	1.695E+03	2.541E+06	1.707E+02
2005	6.610E+03	5.293E+06	3.556E+02	1.766E+03	2.647E+06	1.778E+02
2006	6.880E+03	5.510E+06	3.702E+02	1.838E+03	2.755E+06	1.851E+02
2007	7.150E+03	5.726E+06	3.847E+02	1.910E+03	2.863E+06	1.924E+02
2008	7.414E+03	5.937E+06	3.989E+02	1.980E+03	2.969E+06	1.995E+02
2009	7.660E+03	6.134E+06	4.121E+02	2.046E+03	3.067E+06	2.061E+02

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2010	7.862E+03	6.295E+06	4.230E+02	2.100E+03	3.148E+06	2.115E+02
2011	8.020E+03	6.422E+06	4.315E+02	2.142E+03	3.211E+06	2.157E+02
2012	8.181E+03	6.551E+06	4.401E+02	2.185E+03	3.275E+06	2.201E+02
2013	8.336E+03	6.675E+06	4.485E+02	2.227E+03	3.337E+06	2.242E+02
2014	8.540E+03	6.838E+06	4.595E+02	2.281E+03	3.419E+06	2.297E+02
2015	8.740E+03	6.998E+06	4.702E+02	2.334E+03	3.499E+06	2.351E+02
2016	8.936E+03	7.155E+06	4.808E+02	2.387E+03	3.578E+06	2.404E+02
2017	9.128E+03	7.309E+06	4.911E+02	2.438E+03	3.655E+06	2.456E+02
2018	9.316E+03	7.460E+06	5.012E+02	2.488E+03	3.730E+06	2.506E+02
2019	9.501E+03	7.608E+06	5.112E+02	2.538E+03	3.804E+06	2.556E+02
2020	9.676E+03	7.748E+06	5.206E+02	2.585E+03	3.874E+06	2.603E+02
2021	9.484E+03	7.595E+06	5.103E+02	2.533E+03	3.797E+06	2.551E+02
2022	9.297E+03	7.444E+06	5.002E+02	2.483E+03	3.722E+06	2.501E+02
2023	9.113E+03	7.297E+06	4.903E+02	2.434E+03	3.648E+06	2.451E+02
2024	8.932E+03	7.152E+06	4.806E+02	2.386E+03	3.576E+06	2.403E+02
2025	8.755E+03	7.011E+06	4.711E+02	2.339E+03	3.505E+06	2.355E+02
2026	8.582E+03	6.872E+06	4.617E+02	2.292E+03	3.436E+06	2.309E+02
2027	8.412E+03	6.736E+06	4.526E+02	2.247E+03	3.368E+06	2.263E+02
2028	8.245E+03	6.603E+06	4.436E+02	2.202E+03	3.301E+06	2.218E+02
2029	8.082E+03	6.472E+06	4.348E+02	2.159E+03	3.236E+06	2.174E+02
2030	7.922E+03	6.344E+06	4.262E+02	2.116E+03	3.172E+06	2.131E+02

Results (Continued)

Year	Carbon dioxide		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*
1985	0	0	0
1986	1.289E+02	7.043E+04	4.732E+00
1987	3.911E+02	2.136E+05	1.436E+01
1988	6.481E+02	3.540E+05	2.379E+01
1989	8.999E+02	4.916E+05	3.303E+01
1990	1.147E+03	6.265E+05	4.210E+01
1991	1.389E+03	7.587E+05	5.098E+01
1992	1.626E+03	8.883E+05	5.969E+01
1993	1.859E+03	1.015E+06	6.822E+01
1994	2.186E+03	1.194E+06	8.025E+01
1995	2.426E+03	1.325E+06	8.906E+01
1996	2.793E+03	1.526E+06	1.025E+02
1997	3.452E+03	1.886E+06	1.267E+02
1998	3.692E+03	2.017E+06	1.355E+02
1999	3.830E+03	2.093E+06	1.406E+02
2000	3.977E+03	2.173E+06	1.460E+02
2001	4.139E+03	2.261E+06	1.519E+02
2002	4.311E+03	2.355E+06	1.583E+02
2003	4.473E+03	2.443E+06	1.642E+02
2004	4.651E+03	2.541E+06	1.707E+02
2005	4.844E+03	2.647E+06	1.778E+02
2006	5.043E+03	2.755E+06	1.851E+02
2007	5.240E+03	2.863E+06	1.924E+02
2008	5.434E+03	2.969E+06	1.995E+02
2009	5.614E+03	3.067E+06	2.061E+02

Results (Continued)

Year	Carbon dioxide		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*
2010	5.762E+03	3.148E+06	2.115E+02
2011	5.878E+03	3.211E+06	2.157E+02
2012	5.995E+03	3.275E+06	2.201E+02
2013	6.109E+03	3.337E+06	2.242E+02
2014	6.259E+03	3.419E+06	2.297E+02
2015	6.405E+03	3.499E+06	2.351E+02
2016	6.549E+03	3.578E+06	2.404E+02
2017	6.690E+03	3.655E+06	2.456E+02
2018	6.828E+03	3.730E+06	2.506E+02
2019	6.963E+03	3.804E+06	2.556E+02
2020	7.091E+03	3.874E+06	2.603E+02
2021	6.951E+03	3.797E+06	2.551E+02
2022	6.813E+03	3.722E+06	2.501E+02
2023	6.679E+03	3.648E+06	2.451E+02
2024	6.546E+03	3.576E+06	2.403E+02
2025	6.417E+03	3.505E+06	2.355E+02
2026	6.290E+03	3.436E+06	2.309E+02
2027	6.165E+03	3.368E+06	2.263E+02
2028	6.043E+03	3.301E+06	2.218E+02
2029	5.923E+03	3.236E+06	2.174E+02
2030	5.806E+03	3.172E+06	2.131E+02

Appendix A-3: Condensate Calculation Results

CONDENSATE GENERATION CALCULATIONS/MANAGEMENT

Gas condensate is produced during the collection and transportation of landfill gas. The condensate must be removed at engineered low points in the extraction system header piping, or it will eventually fill up the header lines and impede gas flow. Calculations for maximum condensate generation rates and condensate management techniques are provided in the following subsections. A discussion of condensate and leachate management is required by 40 CFR 60.759.

CONDENSATE GENERATION

Landfill gas is approximately one-hundred percent saturated with water vapor. Liquid condensate is generated when landfill gas experiences a temperature and/or pressure decrease when extracted, and the saturated water vapor condenses out of the vapor state. All condensate generated from the system must be collected and managed. The header collection system alignment is designed to utilize the vertical relief provided by the landfill contours for gravity flow of condensate.

Procedures for Calculating Condensate Generation

1. Utilize the maximum gas flow rate calculated previously, in cubic feet per minute.

2. Determine a maximum gas temperature. This maximum gas temperature can be measured directly if an existing system is present or must be assumed based on typical mesophilic or thermophilic temperatures published in scientific research journals. A typical maximum gas temperature is assumed to range from 90° F to 131° F based on mesophilic conditions.

3. Estimate a minimum gas temperature. Factors such as local climate, depth of frost line, cover soils, etc., should be considered. If minimum extracted gas temperatures are available, they should be used as a reference.

4. Obtain water vapor content of the landfill gas at specified temperatures from the attached "water vapor content of natural gas at saturation" table. The water vapor contents are given in terms of pounds (lb_M) of water per 1 million cubic feet of gas.

5. The chart is read by finding the desired temperature at the bottom of the chart. Follow the corresponding temperature line to the 14.6 (psia) saturation pressure curve. Read directly across to right or left at intersection of temperature and pressure lines to obtain the value for the water content of the gas.

6. Obtain the water vapor content of the saturated gas at both the minimum and maximum temperatures.

Given: q = maximum anticipated gas flow rate = 521 ft^3/min

$T\ (max)$ = maximum anticipated gas temperature = 131° F

$T\ (min)$ = minimum anticipated gas temperature = 90° F

P = saturation pressure = 14.7 psia

Therefore:

The water vapor content of saturated gas at 131° F and 14.7 psia = 7288 $lb_m/1x10^6\ ft^3$

The water vapor content of saturated gas at 90° F and 14.7 psia = 2049 $lb_m/1x10^6\ ft^3$

At a differential temperature drop of 41° F, 5239 lb_m of water vapor will condense out as liquid per every million cubic feet of gas flow.

Therefore:

[521 ft^3/min] [gal/8.34 lb_m] [5239 $lb_m/1x10^6\ ft^3$] [1,440 min/day] = 471 gal/day

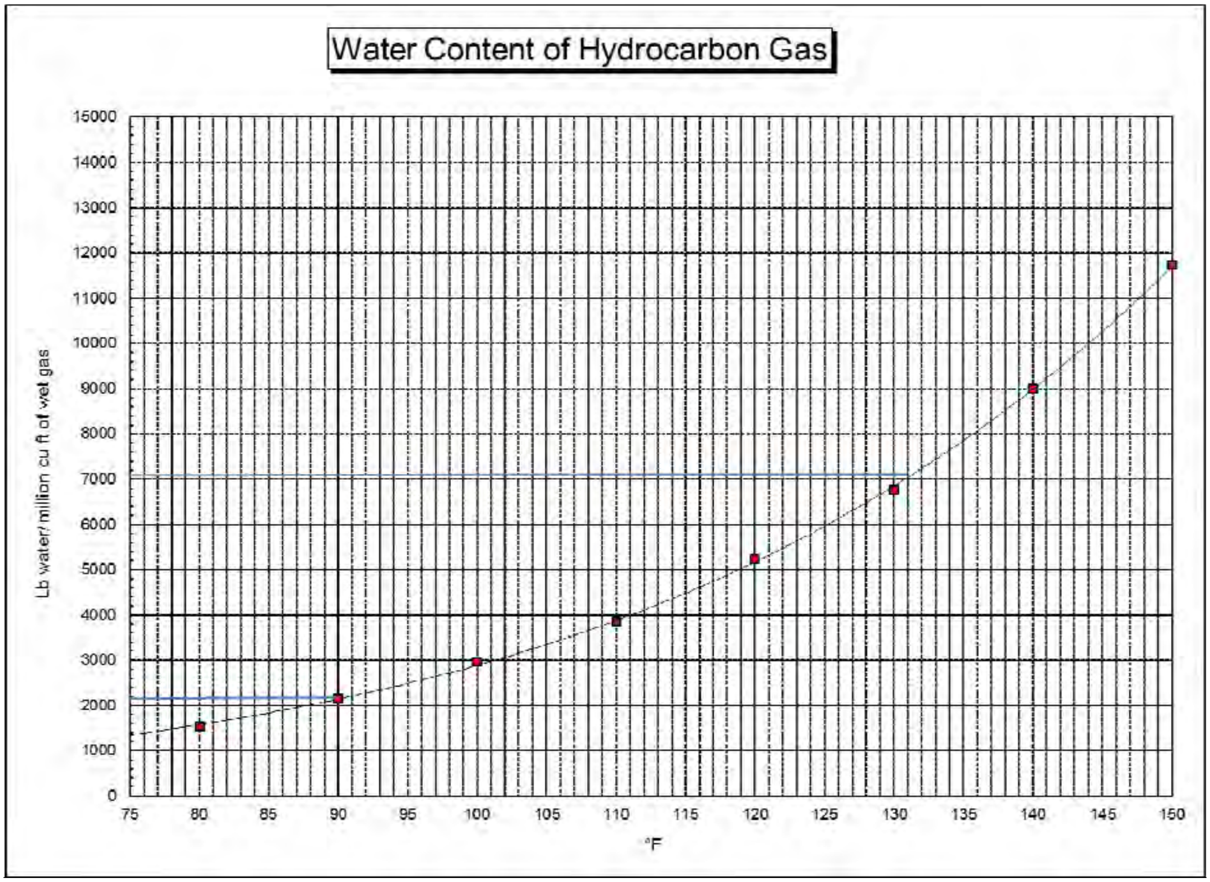
It is anticipated that 471 gal/day would be the maximum volume of condensate generated from the landfill gas management system.

CONDENSATE MANAGEMENT

The gas extraction system at Kekaha Landfill contains engineered low points where gas condensate is separated from landfill gas. Gas condensate is separated by a knockout structure, or drip leg that is then gravity-drained to a leachate wet manhole. Gas condensate is ultimately treated in the same manner as landfill leachate (evaporation).

Water Content Calculation for a Hydrocarbon Gas at 60°F and 14.7 psia

Initial Temperature:	131	°F	7288	lbs water/ mmcf
Final Temperature:	90	°F	2049	lbs water/ mmcf
Water Vapor Condensation:			5239	lbs water/ mmcf
			628	gallons water/ mmcf
Maximum Gas Flow:	749,664	cfd		
Total Daily Condensate Generation:			**471**	gallons water/ day
			0.33	gpm


Water Content of Hydrocarbon Gas
Lb water/ million cu ft of wet gas
°F
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150

Appendix A-4: Header Pipe Sizing Calculations

Header Pipe Sizing

INTRODUCTION

The next step in designing a gas collection system is to lay out a routing for the header line and laterals to connect each of the gas wells into the system, and convey the collected gas to a central location for destruction. After the design engineer has routed the most efficient header system for collecting gas from the extraction wells, the header pipe must be sized appropriately to convey the maximum expected gas flow [40 CFR §60.752(b)(2)(ii)(A)(1)]. Typical design criteria and header construction methods are generally discussed in the following subsections.

The following provides a narrative describing the results of a KYGas® analysis of the proposed landfill gas collection and control system (GCCS) for the facility. The purpose of conducting this analysis was to determine the required piping size for the future system in order to convey the maximum expected gas flow rate.

The KYGas® model was development by the University of Kentucky for performing water and gas distribution flow analyses. The program uses a 2-dimensional model depicting the geometry of the piping system. Once the 2-dimension layout of the system has been entered into the model, the user enters the physical properties of the gas, plus other site-specific parameters for the size and type of pipe, gas flow requirements, and operating pressure conditions to calculate the system gas velocities and pressure distribution.

KYGas® utilizes the Ideal Gas Law for pressure-temperature-density relationships and the Darcy-Weisbach equation for head losses related to uncompressible flow. The program operates under the assumption that all flow in the piping system is steady, one-dimensional, isothermal flow for an ideal gas.

MODEL INPUT DATA

For Kekaha Landfill, the GCCS layout and pipe sizes used in the model are based on the proposed GCCS design included in this plan. High density polyethylene (HDPE) piping having a standard diameter ratio (SDR) rating of 17 was assumed for the inside pipe diameters. Other parameters required for the model include:

- Pipe length
- Roughness within the pipe
- Minor loss coefficient
- LFG operating temperature (assumed to be 110 ºF)
- LFG flow rate into the system at each well or node
- Ratio of specific heats (1.303)
- Specific gravity of the landfill gas (1.036)
- Absolute viscosity of the landfill gas (2.82×10^{-7} lb*sec/ft^2)

The peak landfill gas (LFG) flow rate conditions used in the KY-Gas modeling scenario was derived by the LandGEM Modeling and the ZOI calculations. The AP-42 assumes that a facility can achieve an average collection efficiency of 75%.

The KYGas® model requires the user to specify an operating pressure for each vacuum source used in the analysis. A target vacuum of -40 inches water column gauge ("w.c.) was used during the KYGas® analysis for the blower at the flare station.

The user can start the evaluation of the system once all of the required information is input into the program. This evaluation is an iterative process. Multiple model runs are conducted by adjusting the pipe diameter, until the velocities in the system piping and the vacuum pressure remaining at the furthest node meet design requirements.

The design criteria utilized for the header system is:

- Maximum velocity: 40 feet/second
- Maximum pressure drop: 1 inch per 100 feet of pipe
- Minimum vacuum at any node/well: 10 inches of water column

DESCRIPTION OF KYGAS® MODEL RESULTS

A copy of the KYGas® modeling report is provided after this discussion. Also included are three model-generated layouts of the GCCS. Figure 1 identifies the pipe segment and pipe node names used by the model. These names can be used to reference the information on the model print-out. Figure 2 shows the pipe sizes used, and Figure 3 shows the available vacuum at each well, and the calculated flow rate through each pipe segment for the modeled scenario.

A summary of the simulation is provided, including gas parameters and units of measure. The geometry and operating criteria used in the model is identified, including pipe names, nodes that connect to each pipe segment, pipe lengths and diameters, and pipe roughness.

The next set of pages summarizes the junction "nodes" and their "demand", or the unit flow rate for the quantity of LFG entering the system at that node location. Because the GCCS operates under a negative pressure, the operating flow rates and pressures are entered as negative numbers. Column 3 indicates the LFG extraction flow rate that is introduced to the piping system at that junction location.

The modeling results for each pipe segment are then provided. This includes the calculated LFG flow rate through each pipe segment. A negative number indicates the direction of LFG flow is reversed from the orientation indicated by the pipe nodes. Also shown is the calculated friction loss along the length of pipe segment expressed in inches of water column, the calculated velocity of the LFG flowing through the pipe segment, the density of LFG used in the calculations, and a variable calculated by the model for each pipe segment based on flow rate.

SUMMARY OF LANDFILL KYGAS® RESULTS

The KYGas® results for Kekaha Landfill indicate that all values are well within the specified design criteria. Therefore, the pipe sizing selected meets the NSPS requirement to convey the maximum expected gas flow rate.

Header Slope

The header line is typically sloped at a 3% grade when installed within refuse to provide for gravity drainage of liquid gas condensate and to minimize blockages resulting from differential settlement of the landfill, although certain sections of the proposed header slope in the closed Phase I landfill are at a minimum 1% grade based on existing topography. This will be confirmed by route survey. The header pipe placed outside of refuse limits is sloped a minimum of 1%.

Design Methodology

The optimum diameter of the header pipe is determined after the design engineer has specified the most efficient header system for collecting gas flow from the individual extraction wells. The diameter of each segment of header pipe will vary, depending on the volume of landfill gas it will be expected to convey. The header line that connects the gas wells furthest from the source of vacuum will carry the least amount of gas flow. As the header piping gets closer to the source of vacuum, more and more gas wells will “contribute” flow to the line which necessitates an increase in pipe size.

Header systems usually incorporate “loops” of piping to allow for partial or total loss of header function in one direction without losing gas management system functionality. Therefore, there may be several large diameter lines converging on the source of vacuum from different directions.

Header Construction

The header pipe proposed for installation is HDPE pipe. HDPE pipe is ideal due to its compatibility with landfill gas and waste, its flexibility (if settlement occurs), its long term stability, and its excellent chemical resistance. The pipe is set in a trench, and is surrounded by compatible bedding media.

Control valves are located throughout the collection header network as necessary. The valves can manually shut off the applied vacuum to a particular section of header pipe. This allows portions of the well field to be isolated for monitoring and maintenance purposes.

<u>NSPS Compliance</u>

The header system as described in this section will meet the following requirements listed in 40 CFR 60.759:

- *Gas system expandability & accessibility.* Blind flanges have been incorporated into the design in order to allow for future gas system expansions. In addition, HDPE pipe can be cut and new components fused in place to expand the system easily.
- *Corrosion resistance.* HDPE is resistant to corrosion from landfill gas.
- *Fill settlement.* The flexibility of the material and the modulus of elasticity of HDPE is sufficient to prevent collapse or failure due to settlement
- *Required materials of construction.* The materials of construction are consistent with those specified within the rule.
- *Ability to withstand planned overburden or traffic loads.* The pipe wall thickness and the modulus of elasticity of HDPE is sufficient to prevent collapse due to overburden or traffic loads.

LANDFILL KYGAS® RESULTS

```
* * * * * * * * * * * * * K Y G A S * * * * * * * * * * * * *
*                                                           *
*  Gas Network Analysis Software                            *
*                                                           *
*  CopyRighted by KYPIPE LLC (www.kypipe.com)               *
*  Version: 6.025  10/21/2013                               *
*  Serial #:  8-5537277                                     *
*  Interface:  Classic                                      *
*  Licensed for Pipe2006                                    *
*                                                           *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *

 INPUT DATA FILE NAME FOR THIS SIMULATION  = c:\users\EILLEN~1\desktop\KEKAHA~1\
 2015FE~1\KEKAHA~1.KYP\kekaha20.DAT
 OUTPUT DATA FILE NAME FOR THIS SIMULATION = c:\users\EILLEN~1\desktop\KEKAHA~1\
 2015FE~1\KEKAHA~1.KYP\kekaha20.OT2

 DATE FOR THIS COMPUTER RUN       :  2-06-2015
 START TIME FOR THIS COMPUTER RUN : 10: 9:37:47

 SUMMARY OF DISTRIBUTION SYSTEM CHARACTERISTICS:
 ------------------------------------------------

 NUMBER OF PIPES           =   101
 NUMBER OF JUNCTION NODES  =    99

 UNITS SPECIFIED           = ENGLISH

A CONSTANT DENSITY FLUID IS SPECIFIED - DENSITY =        .08POUNDS/CUBIC FOOT
  ABSOLUTE VISCOSITY                   =   .282E-06 POUND SECONDS/SQUARE FOOT

      USER SPEC. FLOW UNITS (USFU)     = SCF / MIN.
     USER SPEC. PRESSURE UNITS(USPU)  = INCHES OF WATER (GAUGE)
```

```
-------  SUMMARY OF PIPE NETWORK GEOMETRIC AND OPERATING DATA  -------
---------------------------------------------------------------------
    PIPE    NODE    NODE  LENGTH  DIAM.  ROUGHNESS SUM-M PUMP ELEVATION
    NAME     #1      #2  (FT.)  (IN.)  (MILLIFEET) FACT.  ID    CHANGE
------------------------------------------------------------------------
    P-1   Flare      J-2   407.0   11.3      .400      .0   0        .0
   P-10    J-10     GW-8    33.0    4.0      .400      .0   0        .0
  P-100   GW-42    GW-52   174.0    4.0      .400      .0   0        .0
   P-11    J-12     J-10    70.0    5.8      .400      .0   0        .0
   P-12    J-12     J-16   228.0   11.3      .400      .0   0        .0
   P-13    J-13    GW-20   197.0    4.0      .400      .0   0        .0
   P-14    J-13     GW-9    22.0    4.0      .400      .0   0        .0
   P-15    J-16     J-13    98.0    5.8      .400      .0   0        .0
   P-16    J-16     J-19   123.0   11.3      .400      .0   0        .0
   P-17    J-18    GW-21    97.0    4.0      .400      .0   0        .0
   P-18    J-18     J-20   229.0    7.6      .400      .0   0        .0
   P-19    J-20     J-30    44.0    7.6      .400      .0   0        .0
    P-2     J-2     J-38    36.0   11.3      .400      .0   0        .0
   P-20    J-20    GW-22    48.0    4.0      .400      .0   0        .0
   P-21    J-19     J-18   205.0    7.6      .400      .0   0        .0
   P-22    J-19     J-24   398.0    5.8      .400      .0   0        .0
   P-23    J-24    GW-36   191.0    4.0      .400      .0   0        .0
   P-24    J-24     J-25   230.0    5.8      .400      .0   0        .0
   P-25    J-25    GW-37   103.0    5.8      .400      .0   0        .0
   P-26    J-25     J-93   198.0    5.8      .400      .0   0        .0
   P-27   GW-38    GW-57   166.0    4.0      .400      .0   0        .0
   P-28   GW-37    GW-49   186.0    4.0      .400      .0   0        .0
   P-29    J-30    GW-32   209.0    4.0      .400      .0   0        .0
    P-3     J-2     J-97    72.0   11.3      .400      .0   0        .0
   P-30    J-30     J-32   197.0    7.6      .400      .0   0        .0
   P-31    J-32     J-35    71.0    7.6      .400      .0   0        .0
   P-32    J-32    GW-23    22.0    4.0      .400      .0   0        .0
   P-33   GW-48    GW-47   169.0    4.0      .400      .0   0        .0
   P-34    J-35     J-69   163.0    7.6      .400      .0   0        .0
   P-35    J-35    GW-33   223.0    4.0      .400      .0   0        .0
   P-36   GW-17    GW-30   239.0    4.0      .400      .0   0        .0
   P-37    J-38    GW-17   241.0    5.8      .400      .0   0        .0
   P-38    J-38     J-39   153.0   11.3      .400      .0   0        .0
   P-39    J-39     GW-4    82.0    4.0      .400      .0   0        .0
    P-4    GW-6     J-95   105.0    5.8      .400      .0   0        .0
   P-40    J-39     J-42    55.0   11.3      .400      .0   0        .0
   P-41    J-42     J-46   172.0   11.3      .400      .0   0        .0
   P-42    J-42     J-43   218.0    5.8      .400      .0   0        .0
   P-43    J-43    GW-16    28.0    4.0      .400      .0   0        .0
   P-44    J-43    GW-29   243.0    4.0      .400      .0   0        .0
   P-45    J-46     GW-3    68.0    4.0      .400      .0   0        .0
   P-46    J-46     J-49    32.0   11.3      .400      .0   0        .0
   P-47    GW-2    GW-14   135.0    4.0      .400      .0   0        .0
   P-48    J-49     J-51   209.0   11.3      .400      .0   0        .0
   P-49    J-49    GW-15   227.0    4.0      .400      .0   0        .0
    P-5     J-6     GW-6   101.0    7.6      .400      .0   0        .0
   P-50    J-51     GW-2    62.0    5.8      .400      .0   0        .0
   P-51    J-51     J-52   228.0   11.3      .400      .0   0        .0
   P-52    J-52     GW-1    44.0    4.0      .400      .0   0        .0
   P-53    J-52     J-54   215.0   11.3      .400      .0   0        .0
   P-54    J-54    GW-13   107.0    4.0      .400      .0   0        .0
   P-55    J-54     J-58   205.0   11.3      .400      .0   0        .0
   P-56   GW-12    GW-27   194.0    4.0      .400      .0   0        .0
   P-57    J-58    GW-12   131.0    5.8      .400      .0   0        .0
   P-58    J-58     J-59   228.0   11.3      .400      .0   0        .0
   P-59    J-59    GW-11   163.0    4.0      .400      .0   0        .0
    P-6     J-6      J-8   210.0   11.3      .400      .0   0        .0
   P-60    J-59     J-70   245.0   11.3      .400      .0   0        .0
   P-61    J-62    GW-10   111.0    4.0      .400      .0   0        .0
   P-62    J-62     J-65   218.0    7.6      .400      .0   0        .0
   P-63   GW-25    GW-26   192.0    4.0      .400      .0   0        .0
   P-64    J-65    GW-25    72.0    5.8      .400      .0   0        .0
   P-65    J-65     J-68   103.0    7.6      .400      .0   0        .0
   P-66   GW-34    GW-28   203.0    4.0      .400      .0   0        .0
   P-67    J-68    GW-34   236.0    5.8      .400      .0   0        .0
   P-68    J-69    GW-24    28.0    4.0      .400      .0   0        .0
```

```
   ---------------------------------------------------------------------
    PIPE    NODE    NODE  LENGTH  DIAM.  ROUGHNESS SUM-M PUMP ELEVATION
    NAME     #1      #2  (FT.)  (IN.)  (MILLIFEET) FACT.  ID    CHANGE
------------------------------------------------------------------------
   P-69    J-68    J-69   118.0    7.6       .400      .0   0        .0
    P-7     J-8    GW-7    98.0    4.0       .400      .0   0        .0
   P-70    J-70    J-62   149.0    7.6       .400      .0   0        .0
   P-71    J-70    J-72   425.0    5.8       .400      .0   0        .0
   P-72    J-72   GW-45   210.0    5.8       .400      .0   0        .0
   P-73    J-72    J-77   203.0    5.8       .400      .0   0        .0

   P-74   GW-45   GW-46   139.0    4.0       .400      .0   0        .0
   P-75   GW-46   GW-35   130.0    4.0       .400      .0   0        .0
   P-76   GW-44   GW-54   172.0    4.0       .400      .0   0        .0
   P-77    J-77   GW-44   191.0    4.0       .400      .0   0        .0
   P-78    J-77    J-78   368.0    5.8       .400      .0   0        .0
   P-79    J-78    J-79   424.0    5.8       .400      .0   0        .0
    P-8     J-8    J-12   294.0   11.3       .400      .0   0        .0
   P-80    J-78   GW-43   180.0    4.0       .400      .0   0        .0
   P-81   GW-43   GW-53   159.0    4.0       .400      .0   0        .0
   P-82    J-79   GW-42   134.0    4.0       .400      .0   0        .0
   P-83    J-79    J-83   231.0    5.8       .400      .0   0        .0
   P-84    J-83   GW-41    87.0    4.0       .400      .0   0        .0
   P-85    J-83    J-88   200.0    5.8       .400      .0   0        .0
   P-86   GW-51   GW-55   232.0    4.0       .400      .0   0        .0
   P-87   GW-40   GW-51   187.0    4.0       .400      .0   0        .0
   P-88    J-88   GW-40    35.0    5.8       .400      .0   0        .0
   P-89    J-88    J-92   256.0    5.8       .400      .0   0        .0
    P-9    J-10   GW-19   145.0    4.0       .400      .0   0        .0
   P-90   GW-50   GW-56   174.0    4.0       .400      .0   0        .0
   P-91   GW-39   GW-50   162.0    4.0       .400      .0   0        .0
   P-92    J-92   GW-39    38.0    5.8       .400      .0   0        .0
   P-93    J-93   GW-38    74.0    4.0       .400      .0   0        .0
   P-94    J-92    J-93   214.0    5.8       .400      .0   0        .0
   P-95   GW-49   GW-48   244.0    4.0       .400      .0   0        .0
   P-96    J-95   GW-18    71.0    4.0       .400      .0   0        .0
   P-97    J-95   GW-31   207.0    4.0       .400      .0   0        .0
   P-98    J-97     J-6   244.0   11.3       .400      .0   0        .0
   P-99    J-97    GW-5   153.0    4.0       .400      .0   0        .0

---------------------------------------------------------------
JUNCTION           NODE           ELEV       DEMAND     FPN
  NAME             TITLE                     (USFU)     PRESSURE
---------------------------------------------------------------
    Flare                          .00        .00     -40.00
     GW-1                          .00      -6.40
    GW-10                          .00      -9.50
    GW-11                          .00     -11.60
    GW-12                          .00     -10.30
    GW-13                          .00      -9.60
    GW-14                          .00     -18.20
    GW-15                          .00     -18.60
    GW-16                          .00     -16.80
    GW-17                          .00     -16.80
    GW-18                          .00     -13.90
    GW-19                          .00     -14.50
     GW-2                          .00     -10.70
    GW-20                          .00     -15.80
    GW-21                          .00      -8.20
    GW-22                          .00      -6.60
    GW-23                          .00      -7.00
    GW-24                          .00      -6.00
    GW-25                          .00      -7.60
    GW-26                          .00     -21.20
    GW-27                          .00     -22.60
    GW-28                          .00     -22.70
    GW-29                          .00     -22.70
     GW-3                          .00      -8.00
    GW-30                          .00     -22.60
    GW-31                          .00     -22.40
    GW-32                          .00     -18.50
```

```
 ---------------------------------------------------------------
JUNCTION           NODE           ELEV      DEMAND       FPN
  NAME             TITLE                    (USFU)     PRESSURE
---------------------------------------------------------------
    GW-33                          .00     -20.80
    GW-34                          .00     -20.80
    GW-35                          .00      -2.80
    GW-36                          .00      -1.90
    GW-37                          .00      -2.10
    GW-38                          .00      -2.70
    GW-39                          .00      -3.20
     GW-4                          .00      -6.80
    GW-40                          .00      -4.70
    GW-41                          .00      -5.40
    GW-42                          .00      -5.00
    GW-43                          .00      -5.00
    GW-44                          .00      -2.90
    GW-45                          .00      -2.10
    GW-46                          .00      -2.60
    GW-47                          .00      -6.10
    GW-48                          .00      -4.70
    GW-49                          .00      -2.70
     GW-5                          .00      -7.50
    GW-50                          .00      -4.60
    GW-51                          .00      -5.90
    GW-52                          .00      -7.20
    GW-53                          .00      -7.30
    GW-54                          .00      -5.50
    GW-55                          .00      -7.80
    GW-56                          .00      -5.60
    GW-57                          .00      -3.10
     GW-6                          .00      -6.30
     GW-7                          .00      -7.70
     GW-8                          .00      -7.90
     GW-9                          .00      -7.00
     J-10                          .00        .00
     J-12                          .00        .00
     J-13                          .00        .00
     J-16                          .00        .00
     J-18                          .00        .00
     J-19                          .00        .00
      J-2                          .00        .00
     J-20                          .00        .00
     J-24                          .00        .00
     J-25                          .00        .00
     J-30                          .00        .00
     J-32                          .00        .00
     J-35                          .00        .00
     J-38                          .00        .00
     J-39                          .00        .00
     J-42                          .00        .00
     J-43                          .00        .00
     J-46                          .00        .00
     J-49                          .00        .00
     J-51                          .00        .00
     J-52                          .00        .00
     J-54                          .00        .00
     J-58                          .00        .00
     J-59                          .00        .00
      J-6                          .00        .00
     J-62                          .00        .00
     J-65                          .00        .00
     J-68                          .00        .00
     J-69                          .00        .00
     J-70                          .00        .00
     J-72                          .00        .00
     J-77                          .00        .00
     J-78                          .00        .00
     J-79                          .00        .00
      J-8                          .00        .00
   ---------------------------------------------------------------
```

```
JUNCTION           NODE           ELEV      DEMAND       FPN
  NAME             TITLE                    (USFU)     PRESSURE
---------------------------------------------------------------
     J-83                          .00        .00
     J-88                          .00        .00
     J-92                          .00        .00
     J-93                          .00        .00
     J-95                          .00        .00
     J-97                          .00        .00

================================================================================
Set =  0

====================  RESULTS FOR THIS SIMULATION FOLLOW  =================

 Solution was obtained in   10 trials
  Flow Accuracy =  .3657E-02[ <  .500E-02]
    RV Accuracy =  .0000E+00[ <  .100E-02]

--------------------------------------------------------------------------------
     PIPE     NODE     NODE        FLOW     LOSS VELOCITY DENSITY FRICTION AREA
      NO.      #1       #2       (USFU)   (USPU)   (FT/S)  (#/CF ) FACTOR  RATIO
--------------------------------------------------------------------------------
      P-1    Flare      J-2    -554.500      .36    13.65     .075   .0199
     P-10     J-10     GW-8      -7.900      .00     1.56     .075   .0411
    P-100    GW-42    GW-52      -7.200      .01     1.42     .075   .0423
     P-11     J-12     J-10     -22.400      .00     2.04     .075   .0340
     P-12     J-12     J-16    -160.991      .02     3.96     .075   .0245
     P-13     J-13    GW-20     -15.800      .04     3.12     .075   .0343
     P-14     J-13     GW-9      -7.000      .00     1.38     .075   .0426
     P-15     J-16     J-13     -22.800      .01     2.08     .075   .0338
     P-16     J-16     J-19    -138.191      .01     3.40     .075   .0253
     P-17     J-18    GW-21      -8.200      .01     1.62     .075   .0407
     P-18     J-18     J-20     -75.479      .04     4.06     .075   .0269
     P-19     J-20     J-30     -68.879      .01     3.70     .075   .0275
      P-2      J-2     J-38    -313.309      .01     7.71     .075   .0217
     P-20     J-20    GW-22      -6.600      .00     1.30     .075   .0434
     P-21     J-19     J-18     -83.679      .04     4.50     .075   .0264
     P-22     J-19     J-24     -54.512      .13     4.97     .075   .0277
     P-23     J-24    GW-36      -1.900      .00      .38     .075   .0392
     P-24     J-24     J-25     -52.612      .07     4.80     .075   .0279
     P-25     J-25    GW-37     -15.600      .00     1.42     .075   .0374
     P-26     J-25     J-93     -37.012      .03     3.38     .075   .0301
     P-27    GW-38    GW-57      -3.100      .00      .61     .075   .0244
     P-28    GW-37    GW-49     -13.500      .03     2.67     .075   .0356
     P-29     J-30    GW-32     -18.500      .06     3.66     .075   .0330
      P-3      J-2     J-97    -241.191      .01     5.94     .075   .0227
     P-30     J-30     J-32     -50.379      .02     2.71     .075   .0294
     P-31     J-32     J-35     -43.379      .00     2.33     .075   .0305
     P-32     J-32    GW-23      -7.000      .00     1.38     .075   .0426
     P-33    GW-48    GW-47      -6.100      .01     1.21     .075   .0444
     P-34     J-35     J-69     -22.579      .00     1.21     .075   .0360
     P-35     J-35    GW-33     -20.800      .08     4.11     .075   .0321
     P-36    GW-17    GW-30     -22.600      .10     4.47     .075   .0315
     P-37     J-38    GW-17     -39.400      .04     3.59     .075   .0297
     P-38     J-38     J-39    -273.909      .04     6.74     .075   .0222
     P-39     J-39     GW-4      -6.800      .00     1.34     .075   .0430
      P-4     GW-6     J-95     -36.300      .02     3.31     .075   .0303
     P-40     J-39     J-42    -267.109      .01     6.58     .075   .0223
     P-41     J-42     J-46    -227.609      .03     5.60     .075   .0229
     P-42     J-42     J-43     -39.500      .04     3.60     .075   .0297
     P-43     J-43    GW-16     -16.800      .01     3.32     .075   .0338
     P-44     J-43    GW-29     -22.700      .10     4.49     .075   .0315
     P-45     J-46     GW-3      -8.000      .00     1.58     .075   .0410
     P-46     J-46     J-49    -219.609      .01     5.41     .075   .0231
     P-47     GW-2    GW-14     -18.200      .04     3.60     .075   .0331
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 -------------------------------------------------------------------------------
     PIPE     NODE     NODE        FLOW     LOSS VELOCITY DENSITY FRICTION AREA
      NO.       #1       #2      (USFU)   (USPU)   (FT/S)  (#/CF ) FACTOR  RATIO
-------------------------------------------------------------------------------
     P-48     J-49     J-51    -201.009      .03     4.95     .075   .0235
     P-49     J-49    GW-15     -18.600      .07     3.68     .075   .0330
      P-5      J-6     GW-6     -42.600      .01     2.29     .075   .0306
     P-50     J-51     GW-2     -28.900      .01     2.64     .075   .0319
     P-51     J-51     J-52    -172.109      .02     4.24     .075   .0242
     P-52     J-52     GW-1      -6.400      .00     1.26     .075   .0438
     P-53     J-52     J-54    -165.709      .02     4.08     .075   .0244
     P-54     J-54    GW-13      -9.600      .01     1.90     .075   .0390
     P-55     J-54     J-58    -156.109      .02     3.84     .075   .0247
     P-56    GW-12    GW-27     -22.600      .08     4.47     .075   .0315
     P-57     J-58    GW-12     -32.900      .02     3.00     .075   .0309
     P-58     J-58     J-59    -123.209      .01     3.03     .075   .0259
     P-59     J-59    GW-11     -11.600      .02     2.29     .075   .0370
      P-6      J-6      J-8    -191.091      .03     4.70     .075   .0237
     P-60     J-59     J-70    -111.609      .01     2.75     .075   .0265
     P-61     J-62    GW-10      -9.500      .01     1.88     .075   .0391
     P-62     J-62     J-65     -55.721      .02     3.00     .075   .0288
     P-63    GW-25    GW-26     -21.200      .07     4.19     .075   .0320
     P-64     J-65    GW-25     -28.800      .01     2.63     .075   .0319
     P-65     J-65     J-68     -26.921      .00     1.45     .075   .0345
     P-66    GW-34    GW-28     -22.700      .09     4.49     .075   .0315
     P-67     J-68    GW-34     -43.500      .05     3.97     .075   .0291
     P-68     J-69    GW-24      -6.000      .00     1.19     .075   .0446
     P-69     J-68     J-69      16.579      .00      .89     .075   .0392
      P-7      J-8     GW-7      -7.700      .01     1.52     .075   .0414
     P-70     J-70     J-62     -65.221      .02     3.51     .075   .0278
     P-71     J-70     J-72     -46.388      .10     4.23     .075   .0287
     P-72     J-72    GW-45      -7.500      .00      .68     .075   .0466
     P-73     J-72     J-77     -38.888      .04     3.55     .075   .0298
     P-74    GW-45    GW-46      -5.400      .00     1.07     .075   .0461
     P-75    GW-46    GW-35      -2.800      .00      .55     .075   .0493
     P-76    GW-44    GW-54      -5.500      .01     1.09     .075   .0458
     P-77     J-77    GW-44      -8.400      .01     1.66     .075   .0404
     P-78     J-77     J-78     -30.488      .04     2.78     .075   .0315
     P-79     J-78     J-79     -18.188      .02     1.66     .075   .0359
      P-8      J-8     J-12    -183.391      .03     4.51     .075   .0239
     P-80     J-78    GW-43     -12.300      .03     2.43     .075   .0365
     P-81    GW-43    GW-53      -7.300      .01     1.44     .075   .0421
     P-82     J-79    GW-42     -12.200      .02     2.41     .075   .0365
     P-83     J-79     J-83      -5.988      .00      .55     .075   .0504
     P-84     J-83    GW-41      -5.400      .00     1.07     .075   .0461
     P-85     J-83     J-88       -.588      .00      .05     .075   .0295
     P-86    GW-51    GW-55      -7.800      .02     1.54     .075   .0413
     P-87    GW-40    GW-51     -13.700      .03     2.71     .075   .0355
     P-88     J-88    GW-40     -18.400      .00     1.68     .075   .0358
     P-89     J-88     J-92      17.812      .01     1.62     .075   .0361
      P-9     J-10    GW-19     -14.500      .03     2.87     .075   .0350
     P-90    GW-50    GW-56      -5.600      .01     1.11     .075   .0456
     P-91    GW-39    GW-50     -10.200      .02     2.02     .075   .0383
     P-92     J-92    GW-39     -13.400      .00     1.22     .075   .0391
     P-93     J-93    GW-38      -5.800      .00     1.15     .075   .0451
     P-94     J-92     J-93      31.212      .02     2.85     .075   .0313
     P-95    GW-49    GW-48     -10.800      .03     2.13     .075   .0377
     P-96     J-95    GW-18     -13.900      .01     2.75     .075   .0354
     P-97     J-95    GW-31     -22.400      .09     4.43     .075   .0316
     P-98     J-97      J-6    -233.691      .04     5.75     .075   .0228
     P-99     J-97     GW-5      -7.500      .01     1.48     .075   .0418
    Flare    Flare    Flare    -554.500      .00      .00     .075********
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  JUNCTION       NODE          DEMAND   PRESSURE   PRESSURE   PRESSURE   DENSITY

     NAME       TITLE         (USFU)    (USPU)     (PSIA)     (PSIG)    #/CF
--------------------------------------------------------------------------------
     Flare                        .00     -40.00      13.25      -1.44     .075
      GW-1                      -6.40     -39.49      13.27      -1.42     .075
     GW-10                      -9.50     -39.40      13.27      -1.42     .075
     GW-11                     -11.60     -39.42      13.27      -1.42     .075
     GW-12                     -10.30     -39.44      13.27      -1.42     .075
     GW-13                      -9.60     -39.46      13.27      -1.42     .075
     GW-14                     -18.20     -39.47      13.27      -1.42     .075
     GW-15                     -18.60     -39.47      13.27      -1.42     .075
     GW-16                     -16.80     -39.53      13.27      -1.43     .075
     GW-17                     -16.80     -39.58      13.27      -1.43     .075
     GW-18                     -13.90     -39.55      13.27      -1.43     .075
     GW-19                     -14.50     -39.49      13.27      -1.42     .075
      GW-2                     -10.70     -39.51      13.27      -1.43     .075
     GW-20                     -15.80     -39.45      13.27      -1.42     .075
     GW-21                      -8.20     -39.44      13.27      -1.42     .075
     GW-22                      -6.60     -39.41      13.27      -1.42     .075
     GW-23                      -7.00     -39.39      13.27      -1.42     .075
     GW-24                      -6.00     -39.39      13.27      -1.42     .075
     GW-25                      -7.60     -39.38      13.28      -1.42     .075
     GW-26                     -21.20     -39.31      13.28      -1.42     .075
     GW-27                     -22.60     -39.35      13.28      -1.42     .075
     GW-28                     -22.70     -39.25      13.28      -1.42     .075
     GW-29                     -22.70     -39.43      13.27      -1.42     .075
      GW-3                      -8.00     -39.54      13.27      -1.43     .075
     GW-30                     -22.60     -39.48      13.27      -1.42     .075
     GW-31                     -22.40     -39.47      13.27      -1.42     .075
     GW-32                     -18.50     -39.35      13.28      -1.42     .075
     GW-33                     -20.80     -39.31      13.28      -1.42     .075
     GW-34                     -20.80     -39.34      13.28      -1.42     .075
     GW-35                      -2.80     -39.32      13.28      -1.42     .075
     GW-36                      -1.90     -39.36      13.28      -1.42     .075
     GW-37                      -2.10     -39.29      13.28      -1.42     .075
     GW-38                      -2.70     -39.26      13.28      -1.42     .075
     GW-39                      -3.20     -39.24      13.28      -1.42     .075
      GW-4                      -6.80     -39.59      13.27      -1.43     .075
     GW-40                      -4.70     -39.23      13.28      -1.42     .075
     GW-41                      -5.40     -39.23      13.28      -1.42     .075
     GW-42                      -5.00     -39.21      13.28      -1.41     .075
     GW-43                      -5.00     -39.22      13.28      -1.42     .075
     GW-44                      -2.90     -39.28      13.28      -1.42     .075
     GW-45                      -2.10     -39.32      13.28      -1.42     .075
     GW-46                      -2.60     -39.32      13.28      -1.42     .075
     GW-47                      -6.10     -39.23      13.28      -1.42     .075
     GW-48                      -4.70     -39.23      13.28      -1.42     .075
     GW-49                      -2.70     -39.26      13.28      -1.42     .075
      GW-5                      -7.50     -39.62      13.27      -1.43     .075
     GW-50                      -4.60     -39.22      13.28      -1.42     .075
     GW-51                      -5.90     -39.20      13.28      -1.41     .075
     GW-52                      -7.20     -39.20      13.28      -1.41     .075
     GW-53                      -7.30     -39.21      13.28      -1.41     .075
     GW-54                      -5.50     -39.27      13.28      -1.42     .075
     GW-55                      -7.80     -39.18      13.28      -1.41     .075
     GW-56                      -5.60     -39.22      13.28      -1.41     .075
     GW-57                      -3.10     -39.26      13.28      -1.42     .075
      GW-6                      -6.30     -39.57      13.27      -1.43     .075
      GW-7                      -7.70     -39.55      13.27      -1.43     .075
      GW-8                      -7.90     -39.51      13.27      -1.43     .075
      GW-9                      -7.00     -39.49      13.27      -1.42     .075
      J-10                        .00     -39.52      13.27      -1.43     .075
      J-12                        .00     -39.52      13.27      -1.43     .075
      J-13                        .00     -39.49      13.27      -1.42     .075
      J-16                        .00     -39.50      13.27      -1.43     .075
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  JUNCTION       NODE          DEMAND   PRESSURE   PRESSURE   PRESSURE   DENSITY

     NAME        TITLE         (USFU)    (USPU)     (PSIA)     (PSIG)    #/CF
--------------------------------------------------------------------------------
      J-18                        .00     -39.45      13.27      -1.42     .075
      J-19                        .00     -39.49      13.27      -1.42     .075
       J-2                        .00     -39.64      13.27      -1.43     .075
      J-20                        .00     -39.42      13.27      -1.42     .075
      J-24                        .00     -39.37      13.28      -1.42     .075
      J-25                        .00     -39.30      13.28      -1.42     .075
      J-30                        .00     -39.41      13.27      -1.42     .075
      J-32                        .00     -39.39      13.27      -1.42     .075
      J-35                        .00     -39.39      13.27      -1.42     .075
      J-38                        .00     -39.63      13.27      -1.43     .075
      J-39                        .00     -39.59      13.27      -1.43     .075
      J-42                        .00     -39.58      13.27      -1.43     .075
      J-43                        .00     -39.54      13.27      -1.43     .075
      J-46                        .00     -39.55      13.27      -1.43     .075
      J-49                        .00     -39.54      13.27      -1.43     .075
      J-51                        .00     -39.51      13.27      -1.43     .075
      J-52                        .00     -39.49      13.27      -1.42     .075
      J-54                        .00     -39.47      13.27      -1.42     .075
      J-58                        .00     -39.45      13.27      -1.42     .075
      J-59                        .00     -39.44      13.27      -1.42     .075
       J-6                        .00     -39.58      13.27      -1.43     .075
      J-62                        .00     -39.41      13.27      -1.42     .075
      J-65                        .00     -39.39      13.27      -1.42     .075
      J-68                        .00     -39.39      13.27      -1.42     .075
      J-69                        .00     -39.39      13.27      -1.42     .075
      J-70                        .00     -39.43      13.27      -1.42     .075
      J-72                        .00     -39.33      13.28      -1.42     .075
      J-77                        .00     -39.29      13.28      -1.42     .075
      J-78                        .00     -39.25      13.28      -1.42     .075
      J-79                        .00     -39.23      13.28      -1.42     .075
       J-8                        .00     -39.55      13.27      -1.43     .075
      J-83                        .00     -39.23      13.28      -1.42     .075
      J-88                        .00     -39.23      13.28      -1.42     .075
      J-92                        .00     -39.24      13.28      -1.42     .075
      J-93                        .00     -39.27      13.28      -1.42     .075
      J-95                        .00     -39.56      13.27      -1.43     .075
      J-97                        .00     -39.62      13.27      -1.43     .075

 * This designates the use of default density in a low pressure region

 THE NET SYSTEM DEMAND (USFU) =     -554.500

 SUMMARY OF INFLOWS(+).AND.OUTFLOWS(-) :
 ----------------------------------------------------
     NAME      FLOW (USFU)           FPN TITLE
 ----------------------------------------------------
   Flare        -554.5                        Flare
 --------------------------------------------------
 SUMMARY OF MINIMUM.AND.MAXIMUM VELOCITIES (FT/S)
 --------------------------------------------------
       MINIMUM          MAXIMUM
 ----------------------------------------
Flare       .00  P-1         13.65
P-85        .05  P-2          7.71
P-23        .38  P-38         6.74
P-83        .55  P-40         6.58
P-75        .55  P-3          5.94
```
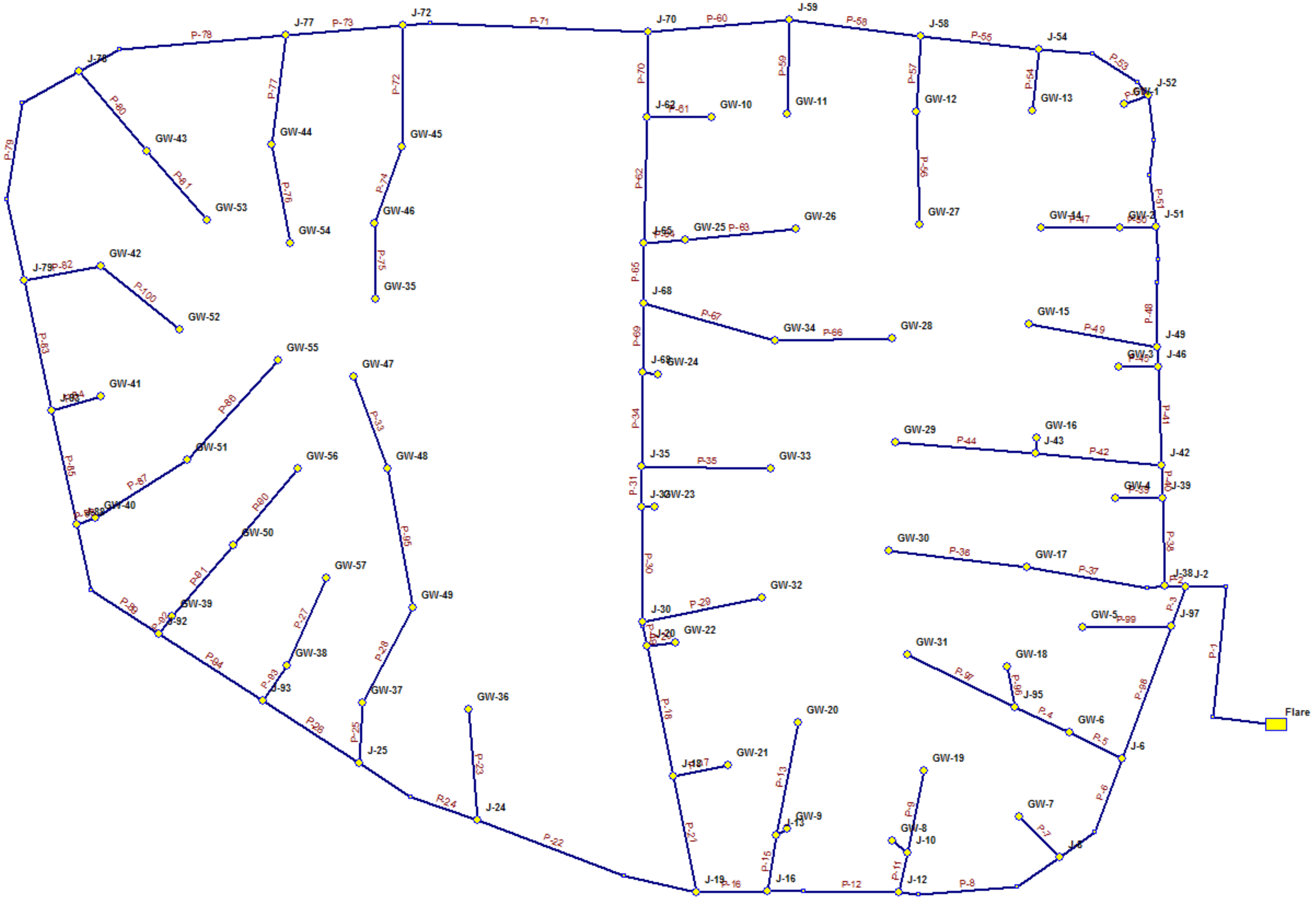

```
 --------------------------------------------------
 SUMMARY OF MINIMUM.AND.MAXIMUM LOSS/1000. (PSI )
 --------------------------------------------------
       MINIMUM          MAXIMUM
 ----------------------------------------
P-85        .00  P-1           .03
P-23        .00  P-66          .02
P-27        .00  P-44          .02
P-83        .00  P-56          .02
P-72        .00  P-36          .02


 -----------------------------------------------
 SUMMARY OF MINIMUM.AND.MAXIMUM PRESSURES (USPU)
 -----------------------------------------------
       MINIMUM          MAXIMUM
 ----------------------------------------
Flare    -40.00  GW-55      -39.18
J-2      -39.64  GW-51      -39.20
J-38     -39.63  GW-52      -39.20
J-97     -39.62  GW-42      -39.21
GW-5     -39.62  GW-53      -39.21


 *************************    END OF KYGAS SIMULATION   ************************


 DATE FOR THIS COMPUTER RUN       :  2-06-2015
 START TIME FOR THIS COMPUTER RUN : 10: 9:37:47
```

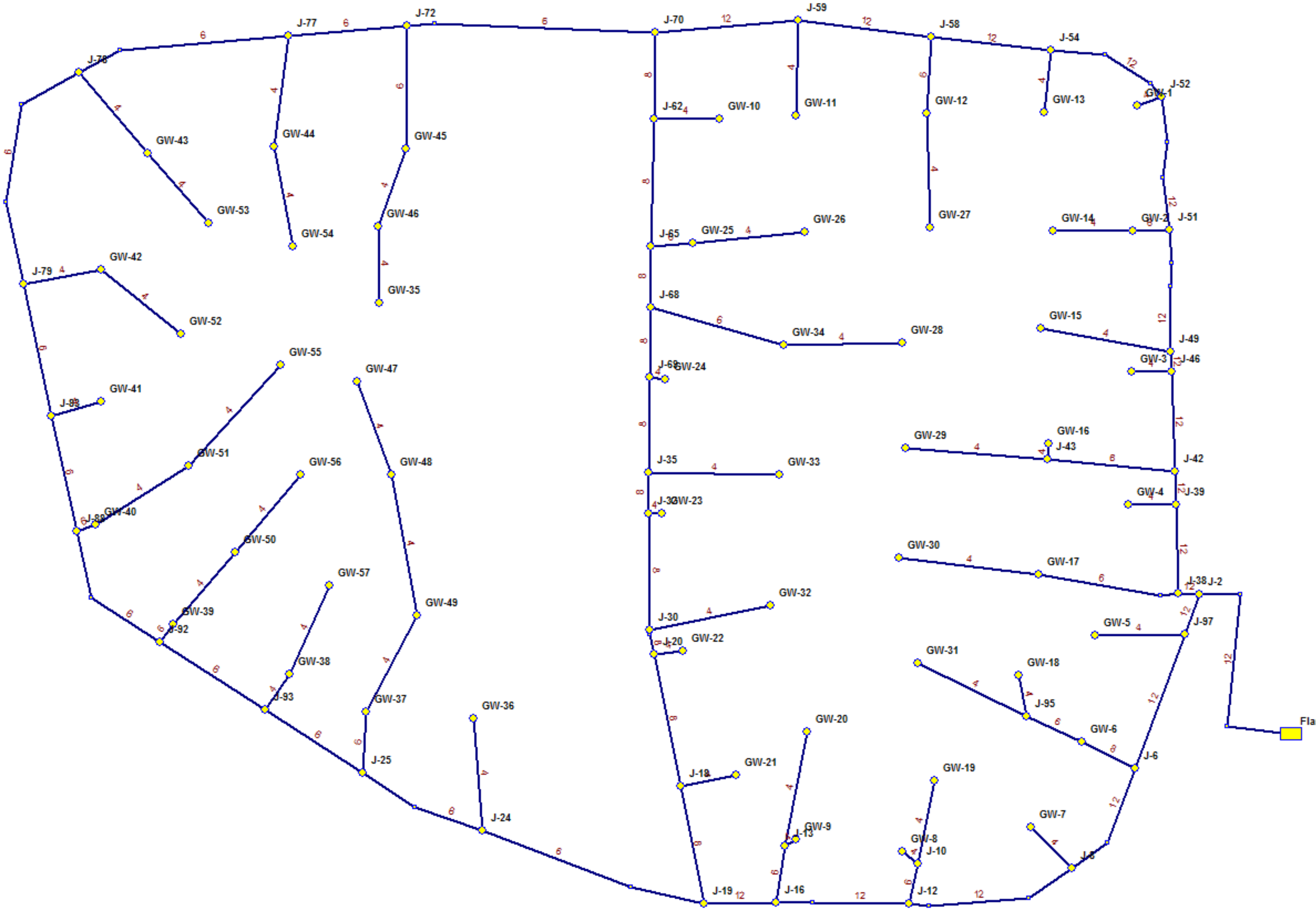
KEKAHA SANITARY LANDFILL

FIGURE 1: PIPE SEGMENT AND PIPE NODE NAMES



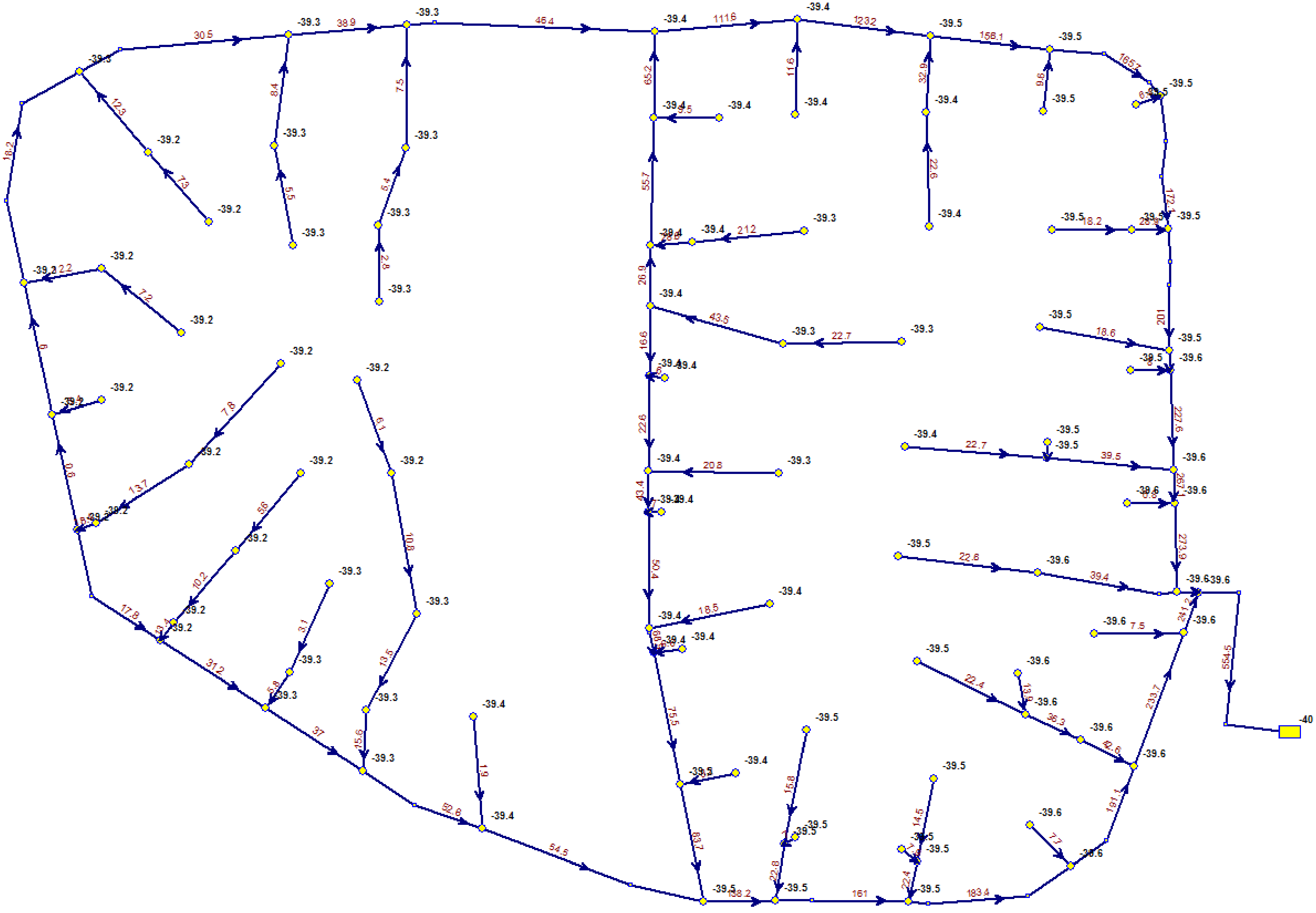
KEKAHA SANITARY LANDFILL

FIGURE 2: PIPE SIZES



KEKAHA SANITARY LANDFILL

FIGURE 3: AVAILABLE



Appendix A-5: Gas Mover & Control Device Criteria

Gas Mover Equipment Sizing

Per 40 CFR 60.752(b)(2)(ii)(A)(1), the active gas extraction system must be designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control system equipment. 40 CFR 60.752(b)(2)(ii)(A)(3) requires that gas be collected at a sufficient extraction rate. As mentioned above, the design is based on all of the projected gas volumes.

Since the blower is responsible for providing the vacuum that actually extracts the gas from the well field and moves it through the system, the sizing of the blower is crucial. General design criteria and the method for determining the required blower size are discussed in the following section.

General Design Criteria:

Flow Volumes:

Since gas flow volumes will vary over the life of the gas extraction system the blower provides a uniform source of vacuum over a wide range of flow rates. Minimum system flows are those expected when only the initial phases of the system have been installed. Maximum flows will occur after the entire gas system is in place.

Pressure Requirements:

The blower must be capable of supplying sufficient negative pressure to overcome pressure drops and resistance through piping and equipment at the calculated maximum gas flow rate, as well as supplying sufficient positive pressure for delivery to the control device (i.e., the enclosed flare) for combustion.

The design blower will accommodate the maximum modeled flow rate of 521 scfm, and provide 40 ”w.c. of available vacuum.

Design Methodologies:

Flow Volumes. The Kekaha Landfill may ultimately require gas mover equipment capable of handling up to 521 scfm landfill gas.

Pressure Losses in Gas System. A discussion of the model used for calculating pressure losses in the header piping was provided in the discussion on header pipe sizing. In order to calculate the maximum pressure drop in the system, P_H, the designer must determine a pressure drop across the system due to elbows, tees, and other fittings in the gas system as well as frictional losses from flow in the pipe itself. Losses are calculated and minimized to ensure that adequate vacuum is available to all extraction points.

The table included in header pipe sizing calculations illustrates that a total pressure drop of less than one inch water column is expected.

Applied Well Vacuums. For design purposes, it is assumed that a minimum of 10 “w.c., P_W, should be available at the gas wells in order to provide sufficient vacuum for gas extraction.

Pressure Loss through Flare. A pressure loss, P_F, on the positive side of the gas mover equipment is created by the discharge piping, the flame arrester, orifice plate and the flare itself. Based on information supplied by flare manufacturers, a maximum drop of 10 ”w.c. can be expected.

Required Vacuum. Based on these pressure losses for the gas management system, the gas mover equipment must ultimately be capable of providing the following vacuum:

$$P_{total} = P_H + P_W + P_F$$

= 1 ”w.c. + 10 ”w.c. + 10 ”w.c.

= 21 “w.c. total static pressure

The blower at the flare station will be rated for 40 “w.c at a flow rate of 521 scfm. Thus, the system is sufficiently designed to generate the required vacuum of 21 “w.c.

Control Device Sizing

The last requirement in designing a gas collection system is to size and select a control device meeting the requirements of 40 CFR 60.752(b)(2)(iii). Further, the control device must be capable of combusting a wide range of flow volumes.

The proposed flare will be located at a flare station on the northeast corner of the site near the office building.

General Design Criteria

The flare at Kekaha Landfill shall be designed to reduce the concentration of NMOCs present in the LFG delivered to the flare by at least 98 percent (by weight) or reduce outlet NMOC concentrations to less than 20 parts per million by volume (ppmv).

Per 40 CFR §60.752(b)(2)(iii)(B)(2), the LFG flare shall operate within the performance ranges established during the source performance tests and is operated in such a manner as to meet the emission requirements of the NSPS.

The flare capacity will meet the minimum 521 scfm flow rate, which is the maximum modeled flow rate for the site.

Control Device Sizing

The facility will periodically evaluate the existing gas control capabilities, prior to each expansion of the gas collection system (if any are necessary), to insure that adequate combustion capacity exists for the expected increase in collected gas volumes. Additional control equipment will be added as needed when collected gas volumes warrant the increase.

All control devices installed will meet the NSPS requirements for monitoring and performance testing, depending on the type of control device selected.

The enclosed flare at Kekaha Landfill will have the following design specifications. The equipment shown on drawing 5 in Appendix B is for illustration purposes only. The flare manufacturer will provide detailed drawings that will be incorporated by reference into this design plan.

LFG Flare System Specifications

- Designed and constructed to operate as a complete pre-assembled unit.
- NFPA, OSHA, NEMA & NEC codes and guidelines are to be followed.
- The design shall include the ability to shut off, neutralize or isolate any energy source.
- System will be completely fabricated, assembled, pre-wired, and tested prior to shipment.

Basic Components

- Unitized welded heavy-duty structural steel skid with lifting lugs and slip resistant decking (diamond plate or similar) as necessary. Skid to be completely galvanized or painted after fabrication.
- Anchor brackets are to be provided, suitable to secure the unit for 110 mph wind in seismic zone 1.
- Blower with VFD to be sized at full rated flare capacity (16.5 MMBtu/hr). All wetted parts (excluding aluminum impellers) shall be phenolic coated for corrosion resistance. Seals for blowers to be designed to resist corrosion and provide a leak tight operation.
- Blower motors to be TEFC
- Drains with valves to drain entire blower per manufacturer’s recommendations, piped to edge of skid. Drain lines to be; of stainless steel material, sized, sloped and installed to promote free draining and accommodate “blow out” cleaning.
- Gas conveyance piping to be corrosion resistant and come fully assembled, mounted, and supported throughout the skid. Pipe sample ports are to be installed to allow for measurement of pressure and temperature at the inlet and outlet of the blower and to provide differential pressure measurement across the flame arrestor and mesh pad of the knockout vessel.

- Moisture separator with demister pad or equivalent shall be designed to resist corrosive condensate. HDPE lids are to be properly reinforced to prevent deflection/bowing under maximum vacuum conditions and operating temperatures to prevent leakage at the connection. Unit shall be designed to accommodate pressures of –5 to +5 PSIG at a minimum and be designed for removal of 99% of all liquid droplets > 10 microns in size. The design should have 4-inch w.c. maximum pressure drop across entire separator at full design flow. Free drain liquids by gravity from sump of moisture separator.
- Pneumatic fail-closed valve shall be a butterfly-type
- Flow Meter to be thermal type mass flow meter with flow straightener, if required to achieve proper flow run. All flow meters shall be installed and used in accordance with manufacturer's published recommendations and meet a minimum accuracy of ±4% across the entire flare flow range as installed. All meters must report flow volumes corrected to 14.7 PSIA and 60°F. To be located and installed in accordance with manufacturer's published recommendations including minimum lengths of straight pipe (upstream and downstream of meter).
- Flame arrestor with internals capable of being removed and cleaned without removing housing. It shall be all aluminum housing with stainless steel element.
- Flare stacks are to be constructed as part of the skid unless the size requires stand-alone shipment and mounting. The flare shall achieve an overall destruction efficiency of 98% minimum. It is to be based on maximum design flow rate within the entire operating range of 30%-55% CH4. The unit shall have a minimum: 10:1 volumetric turndown. The flare shall be designed and constructed for 110 MPH wind load zone 1 seismic classification. Wind load and seismic classification requirements to be met without the use of guy-wires or similar devices. Stable combustion with 30% - 55% methane concentration throughout the design capacity range while maintaining operating temperature without requiring any burner adjustment or flare modification. Maximum 10-inch w.c. pressure drop through flare system (from blower outlet through flare tip). A spark ignited pilot assembly or equivalent is required. Stack to be fabricated using carbon steel. All carbon steel must be, painted, galvanized, or otherwise sufficiently protected (inside and out) against the effects of corrosion and heat with the system operating continuously at maximum design capacity. The flare shall have heavy-duty thermocouple systems designed for maximum life.
- Pilot control system including pressure regulator, fail-closed shutdown valve, manual block valve, strainer, and pressure indicator.
- Electrical equipment: Area classification: Per NEC standards, minimum area classification to be Class I, Div. 2, Group D within 3-feet of any gas (LFG or propane) containing pipe or device. All control panels shall follow all applicable sections of the National Fire Protection Association (NFPA) fire code, and the codes of the National Electrical Manufacturer's Association (NEMA). All control voltage within the control cabinet shall be 120 volt AC or less. All high voltage cabling must be confined to motor control center (MCC) or VFD panel. VFDs (without bypass) with inlet vacuum control via the PLC, to be installed and equipped with "closed loop" air conditioners to properly cool and minimize the

introduction of dust to the drive. Electrical systems shall be isolated and controlled with circuit breakers without fuses for all AC voltages. Weather hood to be provided which extends a minimum of 3’ over front of panels. All enclosures and cabinets that have energized circuits are to be lockable to prevent unauthorized personnel from gaining access.

- Electronic paperless recorder capable of storing a minimum of 30 days of data
- PLC based control system with touch screen to be suitable for intended exterior use and with proper resolution for bright daylight conditions and properly protected from potential damage by vandals or direct exposure to sunlight. Control panel to be equipped with data modem for voice alarm notification and remote service and support of the control system. Modem to be capable of connecting to the Sprint 3G network, AT&T 3G network, Verizon 3G network, or POTS.

Energy Recovery Distribution

System shall include a blind flange and appropriate valves to allow for connection to a future energy recovery system capable of operating in all, partial, or none gas delivery modes. There shall be a minimum flow rate directed to the flare to maintain system operation and compliance.

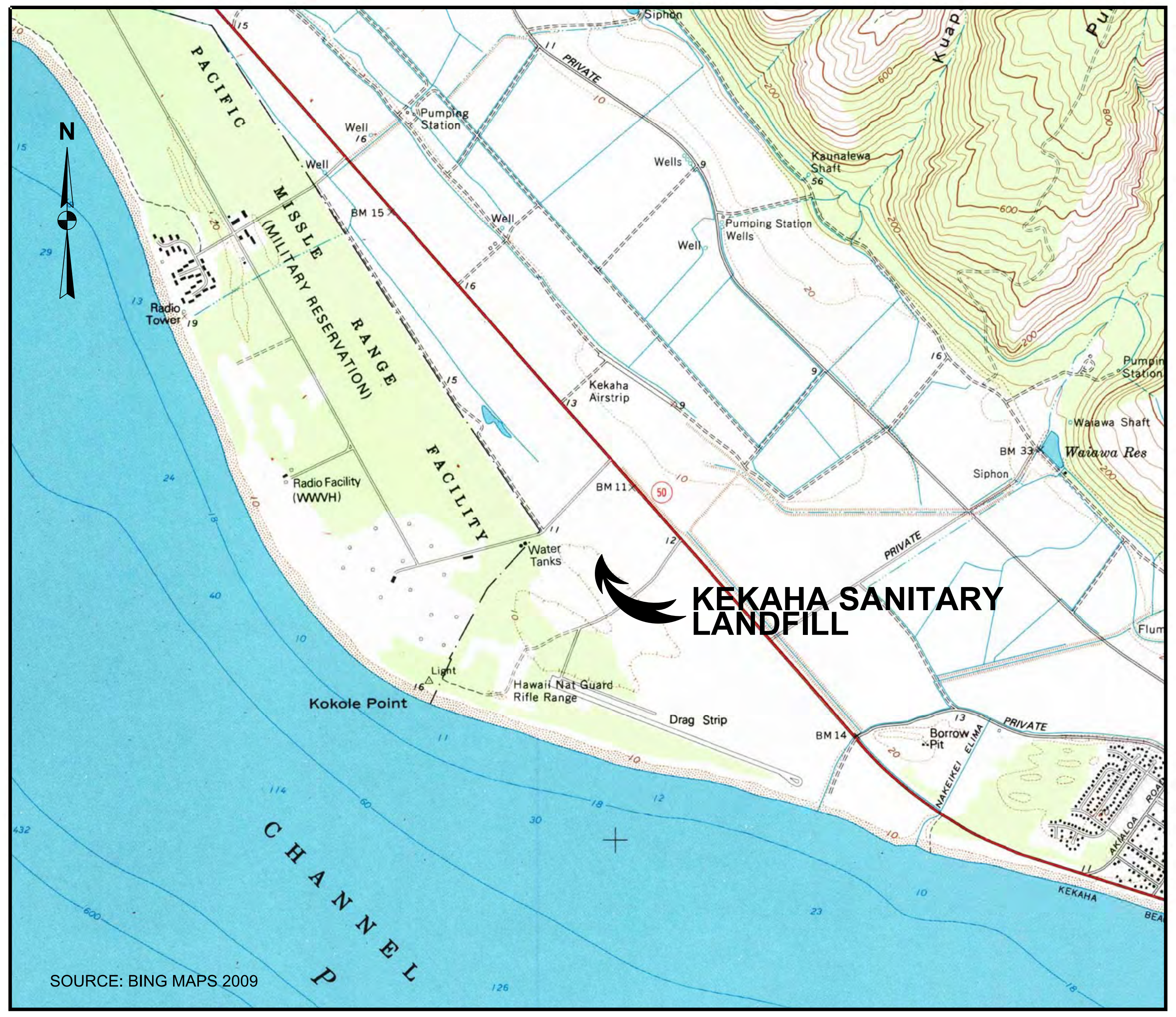
APPENDIX B

GCCS DESIGN DRAWINGS

GAS MANAGEMENT SYSTEM PLAN

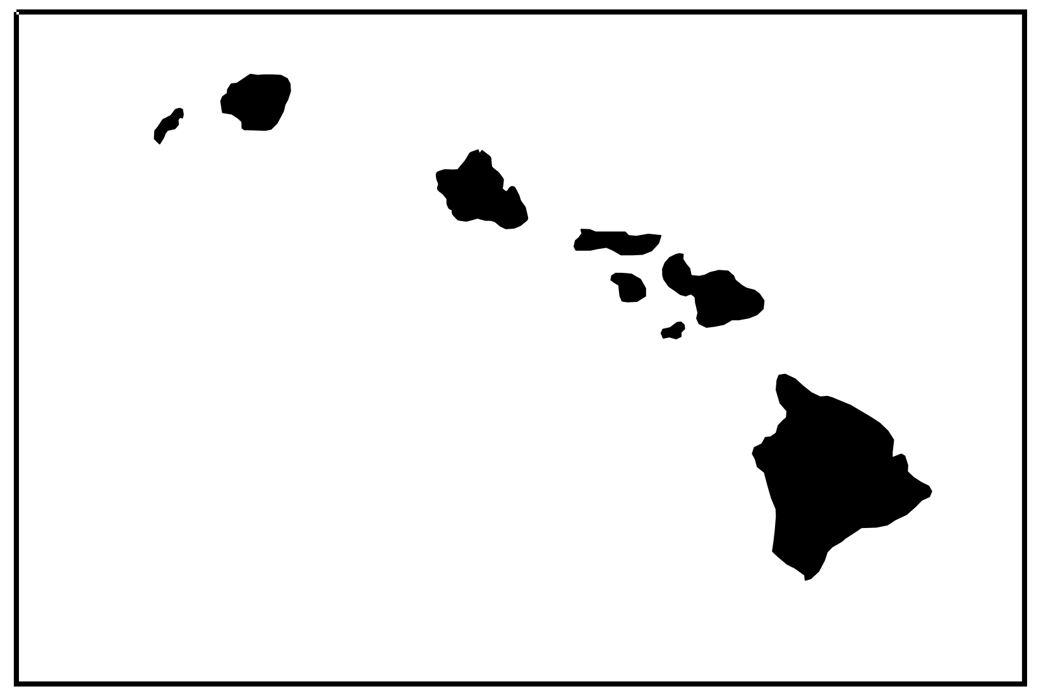
KEKAHA SANITARY LANDFILL
COUNTY OF KAUAI
KEKAHA, KAUAI, HAWAII

MARCH 2015



SOURCE: BING MAPS 2009

SITE LOCATION MAP



HAWAIIAN ISLANDS

SHEET NO	TITLE
1	TITLE SHEET
2	EXISTING CONDITIONS PLAN
3	GAS MANAGEMENT SYSTEM PLAN
4 - 6	GAS MANAGEMENT SYSTEM DETAILS

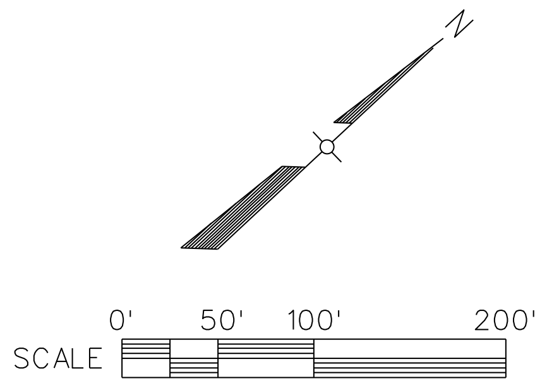
ANDREW J. QUERIO
LICENSED PROFESSIONAL ENGINEER
No. 15174-C
HAWAII U.S.A.

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION

Signature 03-19-15 4/30/16 Expiration Date of License

PREPARED BY

EIL
ENVIRONMENTAL INFORMATION LOGISTICS, LLC



LEGEND:

▬ ▪ ▬ ▪ ▬	PROPERTY LINE
▬ ▪ ▪ ▬ ▪ ▪ ▬	PERMITTED LIMIT OF WASTE
E 1556500	COORDINATE SYSTEM
☐	EXISTING STRUCTURE
PAVED UNPAVED	ACCESS ROAD
680	EXISTING TOPOGRAPHY
☒ 25	APPROXIMATE LOCATION OF EXISTING LANDFILL GAS VENT

NOTES:

1. TOPOGRAPHIC MAP PROVIDED BY MILLER CREEK AERIAL, INC., DATED, FEBRUARY 24, 2015.
2. EXISTING LANDFILL GAS VENTS SHOWN TAKEN FROM DRAWING C-3, ENTITLED "LANDFILL GAS SYSTEM AND GEOTEXTILE 1 PLAN", DATED JANUARY 31, 1996. CREATED BY HARDING LAWSON ASSOCIATES.

ANDREW J. QUERIO
LICENSED PROFESSIONAL ENGINEER
No. 15174-C
HAWAII U.S.A.

Signature 03-19-15 4/30/16 Expiration Date of License

NO	DRN	CHK	DATE

REVISIONS

	INITIAL	DATE
DRN		
DES		
CHK		
APP		

STAMP

PREPARED FOR
COUNTY OF KAUAI KEKAHA SANITARY LANDFILL

PREPARED BY
EIL ENVIRONMENTAL INFORMATION LOGISTICS, LLC

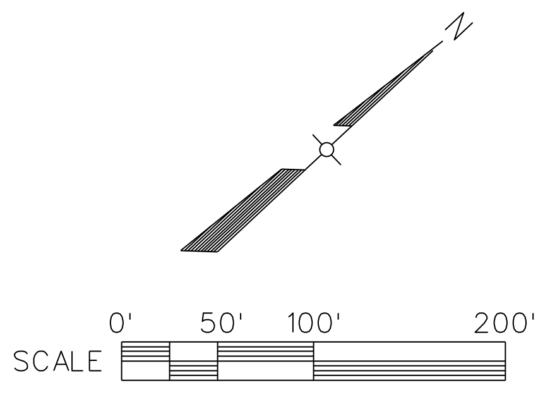
KEKAHA SANITARY LANDFILL
KEKAHA, KAUAI, HAWAII

EXISTING CONDITIONS PLAN

DATE MARCH 2015
PROJECT NO 090605
FILENAME 003 KEK EX COND PLAN
SHEET NO 2 OF 6
DRAWING NO 2

LEGEND:

	PROPERTY LINE		EXISTING STRUCTURE
	PERMITTED LIMIT OF WASTE		LANDFILL GAS COLLECTION HEADER/LATERAL
PAVED UNPAVED	ACCESS ROAD		LANDFILL GAS EXTRACTION WELL
680	EXISTING TOPOGRAPHY	◎	CONDENSATE KNOCKOUT
90	PERMITTED FINAL GRADE	⧓	VALVE
E 1556500	COORDINATE SYSTEM	▣	DRIPLEG



NOTES:

1. TOPOGRAPHIC MAP PROVIDED BY MILLER CREEK AERIAL, INC., DATED, FEBRUARY 24, 2015.
2. GRADES SHOWN DEPICT TOP OF FINAL COVER SYSTEM. MAXIMUM FINAL COVER ELEVATION IS 120 FEET.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN DUE TO ON-GOING LANDFILLING OPERATIONS SINCE THE DATE OF THE AERIAL SURVEY.
4. FOR CLARITY NOT ALL SITE FEATURES ARE SHOWN.
5. PROPOSED LANDFILL GAS EXTRACTION WELLS WILL BE CONSTRUCTED AS FINAL CONTOURS ARE ATTAINED. INTERIM GAS COLLECTION DEVICES WILL BE INSTALLED AS NEEDED TO MEET THE NSPS CONTROL DEADLINES.
6. THE PROPOSED PLAN IS CONCEPTUAL AND REPRESENTS TYPICAL PROPOSED LFG WELL AND HEADER SYSTEM LAYOUT. LFG WELLS AND PIPE LOCATIONS MAY BE ADJUSTED AND ADDITIONAL LFG WELLS AND PIPES MAY BE ADDED DURING AND AFTER WASTE FILLING OPERATIONS.
7. ADDITIONAL WELLS OR COLLECTION DEVICES MAY BE ADDED TO SUPPLEMENT THE DESIGN PRESENTED HEREIN, WITHOUT THE NEED FOR AMENDMENTS TO THIS DESIGN PLAN. AS-BUILTS WILL BE KEPT ON FILE AS-REQUIRED.
8. THE PHASE I EXISTING LANDFILL GAS VENTING SYSTEM WILL BE CAPPED, ABANDONED, AND/OR OTHERWISE DISMANTLED AS THE NEW GAS CONTROL SYSTEM IS CONSTRUCTED AND PUT INTO OPERATION. WHERE APPLICABLE, BASED ON FIELD CONDITIONS, AND PER SITE PERSONNEL DIRECTION, THE SITE MAY CONNECT EXISTING GAS VENTS TO THE PROPOSED GAS COLLECTION SYSTEM AS AN ALTERNATIVE TO INSTALLING NEW GAS EXTRACTION WELLS.
9. THE PROPOSED PIPE SIZES INDICATED ON THIS DRAWING REPRESENTS MINIMUM PIPE SIZES. PIPE SIZES MAY BE INCREASED IF NECESSARY AND ADDITIONAL HEADERS/ LATERALS MAY BE ADDED FOR ADDITIONAL CROSSOVER PIPING.

ANDREW J. QUERIO
No. 15174-C

Signature 03-19-15
4/30/16
Expiration Date of License

NO	REVISIONS	DRN	CHK	DATE

	INITIAL	DATE
DRN		
DES		
CHK		
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PREPARED FOR

COUNTY OF KAUAI KEKAHA SANITARY LANDFILL

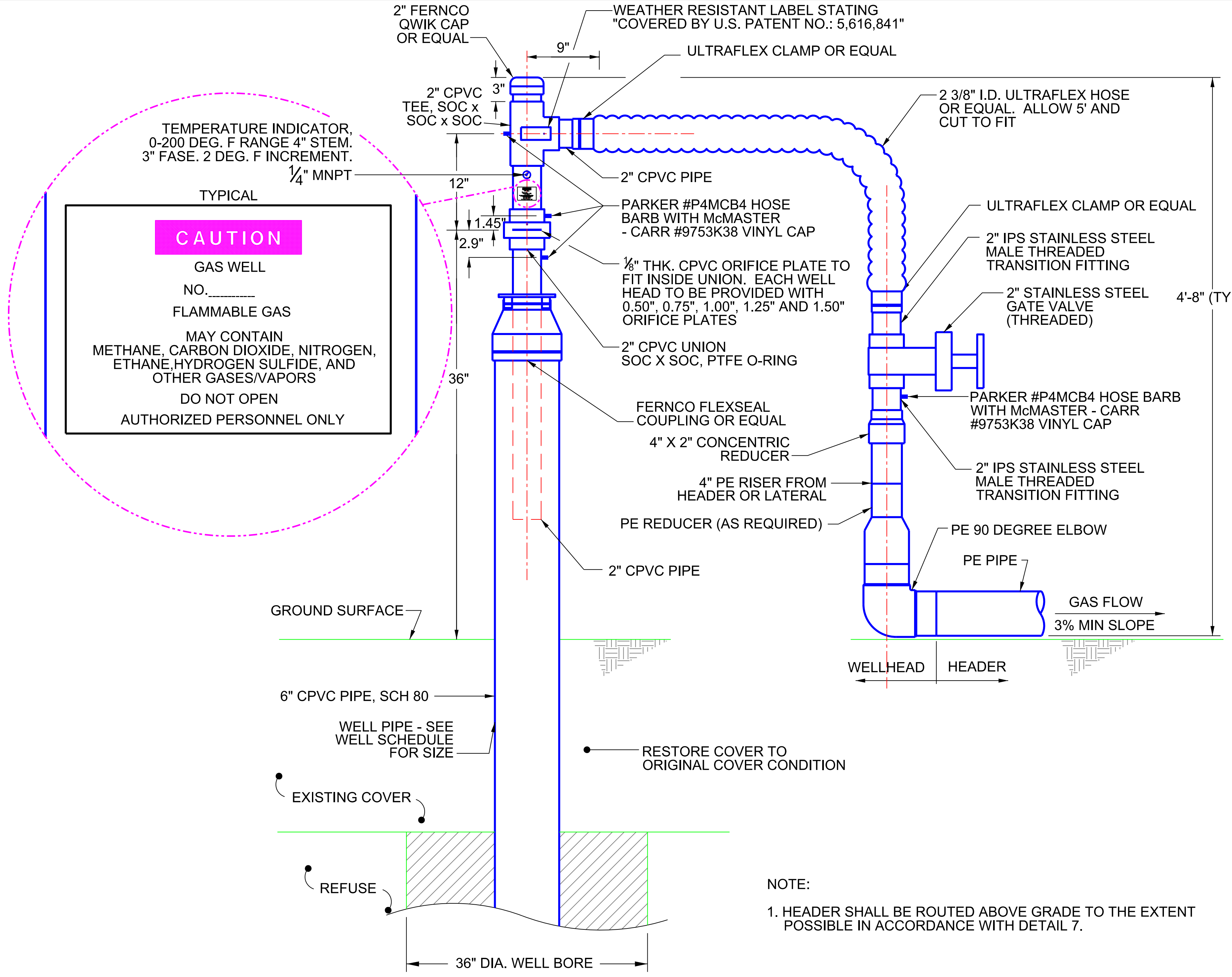
PREPARED BY

ENVIRONMENTAL INFORMATION LOGISTICS, LLC

KEKAHA SANITARY LANDFILL
KEKAHA, KAUAI, HAWAII

GAS MANAGMENT SYSTEM PLAN

DATE MARCH 2015
PROJECT NO 090605
FILENAME 003 KEK GCCS PLAN 080815
SHEET NO 3 OF 6
DRAWING NO 3



NOTE:

1. HEADER SHALL BE ROUTED ABOVE GRADE TO THE EXTENT POSSIBLE IN ACCORDANCE WITH DETAIL 7.

GAS EXTRACTION WELLHEAD DETAIL 1

NTS

WELL NUMBER	Well COORDINATES		FINAL GRADE ELEV.	BASE GRADE ELEV.	BASE OFFSET (FT)	TOTAL WELL LENGTH BELOW GRADE (FT)	LENGTH OF PIPE (FT)		TOP OF CASING ABOVE GRADE (FT)
	NORTH	EAST					SOLID	SCREENED	
GW-1	55,833	1,556,407	65.0	16.0	10	39	25	14	4
GW-2	55,683	1,556,560	65.0	7.4	10	48	25	23	4
GW-3	55,519	1,556,734	60.0	8.5	10	42	25	17	4
GW-4	55,358	1,556,896	57.0	8.3	10	39	25	14	4
GW-5	55,165	1,557,021	58.0	7.5	10	40	25	15	4
GW-6	55,023	1,557,139	55.0	8.3	10	37	25	12	4
GW-7	54,862	1,557,186	60.0	8.5	10	42	25	17	4
GW-8	54,672	1,557,065	61.2	9.7	10	41	25	16	4
GW-9	54,555	1,556,928	60.5	11.1	10	39	25	14	4
GW-10	55,297	1,555,940	71.0	15.0	10	46	25	21	4
GW-11	55,395	1,556,026	76.0	15.0	10	51	25	26	4
GW-12	55,561	1,556,173	72.9	16.0	10	47	25	22	4
GW-13	55,710	1,556,310	71.3	16.0	10	45	25	20	4
GW-14	55,584	1,556,468	103.7	8.2	10	85	25	60	4
GW-15	55,452	1,556,573	106.3	9.0	10	87	25	62	4
GW-16	55,330	1,556,728	97.3	9.0	10	78	25	53	4
GW-17	55,166	1,556,880	96.5	8.2	10	78	25	53	4
GW-18	55,023	1,556,981	90.0	9.5	10	71	25	46	4
GW-19	54,796	1,557,015	86.7	10.0	10	67	25	42	4
GW-20	54,691	1,556,807	93.7	10.5	10	73	25	48	4
GW-21	54,554	1,556,779	63.8	11.7	10	42	25	17	4
GW-22	54,632	1,556,559	60.6	12.1	10	38	25	13	4
GW-23	54,766	1,556,364	60.8	11.5	10	39	25	14	4
GW-24	54,924	1,556,201	59.1	11.8	10	37	25	12	4
GW-25	55,120	1,556,064	63.3	12.5	10	41	25	16	4
GW-26	55,273	1,556,179	114.4	10.8	10	94	20	74	4
GW-27	55,432	1,556,320	119.1	9.3	10	100	20	80	4
GW-28	55,264	1,556,432	119.7	9.4	10	100	20	80	4
GW-29	55,146	1,556,567	120.0	9.7	10	100	20	80	4
GW-30	55,009	1,556,697	119.9	10.0	10	100	20	80	4
GW-31	54,910	1,556,848	119.1	10.3	10	99	20	79	4
GW-32	54,793	1,556,606	102.7	11.4	10	81	20	61	4
GW-33	54,957	1,556,455	113.2	11.3	10	92	20	72	4
GW-34	55,113	1,556,296	112.7	10.8	10	92	20	72	4
GW-35	54,708	1,555,929	38.2	5.0	10	23	10	13	4
GW-36	54,291	1,556,402	33.0	5.0	10	18	10	8	4
GW-37	54,166	1,556,267	35.0	5.0	10	20	10	10	4
GW-38	54,113	1,556,132	37.6	5.0	10	23	10	13	4
GW-39	54,027	1,555,934	39.9	5.0	10	25	10	15	4
GW-40	54,047	1,555,720	42.1	5.0	10	27	20	7	4
GW-41	54,195	1,555,573	43.2	5.0	10	28	20	8	4
GW-42	54,350	1,555,408	42.5	5.0	10	27	20	7	4
GW-43	54,543	1,555,316	42.5	5.0	10	27	20	7	4
GW-44	54,708	1,555,456	38.3	5.0	10	23	10	13	4
GW-45	54,868	1,555,611	34.1	5.0	10	19	10	9	4
GW-46	54,745	1,555,675	36.7	5.0	10	22	10	12	4
GW-47	54,538	1,555,845	44.4	5.0	10	29	20	9	4
GW-48	54,467	1,555,982	42.0	5.0	10	27	20	7	4
GW-49	54,475	1,556,002	37.4	5.0	10	22	10	12	4
GW-50	54,188	1,555,914	41.9	5.0	10	27	20	7	4
GW-51	54,230	1,555,756	44.0	5.0	10	29	20	9	4
GW-52	54,374	1,555,578	46.1	5.0	10	31	20	11	4
GW-53	54,537	1,555,475	46.4	5.0	10	31	20	11	4
GW-54	54,616	1,555,600	43.4	5.0	10	28	20	8	4
GW-55	54,461	1,555,735	47.2	5.0	10	32	20	12	4
GW-56	54,360	1,555,894	43.5	5.0	10	28	20	8	4
GW-57	54,266	1,556,068	39.7	5.0	10	25	10	15	4

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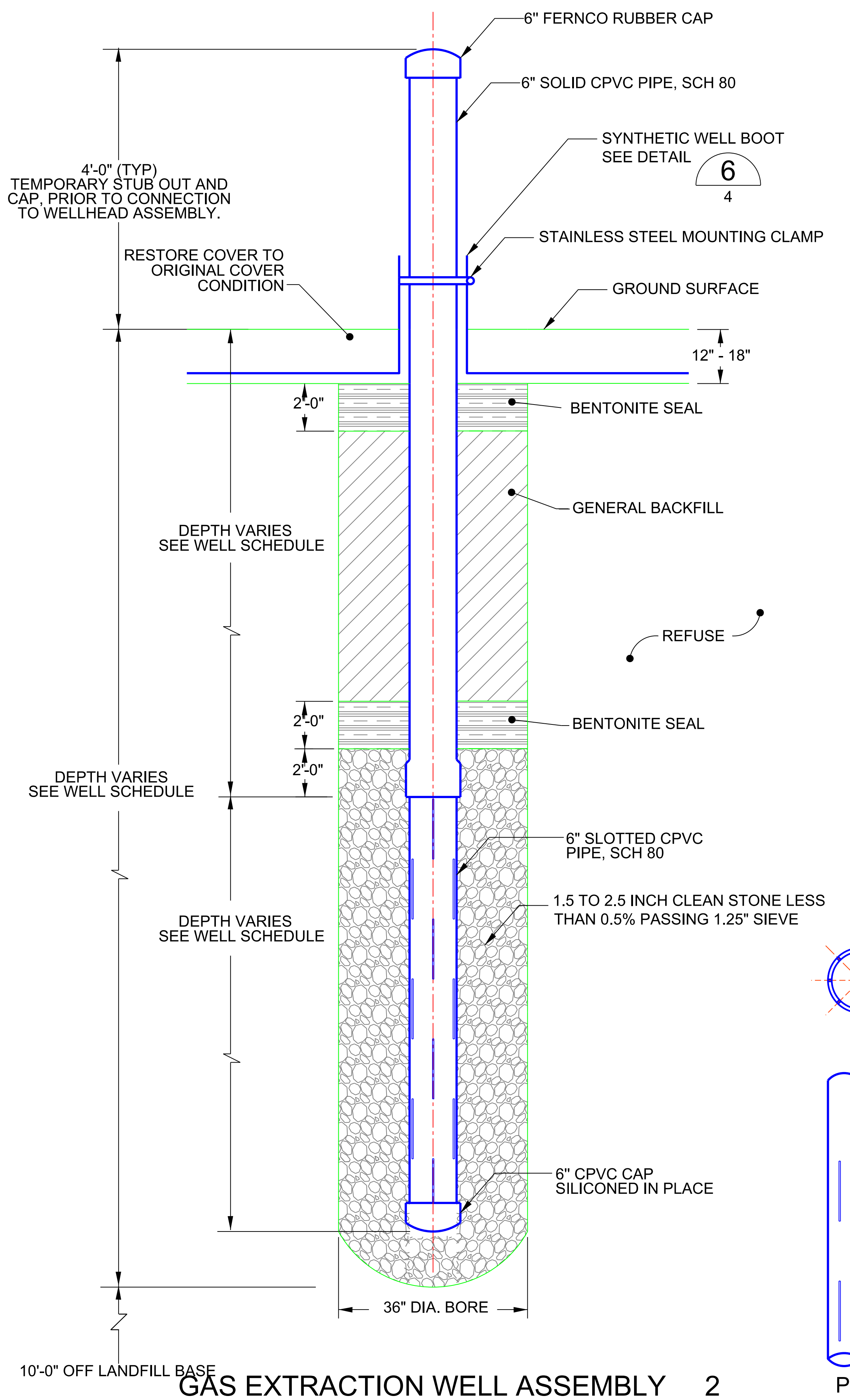
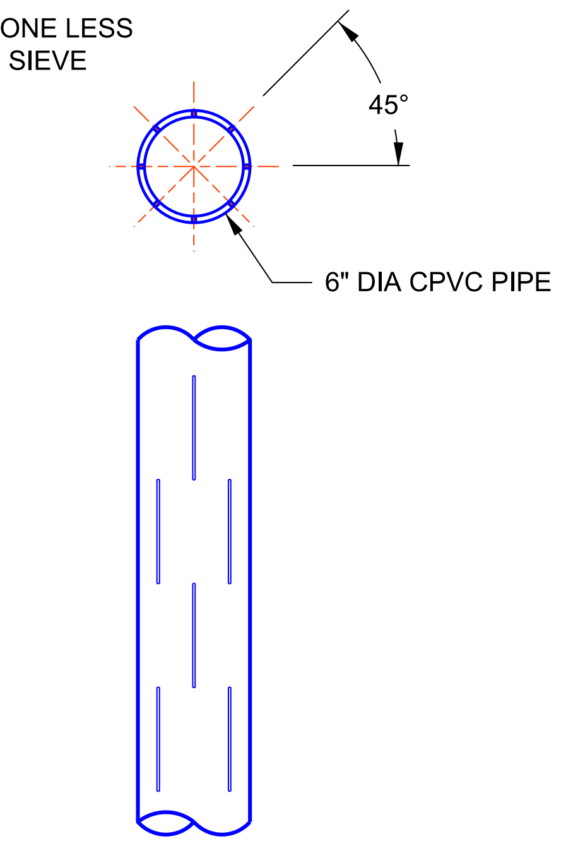


GAS EXTRACTION WELL ASSEMBLY 2

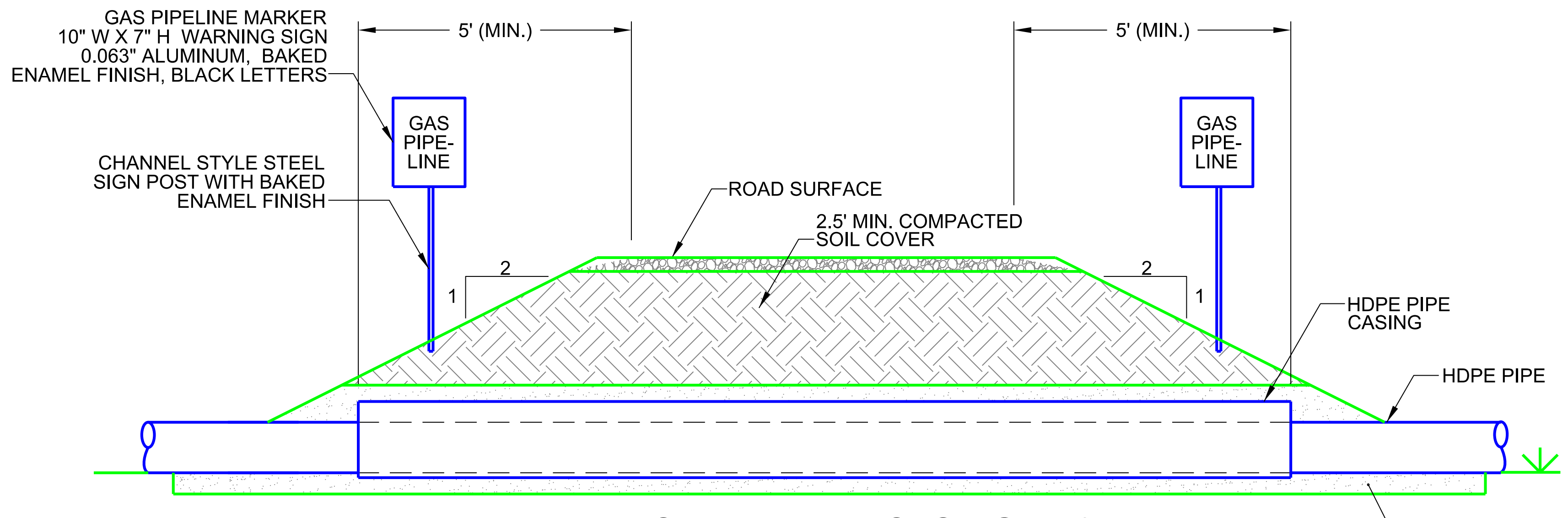
NTS



PIPE SLOTTING DETAIL

NOTE:

SLOT PIPE APPROXIMATELY 3/8" WIDE AND 8" LONG, SPACED 45° APART. MAYBE SUBSTITUTED WITH EQUIVALENT PERFORATIONS.

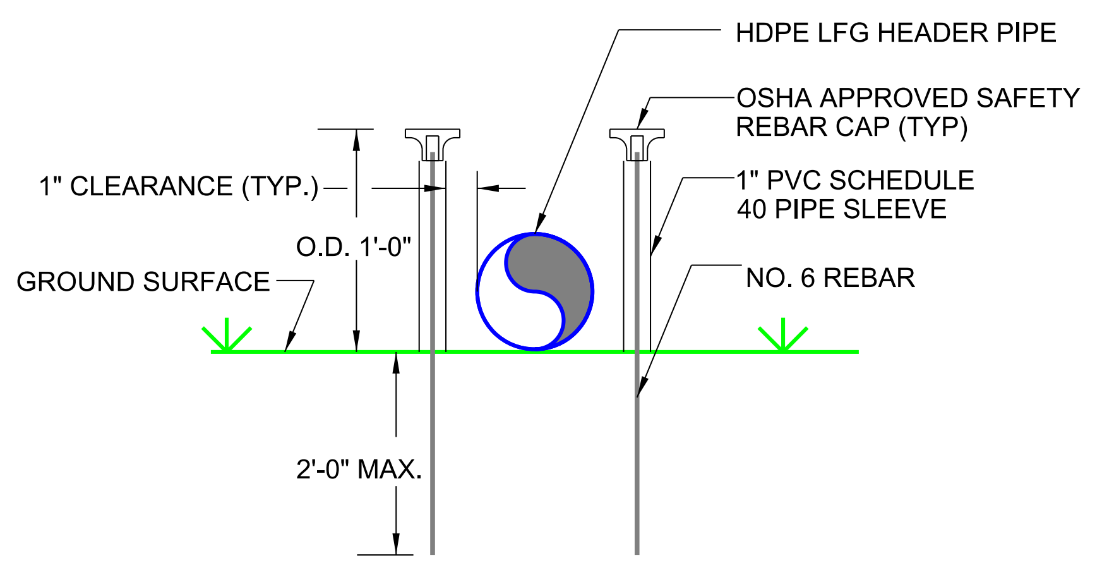


TYPICAL HEADER CASING 3

NTS

NOTES:

1. IN AREAS WHERE A HEADER CASING IS REQUIRED, USE HDPE PIPE CASING TWO PIPE SIZES LARGER THAN HEADER PIPE.
2. HEADER AND LATERAL PIPES TO BE REPAIRED OR REPLACED WHERE A HEADER CASING IS REQUIRED SHALL BE INSPECTED AND IF NECESSARY EXCAVATED. IF PIPES ARE FOUND TO BE IN GOOD CONDITION THEY CAN REMAIN OTHERWISE A NEW PIPE AND CASING IS REQUIRED.
3. LOCATION OF ALL HEADER CASINGS TO BE FIELD DETERMINED BY OWNER.
4. GRADE HEADER CASING CROSS SLOPE TO ORIGINAL ROAD OR GRADE AT A MAXIMUM 8% SLOPE.

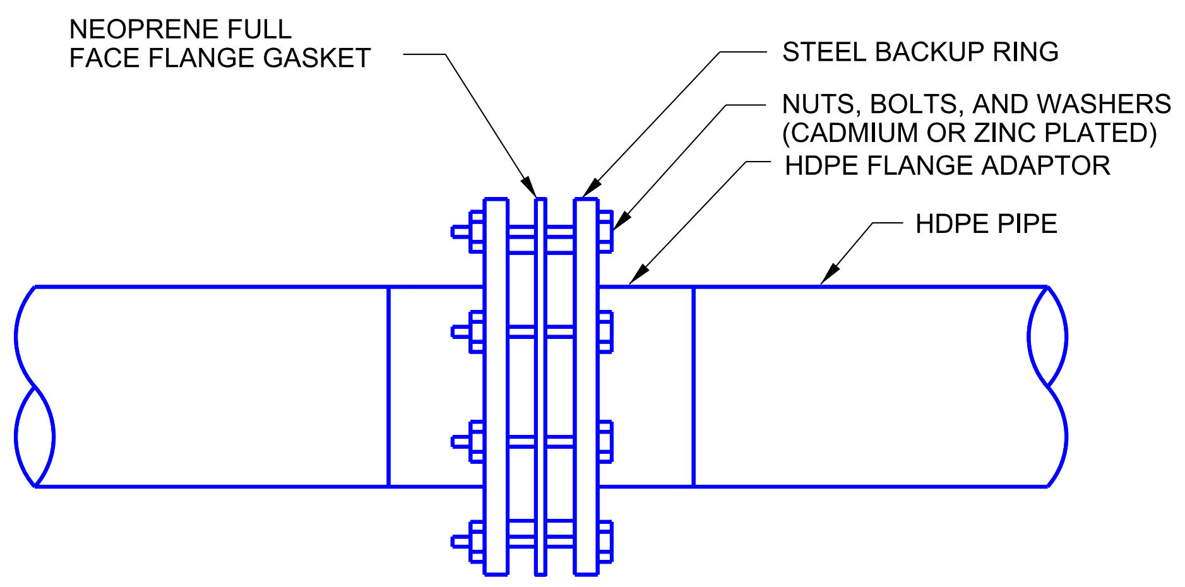


PIPE ANCHOR DETAIL 7

NTS

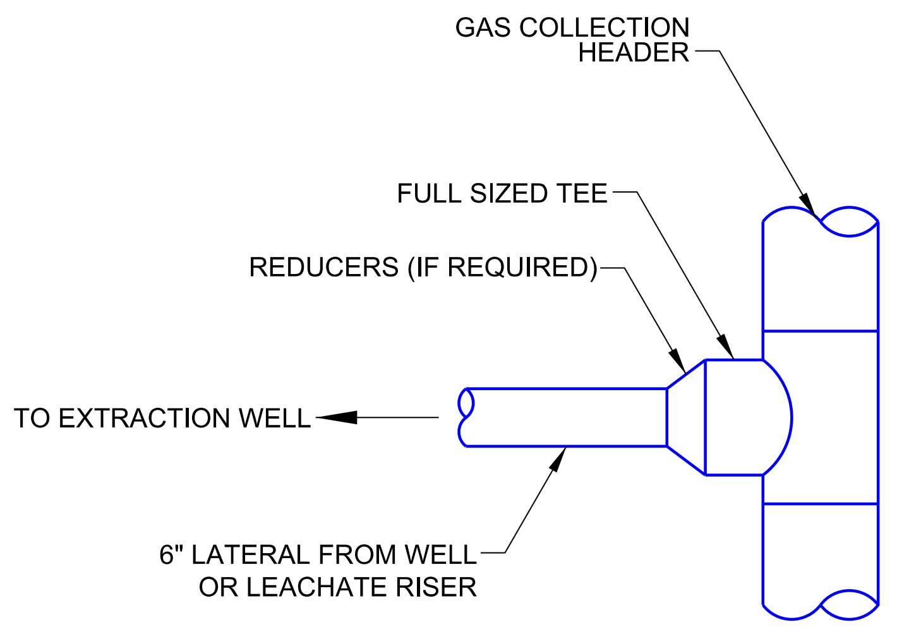
NOTES:

1. ANCHOR DETAIL 20' ON CENTER.
2. CONTRACTOR TO PLACE MINIMUM 2' OF SOIL ABOVE PIPE AT TEES AND 90 DEG. ELBOWS.



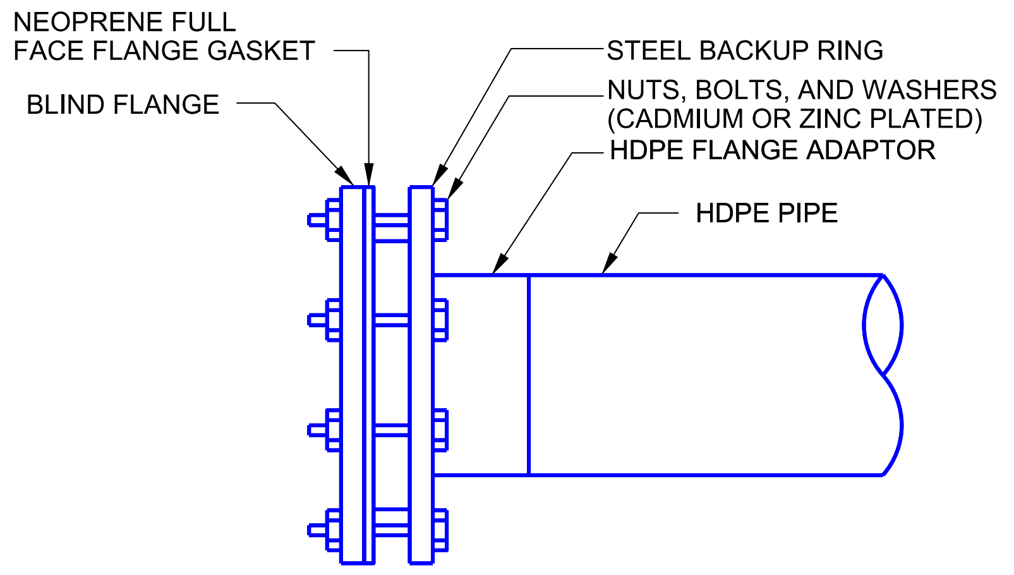
FLANGE CONNECTION (TYP) 4

NTS



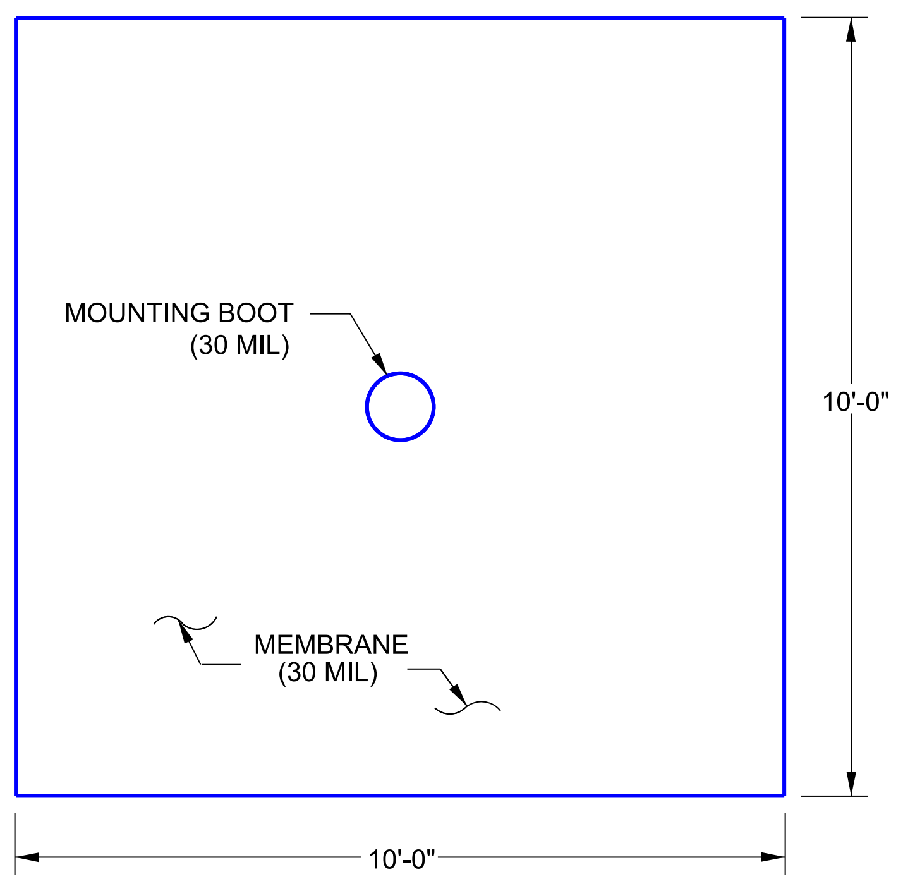
LATERAL CONNECTION DETAIL 8

NTS



BLIND FLANGE (TYP) 5

NTS



SYNTHETIC WELL BOOT 6

NTS

NOTES:

1. ALL HDPE PIPE IS SDR-17 OR SDR-26 (DEPENDING ON SIZE AS SPECIFIED IN SUBSEQUENT CONSTRUCTION PLANS) AND ALL FITTINGS ARE SDR-11 UNLESS OTHERWISE NOTED.
2. ALL CPVC PIPE AND FITTINGS ARE SCH 80 UNLESS OTHERWISE NOTED. HDPE PIPE MAY BE USED IN PLACE OF CPVC AS DIRECTED BY COUNTY ENGINEER AND DESIGN ENGINEER.
3. CLEAN SAND OR SELECT SITE MATERIAL BEDDING AND BACKFILL COMPACTED IN MAXIMUM LIFTS OF 9".
4. REPAIR COVER TO ORIGINAL CONDITIONS AND SPECIFICATIONS.
5. ALL NUTS, BOLTS AND WASHERS ARE CADMIUM OR ZINC PLATED UNLESS OTHERWISE STATED.
6. DIMENSIONS, LOCATION & SIZE OF SYSTEM COMPONENTS ARE SUBJECT TO CHANGE IN THE FIELD DURING CONSTRUCTION.
7. SYSTEM COMPONENTS MAY HAVE SUBSTITUTE COMPONENTS INSTALLED OF EQUAL VALUE & CAPABILITY.

NO | DRN | CHK | DATE | REVISIONS

DRN | DES | CHK | APP | INITIAL | DATE

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PREPARED BY
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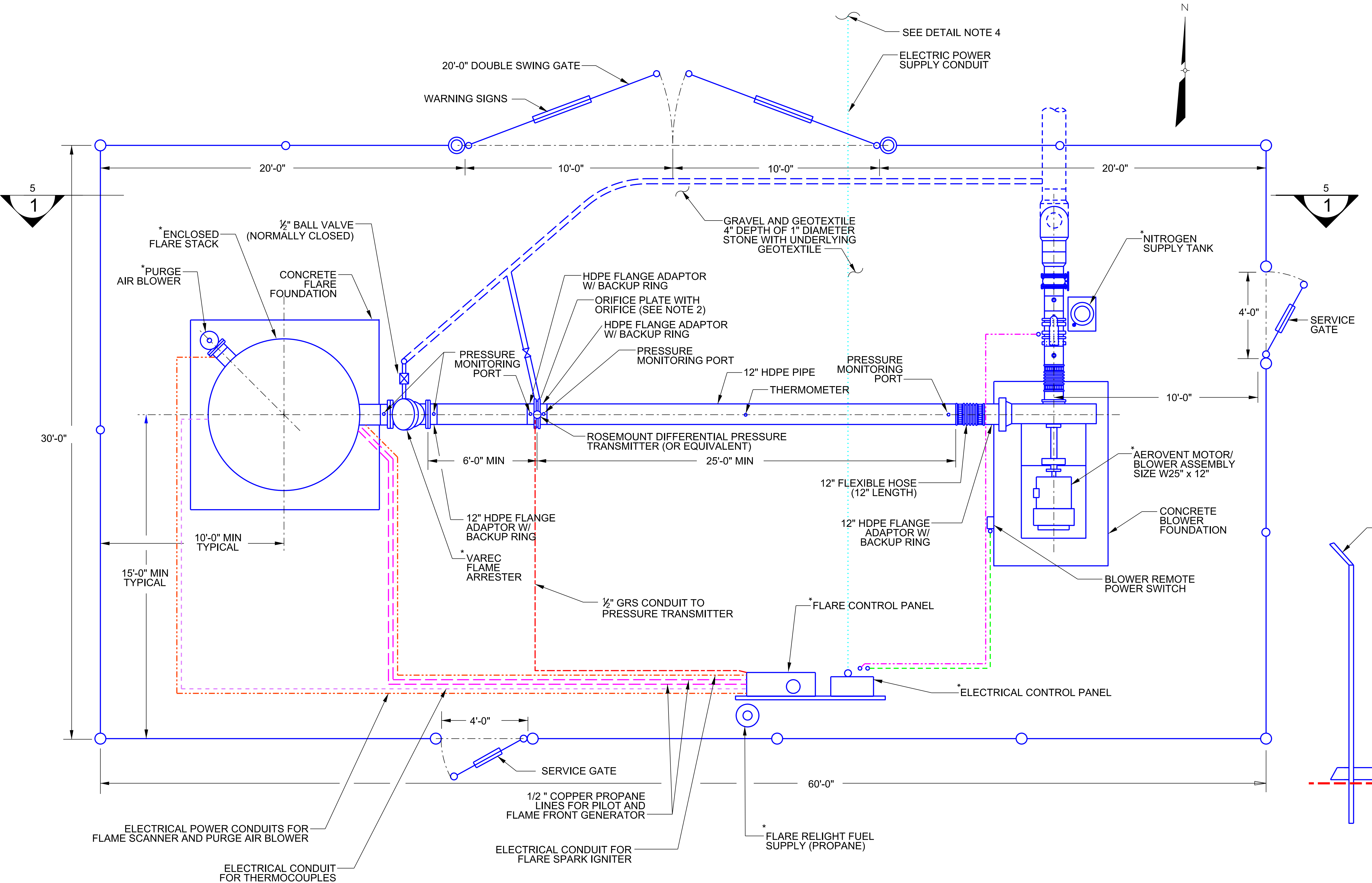
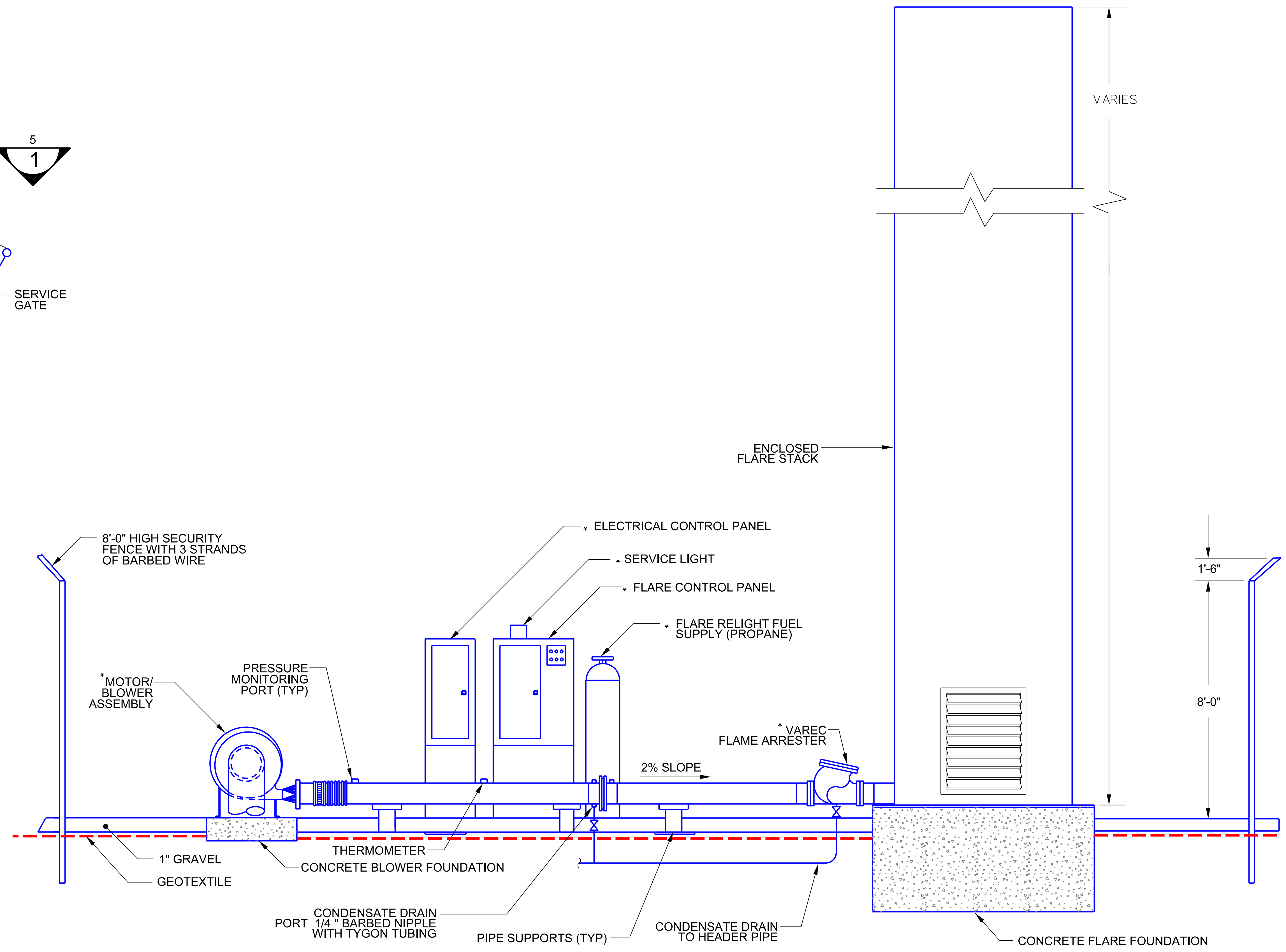
KEKAHA SANITARY LANDFILL
KEKAHA, KAUAI, HAWAII

GAS MANAGEMENT SYSTEM DETAILS

DATE MARCH 2015
PROJECT NO 090605
FILENAME 004 KEK DET1 010815
SHEET NO 4 OF 6
DRAWING NO 4



PLAN VIEW



ELEVATION VIEW

BLOWER/ FLARE STATION 1

NTS

NOTES:

1. PROPOSED BLOWER/ FLARE STATION LAYOUT MAY VARY BASED ON FIELD CONDITIONS ENCOUNTERED. ACTUAL FLARE DESIGN MAY CHANGE BUT WILL CONFORM WITH GCCS DESIGN REQUIREMENTS.
2. THE THERMAL MASS METER SHOULD BE PLACED BETWEEN THE BLOWER AND THE FLARE STACK WITH AT LEAST 10 TIMES THE INSIDE DIAMETER OF THE PIPE UP STREAM THE THERMAL MASS METER AND 5 TIMES THE INSIDE DIAMETER OF THE PIPE DOWN STREAM, WITHOUT ANY FLOW INTERRUPTIONS (SUCH AS ELBOWS, VALVES, SAMPLE PROBES, ETC).
3. PROPOSED BLOWER MOTOR MOUNT SHOULD BE ADAPTABLE FOR INITAL 15 HP MOTOR TO ULTIMATE MAXIMUM OF 50 HP MOTOR.
*4. OWNER TO PROVIDE ELECTRIC SERVICE WITHIN 25 FEET OF FLARE STATION AREA. CONTRACTOR IS RESPONSBILE FOR CONNECTION OF ELECTRIC SERVICE TO FLARE CONTROL PANEL.
5. INDICATES EQUIPMENT PROVIDED BY OWNER.

NOTES:

1. ALL ABOVE AND BELOW GRADE EXPOSED METAL SHALL BE CORROSION PROTECTED WITH BOWMAN GALV-COAT METALLIC ZINC SPRAY OR EQUIVALENT.
2. CONTRACTOR IS RESPONSIBLE FOR INSTALLATION OF PIPE SUPPORT PADS AND SUPPLY TANK SUPPORT PADS. CONTRACTOR SHALL PROVIDE 24" x 24" x 4" CONCRETE SUPPORT WITH UNISTRUT P-1000 VERTICAL STANCHION FOR NITROGEN TANKS.
3. LOCATION OF ALL FENCE ENTRANCE GATES SHALL BE FIELD DETERMINED BY OWNER. CONTRACTOR SHALL VERIFY THE INTEGRITY OF THE INLET VALVE ACTUATOR SUPPLY LINE. FOR ALL ENCLOSED FLARE DIMENSIONAL DATA, INSTALLATION AND OPERATION INFORMATION REFER TO FLARE MANUFACTURER'S SHOP DRAWINGS.
4. LANDFILL GAS AND LEACHATE SYSTEM MAY CHANGE DUE TO SITE CONDITIONS AT THE TIME OF CONSTRUCTION.
5. ALL PVC PIPE AND FITTINGS ARE SCH 80 EXCEPT AS NOTED. ALL HDPE PIPE IS SDR-17 OR SDR-26 (DEPENDING ON SIZE AS SPECIFIED IN SUBSEQUENT CONSTRUCTION PLANS) AND ALL FITTINGS ARE SDR-11 UNLESS OTHERWISE NOTED.
6. FOR ALL BLOWER DIMENSIONAL DATA, INSTALLATION AND OPERATION INFORMATION, REFER TO BLOWER MANUFACTURER'S SHOP DRAWINGS.
7. TO MAINTAIN GRAVEL PACK STABILITY AND VEGETATION GROWTH CONTROL, A GEOTEXTILE SHALL BE INSTALLED IN THE BLOWER/FLARE STATION PRIOR TO FOUR (4) INCHES OF COMPACTED GRAVEL.
8. CONTRACTOR IS RESPONSIBLE FOR DESIGN OF CONCRETE PAD AND REINFORCING. CONTRACTOR SHALL SUBMIT DESIGN FOR OWNER APPROVAL PRIOR TO INSTALLATION.

ANDREW J. QUERIO
No. 15174-C

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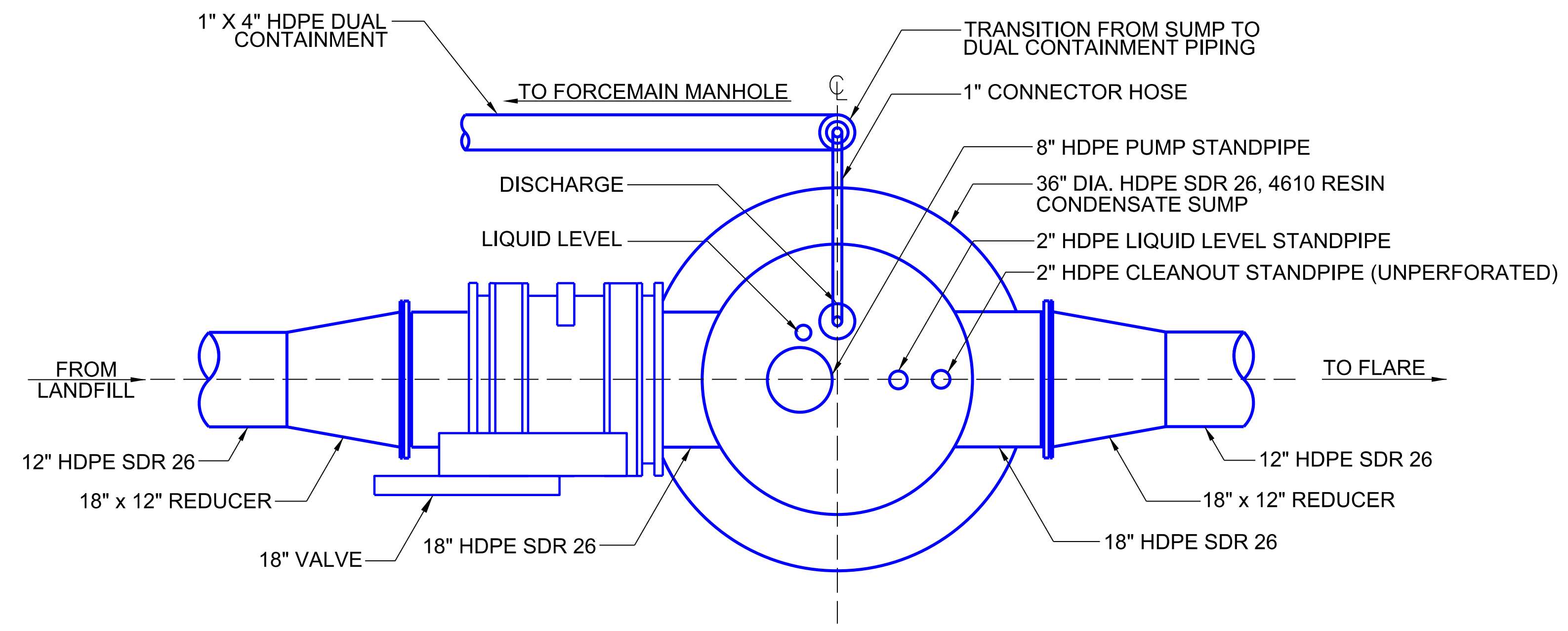
SANITARY LANDFILL

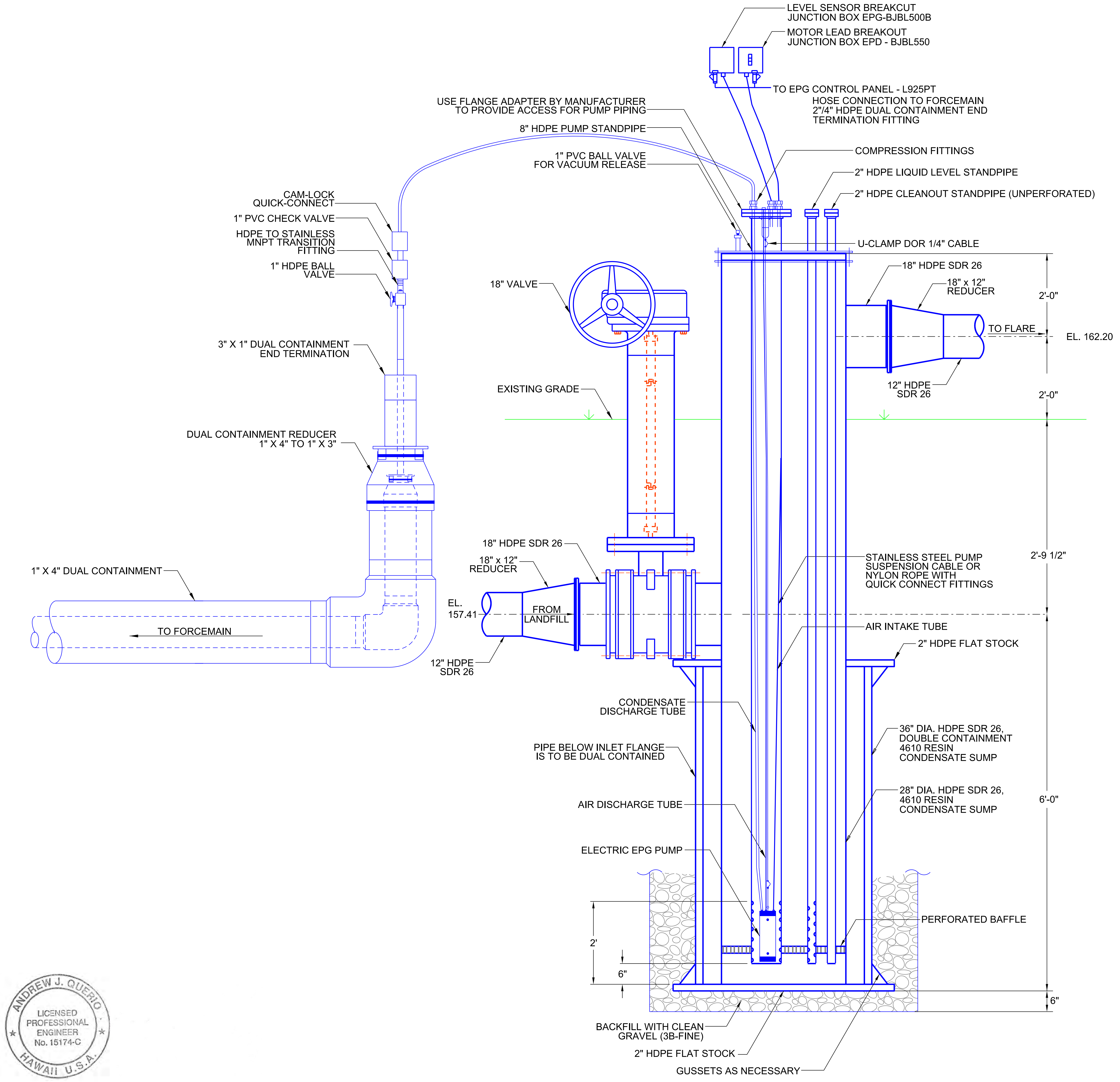
PREPARED BY
EIL
ENVIRONMENTAL INFORMATION LOGISTICS, LLC

KEKAHA SANITARY LANDFILL
KEKAHA, KAUAI, HAWAII

GAS MANAGEMENT SYSTEM DETAILS

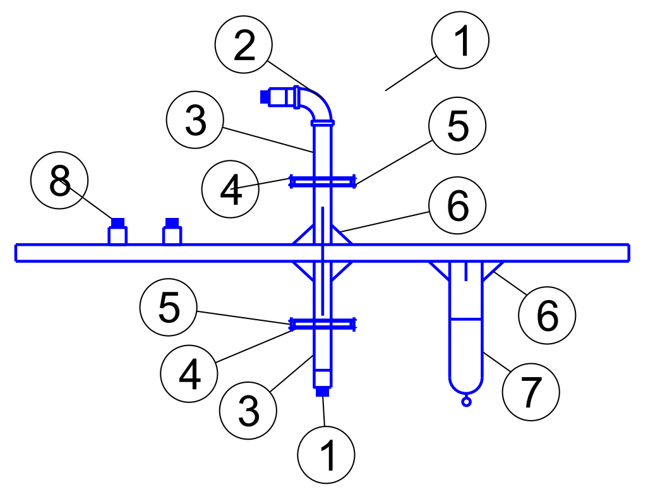
DATE MARCH 2015
PROJECT NO 090605
FILENAME 005 KEK DET2 011415
SHEET NO 5 OF 6
DRAWING NO 5





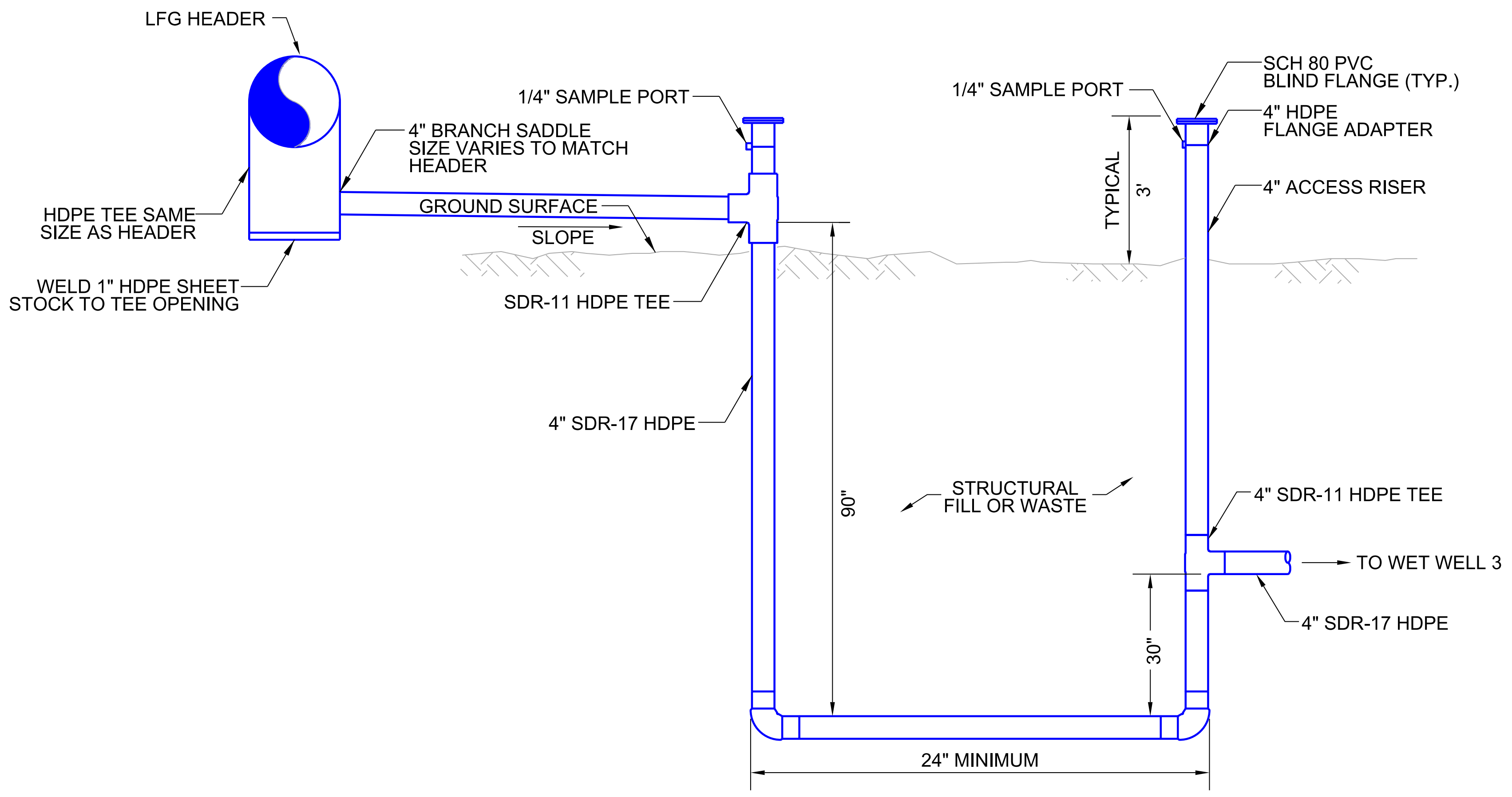
CONDENSATE SUMP (NEW) 1

NTS



COMPONENTS SHOWN OUT OF ORIENTATION FOR CLARITY

1. 1" TYPE A POLYPROPYLENE MALE ADAPTER X FEMALE NPT
2. 1" 304 S.S. 90 DEG.
3. 1" X 4" 304 S.S. NIPPLE
4. 1" S.S. RAISED HEAD THREADED FLANGE
5. 1" HDPE FLANGE ADAPTER W/ DUCTILE IRON BACKUP RING
6. GUSSETS AS NECESSARY
7. 2" STEEL PULLING HEAD TRANSITION FOR HDPE
8. 1/2" CONDUIT X CORD DIA. LIQUID LIGHT CORD CONNECTOR FOR POWER AND LIQUID LEVEL
9. 1" CHEMICAL RESISTANT HOSE W/ TYPE C POLYPROPYLENE FEMALE COUPLER WITH HOSE SHANK (EACH END)



CONDENSATE DRIPLEG 1

NTS

NOTES:

1. DISCHARGE LINE FROM DRIPLEG TO BE DUAL-CONTAINED OUTSIDE OF REFUSE LIMITS.
2. THIS CONFIGURATION IS ADEQUATE FOR A MAXIMUM 60" OF WATER COLUMN VACUUM. THE DEPTH OF THE DRIPLEG MAY BE ALTERED DEPENDING ON VACUUM REQUIREMENTS AT THE TIME OF INSTALLATION.

NOTES:

1. LANDFILL GAS AND CONDENSATE SYSTEM MAY CHANGE DUE TO SITE CONDITIONS AT THE TIME OF CONSTRUCTION.
2. ALL PVC PIPE AND FITTINGS ARE SCH 80 EXCEPT AS NOTED.
3. ALL HDPE PIPE IS SDR-17 OR SDR-26 (DEPENDING ON SIZE AS SPECIFIED IN SUBSEQUENT CONSTRUCTION PLANS) AND ALL FITTINGS ARE SDR-11 UNLESS OTHERWISE NOTED.
4. COMPACTED CLEAN SAND BEDDING AND BACKFILL IN MAXIMUM LIFTS OF 9".
5. ALL NUTS, BOLTS, AND WASHERS ARE CADMIUM PLATED UNLESS OTHERWISE NOTED.
6. ALL UNDERGROUND 2" CONDENSATE DISCHARGE PIPE SHALL BE DUAL CONTAINED.

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HAWAII U.S.A.

4/30/16
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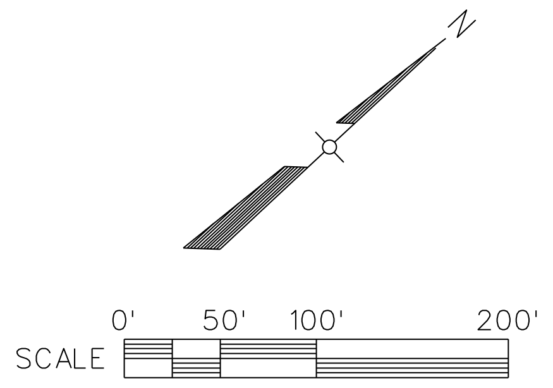
KEKAHA SANITARY LANDFILL
KEKAHA, KAUAI, HAWAII

GAS MANAGEMENT SYSTEM DETAILS

DATE MARCH 2015
PROJECT NO 090605
FILENAME 006 KEK DET3 011415
SHEET NO 6 OF 6
DRAWING NO 6

LEGEND:

- - - - - -	PROPERTY LINE	☐	EXISTING STRUCTURE
-·-·-·-·-	PERMITTED LIMIT OF WASTE	———	LANDFILL GAS COLLECTION HEADER/LATERAL
— — — —	ACCESS ROAD	⊕	LANDFILL GAS EXTRACTION WELL
~680~	EXISTING TOPOGRAPHY	◎	CONDESATE KNOCKOUT
—90—	PERMITTED FINAL GRADE	⊗	CONDESATE KNOCKOUT
E 1556500	COORDINATE SYSTEM	●	HEADER ACCESS RISER
		➤	SURFACE SCAN ROUTE



NOTES:

1. TOPOGRAPHIC MAP PROVIDED BY MILLER CREEK AERIAL, INC., DATED, FEBRUARY 24, 2015.
2. GRADES SHOWN DEPICT TOP OF FINAL COVER SYSTEM. MAXIMUM FINAL COVER ELEVATION IS 120 FEET.
3. CURRENT TOPOGRAPHY MAY DIFFER FROM THAT SHOWN DUE TO ON-GOING LANDFILLING OPERATIONS SINCE THE DATE OF THE AERIAL SURVEY.
4. FOR CLARITY NOT ALL SITE FEATURES ARE SHOWN.
5. THE PROPOSED SURFACE MONITORING PLAN/ROUTE IS CONCEPTUAL AND REPRESENTS A TYPICAL PLAN/ROUTE TO BE FOLLOWED ONCE THE SITE IS PERMANENTLY CLOSED. DEPENDING ON THE ACTUAL FIELD CONDITIONS, THE ACTUAL SURFACE MONITORING MAY FOLLOW A DIFFERENT ROUTE. SURFACE MONITORING CONDUCTED WHILE THE SITE IS STILL ACTIVE MAY FOLLOW A DIFFERENT ROUTE. HOWEVER, THE ROUTE SHALL MEET THE NSPS REQUIREMENTS.

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COUNTY OF KAUAI KEKAHA SANITARY LANDFILL

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KEKAHA SANITARY LANDFILL
KEKAHA, KAUAI, HAWAII

SURFACE SCAN PLAN

DATE MARCH 2015
PROJECT NO 090605
FILENAME KEK SURFACE SCAN PLAN
SHEET NO 1 OF 1
DRAWING NO 1

APPENDIX C

SURFACE EMISSIONS MONITORING PLAN

LANDFILL SURFACE EMISSIONS MONITORING PROTOCOL

This surface emission monitoring (SEM) protocol is submitted in compliance with the requirements of the 40 CFR §60.753 (d).

Sampling Methods and Procedures

A surface concentration below 500 parts per million (ppm) methane above background indicates proper operation of the GCCS. The following test methods and procedures for surface emissions testing satisfy 40 CFR §60.753 (d).

- A portable monitor in general conformance with 40 CFR Part 60, Appendix A, Method 21 will be used to determine the methane concentration at each sampling point. The instrument will be calibrated, according to the manufacturer's recommendations, for methane, diluted to a nominal concentration of 500 ppm in air.

- Monitoring will be performed during typical meteorological conditions.

- The background concentration will be determined by moving the probe inlet upwind and downwind outside the refuse permit boundary of the landfill at a distance of approximately 98 feet (30 meters) in areas without a synthetic cap and approximately 196 feet (60 meters) in areas with a synthetic cap in place.

- The detector probe will be positioned within 2 to 4 inches (5 to 10 centimeters) of the ground.

- A pattern of parallel lines approximately 98 feet (30 meters) or approximately 196 feet (60 meters) apart will be established over a majority of the surface area of the landfill that contains buried refuse. Areas of the landfill with excessive slopes will be excluded from SEM. A monitoring result will be recorded at the appropriate intervals. The anticipated pattern for monitoring of surface emission data is presented on the drawing included in this appendix.

- Any areas where visual observations indicate elevated concentrations of landfill gas, such as distressed vegetation and cracks or seeps in the cover, will be monitored.

- Areas with steep slopes or other dangerous areas may be excluded from the surface testing.

- Any detection of 500 ppm or more above background will be recorded as an exceedance. The location of the exceedance will be marked and recorded. Cover maintenance or adjustments to the GCCS will be made and the location will be re-monitored within 10 calendar days of the initial exceedance or, if inclement weather is observed, in accordance with the SEM variance. If the re-monitoring of the location shows a second exceedance, additional corrective action will be taken and the location will be re-monitored within 10 days of the second exceedance or, once again, in accordance with the SEM variance. A proposed corrective action plan and corresponding timeline will be submitted to DOH for approval for any location where monitored methane concentration equals or exceeds 500 ppm above background three times within a quarterly period.

- Any location that initially showed an exceedance but has a methane concentration less than 500 ppm methane above background at the 10-day remonitoring (REM) event or approved alternate time frame shown in Section 6.2.3 will be re-monitored 1-month from the initial exceedance. If the 1-month re-monitoring shows a concentration less than 500 ppm above background, no further monitoring of that location will be performed until the next quarterly monitoring period. If the 1-month re-monitoring shows an exceedance, the location will be re-monitored within 10 calendar days of the second exceedance or, if inclement weather is observed, as specified in Section 6.2.2. A proposed corrective action plan and corresponding timeline will be submitted to the Department for approval for any location where monitored methane concentration equals or exceeds 500 ppm above background three times within a quarterly period.

Frequency

Surface emissions monitoring will be performed quarterly. If the surface emissions monitoring does not exceed 500 ppm above background at any point for three consecutive quarterly monitoring periods in portions/areas of the landfill that are closed or at final grade (i.e. Phase I of the existing Kekaha Landfill), monitoring will be performed annually in the areas/portions that are closed or at final grade. The site will return to quarterly monitoring of the closed/final grade portions/area of the site if any methane reading of 500 ppm or more above background is detected during the annual surface emissions monitoring event.

Recordkeeping

The location and concentration of each exceedance recorded during the surface emissions monitoring will be reported in an annual report to the Administrator. The concentration recorded at each location for which an exceedance was recorded in the previous month will also be included in the annual report. Reports and monitoring records will be maintained with the site records for a period of five years.

Table C – 1: SURFACE EMISSION RESPONSE TIME TEST RECORD

40 CFR §60.755(d)(3) requires performance evaluation of response factor, response time and calibration precision according to 40 CFR 60 Appendix A, Method 21. The requirements are presented below along with locations to record the evaluations.

Response Factor:
Response factor is the ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the applicable regulation. Since the monitoring instrument is being used to detect methane and the calibration reference compound is methane, the response factor by definition is one. No further evaluation is required.

Response Time:
Response time is the time interval from a step change in VOC concentration at the input of the sampling system to the time at which 9 percent of the corresponding final value is reached as displayed on the instrument readout meter.

Performance Requirement: Method 21 requires the instrument response time to be equal to or less than 30 seconds.

Evaluation Frequency: Prior to placing instrument into service (for the first time or after it was out of service for maintenance or repair). If modification to the sample pumping system or flow configuration is made that would change the response time, a new test is required prior to further use.

Evaluation Procedure: Calibrate instrument with the methane calibration gas. Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. Measure the time from switching to when 90 percent of the final stable reading is attained. Perform this test sequence three times and record the results. Calculate the average response time. Use the following form to document this procedure.

Kekaha Sanitary Landfill
SURFACE EMISSION RESPONSE TIME TEST RECORD

DATE: ______________
TIME:

INSTRUMENT MAKE: ______________
MODEL: ______________
S/N: ______________

MEASUREMENT #1:

Stabilized Reading Using Calibration Gas: _______ ppm
90% of the Stabilized Readings: _______ ppm
Time to Reach 90% of Stabilized reading after starting from Zero Air to Calibration Gas
_______ seconds (1)

MEASUREMENT #2:

Stabilized Reading Using Calibration Gas: _______ ppm
90% of the Stabilized Readings: _______ ppm
Time to Reach 90% of Stabilized reading after starting from Zero Air to Calibration Gas
_______ seconds (2)

MEASUREMENT #3:

Stabilized Reading Using Calibration Gas: _______ ppm
90% of the Stabilized Readings: _______ ppm
Time to Reach 90% of Stabilized reading after starting from Zero Air to Calibration Gas
_______ seconds (3)

CALCULATE PRECISION:

$\frac{(1) + (2) + (3)}{3} =$ seconds (MUST BE LESS THAN 30 SECONDS)

PERFORMED BY: ___

Table C – 2: SURFACE EMISSION CALIBRATION PRECISION TEST RECORD

Calibration Precision:

Calibration precision is the degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between the meter readings and the known concentration to the known concentration.

Performance Requirement: The calibration precision must be equal to or less than 10 percent of the calibration gas value.

Evaluation Frequency: Must be completed prior to placing instrument into service, and at subsequent 3-month intervals or at the next use whichever is later.

Evaluation Procedure: Calibrate instrument with the methane calibration gas. Make a total of three measurements by alternately using zero gas and the specified calibration gas. Record the meter readings. Calculate the average algebraic difference between the meter readings and the known value. Divide this average difference by the known calibration value and multiply by 100 to express the resulting calibration precision as a percentage. Use the following form to document this procedure.

Kekaha Sanitary Landfill
SURFACE EMISSION CALIBRATION PRECISION TEST RECORD

CALIBRATION DATE: ____________________
TIME:

EXPIRATION DATE (3 MOS.): ____________________

INSTRUMENT MAKE: ____________________
MODEL: ____________________
S/N: ____________________

MEASUREMENT #1:

Meter Reading for Zero Air: ppm (1) ________________

Meter Reading for Calibration Gas: ppm (2) ________________

MEASUREMENT #2:

Meter Reading for Zero Air: ppm (3) ________________

Meter Reading for Calibration Gas: ppm (4) ________________

MEASUREMENT #3:

Meter Reading for Zero Air: ppm (5) ________________

Meter Reading for Calibration Gas: ppm (6) ________________

CALCULATE PRECISION: 500

$$\frac{[500 - (491)] + [500 - (499)] + [500 - (496)]}{3} \times \frac{1}{500} \times 100$$

% (must be less than 10%)

PERFORMED BY: ________________________

Table C – 3: SURFACE EMISSION CALIBRATION PROCEDURE AND BACKGROUND DETERMINATION REPORT

The calibration procedures in 40 CFR 60 Appendix A, Method 21 must be conducted immediately before commencing a surface monitoring survey. [40 CFR §60.755(d)(4)] Calibration, background readings and monitoring details can be recorded using this form.

Calibration Procedure:
The calibration gas should be methane in air at a nominal concentration of 500 ppm. [See Method 21 for further calibration gas requirements.]

Assemble and start up the analyzer according to the manufacturer's instructions. After the appropriate warm-up period and zero internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value. Record the calibration information in the table below.

Background Concentration:
Determine the background concentration by moving the probe inlet upwind outside the boundary of the landfill at a distance of at least 30 meters from the perimeter wells. Record the background concentration and location in the following form.

Kekaha Sanitary Landfill
SURFACE EMISSION
CALIBRATION PROCEDURE AND BACKGROUND DETERMINATION REPORT

INSTRUMENT MAKE: ___________________
MODEL: ___________________
S/N: ___________________

Calibration Procedure

1. Allow instrument to internally zero itself while introducing zero air.

2. Introduce calibration gas into the probe.
Stable reading = ___________ ppm

3. Adjust meter to read 500 ppm.

Background Determination Procedure

1. Upwind Reading (highest in 30 seconds): ___________ ppm (1)

2. Downwind Reading (highest in 30 seconds): ___________ ppm (2)

Calculate Background Value:

$$\frac{(1) + (2)}{2}$$

Background = ___________ ppm

PERFORMED BY:

____

Date: ___________________
Time: ___________ PM __________

Table C – 4: SAMPLE INDIVIDUAL MONITORING EXCEEDANCE FORM

Use the following form to record an individual monitoring exceedance and follow-up monitoring activities. This form is only used when a reading of 500 ppm above background is encountered during the surface monitoring. Use a separate form for each initial exceedance.

Landfill Surface Emissions Monitoring
Exceedance and Monitoring Logs

Monitoring Event

Kekaha Sanitary Landfill

Initial Monitoring Event			**1st Re-monitoring Event - 10 Days**		**2nd Re-monitoring Event- 10 Days**		**1st Follow-up - 30 Days**		**Comments**
Monitoring Location No.	Concentration (ppm)	Monitoring Date	Monitoring Date	Concentration (ppm)	Monitoring Date	Concentration (ppm)	Monitoring Date	Concentration (ppm)	

	Initial Monitoring	1st Re-monitoring	2nd Re-monitoring	30 day Re-monitoring
Average Methane Concentration above 500 (ppm):				
Maximum Methane Concentration (ppm):				

Note: Only concentrations above 500 ppm are included in the initial survey

Table C – 5: COVER INTEGRITY FORM

Use the following forms to record monthly cover integrity.

Monthly Cover Monitoring

Kekaha Landfill

LOCATION:
INSPECTION DATE:
TECHNICIAN:

COVER & VEGETATION	YES	NO	COMMENTS
Settling of cap			
Dead vegetation			
Erosion on cap system			
Erosion on side slopes			
Ponding of water on cap			
Surface cracking			
Acceptable vegetation			
Exposed waste			

REPAIR AREAS:

Location	Date of Repair	COMMENTS

Comments:

Cover Integrity Summary Report

Kekaha Landfill

Month	Inspection Date	Repair Date	Inspector Initials	Cover Integrity Probles Found During Inspection	Comments
January				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
February				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
March				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
April				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
May				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
June				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
July				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
August				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
September				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
October				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
November				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	
December				☐ No problems found. ☐ See detailed Monthly Cover Monitoring form.	

The following method will be used as amended pursuant to 40 CFR §60.755(c) and (d) and is included herein as reference. Changes to the method adopted by US EPA after submittal of this plan approval will be used after those changes are published and the following will be void.

40 CFR 60 Appendix A, Method 21

METHOD 21—DETERMINATION OF VOLATILE ORGANIC COMPOUND LEAKS

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.
Volatile Organic Compounds (VOC)	No CAS number assigned.

1.2 Scope. This method is applicable for the determination of VOC leaks from process equipment. These sources include, but are not limited to, valves, flanges and other connections, pumps and compressors, pressure relief devices, process drains, open-ended valves, pump and compressor seal system degassing vents, accumulator vessel vents, agitator seals, and access door seals.

1.3 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method

2.1 A portable instrument is used to detect VOC leaks from individual sources. The instrument detector type is not specified, but it must meet the specifications and performance criteria contained in section 6.0. A leak definition concentration based on a reference compound is specified in each applicable regulation. This method is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rate from individual sources.

3.0 Definitions

3.1 *Calibration gas* means the VOC compound used to adjust the instrument meter reading to a known value. The calibration gas is usually the reference compound at a known concentration approximately equal to the leak definition concentration.

3.2 *Calibration precision* means the degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between the meter readings and the known concentration to the known concentration.

3.3 *Leak definition concentration* means the local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is present. The leak definition is an instrument meter reading based on a reference compound.

3.4 *No detectable emission* means a local VOC concentration at the surface of a leak source, adjusted for local VOC ambient concentration, that is less than 2.5 percent of the specified leak definition concentration. that indicates that a VOC emission (leak) is not present.

3.5 *Reference compound* means the VOC species selected as the instrument calibration basis for specification of the leak definition concentration. (For example, if a leak definition concentration is 10,000 ppm as methane, then any source emission that results in a local concentration that yields a meter reading of 10,000 on an instrument meter calibrated with methane would be classified as a leak. In this example, the leak definition concentration is 10,000 ppm and the reference compound is methane.)

3.6 *Response factor* means the ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the applicable regulation.

3.7 *Response time* means the time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90 percent of the corresponding final value is reached as displayed on the instrument readout meter.

4.0 Interferences [Reserved]

5.0 Safety

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

5.2 Hazardous Pollutants. Several of the compounds, leaks of which may be determined by this method, may be irritating or corrosive to tissues (*e.g.,* heptane) or may be toxic (*e.g.,* benzene, methyl alcohol). Nearly all are fire hazards. Compounds in emissions should be determined through familiarity with the source. Appropriate precautions can be found in reference documents, such as reference No. 4 in section 16.0.

6.0 Equipment and Supplies

A VOC monitoring instrument meeting the following specifications is required:

6.1 The VOC instrument detector shall respond to the compounds being processed. Detector types that may meet this requirement include, but are not limited to, catalytic oxidation, flame ionization, infrared absorption, and photoionization.

6.2 The instrument shall be capable of measuring the leak definition concentration specified in the regulation.

6.3 The scale of the instrument meter shall be readable to ±2.5 percent of the specified leak definition concentration.

6.4 The instrument shall be equipped with an electrically driven pump to ensure that a sample is provided to the detector at a constant flow rate. The nominal sample flow rate, as measured at the sample probe tip, shall be 0.10 to 3.0 l/min (0.004 to 0.1 ft^3/min) when the probe is fitted with a glass wool plug or filter that may be used to prevent plugging of the instrument.

6.5 The instrument shall be equipped with a probe or probe extension or sampling not to exceed 6.4 mm (¼ in) in outside diameter, with a single end opening for admission of sample.

6.6 The instrument shall be intrinsically safe for operation in explosive atmospheres as defined by the National Electrical Code by the National Fire Prevention Association or other applicable regulatory code for operation in any explosive atmospheres that may be encountered in its use. The instrument shall, at a minimum, be intrinsically safe for Class 1, Division 1 conditions, and/or Class 2, Division 1 conditions, as appropriate, as defined by the example code. The instrument shall not be operated with any safety device, such as an exhaust flame arrestor, removed.

7.0 Reagents and Standards

7.1 Two gas mixtures are required for instrument calibration and performance evaluation:

7.1.1 Zero Gas. Air, less than 10 parts per million by volume (ppmv) VOC.

7.1.2 Calibration Gas. For each organic species that is to be measured during individual source surveys, obtain or prepare a known standard in air at a concentration approximately equal to the applicable leak definition specified in the regulation.

7.2 Cylinder Gases. If cylinder calibration gas mixtures are used, they must be analyzed and certified by the manufacturer to be within 2 percent accuracy, and a shelf life must be specified. Cylinder standards must be either reanalyzed or replaced at the end of the specified shelf life.

7.3 Prepared Gases. Calibration gases may be prepared by the user according to any accepted gaseous preparation procedure that will yield a mixture accurate to within 2 percent. Prepared standards must be replaced each day of use unless it is demonstrated that degradation does not occur during storage.

7.4 Mixtures with non-Reference Compound Gases. Calibrations may be performed using a compound other than the reference compound. In this case, a conversion factor must be determined for the alternative compound such that the resulting meter readings during source surveys can be converted to reference compound results.

8.0 Sample Collection, Preservation, Storage, and Transport

8.1 Instrument Performance Evaluation. Assemble and start up the instrument according to the manufacturer's instructions for recommended warmup period and preliminary adjustments.

8.1.1 Response Factor. A response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated at subsequent intervals.

8.1.1.1 Calibrate the instrument with the reference compound as specified in the applicable regulation. Introduce the calibration gas mixture to the analyzer and record the observed meter reading. Introduce zero gas until a stable reading is obtained. Make a total of three measurements by alternating between the calibration gas and zero gas. Calculate the response factor for each repetition and the average response factor.

8.1.1.2 The instrument response factors for each of the individual VOC to be measured shall be less than 10 unless otherwise specified in the applicable regulation. When no instrument is available that meets this specification when calibrated with the reference VOC specified in the applicable regulation, the available instrument may be calibrated with one of the VOC to be measured, or any other VOC, so long as the instrument then has a response factor of less than 10 for each of the individual VOC to be measured.

8.1.1.3 Alternatively, if response factors have been published for the compounds of interest for the instrument or detector type, the response factor determination is not required, and existing results may be referenced. Examples of published response factors for flame ionization and catalytic oxidation detectors are included in References 1-3 of section 17.0.

8.1.2 Calibration Precision. The calibration precision test must be completed prior to placing the analyzer into service and at subsequent 3-month intervals or at the next use, whichever is later.

8.1.2.1 Make a total of three measurements by alternately using zero gas and the specified calibration gas. Record the meter readings. Calculate the average algebraic difference between the meter readings and the known value. Divide this average difference by the known calibration value and multiply by 100 to express the resulting calibration precision as a percentage.

8.1.2.2 The calibration precision shall be equal to or less than 10 percent of the calibration gas value.

8.1.3 Response Time. The response time test is required before placing the instrument into service. If a modification to the sample pumping system or flow configuration is made that would change the response time, a new test is required before further use.

8.1.3.1 Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. After switching, measure the time required to attain 90 percent of the final stable reading. Perform this test sequence three times and record the results. Calculate the average response time.

8.1.3.2 The instrument response time shall be equal to or less than 30 seconds. The instrument pump, dilution probe (if any), sample probe, and probe filter that will be used during testing shall all be in place during the response time determination.

8.2 Instrument Calibration. Calibrate the VOC monitoring instrument according to section 10.0.

8.3 Individual Source Surveys.

8.3.1 Type I—Leak Definition Based on Concentration. Place the probe inlet at the surface of the component interface where leakage could occur. Move the probe along the interface periphery while observing the instrument readout. If an increased meter reading is observed, slowly sample the interface where leakage is indicated until the maximum meter reading is obtained. Leave the probe inlet at this maximum reading location for approximately two times the instrument response time. If the maximum observed meter reading is greater than the leak definition in the applicable regulation, record and report the results as specified in the regulation reporting requirements. Examples of the application of this general technique to specific equipment types are:

8.3.1.1 Valves. The most common source of leaks from valves is the seal between the stem and housing. Place the probe at the interface where the stem exits the packing gland and sample the stem circumference. Also, place the probe at the interface of the packing gland take-up flange seat and sample the periphery. In addition, survey valve housings of multipart assembly at the surface of all interfaces where a leak could occur.

8.3.1.2 Flanges and Other Connections. For welded flanges, place the probe at the outer edge of the flange-gasket interface and sample the circumference of the flange. Sample other types of nonpermanent joints (such as threaded connections) with a similar traverse.

8.3.1.3 Pumps and Compressors. Conduct a circumferential traverse at the outer surface of the pump or compressor shaft and seal interface. If the source is a rotating shaft, position the probe inlet within 1 cm of the shaft-seal interface for the survey. If the housing configuration prevents a complete traverse of the shaft periphery, sample all accessible portions. Sample all other joints on the pump or compressor housing where leakage could occur.

8.3.1.4 Pressure Relief Devices. The configuration of most pressure relief devices prevents sampling at the sealing seat interface. For those devices equipped with an enclosed extension, or horn, place the probe inlet at approximately the center of the exhaust area to the atmosphere.

8.3.1.5 Process Drains. For open drains, place the probe inlet at approximately the center of the area open to the atmosphere. For covered drains, place the probe at the surface of the cover interface and conduct a peripheral traverse.

8.3.1.6 Open-ended Lines or Valves. Place the probe inlet at approximately the center of the opening to the atmosphere.

8.3.1.7 Seal System Degassing Vents and Accumulator Vents. Place the probe inlet at approximately the center of the opening to the atmosphere.

8.3.1.8 Access door seals. Place the probe inlet at the surface of the door seal interface and conduct a peripheral traverse.

8.3.2 Type II—“No Detectable Emission”. Determine the local ambient VOC concentration around the source by moving the probe randomly upwind and downwind at a distance of one to two meters from the source. If an interference exists with this determination due to a nearby emission or leak, the local ambient concentration may be determined at distances closer to the source, but in no case shall the distance be less than 25 centimeters. Then move the probe inlet to the surface of the source and determine the concentration as outlined in section 8.3.1. The difference between these concentrations determines whether there are no detectable emissions. Record and report the results as specified by the regulation. For those cases where the regulation requires a specific device installation, or that specified vents be ducted or piped to a control device, the existence of these conditions shall be visually confirmed. When the regulation also requires that no detectable emissions exist, visual observations and sampling surveys are required. Examples of this technique are:

8.3.2.1 Pump or Compressor Seals. If applicable, determine the type of shaft seal. Perform a survey of the local area ambient VOC concentration and determine if detectable emissions exist as described in section 8.3.2.

8.3.2.2 Seal System Degassing Vents, Accumulator Vessel Vents, Pressure Relief Devices. If applicable, observe whether or not the applicable ducting or piping exists. Also, determine if any sources exist in the ducting or piping where emissions could occur upstream of the control device. If the required ducting or piping exists and there are no sources where the emissions could be vented to the atmosphere upstream of the control device, then it is presumed that no detectable emissions are present. If there are sources in the ducting or piping where emissions could be vented or sources where leaks could occur, the sampling surveys described in section 8.3.2 shall be used to determine if detectable emissions exist.

8.3.3 Alternative Screening Procedure.

8.3.3.1 A screening procedure based on the formation of bubbles in a soap solution that is sprayed on a potential leak source may be used for those sources that do not have continuously moving parts, that do not have surface temperatures greater than the boiling point or less than the freezing point of the soap solution, that do not have open areas to the atmosphere that the soap solution cannot bridge, or that do not exhibit evidence of liquid leakage. Sources that have these conditions present must be surveyed using the instrument technique of section 8.3.1 or 8.3.2.

8.3.3.2 Spray a soap solution over all potential leak sources. The soap solution may be a commercially available leak detection solution or may be prepared using concentrated detergent and water. A pressure sprayer or squeeze bottle may be used to dispense the solution. Observe the potential leak sites to determine if any bubbles are formed. If no bubbles are observed, the source is presumed to have no detectable emissions or leaks as applicable. If any bubbles are observed, the instrument techniques of section 8.3.1 or 8.3.2 shall be used to determine if a leak exists, or if the source has detectable emissions, as applicable.

9.0 Quality Control

Section	**Quality control measure**	**Effect**
8.1.2	Instrument calibration precision check	Ensure precision and accuracy, respectively, of instrument response to standard.
10.0	Instrument calibration	

10.0 Calibration and Standardization

10.1 Calibrate the VOC monitoring instrument as follows. After the appropriate warmup period and zero internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value.

NOTE: If the meter readout cannot be adjusted to the proper value, a malfunction of the analyzer is indicated and corrective actions are necessary before use.

11.0 Analytical Procedures [Reserved]

12.0 Data Analyses and Calculations [Reserved]

13.0 Method Performance [Reserved]

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

1. Dubose, D.A., and G.E. Harris. Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81051. September 1981.

2. Brown, G.E., *et al.* Response Factors of VOC Analyzers Calibrated with Methane for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81-022. May 1981.

3. DuBose, D.A. *et al.* Response of Portable VOC Analyzers to Chemical Mixtures. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81-110. September 1981.

4. Handbook of Hazardous Materials: Fire, Safety, Health. Alliance of American Insurers. Schaumberg, IL. 1983.

17.0 Tables, Diagrams, Flowcharts, and Validation Data [Reserved]

APPENDIX D

NSPS APPLICABILITY DETERMINATION LETTERS INDEX

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

CCS ENGINEER
FEB 1 [illegible]

4APT-ATMB

FEB 09 2005

L. T. Kozlov, P.E.
Program Administrator
Air Resources Management
Central District
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Dear Mr. Kozlov:

The purpose of this letter is to provide you with a written determination regarding proposed changes to the standard operating procedures for landfill gas extraction wells at the Orange County Solid Waste Management Facility. This landfill is subject to 40 CFR Part 60, Subpart WWW (Standards of Performance for Municipal Solid Waste Landfills), and in a request sent to the U.S. Environmental Protection Agency (EPA) Region 4 and to your agency, Orange County proposed changes in standard operating procedures for certain wells in the landfill's active gas collection system. These changes involve an alternative to decommissioning wells where low landfill gas generation rates make it difficult to simultaneously operate wellheads at negative pressure and maintain compliance with oxygen concentration limits. Based upon our review, the changes proposed by Orange County are acceptable. Details regarding the County's proposal and the basis for our conclusions are provided in the remainder of this letter.

Operating requirements for gas collection and control systems (GCCS) are promulgated at 40 CFR §60.753(b), (c), and (d). Under these provisions, wellheads must be operated under negative pressure, the temperature of interior wellheads must be less than 55 °C, gas quality limits for interior wells (either less than 20 percent nitrogen or less than five percent oxygen) must be met, and the methane concentration at the surface of the landfill must be less than 500 parts per million (ppm). Under provisions in 40 CFR §60.755, monitoring to verify compliance with the wellhead pressure, temperature, and gas quality limits must be conducted on a monthly basis. Monitoring to verify compliance with the 500 ppm surface methane concentration limit must be conducted on a quarterly basis.

Orange County's request for approval of changes to its standard operating procedures involves wells where gas flow rates are so low that applying even minimal vacuum results in air infiltration that causes exceedances of the applicable oxygen concentration limit. Shutting such wells down will prevent the air filtration that leads to the oxygen exceedances, but shutting a well down is likely to cause positive pressure in the wellhead as landfill gas builds up. Therefore, simultaneously complying with both

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the negative pressure and oxygen concentration limits in 40 CFR §60.753 can be difficult for wells where gas flow rates have declined over time.

Under provisions in 40 CFR §60.753(b)(3), wells that experience positive pressure after being shutdown to accommodate declining landfill gas flow rates can be decommissioned if permission is granted by the Administrator. As an alternative to decommissioning wells under the provisions, Orange County has proposed to make the following changes to its standard operating procedure for wells where persistent oxygen exceedances are not the result of operations and/or maintenance issues:

1. Wells where oxygen concentrations do not decline to acceptable levels after more than one hour of reduced vacuum will be shut off until the gas quality recovers.

2. The monthly monitoring required by 40 CFR §60.755 will be conducted for wells that have been shutdown, but positive pressure or elevated oxygen concentrations will not be considered exceedances of the operating limits in 40 CFR §60.753.

3. If monthly monitoring indicates that pressure has built up in the well and the oxygen concentration still exceeds five percent, the well will be opened to relieve the pressure and will be shutdown until it is monitored the following month.

4. If the monthly monitoring indicates that gas quality has improved (i.e., the oxygen concentration has dropped below five percent), the well will be brought back on line until the gas quality declines again.

5. The quarterly methane surface concentration monitoring required under 40 CFR §60.755 will be conducted for wells that have been shutdown. Standard remediation steps, including evaluating the need to return wells to full-time service, will be followed if exceedances of the 500 ppm methane surface concentration limit are detected.

According to Mr. Daniel Morical of Orange County Utilities, the operating procedure changes outlined above would apply to approximately four or five of the 130 wells at its landfill at any one time. Mr. Morical also indicated that there is a high probability of gas quality improving to the point it would be necessary to restart wells that had been shutdown. Based upon our review, the proposed changes to Orange County's standard operating procedures are acceptable because shutting down nonproductive wells, instead of decommissioning them, has the potential to lower overall nonmethane organic compound (NMOC) emissions at the landfill. This potential increase in NMOC control system efficiency stems from the ability to quickly resume gas collection if there are improvements in the gas quality or increases in the gas production rate in an area of the landfill where wells have become nonproductive. If wells in a nonproductive area are decommissioned, instead of merely being shutdown, NMOC emissions would not be controlled between the time an exceedance is identified and a new well is installed. One condition for approval of the proposed changes in standard operating procedures at the Orange County Solid Waste Management Facility is that facility diagrams must be updated to indicate which wells have been shutdown because landfill gas production rates are too low to permit continuous extraction.

If you have any questions about the determination provided in this letter, please contact Mr. David McNeal of the EPA Region 4 staff at (404) 562-9102.

Sincerely,

Beverly H. Banister

Beverly H. Banister
Director
Air, Pesticides and Toxics
Management Division

cc: Daniel Morical
Orange County Utilities – Solid Waste Division
5901 Young Pine Road
Orlando, Florida 32829

Environmental Consultants

3012 U.S. Highway 30 rth
Suite 700
Tampa, FL 33619-2242

813 621-0080
FAX 813 623-6757

SCS ENGINEERS

November 9, 2004
File No. 09199036.17

Mr. Dan Morrical, P.E.
Orange County Solid Waste Division
5901 Young Pine Road
Orlando, Florida 32829

Subject: Addendum to the Gas Collection and Control System Design Plan
Standard Operating Procedure for Landfill Gas Extraction Wells
Orange County Solid Waste Management Facility, Orange County, Florida
FDEP Permit No. 0950113-002-AV

Dear Dan:

SCS Engineers (SCS) is providing you this letter for your use in petitioning the United States Environmental Protection Agency (U.S. EPA) to amend the landfill gas collection and control system (GCCS) design plan for the Orange County Solid Waste Management Facility. A similar letter was previously sent to Orange County on December 30, 2003, which was subsequently forwarded to the Florida Department of Environmental Protection (FDEP) Central District office. FDEP recently stated that they did not have the regulatory authority to approve the proposed actions included in this request, and recommended that the County forward the following proposed standard operating procedures to U.S. EPA for their approval.

As you know, in accordance with the New Source Performance Standards (NSPS) for municipal solid waste landfills, Orange County is required to operate each landfill gas (LFG) extraction well in compliance with certain criteria. Per Title 40 of the Code of Federal Regulations (CFR) Part 60.753(b), (c), and (d), Orange County is required to:

- Operate the collection system with negative pressure at each wellhead except under certain conditions such as increased well temperature, when a geomembrane cap is installed and an acceptable pressure limit is specified in the GCCS design plan, or when a landfill fire is present.

- Operate each wellhead with a LFG temperature less than 55 degrees Celsius (131 degrees Fahrenheit) and either a nitrogen level less than 20 percent or an oxygen concentration less than 5 percent by volume.

- Operate the GCCS so that the methane concentration at the surface of the landfill is less than 500 parts per million by volume (ppmv).

The first and third criteria listed above were included in the NSPS by the U.S. EPA in order to require landfill owners/operators to minimize fugitive emissions of LFG to the atmosphere. The second criterion, which is related to oxygen and nitrogen concentration in the gas at each well, is based on historical LFG industry operations and maintenance guidelines aimed at reducing the potential for landfill fires or negatively affecting microbes involved in the anaerobic decomposition of the waste. High oxygen concentrations can occur due to operating the wellfield too aggressively, resulting in the infiltration of ambient air through the cover soils. If the oxygen concentration within a landfill exceeds five percent by volume, the possibility of a landfill fire is greatly enhanced. Note that because most field instruments measure oxygen, and not nitrogen, the method of compliance typically is based on a five percent oxygen concentration, rather than the 20 percent nitrogen requirement at each wellhead.

Unfortunately, the Rule does not provide guidance on how to address an individual criterion when it has the potential to conflict with one of the other criteria. For example, in some situations it may not be possible to maintain compliance with both the vacuum and gas quality requirements of the NSPS. This may be true in the case of a low or diminishing LFG generation rate, when the application of even a small vacuum (i.e., 0.1 to 0.5 inches of water column (in-w.c.)) to a well or collector may cause the oxygen concentration to exceed the NSPS limit of five percent. This typically occurs because LFG is not being generated at a sufficient rate to allow for continuous extraction by the GCCS.

If the LFG generation rate is so low, applying vacuum typically will only worsen the gas quality (i.e., increase the oxygen content), resulting in continued oxygen exceedances. One approach to remedying this situation is to shut down the well for a period of time until gas quality improves and the oxygen concentration declines to below five percent. Once the oxygen concentration is below this level, the well can be reopened and LFG extraction resumed. However, because this approach requires a non-negative pressure at the wellhead, this technique is not compliant with the NSPS.

Therefore, if gas quality cannot be maintained, the only alternative allowed by the NSPS is to decommission the well, provided there are no exceedances of the surface emissions monitoring limit. While such wells could be decommissioned, SCS feels it would be better to leave them in place in case future conditions render them necessary.

PROPOSED STANDARD OPERATING PROCEDURE

SCS proposes to establish the following standard operating procedure for wells at which poor gas quality is consistently recorded despite the application of minimal vacuum (i.e., less than 0.5 in-w.c.). This standard operating procedure is proposed as an addendum to the existing GCCS design plans for the site. It is not intended for wells at which normal wellfield tuning, maintenance, or repair activities can remediate the exceedances.

For wells at which oxygen exceedances are persistent and not the result of operations and/or maintenance issues, the wellhead valve will be adjusted to minimize vacuum. If after more than one hour of decreased vacuum the oxygen concentration does not decline to allowable levels, the wellhead will be shut off until the gas quality recovers. The well will continue to be monitored on a monthly basis, and the wellhead valve opened to purge any accumulated gas and relieve any pressure that may have developed. If, during the routine monthly monitoring, the oxygen concentration is below five percent, the well will be brought back on line until the gas quality again declines.

Gas concentration and pressure will continue to be monitored and recorded during the months in which the wells are shut off. However, a zero pressure or high oxygen concentration will not be considered an exceedance of the wellhead operating criteria included in 40 CFR 60.753(b) and (c), and remedial actions including rechecks will not be required. If a positive pressure is recorded, the well will be reopened to relieve any pressure and to purge the accumulated gas from the well. If the gas quality has improved, the well will be opened and returned to service. However, if high oxygen concentrations are still present in the well, after purging the well and removing any positive pressure, the wellhead valve will again be closed and the well will not be monitored until the next round of monthly monitoring. Quarterly surface emissions monitoring will continue to be used to demonstrate the effective capture and control of LFG from the landfill. In the case of exceedance of the 500-ppmv surface emissions monitoring limit, standard remediation steps will be conducted, including evaluating the need for returning the well to full-time service.

Note that wells under this standard operating procedure will not be physically disconnected from the GCCS, which will allow the County to quickly return the wells to service if the need arises. In the future, if wells are to be permanently decommissioned, the County will submit a formal notice of well decommissioning to FDEP.

Please forward this proposed standard operating procedure/addendum to the GCCS design plan to the U.S. EPA at the following address:

Air Resources Management
United States Environmental Protection Agency, Region
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, Georgia 30303-3104

Please copy the FDEP Central District office at the following address:

Air Resources Management
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT
SINCE 1955

May 31, 2007

Kirby Canyon Landfill
P O Box 1870
Morgan Hill, CA 95037

Attention: **Joe Morse**

Application Number:	**15617**
Plant Number:	**1812**
Equipment Location:	**910 Coyote Creek Glf Dr** **Morgan Hill, CA 95037**

Dear Applicant:

This is your Authority to Construct the following:

A-12 **Landfill Gas Flare with Condensate Injection System, 5 gallons per minute maximum condensate injection rate, 149 MMBtu/hr**

The equipment described above is subject to condition no. 1437.

Notification
Please contact your assigned Permit Engineer, listed in the correspondence section of this letter, in writing, (by letter, fax, or email) at least three days before the initial operation of the equipment so that we may observe the equipment in operation and verify conformance with the Authority to Construct. Operation includes any start-up of the source for testing or other purposes. Operation of equipment without notification to the District may result in enforcement action. **Do not send start-up notifications to the Air Pollution Control Officer.**

Start-up Period
After receipt of the start-up letter required above, this Authority to Construct authorizes operation during the start-up period from the date of initial operation noted in your start-up letter until the Permit to Operate is issued, up to a maximum of 90 days. All conditions (specific or implied) of the Authority to Construct are in effect during the start-up period.

Fees
District Regulation 3 requires a fee for each new Permit to Operate. You will be invoiced upon receipt of your start-up letter. No permits will be issued until all outstanding fees are paid.

Implied Conditions
In the absence of specific permit conditions to the contrary, the throughputs, fuel and material consumption, capacities, and hours of operation described in your permit application will be considered maximum allowable limits. A new permit will be required before any increase in these parameters, or change in raw material handled, may be made.

Expiration
In accordance with Regulation 2-1-407, this Authority to Construct expires two years from the date of issuance unless the authority to construct has been renewed.

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Trade Secret

Unless you have already designated specifically identified materials in your permit application as trade secret, under the California Public Records Act, all data in your permit application, the permit itself and all permit conditions will be considered a matter of public record and may be disclosed to a third party. Please contact your permit reviewer immediately if you wish to amend your permit application submittals or to designate certain permit conditions as trade secret. Unless we hear from you within ten (10) calendar days of this letter, except for materials which have been previously designated as trade secret, you shall be deemed to have waived any claim of trade secret with respect to all materials in the District's files relating to this permit application.

Right of Entry

The Air Pollution Control Officer of the Bay Area Air Quality Management District, the Chairman of the California Air Resources Board, the Regional Administrator of the Environmental Protection Agency, and/or their designees, upon presentation of credentials, shall be granted the right of entry to any premises on which an air pollution source is located for the purposes of:

A. The inspection of the source
B. The sampling of materials used at the source
C. The conduct of an emissions source test
D. The inspection of any records required by District rule or permit condition.

Correspondence

Please include you application number with any correspondence with the District. The District's regulations may be viewed online at www.baaqmd.gov If you have any questions on this matter, please call **Tamiko D Endow, Air Quality Engineer II at (415) 749-4939. Startup information may be faxed to the Engineering Division at 415-749-5030.**

Very truly yours,

Jack P. Broadbent
Executive Officer/APCO

by Scott Lutz
Engineering Division

SBL:TDE: ryr

any dust suppressant applications. The dates and description of all paved roadway cleaning activities. All records shall be summarized monthly.

f. The initial operation date for each new landfill gas well and collector.

g. An accurate map of the landfill that indicates the locations of all refuse boundaries and the locations of all wells and collectors (using unique identifiers) that are required to be operating continuously pursuant to part 6a. Any areas containing only non-decomposable waste shall be clearly identified. This map shall be updated at least once a year to indicate changes in refuse boundaries and to include any newly installed wells and collectors.

h. The operating times and the landfill gas flow rate to the Landfill Gas Flare recorded on a daily basis. A monthly summary of the heat input to the Landfill Gas Flare pursuant to part 8 shall be calculated and recorded.

i. Continuous records of the combustion zone temperature for the Landfill Gas Flare during all hours of operation.

j. Records of all test dates and test results performed to maintain compliance with parts 12 and 13 above or any applicable rule or regulation.

k. Records of landfill gas condensate injection throughput and the duration of the injection recorded daily.

All records shall be maintained on site or shall be made readily available to District staff upon request for at least 5 years from the date of entry. These recordkeeping requirements do not replace the recordkeeping requirements contained in any applicable rules or regulations. (basis: Cumulative Increase, 2-1-301, 2-6-501, 6-301, 6-305, 8-2-301, 8-34-301, 8-34-304, 8-34-501, and 9-1-302)

16. The annual report required by BAAQMD Regulation 8-34-411 shall be submitted in two semi-annual increments. The reporting period for the first increment of the Regulation 8-34-411 annual report that is submitted subsequent to the issuance of the MFR Permit for this site shall be from December 1, 2002 through August 31, 2003. This first increment report shall be submitted by September 30, 2003. The reporting periods and report submittal due dates for all subsequent increments of the Regulation 8-34-411 report shall be synchronized with the reporting periods and report submittal due dates for the semi-annual MFR Permit monitoring reports that are required by Section I.F. of the MFR Permit for this site. (basis: Regulation 8-34-411 and 40 CFR Part 63.1980(a))

17. The gas collection system operating requirements listed below shall replace the well head requirements identified in Regulation 3-4-305.2 through 8-34-305.4 for the specified wells and collectors. All wells and

collectors remain subject to the Regulation 8-34-305.1 requirement to maintain vacuum at each well head.

a. The Regulation 8-34-305.2 temperature limit shall not apply to the Wells 36, 37, 41, 42, 51, and 52, provided that the landfill gas temperature at each of the wells 36, 37, 41, 42, 51, and 52 does not exceed 145 degrees F (63 degrees C).

b. The owner/operator shall demonstrate compliance with the alternative wellhead landfill gas temperature limit in 17(a) above by monitoring the temperature of each wellhead on a monthly basis, in accordance with Regulation 8-34-505.

c. All records to demonstrate compliance with Part 17(a) and all applicable sections of BAAQMD Regulation 8, Rule 34 shall be recorded in a District-approved log and made available to District staff upon request in accordance with Regulation 8-34-501.4, 501.9, and 414.

d. If the temperatures measured at any of the Part 17(a) wells are found to exceed the temperature limit in Part 17(a), the owner/operator shall take all measures necessary to investigate the possibility of subsurface fires, including landfill gas testing for carbon monoxide (CO) on those landfill gas collection wells in Part 17(a) that exceed the operating temperature limit. If a fire is suspected, the owner/operator shall employ all means as appropriate to extinguish the fire, repair the well(s), and bring the well(s) back into service

(basis: Regulation 8-34-301.2, 8-34-303, and 8-34-305, 40 CFR Part 60.755(a) and 60.759)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
GREAT LAKES NATIONAL PROGRAM OFFICE
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

APR 2 6 2004

R-19J

Timothy M. Tilotti
Vice President
Wayne Disposal, Inc.
49350 North I-94 Service Drive
Belleville, Michigan 48111

Dear Mr. Tilotti:

The United States Environmental Protection Agency (U.S. EPA) has reviewed Wayne Disposal Inc.'s (WDI) revised Final Control Plan (FCP) submitted on February 4, 2004, for its municipal solid waste landfill in Belleville, Michigan. By means of this letter, U.S. EPA fully approves the revised FCP. The approved FCP is enclosed herewith. An earlier FCP submission, which was originally submitted pursuant to the Federal Plan for Municipal Solid Waste Landfills, at 40 C.F.R. Part 62, Subpart GGG, was partially approved on January 7, 2002. That FCP submission described WDI's plan for upgrading its active gas collection and control system (GCCS) at its Site #2. When WDI submitted its FCP for approval by U.S. EPA, it included a request for alternative monitoring, recordkeeping and reporting procedures.

In subsequent exchanges of information, numerous issues were raised and resolved. Your most recent FCP submission addresses these issues, as discussed in Enclosure 1. We reviewed your FCP to assure that it meets the criteria set forth at 40 C.F.R. §§ 60.759 and 60.752(b)(2)(ii)(A) and (B) for active and passive gas collection systems. We also include a discussion of U.S. EPA's partial approval of WDI's requests for alternative monitoring, recordkeeping and reporting procedures in Enclosure 2.

If you have any questions, feel free to contact Jeffrey Gahris, of my staff, at (312) 886-6794.

Very truly yours,

Bharat Mathur
Acting Regional Administrator

cc: Dennis M. Drake, Division Chief
Air Quality Division
Michigan Department of Environmental Quality

Gerald Avery, Field Operations Supervisor
Air Quality Division
Michigan Department of Environmental Quality

Enclosures (2)

ENCLOSURE 1

WAYNE DISPOSAL INC.'S FINAL CONTROL PLAN FOR FONS, OLD WAYNE, WAYNE SITE #1, WAYNE SITE #2 APPROVED PURSUANT TO THE FEDERAL PLAN FOR MUNICIPAL SOLID WASTE LANDFILLS SUBMITTED FEBRUARY 4, 2004

ENCLOSURE 2

U.S. EPA REVIEW AND APPROVAL OF WAYNE DISPOSAL INC.'S FINAL CONTROL PLAN FOR FONS, OLD WAYNE, WAYNE SITE #1, WAYNE SITE #2 AND REQUESTS FOR ALTERNATIVE MONITORING, RECORDKEEPING AND REPORTING PROCEDURES

The United States Environmental Protection Agency (U.S. EPA) has reviewed the revised Final Control Plan (FCP) for Wayne Disposal Inc.'s (WDI) municipal solid waste landfill in Belleville, Michigan, submitted by WDI in February 2004. U.S. EPA fully approves the FCP for four contiguous sites - Fons, Old Wayne, Wayne Site #1 and Wayne Site #2 - as meeting the Federal Plan requirements at 40 C.F.R. §§ 62.14353 and 60.752(b)(2).

U.S. EPA partially approved WDI's original FCP submission, which addressed Wayne Site #2 only, on January 7, 2002. Earth Tech, on behalf of WDI, submitted in October 2003 a revised FCP pursuant to the Federal Plan for Municipal Solid Waste Landfills, at 40 C.F.R. Part 62, Subpart GGG. The revised FCP included a passive gas collection and control system for Fons, Old Wayne, and Wayne Site #1. The revision also contained requests for alternative operational standards, monitoring, recordkeeping, and reporting procedures.

<u>Plan approval issues</u>:

1. In its October 2003 FCP submission, WDI requested that U.S. EPA approve a higher operational limit greater than 500 ppm for surface emissions, based on surface scan data, for Fons, Old Wayne and Wayne Site #1. U.S. EPA does not believe it is necessary to approve a higher operational standard. WDI has made representations that the submitted FCP is adequate. Although retrofitting sites with a passive gas collection and control system (GCCS) may not be as manageable as installing an active system, the available data does not show widespread exceedances of the 500 ppm operational standard. Accordingly, U.S. EPA will not relax the 500 ppm standard for these sites. If future surface monitoring following the procedures at 40 C.F.R. § 60.755(c) should show exceedances, WDI has a number of reasonable steps it can take to address the exceedances. These steps include, but are not limited to, the installation of additional passive wells, a reconfiguration of existing flare locations, the use of biologically active mulch, and clay cap improvements, where appropriate. U.S. EPA also expects WDI to conduct appropriate maintenance of the cover systems.

2. The appended FCP includes a schedule for installing the passive flare system, consisting of 18 passive flares for Fons, Old Wayne, and Wayne Site #1. At the time of its FCP submission, WDI anticipated installation by March 15, 2004. It is U.S. EPA's understanding that these flares are fully installed at this time.

3. In its October 2003 FCP submission, WDI also proposed to limit its financial liability for controlling gas emissions from the older sites. Specifically, WDI requested that we consider a limit to the capital expenditures for adjusting the passive system in response to any exceedances of the 500 ppm operational standard. The initial installation cost is $75,000 to install the vent flare system. WDI proposed to limit the total costs for controlling the older sites to $140,400. This is equivalent to about $1400 per Megagram (Mg) of non-methane organic compounds (NMOC) controlled, which is the level of unit costs associated with Site #2 control improvements. This is higher than the NSPS level of $1200/Mg, which is the level U.S. EPA used for setting NSPS standards. Regardless of the merits of this argument, U.S. EPA will not consider the issue at this time since it involves speculation about the potential for future exceedances. Again, we do not believe there is a need for WDI to spend unreasonable amount of funds to maintain compliance using a passive flare system. In its final FCP submission, WDI accepted U.S. EPA's position on this matter, and indicated its intent to request U.S. EPA's reconsideration of its position at a future date should WDI encounter compliance issues with the passive flare system.

4. The Federal Plan requires performance testing for the passive flares, according to the procedures at 40 C.F.R. § 60.18. WDI had proposed to conduct Method 22 testing at only one passive flare for each landfill site. Since U.S. EPA stated it cannot approve this test waiver, WDI has agreed to test all of the operational passive flares.

5. WDI proposed passive flares for all of the vents, including those that appear to have little or no gas venting. WDI also proposed to operate each flare for at least one year. At the end of each year, WDI will review data logger information. If the flares are operating less than 20 percent of the time due to the lack of landfill gas, WDI will retire the flare. For any given site (Fons, Old Wayne, or Wayne Site #1), WDI may discontinue surface monitoring required by 40 C.F.R. § 60.755(c) when the site is determined to be nonproductive. A nonproductive site is one in which the NMOC generation is determined to be less than one percent of the total for the WDI landfill sites as a whole, as provided by 40 C.F.R. § 60.759(a)(3)(ii), or the flares throughout any of the sites named above have become nonproductive, and subsequently removed because they meet the criteria for flare retirement.

6. The appended FCP also describes WDI's work undertaken to upgrade its active GCCS at Wayne Site #2. WDI has completed this work with the exception of Master Cell #5. In this master cell, 37 gas extraction wells are in place now. The well heads are underground, making them inaccessible for monitoring. WDI plans to replace these wells. Because of ongoing "piggy-back" hazardous waste cell construction occurring vertically above Master Cell #5, the existing wells will be phased out and new horizontal wells installed. WDI's request to conduct monitoring at a common header location is approvable pending installation of the new horizontal wells. In its FCP, WDI agreed to submit final design drawings when they become available.

Requests for alternative monitoring, recordkeeping, and reporting requirements:

When WDI first submitted its FCP for approval by U.S. EPA on April 3, 2001, it included proposed alternative monitoring, recordkeeping and reporting procedures for Wayne Site #2. U.S. EPA had only partially approved the FCP on January 7, 2002. Proposed alternative monitoring for all of the sites, not previously addressed by U.S. EPA, are discussed below:

1. U.S. EPA agrees that the flare systems proposed for the passive GCCS meet the requirements of 40 C.F.R. §§ 60.758(b)(4) and 60.758(c)(4) with the installation of a thermocouple and pressure transmitter, with a data logger to record the presence of a flame and gas pressure.

2. U.S. EPA conditionally approved WDI's request to reduce surface monitoring from 30-meter intervals to 60-meter intervals on January 7, 2002. U.S. EPA finds it acceptable to widen the 30-meter spacing required for surface monitoring in areas to 60 meters, but only after data is collected to show that such widening is appropriate. If three consecutive monitoring events show no exceedances, WDI may adopt 60-meter spacing. This approval will be extended to Fons, Old Wayne, and Wayne Site #2 once data is provided to U.S. EPA.

3. WDI proposes that it treat each "master cell" at Wayne Site #2 as an individual landfill for purposes of skipping from quarterly to annual monitoring of operational standards for closed landfills, per 40 C.F.R. § 60.756(f). WDI argued each cell is a distinct landfill. U.S. EPA agrees that Fons, Old Wayne, Wayne Site #1 and Wayne Site #2 are separate landfills, only for the purposes of complying with

40 C.F.R. § 60.756(f), but will not approve the request for master cells within Wayne Site #2. U.S. EPA believes that the individual cells within Wayne Site #2, since they are interconnected by an active GCCS, function as one landfill.

4. On October 23, 2003, U.S. EPA formally approved WDI's use of a vortex shedding meter for measuring gas flow into the internal combustion engines.

5. 40 C.F.R. § 60.758(c)(1)(i) requires combustion temperatures be maintained at more than 28°C below the level established during stack testing for the internal combustion engines. U.S. EPA agreed in its January 7, 2002 letter that exhaust manifold temperatures may be recorded during performance testing, since it is physically impossible to measure temperatures in the combustion zone. WDI must keep records of monitoring data for 3-hour periods to assure ongoing compliance with the value established during the testing. This request is approved.

6. According to 40 C.F.R. § 60.752(b)(2)(v), three removal criteria must be met in order for a landfill owner or operator to cap or remove an installed GCCS:

(A) the landfill is no longer accepting waste and meets closure criteria at 40 C.F.R. § 258.60,

(B) the landfill operated the GCCS for at least 15 years, and can produce an initial performance test that demonstrates the 15-year period has expired, and

(C) the landfill emits less than 50 Mg/year NMOC (calculated) on three successive test dates.

WDI proposed that for purposes of complying with 40 C.F.R. § 60.755(c)(4)(ii), the 15-year minimum period for operating the GCCS should begin retroactively in 1985.

In order for the 15-year operating period to commence prior to October 6, 2002, WDI must submit an equipment removal report pursuant to 40 C.F.R. § 60.757(e) that addresses the criteria enumerated above. In addition to receiving U.S. EPA approval of the GCCS design plan, WDI must have conducted an initial performance test which demonstrated compliance with the performance standards under 40 C.F.R. § 60.752(b)(2) at the beginning of the 15-year period, and documented ongoing compliance with the operational, monitoring and recordkeeping requirements. If the required operational and maintenance records that demonstrate continuous compliance with the requirements of the Federal Plan are not available for any time frame after the initial performance test, that operational time frame shall not be counted toward the 15-year minimum control period. U.S. EPA considered the fact that WDI upgraded its GCCS in 2002 in order to comply with the Federal Plan. Since the GCCS would not have been in compliance before 2002, we cannot retroactively apply the 15-year operating period prior to 2002.

7. U.S. EPA agrees that since the sites stopped receiving waste prior to the promulgation of the Federal Plan, it was not possible for WDI to timely submit a "closure report" as required at 40 C.F.R. § 60.757(d).

8. The Federal Plan requires performance testing for the passive flares, according to the procedures at 40 C.F.R. § 60.18. WDI proposed to conduct Method 22 testing, heat content analysis, and flow rate measurements at only one passive flare for each landfill site. These requests were not approved. If WDI finds that some flares have no flow, testing can be waived. WDI has agreed to test all operational flares.

Fields of Opportunities

STATE OF IOWA

THOMAS J VILSACK, GOVERNOR
SALLY J PEDERSON, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
JEFFREY R VONK, DIRECTOR

March 15, 2006

CERTIFIED MAIL

Debra McDonald
Waste Management, Inc.
125 North Main
Blue Earth, MN 56013

RE: Facility Number: 95-02-012
Project Number: 06-126
Central Disposal Systems Landfill – Updated Design Plan
Determination request for alternative monitoring

Dear Ms. McDonald:

This letter is to inform you that the Central Disposal Sanitary Landfill (CDSL) NSPS Design Plan for the Landfill Gas Collection and Control System has been received by DNR. For your information the updated design plan will be placed in your facility file.

In the updated Design Plan, CDSL has requested alternatives to 40 CFR Sections 60.753 to 60.758.

First Request:
CDSL has requested flexibility in well placement and design components of the collection system:

Section 60.755(b): "For purposes of compliance with §60.753(a), each owner or operator of a controlled landfill shall place each well or design component as specified in the approved design plan as provided in §60.752(b)(2)(i) ..."

CDSL has stated that since the landfill will be open for several more years, it is expected that the industry will develop more efficient methods of collecting gas. Therefore, the design for the gas collection system may be modified in the future to incorporate these new technologies. CDSL is requesting flexibility to modify the design over time to incorporate new technologies, while still meeting the following operational criteria for the NSPS:

Section 60.753(a)(1): "Operate the collection system such that gas is collected from each area, cell or group of cells in the landfill in which solid waste has been in place for:

1. 5 years or more if active;
2. 2 years or more if closed or at final grades."

The facility is proposing to only install permanent vertical wells once final grades are reached and the cell has been active for a minimum of 5 years, closed, or at final grade for a minimum of 2 years. For cells that have been active for 5 years or more and are not yet to final grades, temporary gas extraction wells, horizontal collection trenches and/or passive solar flares will be used for gas extraction until the wells can be installed (i.e. final grades have been reached).

CDSL is further proposing that if the gas collection system is expanded into areas of the landfill that do not yet meet the above age criteria (for example, for odor control purposes), that these wells would not be subject to the monthly monitoring requirements of the NSPS due to the fact that from a waste age standpoint, the area of the landfill where these

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515-242-5100 FAX 515-242-5094 HTTP://www.state.ia.us/dnr

wells have been placed is not yet subject to control. Also the wells are periodically raised in the active areas of the landfill in order to avoid being buried in the trash. When they are raised the HDPE lateral line which provides the vacuum is temporarily disconnected until the surrounding lift of trash is brought high enough to reconnect the well. The time frame between when a well is disconnected and raised, and when the waste height is high enough to reconnect the lateral can range from weeks to months. If the wells are not considered to be part of the NSPS monitoring program it does not matter if the vacuum in the well is temporarily removed and not monitored monthly.

With regard to CDSL's request, DNR will allow the landfill to only install permanent vertical wells once final grades are reached and the cell has been active for a minimum of 5 years, closed or at final grade for a minimum of 2 years. For cells that have been active 5 years or more and are not yet to final grade, temporary extraction wells, horizontal trenches and/or passive solar flares will be used for gas extraction until the wells can be installed (i.e. final grades have been reached). Use of the temporary wells should be considered part of the monitoring system when the HDPE lateral line provides the vacuum, however, when the well is not connected to the HDPE lateral line the temporary wells are not required to be part of the NSPS monitoring program. If the gas collection system is expanded into areas of the landfill that do not yet meet the age criteria (i.e. for odor control purposes), DNR will not consider those cells to be subject to the monthly requirements of the NSPS due to the waste age.

Second Request:
Well head pressure variance request when using geosynthetic final cover and Exclusion of passive gas vent connections, horizontal collection trenches, and leachate sump/riser connection from operating parameters:

Section 60.753(b): "Operate the collection system with negative pressure at each wellhead except under the following conditions:

1. A fire or increased well temperature. The owner or operator shall record instances when positive pressure occurs in efforts to avoid a fire. These records shall be submitted with the annual reports as provided in 60.757(f)(1);
2. Use of a geomembrane or synthetic cover. The owner or operator shall develop acceptable pressure limits in the design plan;
3. A decommissioned well. A well may experience a static positive pressure after shut down to accommodate for declining flows. All design changes shall be approved by the Administrator".

and:

Section 60.753(c): "Operate each interior wellhead in the collection system with a gas temperature less than 55 degrees C and with either a nitrogen level less than twenty percent or an oxygen level less than five percent. The owner or operator may establish a higher operating temperature, nitrogen, or oxygen value at a particular well. A higher operating value demonstration shall show supporting data that the elevated parameter does not cause fires or significantly inhibit anaerobic decomposition by killing methanogens."

The landfill gas collection and control system may have future connections to leachate sumps and cleanout risers in order to extract gas from the leachate collection system for odor/surface emission control and safety purposes. CDSL is requesting that the nitrogen/oxygen exceedance limits, positive pressure limits and 15 day corrective action timelines not apply to the leachate cleanout riser and leachate sump extraction points.

Based on a review of the information provided to DNR, the leachate sumps/cleanout risers may be exempt from NSPS monitoring.

Third Request:
Use of Passive Solar-Powered Flare as a Temporary Mitigative Measure.

CDSL is requesting the use of a passive solar-powered flare be allowed when an upset condition occurs that results in an unexpected release of landfill gas to the atmosphere and that this flare be exempt from the requirements of 60.752(b)(2)(iii). The passive flare will be used to primarily mitigate odor while the facility investigates the cause of the upset condition.

DNR has reviewed this request and will consider it not subject to the requirements of 60.752(b)(2)(iii). The flare is not the primary control system used to reduce NMOC emissions by 98 percent. It should be noted that the flare is being used to control emissions caused by an upset condition and should not be allowed unlimited usage. Upset conditions will occur however they should still be minimized. If the flare is being used to control upset conditions more than 100 hours per twelve-month rolling period then the DNR may need to re-evaluate the purpose of the flare at that time.

Fourth Request:
Exclusion of dangerous areas from surface scan requirements:

Section 60.573(d) Operations Standards for Collection and Control Systems: "A surface monitoring design plan shall be developed that includes a topographical map with the monitoring route and rationale for any site-specific deviations from the 30 meter intervals. Areas with steep slopes or other dangerous areas may be excluded from surface testing...."

When the surface monitoring is initiated the facility proposes to exclude dangerous areas such as roads, the active area, truck traffic areas, and slopes steeper than or equal to 4:1 from surface testing. CDSL is also requesting that areas with ongoing construction of the gas collection system be temporarily excluded from the surface scans, until such time as the collection system is completed and/or functional.

Based on a review of the information provided, DNR will allow the exclusion of the areas identified by CDSL. It should be noted that this exclusion does not prevent DNR from requiring surface testing in the future if DNR deems it appropriate and can be completed safely.

Fifth Request:
Alternative well construction:

CDSL proposes to have the ability to use rock for well construction in certain locations, meeting the parameters for a nonporous corrosion resistant material per Section 60.759(b)(1). Based on a review of the information provided DNR will allow limited usage of rock for wells, however, it should not be relied on as a primary use.

Sixth Request:
Exclusion to monitoring while raising wells:

At CDSL, new vertical gas extraction wells are often place in the active area of a landfill. When the wells are raised the HDPE lateral line which applies the vacuum is disconnected. CDSL is requesting that no more than two months of readings will be missed at a particular well if the facility cannot bring the waste height up to the new grade and re-attach the well, the well will be cut back down and re-attached. This request is being made in accordance with 60.752(b)(2)(i)(B).

Based on a review of the information DNR will allow this request.

Seventh Request:
Extension of 10-day corrective action time frame for surface scan exceedences that can be repaired by cover repairs:

Section 60.755(c)(4): "Any reading of 500 ppm or more.....shall be recorded as monitored exceedance.....cover maintenance or adjustments to the vacuum.....shall be made and the location shall be remonitored within 10 calendar days after detecting the exceedance....."

CDSL has requested additional time to effect repairs to the cover if the facility monitors an exceedance and it rains shortly thereafter. The 10 day time frame may not provide a long enough time to affect the needed repairs without damaging the cover with heavy equipment.

If this situation occurs at the facility, CDSL proposes to log the range of days available for the surface monitoring, the scheduled date of the surface monitoring, a 5-day weather forecast on the scheduled date, together with a 5- day weather forecast from all earlier days with the range of days available; the current weather conditions; and the cap conditions. The log will be kept with the NSPS files. Re-monitoring of the cover after repairs are made will occur as quickly as possible and will not exceed 30 days.

Based on a review of the information provided, DNR will allow CDSL's request.

Eighth Request:
Cover integrity monitoring on closed portions of the landfills to be performed on an annual basis:

Section 60.755(c)(5): "The owner or operator shall implement a program to monitor for cover integrity and implement cover repairs as necessary on a monthly basis."

CDSL has areas of the landfill that have been closed for several years, received final cover and have been vegetated. CDSL expects damage to the cover from erosion to be minimal and requests an annual inspection schedule for monitoring the final cover.

Based on a review of the NSPS, DNR has concluded that there is no authority for DNR to allow an alternative monitoring schedule. Therefore the request for annual monitoring is not allowed.

Ninth Request:
Shutdown limitations:

Section 60.755(e): "The provisions of this subpart apply at all times, except during periods of start-up, shutdown, or malfunction provided that the duration of start-up, shutdown or malfunction shall not exceed 5 days for collection systems and shall not exceed 1 hour for treatment or control devices."

CDSL states that it is impossible to fix some types of control device malfunctions in one hour or less. It is also impossible to do some types of gas system maintenance (such as re-insulating the flare) in five days or less. NESHAP Subpart AAAA requires the preparation of a Start-up, Shutdown and Malfunction (SSM) Plan. The plan must detail the actions to be taken by the site in the event of an SSM event. The duration of each event must be recorded and all such SSM events reported on a semiannual basis.

CDSL is requesting that the one hour/five day shutdown limitations of the NSPS not apply to the facility now that the Landfill NESHAP has been promulgated. These events will now be governed by the more stringent SSM plan recordkeeping and reporting requirements of the Municipal Solid Waste Landfill NESHAP.

Based on a review of the NSPS, DNR has concluded that there is no authority for DNR to allow CDSL this request. If the NSPS had language stating to the effect "per the Administrator's approval" DNR would be able to make a determination as Iowa has been delegated the Administrator of the NSPS & NESHAPs. If CDSL is to pursue this request it must be submitted to EPA.

Tenth Request:
Flare reporting when flare not receiving gas:

Section 60.757(f)(3): "Description and duration of all periods when the control device was not operating for a period exceeding one hour, and length of time the control device was not operating."

The facility is requesting that periods when the flare is not operating in excess of one hour need not be reported provided no gas is being fed to the flare during this time.

As the Administrator, DNR interprets the rule to apply only when gas is being sent to the flare. When gas is not going to the flare reporting is not required.

If you have any questions regarding this letter I may be reached at (515) 281-5012.

Sincerely,

Mark Goedken

Mark Goedken, P.E.
Construction Permitting
IDNR Air Quality Bureau

C: Field Office 2

BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT
SINCE 1955

February 6, 2008

Waste Management of Alameda County
10840 Altamont Pass Rd
Livermore, CA 94551

Attention: Ken Lewis

Application Number: 16984
Plant Number: 2066
Equipment Location: *same as above*

Dear Applicant:

SUBJECT: CHANGE OF PERMIT CONDITIONS

This letter is to advise you that your application for changes in permit conditions for the following equipment has been approved:

S-2 Altamont Landfill with Landfill Gas Collection System

Operation of this equipment will be subject to permit condition no. 19235 which is attached. If you have any questions regarding this matter, please call **Carol S Allen, Senior Air Quality Engineer at (415) 749-4702.**

Very truly yours

Jack P. Broadbent
Executive Officer/APCO

by Scott Lutz
Engineering Division

SBL:CSA
Attachment: Permit Condition no. 19235

Plant No. 2066, Waste Management of Alameda County
Source No. 2, Altamont Landfill with Landfill Gas Collection System
Application No. 16984
Condition No. 19235

1. The S-2 Altamont Landfill shall be equipped with a landfill gas collection system, which shall be operated continuously as defined in Regulation 8-34-219, unless the Permit Holder complies with all applicable provisions of Regulation 8, Rule 34, Section 113. Individual wells, collectors, and adjustment valves shall not be disconnected, removed, or completely closed, without prior written authorization from the District, unless the Permit Holder complies with all applicable provisions of Regulation 8, Rule 34, Sections 113, 116, and 117 or with Part 1c below. The gas collection system shall also be operated in accordance with the wellhead requirements described in Part 1d. (Basis: Regulations 8-34-301.1, 8-34-303, 8-34-304, 8-34-305, and 8-34-404)
    a. The Permit Holder has been issued a Permit to Operate for the landfill gas collection system components listed below as of November 1, 2007. Well and collector locations are described in detail in Permit Application #15498.
        i. The authorized number of landfill gas collection system components is the baseline count listed below plus any components installed and minus any components decommissioned pursuant to subpart 1b, as evidenced by start-up and decommissioning notification letters submitted to the District.
            - 68 vertical wells
            - 7 horizontal trench collectors (shredded tires may be used as fill material)
            - 1 leachate collection system clean-out riser
    b. The Permit Holder has been issued an Authority to Construct to allow for the landfill gas collection system alterations described below pursuant to Permit Application #16863. All collection system alterations shall comply with subparts 1b(i-vii) below.
        i. The authorized collection system alterations are:
            - Install up to 75 additional vertical wells
            - Permanently decommission up to 40 vertical wells
            - Install up to 25 additional horizontal trench collectors

- Permanently decommission up to 10 horizontal trench collectors
- Modify wellhead monitoring locations, as needed, provided that each landfill gas collection system component identified in Part 1a and each new collection system component installed per Part 1b is adequately represented by a wellhead monitoring location. The Permit Holder shall maintain documentation on site that identifies all landfill gas collection system components that are represented by each wellhead monitoring location.

ii. The Permit Holder shall apply for and receive an Authority to Construct before altering the landfill gas collection components described subpart 1a. Installing, altering, or permanently decommissioning a vertical well, horizontal collector, or other gas collection component is subject to the Authority to Construct requirement, unless this change constitutes a replacement as defined in subpart 1b(iii) below.

iii. Replacement of landfill gas collection system components with identical or functionally equivalent components will not be deemed an alteration and will not subject to the Authority to Construct requirement under the following circumstances. If a well or collector will be shut down and replaced by a new well or collector in essentially the same location as the old component and this decommission/installation will be accomplished in accordance with Regulations 8-34-117 and 8-34-118, then this activity shall be considered a component replacement that is not subject to the Authority to Construct requirement. For each individual well or collector replacement, this subpart authorizes a maximum vacuum disconnection time of five consecutive days for compliance with Regulation 8-34-117.5. The disconnected component and the new component shall not be counted toward the subpart 1b(i) limits; the numbers of replacement wells and replacement collectors are not limited. Alterations, repairs, or replacements of non-perforated piping sections (such as risers, laterals, or header pipes), piping connectors, or valves are not subject to the Authority to Construct requirement.

iv. At least three days prior to initiating operation of a well or collector installed pursuant to subpart 1b, the Permit Holder shall submit a start-up notice to the District that contains the component ID number for each new well or collector and the anticipated initial start-up date for each new component.

v. For each well or collector that is permanently decommissioned after June 20, 2007, the Permit Holder shall submit a decommissioning notice to the District within no later than three working days after the component was disconnected from vacuum system. This decommissioning notice shall contain the component ID for each well or collector that was decommissioned, the date and time that each component was disconnected from the vacuum system, and the reason the component was decommissioned.

vi. Within six months of installing a new component or permanently decommissioning an existing component, the Permit Holder shall prepare an updated map of the landfill gas collection system that identifies the ID numbers and locations of all operable wells and collectors. On this map or in accompanying documentation, the Permit Holder shall summarize all component changes that were made since the last map was prepared. The previous collection system map, the updated collection system map, and the component change summary shall be provided to District staff upon request.

vii. If the Permit Holder has a net reduction (number of decommissioned components minus the number of installed components) of more than five components within a 120-day period, the Permit Holder shall submit a more comprehensive decommissioning notice to the District. In addition to the information required by subpart 1b(v), this comprehensive decommissioning notice shall include the maps and documentation required by subpart 1b(vi), shall identify all component changes that have occurred but that are not included on the most recently updated map, shall identify any components that are temporarily disconnected from vacuum pursuant to subpart 1c, shall provide estimated vacuum reconnection dates for these components, shall include a list of all well installations that are expected to occur within the next 120 days, and shall discuss the reasons why this reduction in gas collection components is not expected to result in surface emission leaks. Upon request, the Permit Holder shall provide wellhead monitoring data, surface leak monitoring data, records of repair attempts made to date, and other information to support the need for a net collection component reduction of more than five wells. The District may require additional surface monitoring to verify that this net component reduction is not causing landfill surface leaks. The District will notify the Permit Holder in writing of any additional surface monitoring that is required pursuant to this subpart.

c. The Permit Holder may temporarily disconnect individual wells or collectors from the vacuum system, provided that all requirements of this subpart are satisfied. (Basis: Regulation 8-34-404)
    i. No more than five (5) landfill gas collection system components (wells or collectors) may be temporarily disconnected from the vacuum system at any one time pursuant to subpart 1c.
    ii. For each individual well or collector that is disconnected from the vacuum system pursuant to subpart 1c, the total vacuum system disconnection time shall not exceed 120 days during any 12-month period.
    iii. Collection system components that are disconnected from the vacuum system are not

subject to wellhead limits (Regulation 8-34-305 or Part 1d, as applicable) or monthly wellhead monitoring requirements (Regulation 8-34-505) during this vacuum disconnection time.

iv. Wells or collectors that are temporarily disconnected from the vacuum system continue to be subject to the component leak limit (Regulation 8-34-301.2) and the quarterly leak testing requirement (Regulation 8-34-503) at all times. In addition, the Permit Holder shall conduct the following component leak monitoring at each component that has been disconnected from the vacuum system pursuant to subpart 1c: test for component leaks using the procedures identified in Regulation 8-34-602 within 10 calendar days of disconnection from vacuum and again within 1 month of disconnection from vacuum. If a component leak is detected at the well, the Permit Holder shall take all steps necessary to reduce the leak below the applicable limit, including reconnecting the well to the vacuum system, if no other corrective action measures are successful within the time frames allowed by Rule 34.

v. For each well disconnection event, the Permit Holder shall record each affected well ID number, all well disconnection dates and times, all well reconnection dates and times, all related monitoring dates and monitoring results in a District approved log. This log shall also include an explanation of why the temporary well shut down was necessary and shall describe all adjustments or repairs that were made in order to allow this well to operate continuously, to reduce leaks, or to achieve compliance with an applicable limit. All records shall be retained for a minimum of five years and shall be made available to District staff upon request.

d. Each landfill gas collection system component listed in Part 1a shall be operated in compliance with the wellhead limits of Regulation 8-34-305, unless an alternative wellhead limit has been approved for that component and the operator complies with all of the additional requirements identified in this subpart. Components that are subject to an alternative wellhead limit may still use the

Regulation 8-34-414 repair schedule for operator discovered excesses of the alternative limit; however, invoking this repair schedule does replace the monitoring requirements described in Parts 1d(ii-viii). (Basis: Regulations 8-34-305 and 8-34-414)

i. For each of the wells identified in Part 1d(ii), the Regulation 8-34-305.2 wellhead temperature limit does not apply, and the landfill gas temperature at each wellhead shall not exceed 145 degrees F.

ii. The wells that are subject to the Part 1d(i) alternative wellhead temperature limit are:
#40, #401, #403, #443, #444, #456, #457, and #458.

If any other component has a wellhead temperature of 131 degrees F or higher, the operator may elect to add this component to the above list of alternative temperature limit wells by satisfying all of the following requirements:

- The wellhead temperature shall not exceed 145 degrees F.
- The carbon monoxide (CO) concentration in the wellhead gases shall not exceed 500 ppmv.
- Prior to adding a component to the list in this subpart, the operator shall monitor the gas in the component for CO concentration at least two times, with no more than 15 days between tests. CO monitoring shall continue on a monthly basis, or more frequently if required by subparts 1d(iv-vii), until the operator is allowed to discontinue CO monitoring per subpart 1d(vii).
- The operator shall comply with all applicable monitoring and record keeping requirements in subparts 1d(iii-viii).
- The component shall not exceed any wellhead limit other than temperature and shall have had no excesses of wellhead limits (other than temperature) during the 120 days prior to adding this component to the list in this subpart.
- Within 30 days of adding a component to the list in this subpart, the operator shall notify the District in writing that the operator is requesting to add the component to the Part 1d(ii) list of alternative temperature limit wells. This notification shall include the well ID number, a map of

the collection system to identify the location of this well, and the dates and results of all monitoring conducted on the well to verify that the above requirements have been satisfied.

- If the Regulation 8-34-414 repair schedule has been invoked for the wellhead temperature excess, and the operator has meet the requirements Sections 414.1 and 414.2, then compliance with the requirements of this subpart shall be deemed an acceptable resolution of the wellhead temperature excess in lieu of the collection system expansion specified in Sections 414.3 and 414.4.

iii. The operator shall demonstrate compliance with the alternative wellhead temperature limit in Part 1d(i) by monitoring and recording the temperature of the landfill gas in each wellhead on a monthly basis, in accordance with Regulations 8-34-501.4, 8-34-501.9, and 8-34-505.

iv. If the temperature of the landfill gas in a wellhead exceeds 140 degrees F, the operator shall investigate the possibility of a subsurface fire at the wellhead by monitoring for CO concentration in the wellhead gases and by searching for smoke, smoldering odors, combustion residues, and other fire indicators in the wellhead and in the landfill area near this wellhead. Within 5 days of triggering a fire investigation, the operator shall measure the CO concentration in the landfill gas at the wellhead using a portable CO monitor or an EPA approved test method. CO monitoring shall continue according to the frequency specified in subparts 1d(v-vii).

v. If the CO concentration is greater than 500 ppmv, the operator shall immediately take all steps necessary to prevent or extinguish the subsurface fire, including disconnecting the well from the vacuum system if necessary. If the well is not disconnected from the vacuum system or upon reconnecting a well to the vacuum system, the operator shall monitor the well for CO concentration, wellhead temperature, and other fire indicators on at least a weekly basis until the CO concentration drops to 500 ppmv or less.

vi. If the CO concentration is less than or equal to 500 ppmv but greater than 100 ppmv, the operator shall monitor for CO concentration at least twice per month (not less than once every 15 days) until the CO concentration drops to 100 ppmv or less. Wellhead temperature and other fire indicators shall be evaluated at each of these semimonthly-monitoring events.

vii. If the CO concentration is less than or equal to 100 ppmv, the operator shall monitor for CO concentration on a monthly basis. CO monitoring may be discontinued if three consecutive CO measurements are 100 ppmv or less and the wellhead temperature during each of these three monitoring events is 140 degrees F or less. If a component has three or more CO measurements of 100 ppmv or less but the wellhead temperature was greater than 140 degrees F, the operator must receive written approval from the District before discontinuing the monthly CO monitoring at that component.

viii. The permit holder shall record the dates and results of all monitoring events required by this subpart in a District approved log. If Part 1d(v) applies, the operator shall also describe all actions taken to prevent or extinguish the fire.

2. All collected landfill gas shall be vented to properly operating landfill gas control equipment as described below in Part 2a. Raw landfill gas shall not be vented to the atmosphere, except for unavoidable landfill gas emissions that occur during collection system installation, maintenance, or repair that is performed in compliance with Regulation 8, Rule 34, Sections 113, 116, 117, or 118 and for inadvertent component or surface leaks that do not exceed the limits specified in 8-34-301.2 or 8-34-303. (Basis: Regulations 2-1-403, 8-34-301 and 8-34-303)

   a. The Permit Holder may operate any combination of landfill gas control devices, including: A-15 Landfill Gas Flare, S-6 Gas Turbine, S-7 Gas Turbine, S-23 Internal Combustion Engine, or S-24 Internal Combustion Engine; or may send landfill gas to another facility for additional processing and control; provided that a minimum of 71.47 MM BTU/hour of landfill gas, averaged over any rolling 24 hour period, is collected and controlled by the entire landfill gas control system. The following time periods shall be excluded from the calculation of this rolling 24-hour average landfill gas collection rate:

i. time periods when the gas collection system is not operating because the Permit Holder is conducting inspection or maintenance on the landfill gas collection or control system and is operating in compliance with all applicable requirements of Regulation 8-34-113, and

ii. time periods when the Permit Holder is attempting to prevent or extinguish a fire and is operating in compliance with all applicable requirements of Regulation 8-34-117, and

iii. time periods when the Permit Holder is conducting a source test to determine the appropriate target landfill gas collection rate pursuant to subpart c below, provided that the target landfill gas collection rate during this source test time period is not less than 99% of the limit stated above, and this source test time period does not last more than 120 consecutive hours, and no more than one source test time period exclusion is claimed per calendar year.

b. To demonstrate compliance with this part, the Permit Holder shall record, on a monthly basis, the total landfill gas collection rate for the entire control system averaged over each rolling 24-hour period during the previous month. In this record, the Permit Holder shall also identify the control devices that were operating, time periods that were excluded from the 24-hour average calculation pursuant to subpart a(i, ii, or iii), and the reason for this exclusion. The Permit Holder shall maintain all records necessary to calculate these rolling 24 hour average landfill gas collection rates including: heat input rates to each on-site control device; flow rate records and methane concentration data for landfill gas that was sent off-site; and start-up and shut down times for each control device. For exclusion time periods, the Permit Holder shall also maintain records of inspection, maintenance, fire prevention, or source test activities that occurred to verify the applicability of this exclusion. All records shall be retained on site or shall be made readily available to District staff upon request for a period of at least five years from the date on entry.

c. The target landfill gas collection rate shall be reevaluated at least once every two years in accordance with the following procedures. The Permit Holder may reevaluate the target landfill gas collection rate during any surface emission monitoring event, provided that the Permit Holder complies with subpart a(iii) above. Prior to and during any surface emission monitoring event that is conducted to reevaluate the target landfill gas collection rate limit, the Permit Holder shall:

  i. maintain the total landfill gas collection at no less than 99% of the limit in subpart a and no more than 110% of the limit in subpart a, for at least 48 hours before initiating the surface emission monitoring event and during the surface emission monitoring event,

  ii. record the date and time that the surface emission monitoring event was initiated and completed,

  iii. conduct the surface emission monitoring event in accordance with Regulation 8-34-506,

  iv. record the measured concentration and location of any landfill surface area that was found to have a surface leak above the Regulation 8-34-303 surface emission leak standard,

  v. measure and record the landfill gas flow rate (in standard cubic feet) to each control device and off-site pipeline in accordance with Regulation 8-34-508,

  vi. measure and record the methane concentration in the landfill gas that is delivered to each control device and off-site pipeline in accordance with Regulation 8-34-604,

  vii. calculate and record the hourly heat input rate to each control device and off-site pipeline using a high heating value for methane of 997.7 MM BTU/scf of landfill gas at 68 degrees F and 1 atm for each hour of the surface emission monitoring event, and

  viii calculate and record the total landfill gas heat input rate during the monitoring event, the duration of the monitoring event (in hours), and the average hourly landfill gas heat input rate during the monitoring event.

The following procedures shall be used to determine if the subpart a target landfill gas collection rate limit should be decreased, increased, or remain the same. The target landfill gas collection rate shall be revised in accordance with the procedures identified in Regulations 2-6-414 or 2-6-415.

- ix. If no surface emissions are detected during the surface emission monitoring event and the average hourly heat input rate measured during the event is greater than or equal to the target landfill gas collection rate limit in subpart a, then this limit should remain unchanged. No further action is required.
- x. If no surface emissions are detected during the surface emission monitoring event and the average hourly heat input rate measured during the event is less than the target landfill gas collection rate limit in subpart a, then this limit may be decreased to the average hourly heat input limit measured during the surface emission monitoring event. The Permit Holder may submit permit applications to request that this limit be revised. The Permit Holder must obtain APCO approval before operating at the lower target landfill gas collection rate limit except as allowed under subpart a(iii).
- xi. If surface emissions are detected during the surface emission monitoring event and the average hourly heat input rate measured during the event is less than the target landfill gas collection rate limit in subpart a, then this limit should not decreased, and the target landfill gas collection rate shall be reevaluated during the next scheduled quarterly surface emission monitoring event. If all surface leaks are corrected in accordance with Regulation 8-34-415, then no further action is required.
- xii. If surface emissions are detected during a surface emission monitoring event and the average hourly heat input rate measured during the event is greater than the target landfill gas collection rate limit in subpart a, then the target landfill gas collection rate shall be reevaluated during the next scheduled quarterly surface emission monitoring event. If all surface leaks are corrected in accordance with Regulation 8-34-415, then no further action is required. If surface emissions are detected during two or

more surface emission monitoring events during a year, then the target landfill gas collection rate limit should be increased to the higher of the two average hourly heat input rates measured during these monitoring events. Within 30 days of conducting the second surface emission monitoring event at which surface leaks are detected, the Permit Holder shall submit permit applications to request a revision of the target landfill gas collection rate.

3. The A-15 Landfill Gas Flare shall be fired on landfill gas. Propane may be used as a start-up fuel only. Landfill gas condensate may be injected into A-15, provided that the condensate injection rate does not exceed 3600 gallons during any day and A-15 complies with all limits in Parts 4-10 and any other applicable emission limits during all times that condensate is being injected into A-15. (Basis: Regulation 2-1-301)

4. The Heat Input to the A-15 Landfill Gas Flare shall not exceed 1704 million BTU per day and shall not exceed 621,785 million BTU per year. (Basis: Offsets and Cumulative Increase)

5. The Landfill Gas Flare (A-15) shall be equipped with both local and remote alarm systems. The local and remote alarms shall be activated whenever the total landfill gas collection for the site is less than the target landfill gas collection rate in Part 2a. When operation of A-15 is necessary to meet the target landfill gas collection rate, the local and remote alarms shall be activated if the flare shuts down unexpectedly or if the combustion zone temperature is less than the minimum temperature required by Part 10 below. (Basis: Regulation 8-34-301)

6. The Landfill Gas Flare (A-15) shall be equipped with one flow meter and one recorder meeting the requirements of Regulation 8-34-508. (Basis: Offsets, Cumulative Increase, and Regulations 2-1-301, 8-34-301, 8-34-501.10, and 8-34-508)

7. Nitrogen oxide (NOx) emissions from the A-15 Landfill Gas Flare shall not exceed either:
   a. an exhaust concentration of 44 ppmv of NOx, corrected to 3% oxygen, dry basis; or
   b. an emission rate of 0.06 pounds of NOx (calculated

as NO2) per million BTU.
(Basis: RACT and Offsets)

8. Carbon monoxide (CO) emissions from the A-15 Landfill Gas Flare shall not exceed either:
   a. an exhaust concentration of 361 ppmv of CO, corrected to 3% oxygen, dry basis; or
   b. an emission rate of 0.30 pounds of CO per million BTU.

   (Basis: RACT and Cumulative Increase)

9. The Landfill Gas Flare (A-15) shall comply with either the destruction efficiency or outlet concentration limit specified in Regulation 8-34-301.3.
(Basis: Offsets, Cumulative Increase, and Regulation 8-34-301.3)

10. The combustion zone temperature of the Landfill Gas Flare (A-15) shall be maintained at a minimum of 1400 degrees Fahrenheit, averaged over any 3-hour period. If a source test demonstrates compliance with all applicable requirements at a different temperature the APCO will revise the minimum combustion zone temperature limit in accordance with the procedures identified in Regulations 2-6-414 or 2-6-415 and the following criteria. The minimum combustion zone temperature for a flare (Tmin) shall be equal to the average combustion zone temperature determined during the most recent complying source test (Tavg) minus 50 degrees F, provided that the minimum combustion zone temperature is not less than 1400 degrees F:
   Tmin = Tavg - 50, for Tavg >= 1450 degrees F
   Tmin = 1400, for Tavg < 1450 degrees F
(Basis: RACT, Offsets, Cumulative Increase, Toxic Risk Management Policy, and Regulation 8-34-301.3)

11. The concentration of total reduced sulfur compounds in the collected landfill gas shall not exceed 200 ppmv (dry) expressed as hydrogen sulfide (H2S). In order to demonstrate compliance with this part, the Permit Holder shall measure the total sulfur content in collected landfill gas in accordance with the monitoring schedule identified in Condition # 18773, Part 10. The landfill gas sample shall be taken from the main landfill gas header. (Basis: Regulation 9-1-302 and Cumulative Increase)

*12. The Permit Holder shall submit a permit application for a Change of Permit Conditions, if any site-specific landfill gas characterization test indicates that the landfill gas at this site contains any of the following compounds at a level greater than the concentration listed below. The Permit Application shall be submitted to the Permit Services Division, within 45 days of receipt of test results indicating a concentration above the levels listed below. (Basis: Toxic Risk Management Policy)

Compound	Concentration (ppbv)
Acrylonitrile	500
Benzene	3300
Benzylchloride	600
1,4 Dichlorobenzene	1100
Ethylene Dibromide	300
Ethylene Dichloride	250
Ethylidene Dichloride	1200
Methylene Chloride	2500
Perchloroethylene	2400
1,1,2,2 Tetrachloroethane	550
Trichloroethylene	1400
Vinyl Chloride	1100

13. In order to demonstrate compliance with Regulation 8, Rule 34, Sections 301.3 and 412 and Parts 7 through 12 above, the Permit Holder shall ensure that a District approved source test is conducted annually on the A-15 Landfill Gas Flare. The annual source tests shall be conducted while the flare is operating at or near maximum operating rates and for each of the following operating conditions: (a) while the flare in burning landfill gas without any condensate injection and (b) while the flare is burning landfill gas and condensate is being injected into the flare at or near the maximum injection rate of 2.5 gallons/minute. Each source test shall determine the following:
    a. landfill gas flow rate to the flare (dry basis);
    b. concentrations (dry basis) of carbon dioxide (CO2), nitrogen (N2), oxygen (O2), total hydrocarbons (THC), methane (CH4), and total non-methane organic compounds (NMOC) in the landfill gas;
    c. stack gas flow rate from the flare (dry basis);
    d. concentrations (dry basis) of NOx, CO, NMOC, and O2 in the flare stack gas;
    e. NMOC destruction efficiency achieved by the flare; and
    f. average combustion zone temperature of the flare during the test period.

    The first annual source test for the A-15 Landfill Gas

Flare shall be conducted within 120 days of the initial start up date for A-15. Testing of A-15 while condensate is being injected is not required until the first annual source test that is scheduled to occur after the date that condensate injection commences. Subsequent annual source tests shall be conducted no sooner than 9 months and no later than 12 months after the previous source test. Testing of A-15 while condensate is being injected is not required, if condensate was not injected into the flare during any of the 12 consecutive months prior to the source test date. The Source Test Section of the District shall be contacted to obtain approval of the source test procedures at least 14 days in advance of each source test. The Source Test Section shall be notified of the scheduled test date at least 7 days in advance of each source test. The source test report shall be submitted to the Compliance and Enforcement Division and the Source Test Section within 60 days of the test date. (Basis: RACT, Offsets, Cumulative Increase, Toxic Risk Management Policy, and Regulations 8-34-301.3 and 8-34-412)

14. The Permit Holder shall conduct a characterization of the landfill gas concurrent with the annual source test required by Part 13 above. The landfill gas sample shall be drawn from the main landfill gas header. In addition to the compounds listed in Part 13b, the landfill gas shall be analyzed for the organic compounds listed below, except that acrylonitrile testing shall be conducted once every four years instead of annually. All concentrations shall be reported on a dry basis. The test report shall be submitted to the Compliance and Enforcement Division and the Source Test Section within 60 days of the test date. (Basis: Toxic Risk Management Policy, Cumulative Increase, and Regulation 8-34-412)

    Organic Compounds
    acrylonitrile
    benzene
    benzyl chloride
    carbon tetrachloride
    chlorobenzene
    chlorodifluoromethane
    chloroethane
    chloroform
    1,1 dichloroethane
    1,1 dichlorethene
    1,2 dichloroethane

1,4 dichlorobenzene
dichlorodifluoromethane
dichlorofluoromethane
ethylbenzene
ethylene dibromide
fluorotrichloromethane
hexane
isopropyl alcohol
methyl ethyl ketone
methylene chloride
perchloroethylene
toluene
1,1,1 trichloroethane
1,1,2,2 tetrachloroethane
trichloroethylene
vinyl chloride
xylenes

15. In order to demonstrate compliance with the above conditions, the Permit Holder shall maintain the following records in a District approved logbook.
    a. For the Landfill Gas Flare (A-15), record the date and time for each start-up and shut-down of the flare and the reason for each shut-down.
    b. Summarize the operating hours for the Landfill Gas Flare (A-15), on a daily basis.
    c. Calculate and record, on a monthly basis, the maximum daily and total monthly heat input to the Landfill Gas Flare (A-15) based on operating hours for the flare, the landfill gas flow rate recorded pursuant to Part 6, the average methane concentration in the landfill gas as determined by the most recent source test, and a high heating value for methane of 997.7 BTU/ft3 of landfill gas at 68 degrees F and 1 atmosphere.
    d. Record the total amount of condensate (gallons/day) injected into the A-15 Landfill Gas Flare for each day that condensate is injected into A-15, and summarize these records on a monthly basis.
    e. Maintain records of all test dates and test results performed to maintain compliance with Parts 12 and 13 or with any applicable rule or regulation.

    All records shall be maintained on site or shall be made readily available to District staff upon request for a period of at least 5 years from the date of entry. These record keeping requirements do not replace the record keeping requirements contained in any applicable rules or regulations. (Basis: Offsets, Cumulative Increase, 2-6-501, 8-34-301, and 8-34-501)

16. Any emission reductions that may occur due to the shut-down or modification of S-23 IC Engine or S-24 IC Engine cannot be banked or used to generate contemporaneous on site emission reduction credits for other projects. All such emission reductions shall be use to reimburse the District Small Facility Banking Account (SFBA) for the emission reduction credits provided from the SFBA to offset NOx and POC emission increases from this equipment. Furthermore, the Permit Holder shall use any NOx or POC emission reduction credits generated at any of the Permit Holder's facilities, which are located within the District, to reimburse the SFBA for all emission reduction credits provided from the SFBA on behalf of the Permit Holder, before any of these credits could become eligible for banking. (Basis: Regulation 2-4-303.5)

17. [Reserved]

18. The Permit Holder shall comply with the following waste acceptance and disposal limits and shall obtain the appropriate New Source Review permit, if one of the following limits is exceeded:
    a. Total waste accepted and placed at the landfill shall not exceed 11,150 tons in any day (except during temporary emergency situations approved by the Local Enforcement Agency).
    (Basis: Regulation 2-1-301)
    b. The amount of non-hazardous sludge accepted and placed at the landfill shall not exceed 5,000 tons in any day. (Basis: Regulation 2-1-301)
    c. The maximum design capacity of the landfill (total volume of solid waste placed in the landfill where solid waste has the same meaning as the definition in 40 CFR Part 60.751) shall not exceed 58,900,000 cubic yards. (Basis: Regulation 2-1-301)
    d. The total cumulative amount of all waste placed in the landfill shall not exceed 47,100,000 tons. Exceedance of the cumulative tonnage limit is not a violation of the permit and does not trigger the requirement to obtain a New Source review permit, if the operator can, within 30 days of the date of discovery of the exceedance, provide documentation to the District demonstrating, in accordance with BAAQMD Regulation 2-1-234.3, that the limit should be higher. (Basis: Regulation 2-1-234.3)

19. Water and/or dust suppressants shall be applied to all unpaved roadways and active soil removal and fill areas associated with this landfill as necessary to prevent visible particulate emissions that persist for more than 3 minutes in any hour. Paved roadways at the facility shall be kept sufficiently clear of dirt and debris as necessary to prevent persistent visible particulate emissions from vehicle traffic or wind. (Basis: Regulations 2-1-403, 6-301, and 6-305)

20. This Part applies to the acceptance, handling, storage, and on-site reuse of VOC-laden soil. VOC-laden soil is any soil that contains volatile organic compounds, as defined in Regulation 8-40-213, other than contaminated soil. As defined in Regulation 8-40-205, contaminated soil contains more than 50 ppmw of VOC or has a surface concentration greater than 50 ppmv of VOC as C1, and contaminated soil is subject to Part 21 below instead of this part. Materials containing only non-volatile hydrocarbons and materials meeting the requirements of Regulation 8-40-113 are not subject to this part. For each lot of VOC-laden soil accepted at this site, the Permit Holder shall comply with the limits and monitoring procedures identified in either subpart a or subpart b below to demonstrate compliance with the total carbon limits in Regulation 8-2-301.
(Basis: Regulation 8-2-301)
    a. Unless the Permit Holder demonstrates compliance with Regulation 8-2-301 in accordance with subpart b below, the Permit Holder shall limit the quantity of VOC laden soil handled per day such that no more than 15 pounds of total carbon could be emitted to the atmosphere per day. In order to demonstrate compliance with this subpart, the Permit Holder shall maintain the following records in a District approved log for all VOC-laden soil accepted at the landfill.
        i. Record on a daily basis the amount of VOC laden soil accepted for each truckload or each soil lot, as appropriate. This amount (in units of pounds per day) is Q in the equation in subpart a(iii) below.
        ii. Record on a daily basis the VOC content for each truckload or each soil lot, as appropriate. This VOC Content (C in the equation below) should be expressed as parts per million by weight as total carbon

(or C1).

iii. Calculate and record on a daily basis the VOC Emission Rate (E) using the following equation: E = Q * C / 1E6 This equation may be applied to each truckload or to each soil lot received per day depending on the amount of soil that is represented by the VOC Content data. If the equation is applied to multiple loads per day, the VOC Emission Rate shall be totaled for all loads received each day.

iv. Summarize all daily emission rates on a monthly and calendar year basis.

v. All records shall be maintained on site or shall be made readily available to District staff upon request for at least 5 years from the date of entry.

b. Unless the Permit Holder demonstrates compliance with Regulation 8-2-301 in accordance with subpart a above, the Permit Holder shall screen each lot of VOC-laden soil accepted per day for VOC surface emissions to show that each lot of VOC-laden soil is not contaminated soil.

i. The Permit Holder shall use the testing procedures outlined in Regulation 8-40-604.

ii. The screening test shall be representative of the entire lot of VOC-laden soil. The soil surface shall be disturbed prior to screening to ensure that the screening is representative of the entire load.

iii. The Permit Holder shall maintain records of all testing conducted to satisfy this subpart and shall record the amount of VOC-laden soil accepted and the highest surface concentration measured pursuant to this subpart. These records shall be maintained for each truckload or each soil lot accepted, as appropriate, provided that the records are made or summarized on at least a daily basis.

iv. Summarize the daily soil acceptance rates and the weighted average of the surface concentration records on a monthly basis and for each calendar year.

v. All records shall be maintained on site or shall be made readily available to District staff upon request for at least 5 years from the date of entry.

21. This part applies to any on-site activities involving

contaminated soil as defined in Regulation 8-40-205. Unless stated otherwise, all terms, standards, or procedures described in this part have the same meaning as the terms, standards, and procedures described in Regulation 8, Rule 40. (Basis: Regulation 2-1-301, 2-1-403, 8-40-301, 8-40-304 and 8-40-305)

a. The procedures listed below in subparts b-l do not apply if the following criteria are satisfied. However, the record keeping requirements in subpart m below are applicable.
   i. The Permit Holder has appropriate documentation demonstrating that either the organic content of the soil or the organic concentration above the soil is below the "contaminated" level (as defined in Regulations 8-40-205, 207, and 211). The handling of soil containing in concentrations below the "contaminated" level is subject to Part 20 above.
   ii. The Permit Holder has no documentation to prove that soil is not contaminated, but source of the soil is known and there is no reason to suspect that the soil might contain organic compounds.

b. The Permit Holder shall provide notification to the Compliance and Enforcement Division of the Permit Holder's intention to accept contaminated soil at the facility at least 24 hours in advance of receiving the contaminated soil. The Permit Holder shall provide an estimate of the amount of contaminated soil to be received, the degree of contamination (range and average VOC Content), and the type or source of contamination.

c. Any soil received at the facility that is known or suspected to contain volatile organic compounds (VOCs) shall be handled as if the soil were contaminated, unless the Permit Holder receives test results proving that the soil is not contaminated. To prove that the soil is not contaminated, the Permit Holder shall collect soil samples in accordance with Regulation 8-40-601 within 24 hours of receipt of the soil by the facility. The organic content of the collected soil samples shall be determined in accordance with Regulation 8-40-602.
   i. If these test results indicate that the soil is still contaminated or if the soil was not sampled within 24 hours of receipt by the facility, the Permit Holder must continue to

handle the soil in accordance with the procedures subparts d-l below, until the soil has been placed in a final disposal location and adequately covered. Storing soil in a temporary stockpile or pit is not considered treatment. Co-mingling, blending, or mixing of soil lots is not considered treatment.

ii. If these test results indicate that the soil - as received at the facility - has an organic content of 50 ppmw or less, then the soil may be considered to be not contaminated and need not be handled in accordance with the procedures listed in subparts d-l below, but shall be handled in accordance with Part 20 above.

d. Any contaminated soil received at the facility shall be clearly identified as contaminated soil, shall be handled in accordance with subparts e-l below, and shall be segregated from non-contaminated soil. Contaminated soil lots may not be co-mingled, blended, or otherwise mixed with non-contaminated soil lots prior to treatment, reuse, or disposal. Mixing soil lots in an attempt to reduce the overall concentration of the contaminated soil or to circumvent any requirements or limits is strictly prohibited.

e. On-site handling of contaminated soil shall be limited to no more than two on-site transfers per soil lot. For instance, unloading soil from off-site transport vehicles into a temporary storage pile is considered one transfer. Moving soil from a temporary storage pile to a staging area is considered one transfer. Moving soil from a temporary storage pile to a final disposal site is one transfer. Moving soil from a staging area to a final disposal site is one transfer. Therefore, unloading soil from off-site transport into a temporary storage pile and then moving the soil from that temporary storage pile to the final disposal site is allowed. Unloading soil from off-site transport into a staging area and then moving the soil from that staging area to the final disposal site is allowed. However, unloading soil from off-site transport to a temporary storage pile, moving this soil to a staging area, and then moving the soil again to a final disposal site is three on-site transfers and is not allowed.

f. Contaminated soil shall either be deposited in a

final disposal site or transported off-site for treatment:
- i. within 90 days, if the soil contains less than 500 ppmw of VOC, or
- ii. within 45 days, if the soil contains 500 ppmw of VOC or more.

g. The total amount of contaminated soil disposed of at this site shall not exceed 6000 tons per day. (Basis: Regulation 2-1-301)

h. All active storage piles shall meet the requirements of Regulation 8-40-304 by using water sprays, vapor suppressants or approved coverings to minimize emissions. The exposed surface area of any active storage pile (including the active face at a landfill) shall be limited to 6000 ft2. The types of storage piles that may become subject to these provisions include (but are not limited to) truck unloading areas, staging areas, temporary stockpiles, soil on conveyors, bulldozers or trucks, the active face of a landfill, or other permanent storage pile at the final disposal location.

i. All inactive storage piles shall meet the requirements of Regulation 8-40-305 including the requirement to cover contaminated soil during periods of inactivity longer than one hour. The types of storage piles that may become subject to these provisions include (but are not limited to) soil on trucks or other on-site equipment, staging areas, temporary stockpiles, and the permanent storage pile at the final disposal location. District approved coverings for inactive storage piles include continuous heavy-duty plastic sheeting (in good condition, joined at the seams, and securely anchored) or encapsulating vapor suppressants (with re-treatment as necessary to prevent emissions).

j. The Permit Holder must:
- i. Keep contaminated soil covered with continuous heavy-duty plastic sheeting (in good condition, joined at the seams, and securely anchored) whenever soil is to be stored in temporary stockpiles or during on-site transport in trucks. Soil in trucks shall not be left uncovered for more than 1 hour.
- ii. Establish a tipping area for contaminated soils near the active face that is isolated from the tipping area for other wastes.

    - iii. Spray contaminated soil with water or vapor suppressant immediately after dumping the soil from a truck at the tipping area.
    - iv. Ensure that all contaminated soil is transferred from the tipping area to the active face immediately after spraying with water or vapor suppressant.
    - v. Ensure that contaminated soil in the tipping area is not disturbed by subsequent trucks. Trucks shall not drive over contaminated soil in the tipping area or track contaminated soil out of the tipping area on their wheels.
    - vi. Spray contaminated soil on the active face with water or vapor suppressant (to keep the soil visibly moist) until the soil can be covered with an approved covering.
    - vii. Limit the area of exposed soil on the active face to no more than 6000 ft2.
    - viii. Ensure that contaminated soil spread on the active face is completely covered on all sides with one of the following approved coverings: at least 6 inches of clean compacted soil, at least 12 inches of compacted garbage, or at least 12 inches of compacted green waste.
    - ix. Ensure that covering of soil on the active face is completed within one hour of the time that the soil was first dumped from a truck at the tipping area.
- k. Contaminated soil shall not be used as daily, intermediate, or final cover material for landfill waste operations unless the requirements of Regulation 8, Rule 40, Sections 116 or 117 have been satisfied.
- l. Contaminated soil is considered to be a decomposable solid waste pursuant to Regulation 8, Rule 34. All contaminated soil disposed of at a site shall be included in any calculations of the amount of decomposable waste in place for annual reporting requirements or for purposes of 8-34-111 or 8-34-304.
- m. The Permit Holder shall keep the following records for each lot of soil received, in order to demonstrate on-going compliance with the applicable provisions of Regulation 8, Rule 40 and this part.
    - i. For all soil received by the facility (including soil with no known contamination), record the arrival date at the facility, the

soil lot number, the amount of soil in the lot, the organic content or organic concentration of the lot (if known), the type of contamination (if any), and keep copies of any test data or other information that documents whether the soil is contaminated (as defined in 8-40-205) or not contaminated, with what, and by how much.

ii. If the soil is tested for organic content after receipt by the facility, a report with the sampling date, test results, and the date results were received.

iii. For all on-site handling of contaminated soil, use a checklist or other approved method to demonstrate that appropriate procedures were followed during all on-site handling activities. One checklist shall be completed for each day and for each soil lot (if multiple lots are handled per day).

iv. For soil aerated in accordance with 8-40-116 or 117 record the soil lot number, the amount of soil in the lot, the organic content, the final placement date, the final placement location, and describe how the soil was handled or used on-site.

v. For final disposal at a landfill, record on a daily basis the soil lot number, the amount of soil placed in the landfill, the disposal date, and the disposal location.

vi. Summarize the total amount of contaminated soil disposed of at this site on a monthly and calendar year basis to demonstrate compliance with subpart g.

All records shall be retained for at least 5 years from the date of entry and shall be made available for District inspection upon request.

22. To demonstrate compliance with Parts 18-21 and Regulation 8-34-304, the Permit Holder shall maintain the following records in a District approved logbook.
    a. Record the total amount of municipal solid waste received at S-1 on a daily basis. Summarize the daily waste acceptance records for each calendar month.
    b. For each area or cell that is not controlled by a landfill gas collection system, maintain a record of the date that waste was initially placed in the area or cell. Record the cumulative amount of waste placed in each uncontrolled area or cell on

a monthly basis.

c. If the Permit Holder plans to exclude an uncontrolled area or cell from the collection system requirement, the Permit Holder shall also record the types and amounts of all non-decomposable waste placed in the area and the percentage (if any) of decomposable waste placed in the area.

d. Record the initial operation date for each new landfill gas well and collector.

e. Maintain an accurate map of the landfill that indicates the locations of all refuse boundaries and the locations of all wells and collectors (using unique identifiers) that are required to be operating continuously pursuant to Part 1a. Any areas containing only non-decomposable waste shall be clearly identified. This map shall be updated at least once a year to indicate changes in refuse boundaries and to include any newly installed wells and collectors.

f. Record of the dates, locations, and frequency per day of all watering activities on unpaved roads or active soil or fill areas. Record the dates, locations, and type of any dust suppressant applications. Record the dates and description of all paved road-cleaning activities. All records shall be summarized on monthly basis.

All records shall be maintained on site or shall be made readily available to District staff upon request for a period of at least 5 years from the date of entry. These record keeping requirements do not replace the record keeping requirements contained in any applicable rules or regulations.
(Basis: Regulations 2-1-301, 2-6-501, 6-301, 6-305, 8-2-301, 8-40-301, 8-34-304, and 8-34-501)

23. The annual report required by BAAQMD Regulation 8-34-411 shall be submitted in two semi-annual increments. The reporting period for the first increment of the Regulation 8-34-411 annual report that is submitted subsequent to the issuance of the MFR Permit for this site shall be from December 1, 2003 through April 30, 2004. This first increment report shall be submitted by May 31, 2004. The reporting periods and report submittal due dates for all subsequent increments of the Regulation 8-34-411 report shall be synchronized with the reporting periods and report submittal due dates for the semi-annual MFR Permit monitoring reports that are

required by Section I.F of the MFR Permit for this site. A single report may be submitted to satisfy the requirements of Section I.F, Regulation 8-34-411, and 40 CFR Part 63.1980(a), provided that all items required by each applicable reporting requirement are included in the single report. (Basis: Regulation 8-34-411 and 40 CFR Part 63.1980(a))

End of Conditions

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Determination Detail

Control Number: 0200002

Category: NSPS
EPA Office: Region 3
Date: 01/11/2002
Title: Gas Extraction Well Operating Temperature Increase Requests
Recipient: D. Richard Guidry
Author: Judith Katz
Comments:

Subparts: Part 60, WWW Municipal Solid Waste LANDFILLs

References: 60.13(i)
60.753(c)

Abstract:

Q: Will EPA grant a waiver from the operating temperature of 55.0 degrees C in 40 CFR 60.753(c)?

A: EPA will grant a waiver to 65.6 degrees C for certain wells that show high methane production, low oxygen, carbon monoxide levels below 100 ppm, and no charred debris in the gas collection system.

Letter:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

January 11, 2002

Mr. D. Richard Guidry

Regional Compliance Manager
3474 Atlantic Lane
Waverly, Virginia 23890

Re: King George LANDFILL Inc.
King George County LANDFILL
VADEQ Registration Number: 40903

and

Atlantic Waste Disposal, Inc.
VADEQ Registration Number: 51278
Gas Extraction Well Operating Temperature Increase Requests

Dear Mr. Guidry:

By letters dated July 26 and July 30, 2001, you requested that the U.S. Environmental Protection Agency ("EPA"), Region III allow the King George and Atlantic LANDFILLs to increase the wellhead temperature limit for their LANDFILL gas collection system to 65.60 C (150.0 F). Your letters indicate that both LANDFILLs have wells that consistently have temperatures above the 55.0 C (131.0 F) temperature limit specified in 40 C.F.R. Sec. 60.753(c) for LANDFILL gas collection systems. Subsequently, you sent Region III wellhead data on temperature, methane, oxygen, and carbon dioxide for these LANDFILLs. You also have discussed these issues with Bowen Hosford, Air Enforcement Branch, during several telephone conversations.

Region III reviewed the information you provided, other sources of information, and consulted with another EPA Region on this topic. EPA's concern is that temperatures above the regulatory limit are indicative of a LANDFILL fire or that methanogen have been killed. However, as the data you provide shows, methane production at both LANDFILLs has remained high (not less than 45%). IN addition, oxygen content of the LANDFILL gas has remained below 5%. This indicates that anaerobic activity is continuing. You have also provided carbon monoxide sampling results that indicate carbon monoxide is less than 20 ppm at both LANDFILLs. Carbon monoxide level approaching 100 ppm would be cause for concern.

Finally, you have indicated, during conversations with Mr. Hosford, that there is no physical evidence of fire, such as charred materials, on the inside of the pipes in the LANDFILL gas collection system.

Based on these data, Region III's review of some of the literature on this issue (see enclosed article), and discussion with another EPA region, the increased wellhead temperatures do not indicate fires at the Atlantic and King George LANDFILLs. Therefore, pursuant to 40 C.F.R. Sec. 60.13(i), Region III is granting a temperature increase from 55.0 C (131.0 F) to 65.60 C (150.0 F) at the wells specified in the data provided by you. However, Region III will not grant exemptions to the temperature limits for future wells because Region III believes that exemptions or waivers should be granted on the basis of data fo reach wellhead.

If you have any questions or comments, call Mr. Hosford at (215) 814-3158.

Sincerely,

Judith M. Katz, Director

Air Protection Division

Enclosure

cc: Lisa Childress, VADEQ
Gary E. Graham, VADEQ

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Determination Detail

Control Number: 0600062

Category: NSPS
EPA Office: Region 4
Date: 02/09/2005
Title: Changes to Standard Operating Procedures
Recipient: Kozlov, L. T.
Author: Banister, Beverly H.
Comments:

Subparts: Part 60, WWW Municipal Solid Waste Landfills

References: 60.753(b)
60.753(c)
60.753(d)
60.755

Abstract:

Q: May the Orange County Solid Waste Management facility change its standard operating procedures for landfill gas extraction wells, under 40 CFR part 60, subpart WWW, and shut down, as an alternative to decommissioning, the wells where gas flows are so low that applying even minimal vacuum results in air infiltration that causes exceedances of the applicable oxygen concentration limit?

A: Yes. EPA approves the alternative operating procedure provided that that the facility diagrams are updated to indicate which wells have been shutdown because landfill gas production rates are too low to permit continuous extraction. EPA finds that shutting down nonproductive wells, rather than decommissioning them, has the potential to lower overall non-methane organic compounds emissions by making it easier to resume gas collection in nonproductive areas of the landfill that subsequently experience an improvement in gas quality.

Letter:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA GEORGIA 30303-8960

FEB 09 2005

4APT-ATMB

L.T. Kozlov, P.E.
Program Administrator
Air Resources Management
Central District
Florida Department of Environmental Protection
3319 Maguire Boulevard, Suite 232
Orlando, Florida 32803-3767

Dear Mr. Kozlov:

The purpose of this letter is to provide you with a written determination regarding proposed changes to the standard operating procedures for landfill gas extraction wells at the Orange County Solid Waste Management Facility. This landfill is subject to 40 CFR Part 60, Subpart WWW (Standards of Performance for Municipal Solid Waste Landfills), and in a request sent to the U.S. Environmental Protection Agency (EPA) Region 4 and to your agency, Orange County proposed changes in standard operating procedures for certain wells in the landfill's active gas collection system. These changes involve an alternative to decommissioning wells where low landfill gas generation rates make it difficult to simultaneously operate wellheads at negative pressure and maintain compliance with oxygen concentration limits. Based upon our review, the changes proposed by Orange County are acceptable. Details regarding the County's proposal and the basis for our conclusions are provided in the remainder of this letter.

Operating requirements for gas collection and control systems (GCCS) are promulgated at 40 CFR Sec. 60.753(b), (c), and (d). Under these provisions, wellheads must be operated under negative pressure, the temperature of interior wellheads must be less than 55 degrees C, gas quality limits for interior wells (either less than 20 percent nitrogen or less than five percent oxygen) must be met, and the methane concentration at the surface of the landfill must be less than 500 parts per million (ppm). Under provisions in 40 CFR Sec. 60.755, monitoring to verify compliance with the wellhead pressure, temperature, and gas quality limits must be conducted on a monthly basis. Monitoring to verify compliance with the 500 ppm surface methance concentration limit must be conducted on a quarterly basis.

Orange County's request for approval of changes to its standard operating procedures involves wells where gas flow rates are so low that applying even minimal vacuum results in air infiltration that causes exceedances of the applicable oxygen concentration limit. Shutting such wells down will prevent the air filtration that leads to the oxygen exceedances, but shutting a well down is likely to cause positive pressure in the wellhead as landfill gas builds up. Therefore, simultaneously complying with both the negative pressure and oxygen concentration limits in 40 CFR Sec. 60.753 can be difficult for wells where gas flow rates have declined over time.

Under provisions in 40 CFR Sec. 60.753(b)(3), wells that experience positive pressure after being shutdown to accommodate declining landfill gas flow rates can be decommissioned if permission is granted by the Administrator. As an alternative to decommissioning wells under the provisions, Orange County has proposed to make the following changes to its standard operating procedure for wells where persisten oxygen exceedances are not the result of operations and/or maintenance issues:

1. Wells where oxygen concentrations do not decline to acceptable levels after more than one hour of reduced vacuum will be shut off until the gas quality recovers.

2. The monthly monitoring required by 40 CFR Sec. 60.755 will be conducted for wells that have been shutdown, but positive pressure or elevated oxygen concentrations will not be considered exceedances of the operating limits in 40 CFR Sec. 60.753.

3. If monthly monitoring indicates that pressure has built up in the well and the oxygen concentration still exceeds five percent, the well will be opened to relieve the pressure and will be shutdown until it is monitored the following month.

4. If the monthly monitoring indicates that gas quality has improved (i.e., the oxygen concentration has dropped below five percent), the well will be brought back on line until the gas quality declines again.

5. The quarterly methane surface concentration monitoring requird under 40 CFR Sec. 60.755 will be conducted for wells that have been shutdown. Standard remediation steps, including evaluating the need to return wells to full-time service, will be followed if exceedances of teh 500 ppm methane surface concentration limit are detected.

According to Mr. Daniel Morical of Orange County Utilities, the operating procedure changes outlined above would apply to approximately four or five of the 130 wells at its landfill at any one time. Mr. Morical also indicated that there is a high probability of gas quality improving to the point it would be necessary to restart wells that had been shutdown. Based upon our review, the proposed changes to Orange County's standard operating procedures are acceptable because shutting down nonproductive wells, instead of decommissioning them, has the potential to lower overall nonmethane organic compound (NMOC) emissions at the landfill. This potential increase in NMOC control system efficiency stems from the ability to quickly resume gas collection if there are improvements in the gas quality or increases in the gas production rate in an area of the landfill where wells have become nonproductive. If wells in a nonproductive area are decommissioned, instead of merely being shutdown, NMOC emissions would not be controlled between the time an exceedance is identified and a new well is installed. Once condition for approval of the proposed changes in standard operating procedures at the Orange County Solid Waste Management Facility is that facility diagrams must be updated to indicate which wells have been shutdown because landfill gas production rates are too low to permit continuous extraction.

If you have any questions about the determination provided in this letter, please contact Mr. David McNeal of the EPA Region 4 staff at (404) 562-9102.

Sincerely,

Beverly H. Banister
Director

Air, Pesticides & Toxics
Management Division

cc: Daniel Morical
Orange County Utilities - Solid Waste Division
5901 Young Pine Road
Orlando, Florida 32829

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MUNICIPAL SOLID WASTE LANDFILL NEW SOURCE PERFORMANCE STANDARDS (NSPS) AND EMISSION GUIDELINES (EG) -- QUESTIONS AND ANSWERS

Revised

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

November 1998

November 1998

MUNICIPAL SOLID WASTE LANDFILL NEW SOURCE PERFORMANCE STANDARDS (NSPS) AND EMISSION GUIDELINES (EG) -- QUESTIONS AND ANSWERS

Disclaimer: *It is important that the user understand the purpose and limitation of the "Municipal Solid Waste Landfill New Source Performance Standards and Emission Guidelines Questions and Answers" file. The questions and answers are not intended to fully represent or be used in place of the regulations. These questions can be used to explore the application of the regulations in different scenarios or to shed light on complex issues. The answers provided are not rules nor are they binding upon the Agency in any context. The EPA may withdraw, modify, or depart from the answers provided in this file at any time without notice. For an understanding of the actual regulatory requirements in any given situation, the reader must consult the appropriate sections of Title 40 of the Code of Federal Regulations (CFR), pertinent Federal Registers and EPA guidance documents, as well as relevant State regulations. We recommend that the EPA Regional Offices and States be consulted for specific applicability determinations.*

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INTRODUCTION AND SOURCES OF ADDITIONAL INFORMATION

The following list of questions and answers are provided as a guide for those subject to the new source performance standards (NSPS) or emission guidelines (EG), as well as those implementing the NSPS or EG. It is the intent of EPA to update this list as new questions and issues are raised. If you have a concern you feel should be addressed here, please fax or E-mail your question to:

Questions Concerning	Name	Fax	E-mail
Technical/Rule	Martha Smith	919-541-2421	smith.martha@epamail.epa.gov
Implementation	Mary Ann Warner	919-541-2664	warner.maryann@epamail.epa.gov
Monitoring and Sampling Methods	Foston Curtis	919-541-1039	curtis.foston@epamail.epa.gov
Landfill Air Emissions Model	Susan Thorneloe	919-541-2382	thorneloe.susan@epamail.epa.gov
Part 70 and 71 Permitting	Joanna Swanson	919-541-5282	swanson.joanna@epamail.epa.gov
New Source Review Permitting	Dan DeRoeck	919-541-5593	deroeck.dan@epamail.epa.gov

Additional information regarding the Municipal Solid Waste Landfill New Source Performance Standards and Emission Guidelines can be obtained from the following documents. These documents are available as indicated; however, a new EPA TTN Website under development will accommodate many of these documents at http://www.epa.gov/ttn/uatw/landfill/landflpg.html.

C Municipal Solid Waste Landfills Proposed Rule and Guideline, May 30, 1991 (56 FR 24468).

C Municipal Solid Waste Landfills Final Rule and Guideline, March 12, 1996 (61 FR 9905). Also available on the TTN Web (http://www.epa.gov/docs/fedrgstr/EPA-AIR/1996/March) and in the docket (see address below).

- Amendments to Municipal Solid Waste Landfills Final Rule and Guideline, June 16, 1998 (63 FR 32743). Available on the TTN Web(http://www.epa.gov/docs/fedrgstr/EPA-AIR/1998/June).

- "Air Emissions from Municipal Solid Waste Landfills - Background Information for Proposed Standards and Emission Guidelines," March 1991, EPA-450/3-90-011(a). This document contains technical information on landfill emissions and controls assembled prior to proposal of the standards. It may be obtained from the U.S. EPA Library in Research Triangle Park, NC or from the docket (see address below).

- "Air Emissions from Municipal Solid Waste Landfills - Background Information for Final Standards and Guidelines," December 1995, EPA-453/R-94-021. This document summarizes all public comments on the proposed NSPS and EG and the EPA responses. This document may be obtained from the TTN Web, the U.S. EPA Library in Research Triangle Park, or from the docket (see addresses below).

- "Municipal Solid Waste Landfills, Volume 1: Summary of the Requirements for the New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills," EPA-456R-96-004 (MSW Landfills, Volume 1) has been posted on the TTN Web (see address below) and explains the requirements of the NSPS and EG. Explanations and tools are provided to help implementing agencies determine applicability, ensure compliance, collect and review reports, and conduct inspections. The document will also be available in the docket (see address below) and EPA Regional libraries (Regions I-X).

- "Municipal Solid Waste Landfills, Volume 2: Summary of the Requirements for Section 111(d) State plans for Implementing the Municipal Solid Waste Landfill Emission Guidelines," EPA-456R/96-005 (MSW Landfills, Volume 2) has been posted on the TTN Web (see address below), and explains the State plan development and approval process. MSW Landfills, Volume 2 outlines and explains the required content of State plans, outlines the timeline and responsibilities for developing and submitting State plans, and answers general questions about how to prepare State plans. The document is also available in the docket (see address below) and EPA Region Libraries (Regions I-X).

The docket is available at the following address. A reasonable fee may be charged for copying.

U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
Air and Radiation Docket and Information Center
Room M-1500 Waterside Mall, Ground Floor
Phone: (202) 260-7548
Refer to Docket Number: A-88-09

The U.S. EPA Library in Research Triangle Park address and phone number are as follows:

U.S. EPA Library (MD-33)
Research Triangle Park, NC 27711
Phone: (919) 541-2777

Electronic file(s) can be accessed through the EPA Technology Transfer Network Website (TTN Web). The files are located under “OAR Policy and Guidance Information”. The TTN Web can be accessed through the World Wide Web at http://www.epa.gov/ttn/oarpg. Many of these landfills files are available at http://www.epa.gov/ttn/uatw/landfill/landflpg.html. The TTN Web help number is (919) 541-5384.

The EPA Regional offices may also be contacted for assistance. The appropriate contacts are listed below:

Name	Region	Phone	Fax
Jeanne Cosgrove	1	617-565-9451	617-565-4940
Christine DeRosa	2	212-637-4022	212-637-3901
Jim Topsale	3	215-814-2190	215-814-2114
Scott Davis	4	404-562-9127	404-562-9095
Charles Hatten	5	312-886-6031	312-886-0617
Mick Cote	6	214-665-7219	214-665-7263
Ward Burns	7	913-551-7960	913-551-7065
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I. OVERVIEW AND APPLICABILITY

A. Overview of Requirements and Applicability

1. Question: What is required of landfills to which the NSPS or the EG applies?

Answer: All sources to which the NSPS or EG applies must submit a design capacity report -- regardless of their size or capacity. Those sources with a design capacity greater than or equal to 2.5 million Mg and 2.5 million m^3 must also submit periodic emissions reports. If those sources emit more than 50 Mg/yr of non-methane organic compounds (NMOC), they are required to comply with the emission control requirements of the NSPS (new landfills) or the EG (existing landfills).

2. Question: A commenter submitted an applicability table to summarize which requirements apply to landfills depending on their size and emission rates and asked if the table was correct for both existing landfills and new landfills as defined under Subparts Cc (EG) and WWW (NSPS).

Answer: The following table is a correct summary of the applicability of the requirements of the NSPS and EG.

Applicability Table based on §§ 60.33c(a) and 60.752

Design Capacity (Million Mg and/or Million m^3)	Emissions (Mg/yr NMOC)	Design Capacity Report Required	Periodic NMOC Emission Reports Required	Controls Required	Title V Permit Required
<2.5 (Mg or m^3)	< 50	Yes	No	No	*
<2.5 (Mg or m^3)	≥ 50	Yes	No	No	*
≥2.5 (Mg and m^3)	< 50	Yes	Yes	No	Yes
≥2.5 (Mg and m^3)	≥ 50	Yes	Yes	Yes	Yes

* The landfills NSPS and EG does not require a part 70 or 71 operating permit for these landfills, but part 70 or 71 requires a permit if the landfill is a major source as defined in part 70 or 71 or is subject to part 70 or 71 for some other reason (e.g., subject to another NSPS or NESHAP). A landfill is a major source and requires a title V permit if the air emissions are > 100 tons/yr or the HAP emissions are >10 tons/yr for one HAP or 25 tons/yr for a combination of HAP's or if it emits major source levels of criteria pollutants such as VOC (major source thresholds are different for attainment and nonattainment areas--see the definition in 40 CFR section 70.3(a)).

3. Question: What is the difference between the NSPS and the EG? Is there any freedom of ability to modify the standards in the EG which is not available in the NSPS?

Answer: There are two main differences between the NSPS and EG. First, the NSPS applies to new, modified, or reconstructed municipal solid waste (MSW) landfills. The recent amendments (63 FR 32743, June 16, 1998) clarify that a new, modified, or reconstructed landfill is defined as a landfill that commenced construction, modification, or reconstruction on or after May 30, 1991. The EG applies to existing MSW landfills. An existing landfill is defined as a landfill that accepted waste on or after November 8, 1987 and is not new, modified, or reconstructed.

In addition, the NSPS is a single federal rule that applies to all new sources, the EG provides guidance for regulating landfill gas emissions which the States are required to implement through individual State plans. While State plans must generally be as stringent as the EG, there is flexibility, on a case-by-case basis, to apply less stringent limitations or compliance schedules if certain criteria are met (see section V.E. for additional details). State plans could also be more stringent than the EG. (See section II.E for additional details).

4. Question: What is the significance of the November 8, 1987 date that is specified in the EG? Are landfills that accepted waste after this date subject to the EG or the NSPS?

Answer: A cutoff date of 1987 was established to focus on landfills that accepted waste more recently and would thus have a higher emission potential. Another important consideration was the potential difficulty of locating landfills that closed prior to 1987 and establishing responsibility for installation of controls at older closed landfills for which ownership may be uncertain.

The Hazardous and Solid Waste Amendments to RCRA of 1984 required States to establish a permit program or other system of prior approval to ensure that facilities that receive household hazardous waste or small quantity generator hazardous waste are in compliance with 40 CFR part 257, "Criteria for Classification of Solid Waste Disposal Facilities and Practices." This permit program was to be established by November 8, 1987. This date was selected as the regulatory cutoff in the EG for landfills that are no longer receiving wastes because EPA judged States would be able to identify active facilities as of this date. [See pages 24475 and 24476 of the proposal preamble (in the May 30, 1991, Federal Register), Section IV Rationale, Selection of Affected and Designated Facilities]. Landfills that accept waste after this date could be subject to either the EG or NSPS depending upon when they are permitted to exceed 2.5 million Mg and 2.5 million cubic meters in design capacity (see the following questions and answers).

B. Applicability for Modified Landfills

5. Question: If an existing landfill subject to the EG is modified, does it remain subject to the EG or become subject to the NSPS?

Answer: The recent amendments (63 FR 32743) clarify that all landfills that commence modification on or after May 30, 1991 (regardless of size) are classified as new, and subject to the NSPS.

6. Question: What constitutes a "modification"? Some State solid waste regulations specify that a vertical or horizontal expansion constitutes a modification.

Answer: The recent amendments clarify that a modification is an increase in the permitted volume design capacity of a landfill by either vertical or horizontal expansion. For the modification to have occurred, the owner or operator must have commenced construction on the horizontal or vertical expansion. For landfills, modifications that increase capacity and emissions are typically implemented by horizontal (lateral) or vertical (upward) expansion of the existing landfill. If a vertical (upward) or horizontal (lateral) expansion increases the design capacity of the landfill above the previously permitted level then it is a modification. Furthermore, adding a new MSW landfill area at the same location as an existing MSW landfill causes the entire site (contiguous geographic area) to be considered a modified landfill subject to the NSPS. (See section I.D.)

If an existing landfill makes an operational change, then it will continue to be subject to the EG rather than becoming subject to the NSPS. For example, an increase in design capacity may result from not only an increase in the permitted volume of the landfill but also from an increase in the density as documented in the annual recalculation required in § 60.758(f). This density change is not a modification, and does not subject an existing landfill to the NSPS; but if capacity is increased to $ 2.5 million Mg and 2.5 million m^3 in this way, the landfill would file an amended design capacity report under the EG and perform the NMOC emission rate calculation to determine if control is required.

7. Question: Is there a minimum amount of increase in design capacity that triggers the requirements of the NSPS?

Answer: No, any vertical or horizontal expansion that increases the design capacity is a modification and triggers NSPS applicability for landfills. If the capacity is increased to or above 2.5 million Mg and 2.5 million m^3, an amended design capacity report must be filed and the landfill must begin calculating the annual NMOC emission rate using the tier procedures in the rule and must submit NMOC emission rate reports.

8. Question: Suppose an MSW landfill is subject to the EG, but the facility then makes a modification that increases the design capacity. Is the entire landfill then subject to the NSPS, or is the "new" modification to the landfill subject to the NSPS while the rest of the landfill remains subject to the EG?

Answer: If the landfill is modified (an increase in the design capacity by vertical or horizontal expansion) after May 30, 1991, then the entire landfill is subject to the NSPS.

C. Date of Commenced Construction

9. Question: Does the NSPS apply based on the date of permit issuance or initial waste placement? Which permit should serve as the basis for establishing the date of commenced construction?

Answer: As clarified in the recent amendments (63 FR 32743), a new landfill is a landfill that commences construction, modification, or reconstruction on or after May 30, 1991. The definition of "commenced" is contained in the NSPS General Provisions in 40 CFR 60 subpart A § 60.2. "Commenced means...that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a contractual obligation to undertake, within a reasonable time, a continuous program of construction or modification". Depending on the specific case, the date a permit was issued, the date a contract was signed, or the date that physical construction began could be the date of "commenced" construction. Because one or more of these events would need to occur prior to the date of initial waste acceptance, it is likely that the date of waste acceptance would not be the date construction "commenced". The regulatory authority has responsibility for determining the appropriate date considering the sequence of events for the specific landfill.

D. Definition of Source/Contiguous Area

10. Question: How are contiguous or adjacent landfills handled? For example, a county landfill, built in the early 1970s, is in the process of closing, however, it is still accepting waste. As an

expansion to the existing landfill, another cell obtained a permit in February 1993, but is still under construction. These two landfill sites are separated by an access road. In order to calculate its emissions, is this considered one landfill or two? Also, is the addition of these cells a modification, or would it be considered a new source? Another county landfill has two cells separated by a county road. Is this considered one landfill or two? A third landfill has cells or sites separated by a golf course.

Answer: A landfill is considered a single landfill if the cells are contiguous and under common ownership or control, even if a road or golf course separates the cells. This is the historical interpretation for source definition for all NSPS, and it has been adopted for landfills. The addition of a cell that increases the permitted volumetric design capacity for one of these landfills would be considered a modification, not the opening of a separate new landfill. A modification causes the entire landfill (the existing cells and the newly permitted cell) to become subject to the NSPS.

11. Question: If a landfill expands by opening a new area, must inactive as well as active areas be controlled? For example, suppose a landfill with a design capacity of 1.6 million m^3 (est 1979) decides to expand such that the design capacity totals 4.0 million m^3; and therefore it becomes subject to the NSPS. The 1.6 million m^3 will be closed in 1998. Since the site will be inactive, will a flare be required for the closed area or just the new area once 50 Mg/yr of NMOC emissions is exceeded?

Answer: The entire landfill is included in both the design capacity and the NMOC emission rate calculation. The entire area becomes subject to the landfill gas collection and control requirements once the calculated NMOC emission rate equals or exceeds 50 Mg/yr.

E. Applicability to Closed Landfills

12. Question: What are the requirements for landfills that close after 1987?

a) Upon reading the rule it appears that these landfills must submit an initial maximum design capacity and initial NMOC emission rate report. Are they required to submit annual reports documenting the NMOC emissions? Since their NMOC emissions are only going to go down it does not seem to make sense to require a closed landfill with NMOC emissions < 50 Mg/yr to submit annual NMOC reports.

b) If a closed landfill has NMOC emissions $ 50 Mg/yr, what are the retrofit collection/control requirements including design parameters? Are these requirements different than for an active landfill that can design these systems as they grow? Retrofitting may be more expensive.

c) Are closed landfills required to have controls on for 15 years from the date of installation?

Answer: All landfills operating after November 8, 1987, whether closed or open, are required to submit a design capacity report -- regardless of their size or capacity. Only those sources (closed or open) with a design capacity greater than or equal to 2.5 million Mg and 2.5 million m^3 are required to submit an initial NMOC emission rate report. They are also required to submit periodic (e.g., annual) reports until the calculated NMOC emission rate is ≥ 50 Mg/yr or until the landfill is closed. If the initial or a subsequent NMOC rate emission report shows emissions of 50 Mg/yr or more, the landfill must install controls or demonstrate, using Tier 2 or 3 procedures, that NMOC emissions are less than 50 Mg/yr.

If the landfill is closed, they can stop doing annual NMOC emission rate calculations and reports, as provided in § 60.752(b)(1)(ii). A "closed" landfill means a landfill in which solid waste is no longer placed, and in which no additional solid waste will be placed without first filing a notification of modification. Once a notification of modification is filed and additional waste is placed in a landfill, it is no longer closed and must resume NMOC emissions reporting.

Closed and active landfills have the same control requirements. These control systems are appropriate for installation in existing landfills, such as closed landfills or existing landfills with waste in place. In either case, the wells are drilled into the existing waste. The collection system of header pipes is installed above the ground. It would generally be easier and cheaper to install a well and collection system in a closed landfill area because it would be separate from the day-to-day landfill operations and no additional waste would be deposited in the area (see section II.B for additional details).

Closed landfills must have controls on for at least 15 years from the date of installation and until the NMOC emissions are less than 50 Mg per year in three successive emission rate reports.

13. Question: What should a State do about a landfill that accepted waste after November 8, 1987 but is now closed? How can the

collection and control system be installed if there are no funds available?

<u>Answer</u>: Once a closed landfill has been identified, the State will need to identify and locate the owner/operator or responsible party. Identifying and locating owners or operators of closed landfills may be difficult. However, only landfills that have accepted MSW since November 8, 1987 are subject to the EG. Therefore, these landfills should have permits that would identify the owner/operator.

The source of funding for collection and control systems on landfills that are closed will vary depending on the landfill ownership and circumstances surrounding its closure. If the landfill is of private ownership, the owner would be responsible for the costs. If the landfill is of State or local ownership the costs could be borne by a reallocation of State or local funds, bonds, or other State or local budget mechanisms.

It is also possible that the State plan could establish a less stringent standard for a specific landfill or class of landfills. To do this, the State must apply to EPA and demonstrate that the criteria listed in § 60.24(f) of subpart B are met. These criteria include (1) unreasonable cost of control resulting from age, location, or design, (2) physical impossibility of installing the necessary control equipment, or (3) other factors specific to the landfills that make application of a less stringent standard significantly more reasonable.

F. <u>Applicability to Superfund Sites</u>

15. <u>Question</u>: What is the applicability of the MSW landfill NSPS and EG to superfund sites? Is this a part of their clean-up plan? Who will calculate the design capacity for Superfund sites? Are they required to provide the Design Capacity Report? Also, how does this relate to the preamble language that implies "that the standards may also be determined relevant and appropriate for sites that accepted waste prior to November 8, 1987." Also, if a cell was classified as a Superfund site and closed prior to 1987, is this site considered part of the larger landfill?

<u>Answer</u>: The landfills NSPS or EG apply to MSW landfills including ones determined to be Superfund sites if they have accepted waste since November 8, 1987 or have additional design capacity available for future waste acceptance. This would include the requirement to submit a design capacity report. The design capacity report is required by the NSPS and EG under the Clean Air Act and is

a separate activity from the Superfund clean-up plan. The responsible party should calculate the design capacity.

An MSW landfill Superfund site may be required, under Superfund, to install collection and controls if it is determined that controls are "relevant" and "appropriate" even if the landfill did not receive MSW after November 8, 1987. Superfund landfills are individually reviewed on a case-by-case basis, under Superfund, to determine relevant and appropriate controls.
(See the preamble to the final rule [61 FR 9909, March 12, 1996] for additional discussion of Superfund sites.)

The classification of a landfill cell as a Superfund site would not affect the determination of whether or not it is part of the larger landfill. See section I.D. for related questions and answers.

G. Independent Power Producers

16. Question: Is an independent power producer located on an MSW landfill exempt from complying with the NSPS/EG?

Answer: If the independent power producer is combusting landfill gas it would be subject to the NSPS or EG.

II. CONTROL REQUIREMENTS AND COMPLIANCE TIMES

A. General

1. Question: What emission controls are required for the NSPS or the EG?

Answer: Both the NSPS and EG require the use of best demonstrated technology (BDT) for reduction of NMOC landfill emissions. BDT for MSW landfills includes: (1) a well designed and well operated gas collection system, and (2) a control device capable of reducing NMOC in the collected gas by 98 percent by weight.

B. Design and Installation of Collection Systems

2. Question: For purposes of submitting a collection and control system design plan, does this design submittal cover the entire permitted landfill area (even those areas that are not currently constructed, although permitted)? Since the influence from extraction wells is predicted on the depth of waste, the design of the system will vary as landfilling continues. As such, is the design submittal called out in the NSPS for the entire permitted area, or for only those areas warranting control (i.e., those active

areas that have waste in place that is 5 years or older or closed areas 2 years or older)? This is an important issue. A registered engineer who must sign the design for the entire permitted footprint may not feel comfortable because the interim system installations may be different than his total plan. Please clarify.

Answer: The plan must cover the area to be controlled over the intended period of use (lifetime) of the gas control system, not the entire landfill. As specified in § 60.752(b)(2)(ii), the collection system must be designed to handle the maximum expected gas generation rate from the entire area of the landfill that warrants control over the intended period of use of the gas control or treatment system. Active areas in which the initial waste has been in place 5 years and closed or final grade areas where the initial waste has been in place 2 years must be controlled. As the landfill expands, the collection system must be expanded into areas that meet these criteria. Thus, if a control system is expected to last 15 years (for example), the design plan must take into account all active areas of the landfill that are expected to meet the 2 year/5 year criteria within the next 15 years, given the expected waste acceptance rate. The design plan should include the initial design and plans for system expansion.

3. Question: For those landfills that equal or exceed 50 Mg NMOC/yr, but only have waste in place for 1 or 2 years (have no areas that are active which are 5 years or older or 2 years or older in areas that are closed), is a collection and control system design plan required within 1 year of reporting to the agency that the facility exceeds 50 Mg NMOC/yr?

Answer: A situation where a landfill that has accepted waste for only 1 or 2 years exceeds the 50 Mg/yr emission rate is expected to be infrequent. However, in such a case, the design plan is due within 1 year of the report showing NMOC emissions $ 50 Mg/yr, unless the owner or operator elects to perform Tier 2 or 3 testing to demonstrate that emissions are less than 50 Mg/yr. The collection and control system must be installed within 30 months of the first report showing emissions over 50 Mg/yr. These systems must be installed in active areas that have waste in place for 5 or more years or areas at final grade that have waste in place for at least 2 years. However, in the commenter's example, if a landfill that had been accepting waste for only 1 year submitted a report showing NMOC emissions $ 50 Mg/yr, and 30 months after that (e.g., 3 ½ years after the landfill began accepting waste) had no active areas where waste had been in place 5 years and no areas at final grade where waste had been in place 2 years, they could wait to install and operate the collection and control system until an area of the landfill met the 5 year/2 year criteria above.

If the landfill elected to perform Tier 2 testing to demonstrate that NMOC emissions are less than 50 Mg/yr, they would wait to perform Tier 2 measurements until the first waste has been in place for 2 years because the Tier 2 measurement procedures can only be done where waste has been in place for 2 years [see § 60.754(a)(3)]. If Tier 2 shows emissions < 50 Mg/yr, the design plan and control would not be required until after the annual NMOC emission rate reports show that emissions have increased to 50 Mg/yr or more.

4. Question: What are the requirements for installing a collection system in cells that have not yet reached final grade, but are subject to collection, where adjacent cells are being developed? Is it possible to allow landfills to install a collection system in applicable cells only when they reach final grade, provided it is done within a specified time period (i.e., they can't stall reaching final grade to put off installing a collection system)?

Answer: The rule requires collection and control of NMOC from all applicable areas that warrant control (those meeting the 2 or 5 year criteria), regardless of the activity at adjacent cells.

5. Question: Suppose a landfill subject to the NSPS has total NMOC emissions greater than 50 Mg/yr and therefore is required to install a gas collection system. Are there any exceptions to the NSPS requirement to install collection and control systems in active areas where waste has been in place 5 years? For example, suppose one portion of the landfill contains waste that is over 5 years old, but will be covered with an additional 200 feet of waste. The installation of collection wells in this portion of the landfill appears impractical given that the well piping would have to extend at least 200 feet above the present surface of the waste and machinery to place waste would need to maneuver around the wells. What options does this landfill have?

Answer: There are no exceptions to the requirement to install collection systems in active areas where the initial solid waste has been placed for 5 years, however the landfill does not need to install wells that extend into the air. The system can be built incrementally. The landfill can install wells in the existing waste and connect the well headers with lateral piping routed to a control device. After waste is later placed in the area above these wells, new wells can be sunk into the new waste. The new wells will be above the old wells. Landfills should keep the collection system requirements in mind when planning their filling practices, in order to allow efficient collection system design and installation.

C. Passive Collection Systems

6. Question: Can a landfill use trenches to prevent the off-site migration of gases from the landfill even after a gas collection system is installed?

Answer: The use of trenches to stop off-site migration of landfill gases is often done for safety considerations, often in problem cases where a landfill gas collection system is installed. In some instances, the installed collection system of vertical wells did not capture all the landfill gas, whereas the lateral trenches did. The off-site migration of landfill gas could result in an emergency situation, especially when adjacent properties are operating such that a fire could be started and/or fueled by the migrating landfill gas.

The NSPS allows for the use of alternative system designs to incorporate the many site-specific factors involved with landfill gas system design. Section 60.752(b)(2)(i)(D) states that a wide variety of system designs are possible, such as vertical wells, combination horizontal and vertical collection systems, or horizontal collection systems, leachate collection components, and passive systems. In the situation where a trench is used to prevent off-site migration, a pipe must be put into a lateral trench to stop the landfill gas migration and lateral gas extraction will be accomplished through a vacuum. The gas collection system and trench gas extraction system are operated simultaneously.

7. Question: For passive collection systems, what kind of liners can be put in as new cells are built? Should the liners be Subtitle D or State equivalent? Do landfills have to put liner on the sides as well as bottom as new cells are built?

Answer: Section 60.752(b)(2)(ii) states that passive collection systems must be installed with liners on the bottom and all sides in all areas in which gas is to be collected. Thus, liners must be installed on the sides as well as the bottom as new cells are built. The NSPS also specifies that the requirements of § 258.40 (RCRA solid waste regulations) be followed for liner installation. Section 258.40 requires that new MSW landfills and lateral expansions be constructed in accordance with a design approved by the Director of an approved State or as specified in § 258.40(e) for unapproved States. Performance standards and criteria for liners are included in § 258.40.

8. Question: The language for collection systems seems inconsistent with the requirement of a negative pressure gradient at

wellheads. The regulation allows the use of either passive or active collection systems, but then goes on to require a negative pressure gradient at each wellhead. A negative pressure gradient can only be accomplished with an active system.

Answer: The rule allows flexibility for the owner or operator to propose the use of alternative collection systems and alternative monitoring in their collection and control system design plan. Specifically, § 60.752(b)(2)(i)(B) allows the owner or operator to "include (in the collection and control system design plan) any alternatives to the operational standards, test methods, procedures, compliance measures, monitoring, recordkeeping or reporting provisions of §§ 60.753 through 60.758 proposed by the owner or operator." Therefore, when an owner/operator submits a design plan for a passive collection system, they can also specify that the negative pressure requirement does not apply and propose alternative monitoring. The regulatory agency will review the proposed design plan and monitoring requirements, and the landfill will be subject to the specific requirements that are approved.

D. Landfills with Existing Collection and Control Systems

9. Question: Several sites subject to the NSPS already have existing gas collection and control systems. For the purposes of the design plan submittal (due within one year of reporting to the Agency that the facility equals or exceeds 50 Mg NMOC/yr), the landfill owner/operator plans to conduct an inspection of the gas system to ensure that all required monitoring can be conducted and a surface scan to verify that the system collects all the gas from those areas warranting control and meets the criteria stated under § 60.752. These results along with as built documentation of the system will be submitted as part of the collection and control system design submittal. Is this an acceptable demonstration of compliance?

Answer: The general compliance demonstration approach described in the question sounds acceptable. However, keep in mind that the documentation submitted must also show that the criteria in § 60.752(b)(2)(ii) are met (e.g., that the system is designed to handle the maximum expected gas flow rate over the life of the control equipment, that gas will be collected from each area meeting the 5 year/2 year waste in place criteria, and that off-site migration is minimized). Furthermore, if the system does not conform with the specifications for active collection systems in § 60.759, a demonstration of the sufficiency of the alternative design must be included. The landfill will also be required to submit a performance test to show that the control device achieves 98 percent reduction (or must use a flare that meets the criteria specified in § 60.18).

Section 60.757(g) requires information about the collection system design to be submitted with the test report.

10. Question: If existing MSW landfills have a flare system, but do not meet the exact specifications in 40 CFR 60, Subparts Cc and WWW, are they required to "upgrade" and/or replace their system? Or can the State "control" through permitting requirements?

Answer: In general, State plans for existing landfills must be at least as stringent as subpart Cc. This includes compliance with the flare specifications. However, in a few situations the State standards for a specific existing landfill may be less stringent than the EG. In such cases, the State must demonstrate that less stringent requirements are warranted based on specific criteria contained in § 60.24(f) of subpart B. These criteria include unreasonable costs, physical impossibility, or other factors specific to the landfill that make application of a less stringent standard significantly more reasonable. If the State believes that an upgrade of the flare would meet one of these criteria and wants to prescribe less stringent specifications, it could make such a demonstration. These demonstrations must be reviewed by EPA as part of the State plan approval process. Any new landfills that are subject to the NSPS and use a flare to comply with the NSPS control requirements must meet the specifications in subpart WWW and § 60.18.

E. Other Control Concerns

11. Question: If a facility submitted the Tier 1 report in June 1996 and that report indicated emissions greater than 50 Mg NMOC/yr, can Tier 2 still be used to demonstrate a lower emissions rate? Some States are allowing the submittal of Tier 2 reports later than the cutoff schedule published in the NSPS.

Answer: The NSPS requires submittal of the Tier 2 report within 180 days of the Tier 1 report.

12. Question: One commenter stated that the maximum 500 ppm methane surface concentration required in monitoring would result in reduced Btu value of the gas they supply to a client. This commenter supplies gas that is 55 percent methane to their client. Remaining below the 500 ppm methane surface concentration would increase the chance of air intrusion in their system. This may result in the methane concentration being reduced to 40 percent methane, which their client is not able to handle. They base their conclusions on California, which has less rain and apparently has more sand in the cover than in Minnesota (In Minnesota it is mostly clay). The

commenter would like to know if the EPA has any information on this issue.

Answer: The purpose for the surface monitoring is to ensure that the landfill cover or cap and gas extraction system are properly designed and operated to ensure capture of the landfill gas. Landfills with properly designed and operated systems should not have air intrusion that would lower the BTU content of the gas. If air intrusion occurs. The owner/operator may need to reduce the vacuum, improve the cover, install additional collection wells, or a combination of these.

F. Compliance Times

13. Question: When does a facility become subject to the EG? If the State/local authority has not yet adopted the guidelines, is the facility considered "subject" to them, or must the regulation be adopted first? Is the compliance date for existing landfills 30 months from the effective date of a State standard or 30 months from the date EPA approves the State standard? Is there any "no later date" for complying other than this date? If a landfill is subject to the NSPS (not EG), what is the time frame for compliance with the NSPS rule?

Answer: An existing facility is not subject to any Federal requirements until either a State plan is approved by EPA or a Federal plan is promulgated for existing facilities. A facility becomes subject to the State standard upon the effective date of the State standard. The EG, as recently amended, States that the compliance date for existing landfills $\geq$ 2.5 million Mg and 2.5 million m^3 is 30 months after the initial or subsequent NMOC emission rate report which first shows that NMOC emissions equal or exceed 50 Mg/yr. However, States may adopt compliance schedules more stringent than the EG and NSPS, consistent with 40 FR part 60, subpart B. Section 60.24(c) of subpart B requires "emission standards shall be no less stringent than the corresponding guideline(s) specified in subpart C of this part, and final compliance shall be required as expeditiously as practicable but no later than the compliance times specified in subpart C of this part." There is no later date for complying with the EG. If the State agency does not submit an approvable plan, a Federal plan will be implemented to require control of landfills in that State.

The time frame for NSPS compliance is as follows: A facility must submit a design capacity report by June 10, 1996 or within 90 days after commencement of construction, modification, or reconstruction. If the facility has a design capacity $\geq$ 2.5 million

Mg and 2.5 million m^3, then it must calculate its NMOC emissions potential using the tier 1 calculations in the rule and report the results. If this report indicates NMOC emissions $\geq$ 50 Mg/yr it must submit a collection and control design plan within 1 year, and install a collection and control system within 30 months of the first report indicating emissions $\geq$ 50 Mg NMOC/yr, unless the landfill performs tier 2 or 3 measurements that show NMOC emissions <50 Mg/yr.

III. DESIGN CAPACITY DETERMINATIONS

1. Question: The maximum design capacity of a landfill is specified in its solid waste permit. If a landfill was never permitted but has a closure/post-closure plan which specifies the projected volume of waste in place upon closure, can those estimations be used instead of design calculations?

Answer: The landfill owner/operator should use the best credible information to estimate the design capacity in the absence of a permit limit. The basis for the estimate must be fully documented. A closure plan could be a good source of information, but the regulatory agency would likely want the landfill owner to verify it with calculations to be sure it is a reasonable estimate.

2. Question: In § 60.33c(a)(2), does the design capacity include planned but not permitted landfill capacity?

Answer: No. Design capacity is based upon the most recent permit issued by the State, local or Tribal agency responsible for regulating the landfill (plus any waste already in place that is not accounted for in the most recent permit).

3. Question: In determining the design capacity, do Mg take precedence over m^3?

Answer: Section 60.752(a) of the rule states that the owner or operator may calculate the design capacity in either Mg or m^3 for comparison with the exemption values. Under the NSPS and EG, design capacity is used to determine whether or not a landfill is below the design capacity cutoff. If the design capacity in the permit is below either 2.5 million Mg or 2.5 m^3, the landfill is exempt (except for design capacity reporting requirements). A landfill with a volumetric permit may choose to calculate design capacity on a mass basis, or vice versa, based on a site-specific density. The initial design capacity report must provide supporting documentation.

For example, a landfill may have a permitted design capacity greater than 2.5 million m^3 by volume; but the landfill may have documented calculations showing that, based on the actual waste density, the design capacity is less than 2.5 million Mg by weight. Because the design capacity is less than 2.5 million Mg, the landfill is below the design capacity cutoff. If such a conversion is made, records must be kept of the annual recalculation of the site-specific density and design capacity with supporting documentation. If such a landfill changes its compaction practices such that the density of the waste placed in the landfill increases, the design capacity could become greater than 2.5 million Mg, and the landfill would then need to submit an amended design capacity report.

4. Question: What density should be used to convert volume waste to weight of waste?

Answer: If a landfill chooses to convert design capacity from a volume basis to a mass basis for comparison with the 2.5 million Mg exemption level (instead of the 2.5 million m^3 exemption level), the owner or operator must document the calculations. The site-specific density must be recalculated and documented annually.

An appropriate site-specific density should be used and documented since density will depend on the type of waste and compaction practices at the landfill. Landfill densities range from 0.18 to 1.2 Mg/m^3 (300-1800 lbs/yd^3), with more typical values between 0.5 and 0.6 Mg/m^3 (800-1000 lbs/yd^3). A landfill's density depends on the composition of the waste, its original density, and its compactability. For example, residential waste, which is usually not as dense as construction debris, is more easily compacted than construction debris. A landfill with more residential waste would be more dense than one with construction waste.

5. Question: Can non-degradable waste such as auto fluff (shredded cars without the metal) or low level petroleum contaminated soil that is used as daily cover be excluded from waste calculations. Also, can process industrial sludge such as paper mill sludge be excluded from waste calculations? What documentation is required to subtract non-degradable waste from the design capacity?

Answer: In a landfill that has municipal solid waste all the waste is included in calculating the design capacity. Non-degradable waste cannot be subtracted from the permitted landfill design capacity. However, nondegradable waste can be subtracted from the mass of solid waste when calculating the NMOC emission rate because such waste would not produce NMOC emissions. Nondegradable waste is defined as waste that does not break down through chemical or microbiological activity. Examples include concrete, municipal waste combustor ash, and metals. Petroleum contaminated soils (PCS) and paper mill sludges likely contain organics that could be emitted as MSW landfill gas emissions. Therefore, emissions from PCS and sludges would need to be accounted for in the emission estimate only. The direct final notice clarifies that documentation of the nature and amount of non-degradable waste needs to be maintained when subtracting the mass of non-degradable waste from the total mass of waste for NMOC emission rate calculations (See question 1 in section IX Miscellaneous).

IV. ESTIMATING EMISSIONS

A. NMOC vs VOC

1. Question: What is the difference between NMOC and VOC? Is NMOC for landfills only?

Answer: NMOC is non-methane organic compounds, which include volatile organic compounds (VOC) as well as other organic compounds. At this time, NMOC is only used for landfill purposes.

B. Tier Calculations

2. Question: When there is insufficient information to use the emissions calculation formulas, can landfill owners/operators use AP-42 emissions calculations?

Answer: No, to determine applicability consistently, the owner/operator must use the equations and Tier 1 default values provided in the NSPS and EG to determine NMOC emissions or develop site-specific values using the Tier 2 or 3 procedures in § 60.754 of the NSPS or EG. The tier calculations are a purposely conservative approach to predict the eventual need for controls. The Tier 1 default values of k, L_O, and C_{NMOC} in the NSPS and the EG tend to overstate NMOC emission rates to predict the eventual need for controls, to encompass a wide range of landfills, and to encourage site-specific data. The AP-42 calculations are for determining more typical landfill emissions for inventories, PSD and NSR permitting, and other purposes. Two equations are provided in the tier calculations: one for use if the actual year-to-year acceptance rate is known and the other for use if it is unknown. For Tier 1 calculations, the only information needed to use these equations is the mass of solid waste in each section and the age of each section, or the average annual acceptance rate, age of the landfill, and time since closure. Landfills generally have or can calculate the information needed to use the procedures in the NSPS and EG. The AP-42 procedures require the same information.

3. Question: In the promulgated rule § 60.754(a)(1) requires sources to use assumed values of k, L_O, and C_{NMOC} when calculating emissions for the purpose of applicability. Many sources in Region 9, particularly in Southern California and Arizona, argue that these assumed values should not apply to them because of the arid environment in which they are located. Can other values be used?

Answer: The recent amendments (63 FR 32743) includes a separate default k value to be used in arid areas (those with 30-year average annual precipitation of less than 25 inches as measured at the nearest representative official meteorological site). The arid k value accounts for the slower decomposition rate of waste in those areas. This optional k value should allow arid areas to account for the lower gas production rate without having to incur the additional cost of Tier 3 site-specific testing. Furthermore, the 3-tier emission estimation procedure in § 60.754(a)(4) allows any owner/operator to use site-specific values for k and C_{NMOC}, based on testing, in lieu of the default constants if a landfill uses Tier 2 or 3 emission estimation procedures. The site-specific values would reflect any unique characteristics that would affect the emission rate of NMOC for that particular landfill.

4. Question: If an existing landfill greater than 2.5 million Mg and 2.5 million m^3 already has a collection system in place that is controlled, how should it be determined if it emits NMOC greater than/less than 50 Mg/year? Under Tier 1 calculations they would probably show landfill gas emissions $ 50 Mg/year. Tier 2 calculations also may not be appropriate.

Answer: This issue was raised in one case where Tier 1 calculations for a landfill that already had a control system indicated emissions greater than 50 Mg/yr. The tier procedures in the NSPS do not specifically address how to estimate uncontrolled emissions from already controlled landfills for purposes of determining if the emissions exceed 50 Mg/yr and whether the landfill must meet the NSPS or EG control requirements and emission limits. The State agency reasoned that to determine uncontrolled emissions for a landfill with a collection and control system already in place, it would be appropriate to use the equation and NMOC concentrations measurement procedure in § 60.754(b). This equation is the one used for controlled landfills to determine if uncontrolled emissions have fallen below 50 Mg/yr such that the control system can be removed. It requires measuring NMOC at the common header pipe of the collection system prior to the control device.

Using this approach, landfills that already have collection and control systems would calculate uncontrolled NMOC emissions for the portion of the landfill from which gas is collected using the equation and NMOC concentration measurement procedures in § 60.754(b). (If there are areas of the landfill from which gas is not collected, the tier procedures would be used for these areas.) In order for the equation in § 60.754(b) to be appropriate, the collection system must be well designed and operated. In particular, for an active collection system, a negative pressure should be maintained at the wellheads without excess air infiltration. Also, if surface monitoring has been done at the landfill, it should show methane concentrations below 500 ppm.

In addition to using the equation found in § 60.654(b) in combination with the actual measured NMOC concentration collected at the header, the NMOC concentration measured at the header (as described in VII.E.13, Testing and Monitoring) could also be used in the equation found in § 60.754(a)(1) to determine if the landfill should be subject to the requirements found in the NSPS or EG.

If total uncontrolled emissions are < 50 Mg/yr, the landfill is not subject to the control requirements of the NSPS or EG, but must continue to submit annual NMOC emission rate reports (unless it is closed). If the annual NMOC report shows that the uncontrolled emission rate has increased to 50 Mg/yr or greater, the landfill would become subject to the control requirements of the NSPS or EG. The landfill would then have 1 year to submit a design plan to either document that the existing system meets the requirements of the NSPS or EG or to specify plans to upgrade the system to achieve compliance. The landfill would need to come into compliance and begin required testing and monitoring within the time frames specified in the NSPS or EG.

5. Question: Can a landfill with uncontrolled emissions $ 50 Mg/yr install a control system that does not meet NSPS or EG requirements to reduce actual emissions to <50 Mg/yr and thereby avoid being subject to NSPS or EG control requirements?

Answer: No. As explained in the answers to the previous questions, the uncontrolled emission rate is used to determine whether the landfill is subject to NSPS or EG control requirements.

6. Question: Has EPA recognized any alternative models, other than the Landfills Air Emissions Estimation Model? If one is proposed at the State level, what would be the mechanism for getting this model approved?

Answer: Currently the EPA has not approved any models that can be used as alternatives to the Landfills Gas Emissions Model (LandGEM). Version 2.01 of this model and the user's manual can be found on the web at:http://www.epa.gov/ttn/catc/products.html. Alternative models should be sent to Susan Thorneloe of EPA/ORD for evaluation (see e-mail address in the Introduction to this document). In order for an alternative model to be approved, it should use the emissions estimation equations in the rule (which are the same as those used in the LandGEM) or another approach that is demonstrated to provide a reasonable measure of landfill gas generation.

7. Question: Does the landfill air emissions model handle the situation where leachate is recycled through the landfill?

Answer: The landfill air emissions model does not contain specific factors that would address the recycling of leachate through the landfill. However, under Tier 3 of the NMOC calculation procedure [§ 60.754(a)(4)] the owner/operator can substitute a site-specific methane generation rate in lieu of the methane generation rate constant (k). The site-specific methane generation rate is determined by the owner/operator by using gas flow testing (Method 2E). This site-specific methane generation rate could incorporate the effects of leachate recycling on the methane generation rate for that specific landfill.

C. Estimating Emissions for Inventory or Permitting Purposes

8. Question: Should the equations and assumed default values for K, L_O and C_{NMOC} in the NSPS and EG for estimating NMOC emissions be used for title V and emission inventory purposes? Should these same values be used for determination of applicability under PSD and nonattainment NSR permitting?

Answer: The Tier 1 default values of k, L_O, and C_{NMOC} tend to overstate NMOC emission rates for most landfills, and are intended to be used to indicate the need to install a collection and control system or perform a more detailed Tier 2 analysis. It is not recommended that these default values be used for estimating landfill emissions for purposes other than the NSPS and EG. The EPA document "Compilation of Air Pollution Emission Factors" (AP-42) provides emission estimation procedures and default values that can be used for emissions inventories, PSD and NSR permitting, and other purposes.

V. ELEMENTS OF A STATE PLAN

A. List of Plan Elements

1. Question: What should be included in a State plan for implementing the EG?

Answer: In some cases, local agencies, tribal agencies, or protectorates of the United States may submit plans for landfills on their jurisdictions. The same guidance applies. The term “State plan” used throughout this document includes plans developed by local or tribal agencies or protectorates. A State plan must include the following components:

1. Identification of enforceable State mechanisms selected by the State for implementing the EG,

2. A demonstration of the State's legal authority to carry out the Section 111(d) State plan as submitted,

3. An inventory of MSW landfills in the State affected by the EG. This includes existing MSW landfills that have accepted waste since November 8, 1987, or have additional capacity for future waste deposition. An existing landfill may be active (currently accepting waste or having additional capacity available for waste deposition) or closed (no longer accepting waste nor having available capacity for future waste deposition),

4. An inventory of NMOC emissions from MSW landfills in the State,

5. Emission standards for MSW landfills that are "no less stringent" than those in the EG[1],

6. A State process, as specified in § 60.33c(b) of Subpart Cc, for State review and approval of site-specific gas collection and control system design plans,

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[1] On a case-by-case basis, the State may provide for a less stringent standard or a longer compliance schedule if the State demonstrates to EPA that the criteria in § 60.24(f) of Subpart B are met, and the EPA approves the standard or schedule. The State may also provide for a more stringent standard (see section II.F).

7. Compliance schedules extending no later than 30 months after the date the annual NMOC emission rate equals or exceeds 50 Mg/yr[1],

8. Testing, monitoring, recordkeeping, and reporting requirements,

9. A record of public hearing(s) on the State plan, and

10. Provision for annual State progress reports to EPA on implementation of the State plan.

These components are described in detail in MSW Landfills, Volume 2.

B. Emission Inventories

2. Question: Is an emission inventory required only for major sources or only for landfills with design capacities $ 2.5 million Mg and $ 2.5 million m^3? Is this also true of the emissions report that is to be part of the State plan?

Answer: An emission inventory of all landfills, including those that are not major sources or are < 2.5 million Mg or 2.5 million m^3, is a required part of the State plan. This is specified in Subpart B [40 CFR § 60.25]. Subpart B also requires annual updates of the State emissions inventory for all existing landfills, regardless of design capacity. This is discussed further in MSW landfills, Volume 2. However, in view of the limited requirements of the EG and NSPS on owners and operators of small MSW landfills, the EPA will allow States, in limited circumstances, to submit emission inventories as part of State plans without requiring that, in all cases, that States develop emissions data for MSW landfills below 2.5 million Mg or 2.5 million m^3 where development of such data would be unreasonable and impractical. However, where accurate data are already available, or can reasonably be generated without undue expense or effort, States should require and include such data in their State plans. Details of this policy are discussed in a memorandum entitled “Emission Inventories for Existing MSW Landfills with Design Capacities Below 2.5 Million m^3". The memorandum is available on the EPA TTN under recently issued policy and guidance memorandums at http://www.epa.gov/ttn. The memorandum also discusses situations where it may be “unreasonable or impractical” to estimate NMOC emissions.

This easing of the NMOC emission inventory requirement, however, does not relieve States of the obligation to provide, as part of their State plan, an inventory of all existing MSW landfills within the State. Also, landfills with design capacity $ 2.5 million Mg and $ 2.5 million m^3 must submit an annual NMOC emission report to the EPA or State.

3. Question: Can the submittal of design capacities for small landfills substitute for the emission inventory?

Answer: No. The inventory is a requirement as part of subpart B. Also, the public has the right to know what the landfills are emitting. (See the preceding question for an exception to the emission inventory requirement.)

C. Enforceable Mechanisms including Incorporation by Reference or use of Title V Permits

4. Question: If States adopt by reference the NSPS or the EG, will States still have to go through rulemaking, if not, is EPA implying that the States can simply include the requirements in a title V permit? If the latter scenario is true, will the EPA have to receive a copy of the title V permits on or before December 12, 1996, as satisfying section 111(d), and the public hearing requirements as well? In addition, do States have to submit a 111(d) plan if they are adopting the landfill NSPS by reference for both existing and new sources. If the State's rulemaking procedure includes public participation, would this fulfill the required element?

Answer: The State will have to provide the underlying authority through a mechanism that is enforceable by the State such as rulemaking, State operating permit, or regulatory compliance or administrative orders. Title V permits may not have that underlying authority. If a State uses a mechanism other than rulemaking, an Attorney General's opinion is strongly encouraged.

Under 40 CFR § 60.23(a), States are required to adopt and submit to the Administrator a plan implementing requirements of the EG within 9 months after promulgation of the EG. This plan is required regardless of the enforceable mechanism that is chosen. Even if the State adopts the landfill NSPS by reference for both existing and new sources, a State plan is still required to be submitted that has all of the required elements as specified in 40 CFR Subpart B. The rule is only one part of this plan and typically does not contain all of the required elements for a State plan. In addition, even though there was public participation in the development of the rule, a separate public hearing is required on the State plan, of which the rule is only one part.

5. _Question_: Can States revise their existing landfill rules instead of writing new ones? California stated that they will only need to revise portions of their current landfill rules. Wisconsin stated that they wish to use their existing landfill rules also, because, in their opinion, they are more stringent in some ways. However, since title V permits are a requirement for some landfills, Wisconsin does not believe their State Attorney will allow them to apply (or revise, if necessary) their current State landfill rules (developed in the Solid Waste Division) as a means of regulating MSW landfills under rules not developed from the Air Division.

Answer: To go in a title V permit, the underlying authority such as the rule must be an applicable requirement of the Clean Air Act (CAA). If the State landfill rules are not an applicable requirement of the CAA, a separate rulemaking would likely be needed. This requirement of this rule could then go into title V permits.

6. _Question_: Can States incorporate the EG by reference?

Answer: Yes, as long as the State demonstrates that it has the legal authority to enforce its rule against a landfill owner or operator. The State may want to add a clause to say that designated facilities under the respective subpart shall comply with the requirements for State plan approval in 40 CFR 60.33c, 60.34c, and 60.35c. This will ensure that the State would be able to enforce its rule directly against sources. Also, some States that incorporate the EG by reference may want to provide an attorney’s opinion regarding the State regulation to ensure that the State could enforce the rule directly against a landfill owner or operator.

7. _Question_: Can the NSPS be adopted as the State rule for existing sources with the provision for the submittal and compliance dates that are specified in the EG?

Answer: Yes, if a State has the legal authority to do this. Any compliance schedule that extends more than 1 year beyond the date of EPA's approval of the plan must include all the increments of progress required under §§60.24(a) and 60.24(e)(1). The NSPS does not contain dates for awarding contracts, initiating construction, and completing construction (unless this date is the same as the compliance date).

D. _Public Hearings_

8. _Question_: If individual air districts (as in California) have public hearings for the district State plans, does the State also have to have a public hearing for the overall plan?

Answer: No, the individual public hearings will suffice.

E. Stringency of State Standards

9. Question: The Agency has indicated that the State programs must generally be at least as stringent as the EG, and can be more stringent. Does the Act allow for less stringent requirements, as long as there is justification? Can the EPA provide guidance on criteria and specific conditions which may allow for a less stringent emission standard or a longer compliance schedule to apply.

Answer: Section 60.24(f) of subpart B states that:

> "On a case-by-case basis for particular designated facilities, or classes of facilities, States may provide for the application of less stringent emission standards or longer compliance schedules than those otherwise required by paragraph (c) of this section, provided that the State demonstrates with respect to each facility (or class of facilities):
>
> (1) Unreasonable cost of control resulting from plant age, location, or basic process design;
>
> (2) Physical impossibility of installing necessary control equipment; or
>
> (3) Other factors specific to the facility (or class of facilities) that make application of a less stringent standard of final compliance time significantly more reasonable."

More specific conditions cannot be provided at this time because the decisions must be made on a case-by-case basis considering the specific situations.

If a State believes that one of these criteria apply and wants to prescribe less stringent specifications, they can make such a demonstration as part of the State plan. These demonstrations must be approved by EPA as part of the State plan approval process.

10. Question: Why would a State plan be more stringent than the NSPS?

<u>Answer</u>: States have the discretion of developing a State plan for implementing the EG, or a State standard for new sources, that is more stringent than the NSPS or EG (see section II.F for additional details). Sometimes, States have more stringent standards to address State and local air quality issues or public health concerns. If a State has a regulation or law that limits its ability to adopt and implement regulations more stringent than the Federal requirements, then such a State should make clear its authority for adopting more stringent requirements than the Federal requirements.

F. <u>Plan Approval Notices, Other State Plans</u>

11. <u>Question</u>: How can I get a copy of a FR notice that has already been published for a State plan?

<u>Answer</u>: 40 CFR Part 62, Approval and Promulgation of State plans for Designated Facilities and Pollutants, lists State plans that have been approved by EPA. Each State plan is referenced to a Federal Register citation by location and date.

12. <u>Question</u>: Which States have developed rules/plans already? Can these State rules be made available to States that are further behind in developing a rule?

<u>Answer</u>: The EPA will keep an up-to-date list of State plan submittals and approvals on the EPA TTN Web at http://www.epa.gov/ttn/oarpg. Also you may contact your Regional EPA office for information on which States have adopted rules.

G. <u>SIP Program</u>

13. <u>Question</u>: Since the landfill rule also deals with criteria pollutants (i.e., VOCs), will the State/EPA also have to do a SIP revision?

<u>Answer</u>: The section 111(d) designated pollutant is landfill gas, which includes both toxics and VOC and other elements. The State must prepare a section 111(d) State plan to implement the landfills EG for landfill gas. The NSPS and EG regulate NMOC emissions as a surrogate for landfill gas. Thus, the section 111(d) State plans for landfills must address NMOC. This rule in no way adds to or deletes from any obligation for VOC control or toxics control. Therefore, A SIP revision would not be required because of this rule. However, if a landfill meets a VOC or toxics threshold, that may trigger other requirements, such as PSD review or a MACT standard or title V permit, independent of the NSPS and the EG.

H. Other

14. Question: When is the State delegated authority to implement the EG or NSPS?

Answer: For the EG, States have authority to implement and enforce the EG upon EPA approval of their State plans. For the NSPS, many States have already been given the authority to implement and enforce all NSPS. However, other States have been delegated authority only for certain subparts, but not for all NSPS. Such States may request delegation of the landfills NSPS. A list of States that have been delegated authority appears in 40 CFR 60, § 60.4(b).

VI. REPORTING REQUIREMENTS

A. General

1. Question: What format should be used for the reports?

Answer: Appendix H of MSW Landfills, Volume 1 provides an example format for the reports required by the NSPS and EG. States and landfills have discretion to use any format as long as all the information specified by the NSPS or EG is included.

2. Question: To whom should the reports be submitted?

Answer: For landfills subject to the NSPS, the General Provisions of Part 60 require that reports be sent to the appropriate EPA regional office. Reports must also be submitted to the appropriate State air agency contacts where the State has been delegated authority to implement and enforce the NSPS. Addresses for EPA regional offices and State agencies that have been delegated authority are listed in 40 CFR 60, § 60.4.

For landfills subject to the EG, if the State in which the landfill is located has an approved State plan, reports are submitted to the State. If the State or tribal area in which the landfill is located does not have an approved plan that covers that landfill, then a Federal plan will be promulgated. Enforcement of the Federal plan may be delegated to the State or retained by EPA. If a landfill is subject to a Federal plan and enforcement has been delegated to the State, then reports should be sent to both the State and the EPA regional office. If enforcement of the Federal plan has not been delegated, reports should be sent to the EPA regional office.

B. Design Capacity Reports

3. Question: In developing their section 111(d) plan, do the States need to require all landfills to submit design capacity reports? If a State is addressing the EG by regulating large landfills with Compliance Orders instead of a rulemaking, will they also need to require the small landfills to do design capacity reports? Do States that submit a negative declaration stating that they do not have any large landfills need to require that all of the small landfills submit design capacity reports?

Answer: The State must require that all landfills submit the initial design capacity report unless an alternative approach is approved for the State under § 60.24(f) of 40 CFR 60 subpart B. Submittal and review of these reports helps ensure that the landfill has correctly calculated their landfill capacity. The State may calculate design capacities for small landfills as part of the State plan as long as the State verifies their calculations with the small landfill owner or operator.

4. Question: Section 60.757(a)(2) lays out the requirements of the design capacity report (map, maximum design capacity from permit or calculations, etc.). If the State already has this information in its records from when the landfill was initially constructed (maybe even 30 years ago), and the information is still accurate, must the landfill owner/operator submit this information himself?

Answer: Unless an alternative reporting approach is approved for the State under § 60.24(f), a report must be submitted. The State may allow the owner/operator to submit a letter indicating that the information has been submitted previously, the date it was submitted, why it was submitted, and a signed statement that the previously submitted information is still current.

5. Question: Is there any lower design capacity below which a facility does not have to submit an initial design capacity report pursuant to § 60.752(a)?

Answer: No, all landfills must submit an initial design capacity report.

6. Question: For the NSPS, is it true that only modifications which result in a maximum design capacity greater than or equal to 2.5 million Mg and 2.5 million m^3 are required to submit an amended capacity report?

Answer: Landfill owners/operators who are already subject to the NSPS but are <2.5 million Mg or 2.5 million m^3 are required to submit an amended design capacity report only if there is an increase in the design capacity to or above 2.5 million Mg and 2.5 million m^3. Such a capacity increase could be a result of a modification (i.e., an increase in permitted volume by vertical or horizontal expansion) or a change in density if a site-specific density has been used to convert from mass to volume or from volume to mass. The amended design capacity report must be submitted within 90 days of the capacity increase.

If an existing landfill subject to the emission guidelines is modified, then it becomes subject to the NSPS and must submit the NSPS initial design capacity report. This report must be submitted within 90 days after the date the modification is commenced as required by § 60.757(a) of the rule, as recently amended. This requirement applies even if the modified capacity is <2.5 million Mg or 2.5 million m^3.

7. Question: The information requested in 40 CFR Part 60 Subparts Cc and WWW (§ 60.757) requires that depth of refuse be specified. The depth of refuse will vary in different cells and will even vary within a single cell when base grades of the cell are sloped to facilitate leachate collection. What is EPA looking for as an acceptable response? A range? Why is this information needed if the permitted volume is specified? Regarding compaction practices, what kind of response is desired? A description of the compaction equipment used? A gate-to-bank compaction ratio with gate density specified? An in-place waste density? With regard to the annual refuse acceptance rate, is this a projected maximum for the life of the landfill, the project waste receipts for the current year, or is it the average waste receipts since the landfill began receiving waste?

Answer: Section 60.757(a)(2)(ii) specifies that the maximum design capacity that is specified in the permit issued by the State, local, or Tribal agency responsible for regulating the landfill be submitted in the initial design capacity report. A copy of the permit may be included. Only if this permitted value is not available, or if the permit is by volume and the owner/operator wishes to convert it to a mass basis (or vice versa) is the owner or operator required to submit engineering calculations supported with data. The direct final rule clarifies that values of appropriate parameters must be submitted with the calculations. The owner/operator must provide sufficient data to support the calculations. If depth varies or waste acceptance rate used in the calculation varies, the calculations and supporting documentation should show what values were used in the calculations and explain why these values were used and how the variation was accounted for. If the design capacity is being converted from volume to mass, or from mass to volume, a site-specific density must be used in the calculations. Supporting documentation must document and justify the density value used in the calculation. Typical landfill densities range from 0.5 to 0.6 Mg/m^3, but they can range from about 0.18 to 1.2 Mg/m^3. A landfill's density depends on the composition of the waste, its original density, and its compactability.

C. Timing of Reports

8. Question: When must the required reports be submitted? What should the EPA do if design capacity and emission reports are not submitted by June 10, 1996?

Answer: For landfills subject to the NSPS, the initial design capacity report must be submitted no later than:

- June 10, 1996, for landfills that commenced construction, reconstruction or modification on or after May 30, 1991, but before March 12, 1996.

- 90 days after the date of commenced construction, modification, or reconstruction for landfills that commence construction, modification, or reconstruction on or after March 12, 1996.

The initial NMOC emission rate report (required if the design capacity is $\geq$ 2.5 million Mg and $\geq$ 2.5 million m^3) must also be submitted by these same dates and may be combined with the initial design capacity report. Subsequent NMOC emission rate reports must be submitted annually thereafter, except as provided in § 60.757(b)(1)(ii) and (b)(3).

For existing landfills, the report is due to the State 90 days after the effective date of the State's section 111(d) plan approval unless a different date is specified in the approved State plan. This due date is consistent with the NSPS. It is also consistent with the recent amendment's (63 FR 32743) clarification that landfills \$ 2.5 million Mg and \$ 2.5 million m^3 become subject to the requirement to submit a Title V permit application 90 days after the effective date of State 111(d) program approval. Design capacity reports would need to be submitted at or before this time to determine which landfills are subject to Title V permitting requirements as well as NMOC emission reporting and control requirements. The report due date will differ from State to State, depending upon how soon the State develops and obtains approval for a State plan for implementing the EG.

The enforcement agency can take enforcement action on those landfill owners or operators that fail to submit reports by the required date. The exact nature of the appropriate enforcement action would be determined by the enforcement agency.

D. Monitoring Reports

9. Question: Is there no collection system reporting if the system is passive?

Answer: If the landfill uses a passive collection system, then it must designate and submit parameters to be monitored and reported that indicate the correct performance of the passive collection system.

VII. TESTING AND MONITORING

A. General

1. Question: a) When do monitoring requirements start for existing and new sources? b) For those facilities that have emissions greater than 50 Mg NMOC/yr, but already have a complying gas collection and control system (although not currently approved by the Agency), when does the compliance monitoring begin?

Answer: a) Monitoring starts for both existing and new sources upon startup of the required collection and control system. The first monitoring report is due 180 days after installation and start-up of the new collection and control system, per § 60.757(f). b) In the case of a landfill that is already controlled with a complying system, the landfill owner would submit documentation that the system design meets the requirements of the NSPS or EG at the time the design plan is due. The EPA or the State agency will review the plan. The landfill should begin monitoring within 180 days of becoming subject to the NSPS or EG requirements and submit the first monitoring report.

2. Question: Is surface monitoring required for NMOC?

Answer: No, surface monitoring is required for only methane.

3. Question: Are there any air monitoring standards for landfills in terms of parts per million of NMOCs or methane?

Answer: There are no fence line ambient air monitoring requirements in the standards. Proper collection system design and operation are ensured through landfill surface monitoring for methane and monitoring of operating parameters. In § 60.753(d) of the rule, owners and operators are required to operate collection systems so that the methane concentration is less than 500 ppm above background at the surface of the landfill. To determine if this level is exceeded, the owner or operator is required to conduct surface testing around the perimeter of the collection area and along a path traversing the landfill at 30 meter intervals.

B. Surface Methane Monitoring

4. Question: One commenter stated that it is infeasible to conduct surface methane sampling in the winter due to icy slopes and the sensitivity of the monitoring equipment in freezing temperatures. Is it acceptable to exempt landfills from surface methane sampling in the winter? Minnesota plans to do this in their rule, requiring monitoring at least three times per year. The timing of the sampling will coincide with other sampling at landfills in Minnesota.

Answer: Section 60.755(c) of the NSPS requires that each owner and operator monitor the surface concentrations of methane on a quarterly basis. However, the NSPS allows some flexibility in this requirement. General flexibility is provided for in the general allowances for alternative programs that the owner/operator can demonstrate would be as effective as the rule. In addition, Section 60.753(d) states that "areas with steep slopes or other dangerous areas may be excluded from the surface testing." Although it would not exempt a landfill from all winter testing, this clause would allow the owner or operator to exclude monitoring of dangerous icy slopes.

Under the authority of § 60.13(i) of the NSPS General Provisions, owners and operators of landfills subject to the Landfill NSPS can submit written requests to the Administrator for alternative monitoring procedures or requirements.

For existing landfills subject to the EG, § 60.24(f) of Subpart B gives States some flexibility for State plans to request EPA approval for "less stringent emission standards or longer compliance schedules." To do this, it must be demonstrated that a particular landfill or class of landfills would incur unreasonable costs, installing controls is a physical impossibility, or there are other factors that make application of a less stringent standard or final compliance time significantly more reasonable. Less frequent monitoring might be considered a less stringent standard. The State should discuss this issue with the EPA Regional Office that will be reviewing their State plan.

5. Question: For monitoring, the rule allows the owner/operator to establish an alternative traversing pattern that ensures equivalent coverage. Would a well-to-well monitoring method be equivalent to the method of monitoring at a 30-meter spacing and where visual observations indicate elevated concentrations of landfill gas (e.g. cracks) as required in the rule?

According to the commenter the monitoring method in the rule would require the landfill to:

1. Mow and resurvey each quarter. The well-to-well path is already mowed as it is used to periodically balance the well field.

2. Walk 9 miles to cover the landfill, whereas, sampling from well to well would only be 2.5 miles.

The commenter believes that one is most likely to see high concentrations between wells.

A possible alternative method would be to have them do the full 9 mile pattern once per year, then well to well the other 3 times. A commenter noted that cracks may not be an issue with a synthetic liner, so they should only be required to monitor from well to well.

Answer: Section 60.753(d) of the NSPS allows the owner and operator to establish alternative traversing patterns that ensure equivalent coverage as the 30 meter interval pattern. Therefore, in order for the commenter to implement their alternative sampling pattern, the commenter must apply to the regulatory authority for approval of an alternative approach.

6. Question: Why didn't the EPA require well-to-well surface sampling in the rule?

Answer: The 30-meter interval sampling pattern provides a systematic method that ensures adequate landfill coverage. Collection system problems or cracks and fissures resulting in areas of high surface emissions could occur at random throughout the landfill, not just on direct lines between wells. The 30-meter traverse pattern assures systematic coverage of the landfill area and will measure surface concentrations at varying distances and directions from wells. The well-to-well sampling pattern would differ from landfill to landfill depending on the spatial configuration of the wells, may be more difficult to define, and may not always ensure adequate coverage.

7. Question: A commenter suggested two options to surface monitoring based on a California model. The first is "integrated sampling", which allows composite sampling over an area. Why did the EPA use a point basis rather than a composite basis for sampling?

The second option suggested was to obtain a range of extraction rates that would meet 500 ppm and then maintain gas extraction within that range, updating the effective range every two years.

Answer: The rule is based on point sampling because the purpose of the testing is to determine where the landfill gas collection system is insufficiently designed or operated. With point sampling the location of the landfill gas emissions is pin-pointed so that the adjacent well vacuum can be adjusted, cover maintenance can be performed, or additional wells can be installed. Integrated sampling provides an average value over an area. This averaging could mask areas of poor system performance by dilution. In addition, integrated sampling has a much lower action level and is more an indicator of emission rate than system performance. Since the purpose of the testing is to identify locations of poor system performance, integrated testing is not indicated.

Regarding the second suggested option, a consistent extraction rate would not work because landfill gas production is a dynamic process that is not consistent in all areas. Also, cracks and fissures can occur at any time and would result in emissions that would not be detected or corrected by maintaining a constant extraction rate.

8. Question: Would remote sensing not be a more efficient, if not more accurate means to measure surface emissions? (By doing two sides I would assume you could even locate hot points.)

Answer: In general, remote sensing would not be feasible for the purpose of monitoring surface methane concentrations. The purpose of performing Method 21 along a pattern that traverses the landfill at 30 m intervals is to cover the entire surface area of the landfill and to identify specific locations of high methane concentration so that cover and collection system performance problems can be identified and corrected. Method 21 uses portable hydrocarbon analyzers that can be easily carried by the person performing the sampling and provides readings for specific locations. Remote sampling would not be an effective way to pinpoint problem spots. With remote sampling, the equipment is set up at a fixed location and monitors along a straight line from one point to another. In order to cover the entire surface area of the landfill, the remote sensing equipment would need to be moved and set up a large number of times. Also, if the surface of the landfill is not flat, this could cause difficulties for remote sensing since measurements must be conducted just above the landfill surface to minimize effects of dispersion and dilution. It should be noted that the NSPS allows landfill owners and operators to apply to use alternative monitoring methods. If remote sensing or another method would be effective for a particular landfill, they can apply to use it.

C. Gas Flow Monitoring

9. Question: The rule requires a gas flow rate measuring device that records the flow to the control device every 15 minutes or a lock and key to prevent bypass. The commenter stated that their systems are designed to shut everything off (e.g. the blower) if there is a problem, for example, with the flare. Can they disregard the gas flow/lock & key requirements as long as their system is designed with no means to bypass the control device?

Answer: The gas flow measurement or lock and key requirements would not apply to a system that is designed such that there is no physical means to bypass the gas flow before it reaches the control device.

D. Use of Alternative Test Methods

10. Question: Can test data obtained using TO-14 be used in lieu of data obtained using Method 25C? The enabling document provides only one reason for not allowing TO-14--the cost. Is there another reason, or are the methods otherwise equivalent?

A landfill already has test data using this method and shows that one of Minnesota's larger landfills would not be subject to the standard because of too low of an NMOC concentration. This landfill has a gas extraction system already.

Answer: The rule requires that landfills measure NMOC, which includes numerous organic components. TO-14 (toxic organic test #14) measures specific toxic compounds which may not total to NMOC. Therefore, Test Method 25C must be used.

11. Question: Would EPA accept the site-specific testing conducted in compliance with the Chapter 115 rule in nonattainment areas?

Answer: Testing must meet the requirements in the NSPS and EG, in terms of test methods and procedures. A landfill owner or operator or State could apply to use a different method if they can demonstrate that it is equivalent.

E. Test Methods 18 and 25C

12. Question: Does Method 18 give lower NMOC results than Method 25C? A recent talk given at a conference indicated this and concluded that, although Method 18 is somewhat more costly, it should be the preferred method due to the lower results it gives.

Answer: No comparison studies have been done to indicate that Method 18 gives lower NMOC results than Method 25C. Method 18 was allowed as a flexibility option in case some unforeseen special need developed. Method 18 is significantly more costly than Method 25C. With Method 18, the sample must be analyzed for all of the compounds on the latest AP-42 list. This means calibrating an analyzer at 3 points for each compound. As a minimum, each calibration point requires duplicate injections. This results in a burdensome calibration of approximately 246 injections. Add to this the requirement to obtain an acceptable recovery of each 10th sample which is spiked with approximately 40 compounds. If Method 18 is performed correctly, the time and expense required will greatly exceed that of Method 25C.

13. Question: Can NMOC samples be collected from passive vent systems or collection system headers already in place ? This will give a more representative sample and help protect synthetic membranes used at some landfills. In sampling for landfill gas, the method requires one to insert the ss probe 3 feet into the landfill. How does one accomplish this through a HDPE geomembrane cap, without destroying cap integrity?

Answer: Sampling using Method 25C or 18 may be done for two purposes: (1) Tier 2 calculations to determine the NMOC emission rate as specified in §60.754(a), and (2) testing after installation of collection and control systems to calculate NMOC emission rate for purposes of determining whether the control system can be removed, as specified in § 60.754(b).

For the purposes of tier calculations, Tier 1 calculations are performed first. Tier 1 uses default values and does not require any sampling. Owners are not required to perform Tier 2 sampling. However, if Tier 1 shows NMOC emissions $ 50 Mg/yr, a landfill owner may elect to perform Tier 2 sampling to try to demonstrate that emissions are < 50 Mg/yr. Method 25C or 18 is used for Tier 2. The rule (§ 60.754(a)) requires at least two sample probes per hectare of landfill surface where waste has been in place for at least 2 years, up to a total of 50 samples. Method 25C provides specifics on the collection of the samples using the sample probes. If the landfill already has a collection and control system and is being sampled to determine whether the system can removed, the sample is taken from the common header pipe as described in § 60.754(b).

Many landfills with covers such as that described in the question have in place passive vents (venting to the atmosphere). If passive vents are in place, a sample could be taken through these, but with caution. If collection lines and a control system are in place, it is possible to tap into the collection lines to withdraw a sample, again with caution (i.e., allowing minimal oxygen to enter to avoid creating an explosive situation).

Testing passive vents and header systems is evaluated on a case-by-case basis. The landfill needs to contact the EPA and State agency with a written request and diagram so that the specific plan can be reviewed to assure that the sample will be representative. The main criteria for passive systems are that at least 2 wells be located per hectare and the sampling location can be made leak-tight. Many passive systems are vertical vents connected to a network of horizontal tubing that traverses the landfill. With this arrangement, the 2 vertical wells/hectare criterion may be met with fewer wells if samples representative of the affected area can be taken. Sampling at collection system headers is allowable if they will provide representative samples and the gas is collected before any condensate traps. A minimum of 3 samples must be taken from headers to constitute a compliance test. Therefore, it is acceptable to take samples from either passive vents or collection system headers to avoid degradation of cap integrity if the criteria discussed above have been met including the securing of prior approval.

Furthermore, the rule allows for alternative procedures to determine the NMOC concentration if the method has been approved by the Administrator.

14. <u>Question</u>: For GC/FID method 25C, is it necessary to analyze all 100 species known to be present in LFG? If not, which compounds should be included, and how is total NMOC determined? Should air toxics be identified individually for health risk assessment? How about evaluating odor potential?

<u>Answer</u>: Method 25C does not speciate (or separate) individual organic compounds. Rather, the procedure provides a single peak of all the organic compounds except methane. The instrument response to the peak is referenced to a single calibration peak. Individual toxics cannot be reported using Method 25C and do not need to be reported. The NSPS and EG do not require health risk assessment or evaluation of odor potential.

15. Question: Method 18 is allowed in the final rule to analyze NMOC concentrations. What sampling procedure should be followed if method 18 is used for analysis of the samples?

Answer: Method 18 specifies sampling equipment and procedures. It requires samples be taken by one of three means: 1) Tedlar bag, 2) direct instrumental interface, or 3) adsorption tube. In addition, a detailed discussion of the procedures is discussed in Section 5 of Method 18 (see 40 CFR Part 60, Appendix A, Method 18). Section 60.754(a) and (b) also provide specifications for sample probe location and number of samples for Tier 2 or control system removal testing. Alternative testing media will be considered on a case-by-case basis.

16. Question: What are the requirements for composite sampling with Method 25C?

Answer: Composite sampling with Method 25C is allowed under § 60.754. In compositing, samples from more than one probe are collected in a single evacuated cylinder. The following conditions are required for acceptable compositing.

(a) A cylinder's composite samples must be of equal volume

(b) Equal sampling must be documented by recording the appropriate flow rate/sampling time/tank vacuums

(c) Each composite sample must have a minimum volume of 1 liter

(d) The tank must be under vacuum after the last composite sample is collected vacuum

17. Question: Is a nitrogen analysis of each sample required for Method 25C? What if some samples show nitrogen analyses higher than 20% but corresponding oxygen levels are very low and do not reflect the ratio in ambient air?

Answer: A nitrogen analysis for leak determination is required of all Method 25C samples. In cases where the sample nitrogen analysis is greater than 20% but an additional oxygen analysis is less than 5%, the samples may be considered valid for purposes of leak determination only. If samples are collected from other purposes, they may not be representative of normal landfill conditions.

18. Question: For the Method 25C analysis, can less than triplicate injections be performed?

Answer: All Method 25C analytical injections must be performed in triplicate.

19. Question: There is a DOT container size limitation of 2.5 liters when shipping methane at certain concentration levels. Method 25C specifies 4-liter canisters as a minimum.

Answer: Containers smaller than 4 liters will be allowed to comply with this DOT limitation. However, in most cases where the sample tank is filled to 325 mm with dry helium as prescribed before sampling, this critical methane limit will not be exceeded.

F. Test Method 21

20. Question: When using Method 21 for monitoring methane concentration, does one move continuously across the surface? Doesn't method 21 require sampling time be related to response time of the instrument? Does this mean that the sample must stop at intervals? If so, what intervals?

Answer: The sampler should walk slowly across the surface, there is no need to stop.

VIII. NONATTAINMENT NEW SOURCE REVIEW/PREVENTION OF SIGNIFICANT DETERIORATION PERMITTING ISSUES

1. Question: What are the requirements for NSR? What are the thresholds? Will landfill owners and operators of new or modified landfills also be required to install controls to meet New Source Review (NSR)? Do States have to amend their NSR rules on the same track as this rule?

Answer: Nonattainment NSR applies to new or modified major stationary sources located in nonattainment areas. Nonattainment areas are areas not meeting air quality standards for one or more air pollutants. If a new landfill locates in a nonattainment area and emits, or has the potential to emit, major amounts of a nonattainment pollutant then nonattainment NSR applies. The major source threshold for nonattainment NSR may vary for different air pollutants. For example, the major source threshold for ozone nonattainment areas ranges from 100 tons per year to as low as 10 tons per year depending on the severity of the ozone problem. A modification at an existing landfill may be subject to nonattainment NSR if the existing landfill is a major source for the nonattainment pollutant and the modification results in a significant net emissions increase of the nonattainment pollutant. For ozone nonattainment areas the significant threshold for VOC and NO_X is any increase for extreme areas, 25 tpy for serious and severe areas, and 40 tpy for all other ozone nonattainment areas. The technology requirement for nonattainment NSR is that the source meet the lowest achievable emissions rate, known as LAER. In meeting LAER it is likely that pollution controls or other emissions reduction techniques may be needed. In general, nonattainment NSR also requires that the proposed emissions increase of the nonattainment pollutant (or its precursors in some cases) be offset by actual emissions reductions from existing sources. Other nonattainment NSR requirements include an alternatives analysis and a certification that all major sources owned by the applicant in the State are in compliance, or on a schedule for compliance, with air program requirements. For new or modified landfills in nonattainment areas the air pollutants of concern are typically VOC and NO_X (both precursors of ozone) and CO. The NO_X and CO emissions are typically products of combustion.

The major NSR requirements for prevention of significant deterioration (PSD) apply to new or modified major stationary sources in attainment areas. An area is attainment for an air pollutant if area is in compliance with the ambient air quality standard for the pollutant. The PSD requirements apply if a new landfill will emit, or has the potential to emit, major amounts of one or more PSD regulated pollutants. In general, the PSD major source threshold for new landfills is 250 tons per year of any PSD regulated pollutant. For PSD the technology requirement is best available control technology (BACT). For example, in meeting BACT for new or modified landfills, controls may be needed for NO_X. Also, under PSD the applicant must demonstrate that the proposed emissions will not violate ambient air quality standards and increments, not adversely impact Class I areas, and must consider the impacts on soils, vegetation, and visibility. For existing landfills that are major sources, the PSD requirements apply to modifications that result in a significant net emissions increase of a PSD regulated pollutant. For modifications, a PSD significance level of 50 tpy for landfill gas emissions (measured as NMOC) has been established concurrent with promulgating the NSPS and EG.

The EPA's NSR regulations for nonattainment areas are set forth at 40 CFR 51.165, 52.24 and Part 51, Appendix S. States with existing nonattainment areas were required by the Act to have nonattainment NSR rules adopted by November 15, 1992. The EPA’s PSD program rules are at 40 CFR 52.21 and 51.166. States’ PSD rules should be amended within nine months after the effective date of the change to EPA’s PSD rules to add landfill gases. Landfill owners or operators are encouraged to contact the appropriate State or local air permitting authority to discuss construction permitting requirements prior to landfill construction or modification.

2. Question: If small landfills are only required to report their design capacity, how would a State determine if they had an emissions increase of NMOC that may or may not be subject to NSR?

Answer: The NSPS and EG only require reporting of design capacity for purposes of determining applicability of the NSPS or EG. However, State construction permit programs may apply independently to new or modified landfills. State major NSR programs apply to new landfills that may be major sources as defined in the NSR program or modifications of existing major sources that have a significant net increase in emissions. In other words, State preconstruction approval programs are not determined by the applicability of the NSPS and EG.

IX. MISCELLANEOUS

1. Question: What should be done about landfills that have asbestos in them where the location of the asbestos is not accurately documented? Would controls be required if asbestos is present throughout the landfill?

Answer: The NSPS [§ 60.759(a)(3)(i)] states that segregated areas of asbestos or nondegradable materials may be excluded from collection if there is documentation of the nature, date of deposit, amount, and location of the material. The reason for the exclusion is that such areas would not emit NMOC. If asbestos is co-mingled with MSW, these areas will emit NMOC. If a landfill requires control and the location, amount, and date of deposit of asbestos is not documented, or if the asbestos is co-mingled with MSW, collection and control systems will need to be installed throughout the landfill, including areas that may contain asbestos. Asbestos in landfills may also be subject to the asbestos NESHAP regulations.

2. Question: Is there any prohibition from using chemical contaminated soils for landfill daily cover if the soil has not first been treated to remove the NMOCs?

Answer: If the spill is a hazardous waste under RCRA, it could not be put in an MSW landfill. If the soil is determined to be a non-hazardous waste, then there would be no Federal restrictions on using the soil as cover material or disposing of it in an MSW landfill. However, some States specifically exclude these materials from landfills.

3. Question: Is EPA aware of any energy tax credit program that is operating now or anticipated in the immediate future that would provide a tax credit for landfills installing gas collection and energy recovery systems?

Answer: There are currently two Federal programs potentially available for landfill gas energy recovery systems:

1. the Federal tax credit under section 29 of the IRS code for production and sale of gas from biomass, and

2. the Department of Energy (DOE) renewable energy production incentives program (REPI).

The section 29 tax credit offers privately owned landfills approximately 1 cent/kilowatt hour (kWh) (or $1.00/million Btu) for projects that involve the beneficial use of landfill gas. To qualify, the landfill needs to have signed a binding gas rights agreement for the sale of their gas to another party by December 31, 1996. They also needed to have installed the landfill gas collection system by June 30, 1998.

REPI offers municipally owned landfills that produce electricity from landfill gas approximately 1.5 cents/kWh. The final rule for this program was published in the Federal Register on July 19, 1995. Applications must be submitted to DOE between October 1 and December 31 of each year. However, REPI is subject to annual appropriations by Congress, and in some years there may not be sufficient allocations to pay all projects the full amount.

In addition, State and local agencies are beginning to establish programs to promote or provide incentives for utilizing renewable energy sources including landfill gas. A report summarizing some of these State and local programs can be obtained by calling toll-free landfill methane outreach program hotline at 1-888-782-7937. The hotline can also provide other general landfill gas-to-energy information.

4. Question: It was mentioned that there is litigation on the rule. How does this affect the State plan schedule?

Answer: The landfill rule remained in effect, throughout the litigation settlement discussions and States were required to have submitted their plans by December 1996. As a result of litigation settlement agreements, a Federal Register notice to revise the rule was published on June 16, 1998 and the revisions become effective on August 17, 1998. These revisions are mainly clarifications and do not change the basic control, monitoring, recordkeeping or reporting requirements of the rule. The revisions do not change the required content or due date of State plans. States that have not already submitted State plans are encouraged to submit them as soon as possible. (Indeed many States are actively working on their State plans.) A Federal plan is being developed to cover landfills in States that do not submit an approvable State plan.

5. Question: Are NMOC emissions creditable for the Attainment Demonstration? If so, at what rates? (Region VI)

Answer: Yes, if the emissions were included in the 1990 base year inventory and the emissions and reductions in those emissions were accounted for in the rate of progress plan. This inventory served as the basis for determining rate of progress emissions reductions that would be necessary to achieve a 15 percent reduction in VOC emissions by 1990 and 3 percent per year thereafter until attainment of the ozone standard. The portion of NMOC emissions that are VOC will need to be calculated for use in the attainment demonstration and rate of progress demonstration.

6. Question: Is an MSW landfill that burns landfill gas and produces electricity for sale to the grid subject to title IV acid rain requirements?

Answer: An MSW landfill is not subject to title IV acid rain requirements as long as the landfill is not burning a supplemental fuel. Burning a supplemental fuel such as coal, oil, or natural gas could trigger title IV acid rain program requirements.

SWANA®
SOLID WASTE ASSOCIATION of North America

NSWMA

November 7, 2006

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a-and-r-docket@epa.gov
Docket ID No. EPA-HQ-OAR-2003-0215
Air and Radiation Docket and Information Center
U.S. Environmental Protection Agency (6102T)
1200 Pennsylvania Ave., NW
Washington, DC 20460

Dear Ms. Rackley:

The Solid Waste Association of North America (SWANA) and National Solid Wastes Management Association (NSWMA) would like to express its appreciation to EPA for addressing a significant portion of the comments in a very constructive manner as put forth in our comments on October 14, 2004 and subsequently discussed in our November 10, 2005 meeting. We are encouraged that EPA recognizes the unique nature of landfill operations as it relates to this proposed rulemaking and has structured the regulations to encourage energy recovery from landfill gas.

Our memberships, representing local governments and private sector members in the 50 states, are involved in all aspects of municipal solid waste management with particular expertise at operating landfills and associated landfill gas systems. SWANA and NSWMA have jointly developed the following comments in response to the proposed amendments to the Standards of Performance for Municipal Solid Waste Landfills (NSPS), to the Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills (EG), to the National Emission Standards for Hazardous Air Pollutants: Municipal Solid Waste Landfills (NESHAP) and to the Federal Plan Requirements for Municipal Solid Waste Landfills (GGG):

Definition of MSW Landfill Owner / Operator, Definition of MSW Landfill Gas Collection, Control or Treatment System Owner / Operator and Allowance for Offsite Control or Treatment

SWANA and NSWMA are pleased that EPA is structuring regulations to encourage energy recovery from landfill gas especially in light of the rising cost of fossil fuels. Beneficial use projects should be the ultimate landfill gas management goal. The constructive resolution of the "Third Party" issue has always been one of the more important issues facing the landfill industry because of the dampening effect unresolved liability could have on the beneficial use projects. We believe the current EPA proposal will go a long way to resolving this issue. The ability for owners and/or operators to continue to subdivide liability with respect to compliance with the NSPS/EG/GGG/NESHAP rules is consistent with historical practices and is a vital step forward for a workable regulatory approach. Comments presented here are meant to strengthen the proposed approach by indicating where in the proposal the goal for providing equitable divisions of compliance for multiple owner/operators, is not met.

In SWANA's July 2002 letter regarding third party operational issues, SWANA stressed the importance of providing the greatest level of flexibility to all MSW third parties. In that light, we recommended that third parties be given the option to certify that they would be willing to accept liability.

EPA's current proposed language uses a similar approach in requiring that all parties maintain a "list" that shows very specifically which aspects of the NSPS requirements each party is willing to comply with. We support this approach, however, SWANA and NSWMA must stress that the approach should be voluntary, not a requirement. If this approach is mandatory, then all existing landfills that have third party operations must establish a list of responsibility. The reality is that in many situations relationships between parties may not allow for that level of constructive dialogue. In fact, in a worst-case example, in the absence of substantive contracts a third party may find it advantageous not to cooperate since under the current proposed language, liability may default back to the landfill owner. In a best-case example, very solid contracts specifying compliance obligations between a landfill owner and the third party may be in place that negate the need for developing "list."; a mandatory obligation is just more "paper work." Having presented a "worst" and "best" case, we believe that there are many cases in between where this concept is workable. Once again, the goal of the proposed amendments should be to encourage beneficial use projects. We believe EPA should provide a host of options to achieve this end and recommend that EPA make the "list" approach voluntary.

We are encouraged by EPA's attempt to define gas collection and control system operating responsibilities through the proposed definition of *Municipal solid waste landfill gas collection, control, or treatment system owner/operator.* In order to further clarify the division of owner/operator compliance responsibilities, SWANA and NSWMA recommend that in Section 60.751 the proposed definition be replaced with three distinct definitions, as presented below:

> ***"landfill gas collection system owner/operator" means an entity that owns or operates any stationary equipment for the collection of landfill gas pursuant to §60.752(b)(2)(ii).***
>
> ***"landfill gas treatment system owner/operator" means an entity that purchases the landfill gas from the municipal solid waste landfill owner/operator and owns or operates any stationary equipment for the treatment of landfill gas pursuant to §60.752(b)(2)(iii)(D).***
>
> ***"landfill gas combustion system owner/operator" means an entity that purchases untreated landfill gas from the municipal solid waste landfill owner/operator and owns or operates any stationary equipment for the combustion of landfill gas.***

We also have a concern with the requirement, as outlined in §60.758 (g) and, §63.1980 (j) that *all entities involved are responsible for compliance with missing items*. It is the situation where *all* entities involved hold responsibility that the proposed amendments are trying to avoid. This leads to difficult contract disputes and legal bickering that eventually discourage third party developers from attempting to utilize landfill gas in a beneficial manner. We recommend that in the absence of the compliance list, liability remain with owner/operator of the affected equipment, as defined above. This provides incentive for all parties engaged in collection and control activities to complete a comprehensive list of compliance responsibilities for the affected MSW Landfill.

In §60.750 (a) and §62.14352 (g), if the MSW landfill and the associated gas collection, control and/or treatment system are under *common control,* the entity exercising such control is responsible for specified requirements. This language is contrary to the goal of clearly specifying who has liability for compliance. *Common control* is never clearly defined as it applies to the proposed regulations and can only add a significant level of ambiguity to the proposal. As stated above, it is the situation where *all* entities involved hold responsibility, that the proposed amendments are trying to avoid, yet the introduction of the concept of *common control,* as explained in the Preamble to the proposed regulation, does just that. More specifically, the Preamble states on page 53275 that:

> *It is important to note that in cases of common control, although the owner/operator of the single source (e.g., the owner/operator of the landfill and/or gas collection, control, and/or treatment system) is ultimately responsible for ensuring compliance at the source, enforcement action could be taken by EPA or a State against the owners/operators of individual affected sources/emission units in addition to the owner/operator of the single source.*

In the absence of any examples or explanations to the contrary, *common control* under this proposed wording, appears to provide EPA all the rights to take enforcement action against all entities owning or operating a source. If all landfill owners and operators are willing through a voluntary action establish a comprehensive list of compliance responsibly then issues of common control need not be considered. In addition, we believe that because of the ambiguous use of *common control* in the proposal individual EPA Regions may draw different interpretations on how to apply common control decisions. Once again, this is contrary to the need for clarity on NSPS liability with the goal to encourage beneficial projects. Therefore, we recommend all references to *common control* be removed to avoid confusion. EPA always has the authority to make common control decisions in any situation.

If EPA decides not to proceed with our recommendation, we suggest the EPA specifically state that "*separately owned and/or operated landfill gas control and/or treatment operations should not be considered to be under common control of the landfill owner/operator.*"

In the Preamble, EPA requests comment on two alternatives to the proposed approach. In both approaches, and much more so for Alternative #2, excess liability is placed on the landfill owner, while each individual source maintains its responsibility for compliance, as well as potential liability. In Alternative #1, for instance, it is proposed that in cases of *flagrant violations*, future liability shift back to the landfill owner/operator. The use of subjective terminology such as *flagrant* and even *minor* with regard to violations, bring uncertainty to contractual relationships and set the stage for abuse by both individual owner/operators and regulators. In Alternative #2, it is very clear that all parties will be held responsible for non-compliance with landfill owner/operators being held to the highest standard. As EPA correctly points out, *There are some concerns that this alternative approach could inhibit the beneficial use of landfill gas.* We agree, and strongly recommend that EPA not consider either alternative since both are counter to encouraging energy production from landfill gas.

Landfill Gas Treatment Systems

EPA has established a new definition for *Treatment* based upon contacts with manufacturers of combustion devices who provided fuel specifications. SWANA and NSWMA recommend that the *treatment* definition be modified to read:

> *Treatment system means a system that compresses the landfill gas, has an absolute filtration rating of 10 microns or less and achieves a degree of de-watering consistent with specifications for good combustion supplied by the manufacturer or supplier of the combustion equipment. Any treatment system for which a site-specific EPA or NSPS-delegated state or local agency applicability determination or written, or through a written*

> *Title V permit determination by a NSPS-delegated state or local agency has been issued that the treatment system satisfies 40 CFR 60.752(b)(2)(iii)(C) is deemed to meet this definition.*

SWANA and NSWMA recommend that all existing projects that have received written applicability determinations or approvals from EPA or delegated state/local authority that the existing treatment system meets 40 CFR §60.752(b)(2)(iii)(C) requirements as of the effective date of the final rule be exempt from any further action. In these cases, EPA has already evaluated the adequacy of the project's treatment system.

For new projects, or existing projects seeking to comply with 40 CFR §60.752(b)(2)(iii)(C), SWANA and NSWMA believe that the 20 degree dew point suppression is not practical for reasons described below. Therefore, in addition to revising the definition of treatment, SWANA and NSWMA recommend that manufacturer's/supplier's specifications for treatment be obtained by the gas treatment system owner/operator. Further, SWANA and NSWMA recommend that a site-specific preventive maintenance plan (PMP) be developed and included as part of the Start-up Shutdown and Malfunction Plan. Such PMP would be available on-site for agency inspection. The PMP would include provisions for periodic monitoring and recording of the gas treatment system operations to demonstrate proper operation in accordance with manufacturer's/supplier's specifications/standards. The periodic monitoring requirements for filtration should not be more stringent than weekly monitoring and recording of differential pressure to support appropriate preventive maintenance activities and to assure that a catastrophic failure of the treatment system is prevented. Compliance with the PMP would be used in lieu of any specified requirement for continuous monitoring and recording of treatment system parameters and would allow site-specific determination of the best procedure for achieving and monitoring treatment system performance as envisioned in the rule.

In support of our recommendations, it is important to understand that treatment system design and operation vary according to the type and size of the beneficial use project. Some engine facilities operate in cold climates where the landfill gas can be cooled from the wellhead to temperatures in the 40-degree range simply because of ambient conditions. In cases like this it is impossible to meet the proposed definition. Also, verifying the temperature is difficult because of varying inlet and outlet conditions that can vary depending upon the pressures in the system. Accounting for these conditions could require multiple points of measure plus an algorithm to determine compliance. In addition, a dew point suppression standard does not account for water removal that may be occurring in other parts of the gas collection system, such as in header lines where condensate is continually being collected. In fact, long pipeline runs may remove significant amount of liquid, perhaps even equivalent to that removed by active dew point suppression.

Operating data exists for boiler systems that confirms such systems have operated successfully for two decades, fully meeting all NSPS requirements with only minimal gas treatment, filtration and moisture separators. There are also numerous engine facilities operating around the country, many that have received EPA exemptions, that only use coalescing filters for moisture removal, compression, and air-to-air heat exchanges. Many of these facilities have source tested the combustion devices and have demonstrated compliance with the 98% destruction efficiency, or 20 ppm NMOC, as hexane NSPS requirements, with this level of treatment. SWANA and NSWMA can supply this data upon request from EPA. Other examples exist where gas sent offsite to an end user has only mechanical filtration and compression for moisture removal before entering a pipeline for transport to a local utility. In all these cases treatment is far less than a 20-degree dew point suppression.

From a developer, or landfill gas combustion system owner/operator perspective, it is important to realize that utilization of improperly treated landfill gas will result in potentially significant financial losses due to excessive equipment maintenance costs and downtime; this does not make business sense. Therefore, the level of treatment necessary for the efficient and long-term operation of the end use equipment should be determined on a case-by-case basis, based upon sound engineering. The real-world examples of landfill gas combustion equipment operating with treatment systems very different than what EPA proposes demonstrates that a "one size fits all" approach is not practical. Not only is it impractical, but also requiring existing projects to meet the proposed definition can be financially damaging to the industry, and most importantly, may be unnecessary.

1-Hour/5-Day Downtime of Gas Collection and Control Systems

SWANA and NSWMA support EPA's determination that a GCCS often cannot be reasonably brought back on-line after a downtime event in less than one hour. In fact during most downtime events it could take multiple days to return the GCCS to operating condition. We also support EPA's decision to clearly define that the 1-hour threshold should only be applied to free venting of LFG after a control device goes off-line and before the gas mover equipment can be shutdown to prevent untreated gas from passing through the control device.

However, we are concerned with language contained within the draft preamble, which seems to suggest that the current version of the NSPS does contain a 1-hour limit on control device downtime, regardless whether free venting is occurring. It has been the MSW landfill industry's position and interpretation since the original NSPS was promulgated in 1996 that the 1-hour threshold was always a free venting standard. This is particularly important to us since, as you know, there have been several enforcement actions filed under this 1-hour provision, and your preamble language would seem to suggest that those actions are viable and can be enforced until this rule change takes effect. SWANA and NSWMA, therefore, request that EPA revise the preamble language to clarify that the 1-hour standard was originally meant to be a free venting standard and that any other interpretation is inaccurate.

Further, §60.757(f)(3) of the NSPS rule still requires sites to report all instances where the control/treatment device was not operating for more than 1 hour. This appears to contradict the intent of §60.755(e) which eliminates the 1-hour requirement. Wording of §60.757(f)(3) should be revised to require reporting of all instances where free-venting of landfill gas occurred for more than 1 hour in duration.

With respect to the proposed elimination of the 5-day provision, SWANA and NSWMA are appreciative of EPA's efforts to give the landfills flexibility in determining a reasonable limit on total downtime for a GCCS through the SSM provisions of the NESHAPs rule. However, we are concerned that the proposed language would give too much discretion to state or local agencies in determining a maximum downtime limit, and those agencies could select something less than 5 days. The MSW landfill industry has always felt that 5 days is a reasonable maximum limit for GCCS downtime and are willing to commit to it as a regulatory threshold. Keeping the 5-day limit will ensure that there is a upper end time limit for downtime allowed under the rule, allow consistency across the country, and prevent state or local agencies from selecting shorter time frames, thereby eliminating the flexibility USEPA is trying to create.

As an alternative, SWANA and NSWMA would support the use of the SSM process for determining a maximum allowable downtime for a particular site as long as there is a provision in the rule which specifies that the allowable downtime cannot be less than 5 days.

On another note, in order to make the remainder of the NSPS regulations consistent with the removal of the 1-hour downtime limitation, the reporting section of the NSPS needs to be revised as follows:

> 40 CFR §60.757(f)(3): Description and duration of all periods when the control device or treatment system was not operating for a period exceeding one hour and length of time the control device or treatment system was not operating, ***only if the valves in the collection and control system contributing to venting of gas to the atmosphere were not closed within one hour.***

SSM Provisions

The proposed rulemaking makes several changes to the SSM provisions within the NESHAPs rule, beyond the 1-hour and 5-day requirements. One of these changes is the clear delineation that routine maintenance events should be included in the SSM plan. The MSW landfill industry has always believed that the SSM requirements include routine maintenance, so we do not take issue with your inclusion of this requirement in the rule. Because of this, it is unnecessary to require that a routine maintenance plan be added to each SSM plan, which has already been developed by MSW landfill owners/operators. Instead, making it clear that routine maintenance events are regulated SSM events should be sufficient for this rulemaking. Further, the industry already includes routine maintenance events in semi-annual SSM reports, so this change is unnecessary but acceptable to us.

The second change to the SSM requirements is the removal of the cross-referencing table to the NESHAPs general provisions (40 CFR Part 63, Subpart A) and replacement with all specific requirements contained within 40 CFR Part 63, Subpart AAAA. SWANA and NSWMA are supportive of this change as the cross-referencing element was always unclear and hard to follow.

The third change is described as a minor change to the block averaging requirement for 3-hour temperature values in the NESHAPs rule to be consistent with what is reportedly contained within the NSPS rule. This includes the removal of the allowance to exclude SSM events from the calculation of 3-hour block averages for determining compliance with the minimum temperature requirement under the NSPS. SWANA and NSWMA take serious issue with this requirement. Inclusion of SSM events in 3-hour block averages will lead to numerous temperature deviations due to low temperature at almost all landfills. When a control device goes off-line for SSM events the temperature will drop to ambient levels (versus operating levels over 1400 F for flares), and when this is averaged with any operating time, deviations will inevitably exist.

This would result in a temperature deviation for almost any SSM event of more than a few minutes in duration and leave us at the mercy of state and local regulators, who could take enforcement action regardless of whether our SSM plans were implemented or not. As an example, if a flare normally operates and is tested at 1500 ° F, then its minimum temperature for compliance would be 1450 ° F per the rule. During an SSM event, the flare temperature would drop quickly toward the ambient temperature of the surrounding area. It is not uncommon for flare temperatures to drop below 500 ° F within minutes. Assuming an SSM event of 10 minutes (common automatic restart cycle for many flares) and an average temperature during the SSM event of 500 ° F, the 3-hour block average including this SSM event would be 1444 ° F, which would be a deviation of the minimum temperature requirement. So, in this case, the flare could actually restart as it is designed to do, and yet a temperature deviation would still result. This is clearly an unworkable situation.

The MSW landfill industry has always viewed the NESHAPs rule language of exclusion of SSM events from the block average calculation as a clarification of unworkable rule language within the NSPS. With this proposed rulemaking, we would return to this unworkable situation for temperature calculations. As such, SWANA and NSWMA strongly request that the proposed rule be revised to continue to allow exclusion of SSM events for the 3-hour block average calculations for both the NSPS and NESHAPs rules.

Removal of GCCS Requirements for Closed Landfills

EPA requested comments on approaches for addressing removal of controls in closed landfill areas and specific criteria that could be applied to determine which areas warrant control and which may remove control. As stated succinctly in the preamble to the proposed rules, there are many situations in the landfill industry in which an old, closed portion of a landfill has been inappropriately drawn into the NSPS because of its location to an adjacent, newer facility. This can lead to problems when gas production in the older areas has fallen off so significantly that it is difficult if not impossible for this portion of the site to comply with the NSPS operational standards.

Further, many closed landfills installed gas collection and controls systems prior to the NSPS, EG and Federal GGG requirements. The current rule language states that the minimum 15-year duration for gas system operations begins with the date of the initial performance test required by the NSPS or EG/Federal GGG rules. For sites subject to the NSPS, initial performance tests of the control system likely occurred during December 1998 and June 1999. However, for the sites subject to either state/local EG rules or the Federal GGG Plan, the initial performance test dates occurred as late as October 2002 to April 2003. Typically closed landfills are subject to the state EG or Federal GGG requirements and not the NSPS requirements. Therefore at many closed sites the useful life of the equipment (i.e., 15 years) has already been surpassed.

There are several potential solutions to address declining gas flows and gas quality at closed landfills for consideration which include the following:

For a closed MSW landfill, not co-located with other landfill units (active or closed), the closed MSW landfill should be able to remove NSPS control requirements once the site demonstrates it emits less than 25 Mg/yr NMOC based on actual landfill gas flow in accordance with §60.754(b) irrespective of the age of the gas collection and control system. The 50 Mg/yr NMOC threshold should be maintained where sites can demonstrate 15-years of gas system operations in accordance with existing rule requirements. SWANA and NSWMA recommend that the NSPS (also applies to appropriate sections in the EG / GGG rules) rule language under 40 CFR 60.752(b) be revised as follows:

The collection and control system may be capped or removed provided that the conditions of paragraphs (b)(2)(v)(A), and either (B) or (C) are met:

- *(A) The landfill shall be a closed landfill as defined in § 60.751 of this subpart. A closure report shall be submitted to the Administrator as provided in § 60.757(d); and*
- *(B) The collection and control system shall have been in operations a minimum of 15 years and following the procedures specified in § 60.754(b) of this subpart, the calculated NMOC gas produced by the landfill shall be less than 50 megagrams per year on three successive test dates. The test dates shall be no less than 90 days apart, and no more than 180 days apart; or*
- *(C) For a closed landfill not co-located with other landfill units, follow the procedures specified in § 60.754(b) of this subpart, the calculated NMOC gas produced by the landfill shall be less than 25 megagrams per year on three successive test dates. The test dates shall be no less than 90 days apart, and no more than 180 days apart.*

As for closed landfill units or areas co-located with active landfill units, several options exist within the confines of the existing rules. These include:

1) For a closed landfill unit or area co-located with active landfill units the site should be able to remove NSPS control requirements based on 15-years from the initial well installation date for the affected landfill or area, not the date of NSPS or EG performance test. This is similar to the language found in Ohio's EG program (OAC 3745-76-07(B)(2)(e)). The USEPA approved OEPA's EG program on October 6, 1998. 2) Include a provision for a 10% NMOC threshold for non-producing areas in order to address declining flows from closed landfill units or areas of an MSW landfill. The 10% NMOC threshold may be determined in accordance with 40 CFR §60.754(b) as gas collection is installed in these areas.

The non-producing area(s) would not be subject to monthly wellhead monitoring requirements or obligation to meet pressure, temperature and oxygen standards for wells located in the closed area(s). This proposed provision is ***<u>in addition to the existing 1% NMOC threshold</u>*** already provided for in 40 CFR §60.759(a)(3)(2) for non-producing areas without a gas collection system.

To demonstrate that the 10% threshold is still protective of the environment, the site would continue to conduct monthly cover integrity inspections and quarterly surface emissions monitoring. If readings above 500 ppm are not detected in non-producing area(s) after three consecutive quarters, then the site could defer to annual surface emissions monitoring as allowed in 40 CFR §60.756(f). If exceedance(s) are detected (above 500 ppm), then apply corrective actions in accordance with 40 CFR §60.755(c)(4). The site would re-initiate quarterly monitoring until three consecutive quarterly events demonstrate no exceedances of 500 ppm standard. The site would then defer to annual monitoring as allowed in 40 CFR 60.756(f). Monthly cover integrity inspections and surface emissions monitoring would cease once the landfill met the following condition:

When a 1% NMOC threshold is achieved for non-producing area(s) as determined in accordance with 40 CFR 60.754(b).

Following are three case studies which illustrate the importance of developing options for addressing closed landfill areas.

Landfill A is located in a mountain region of the Western United States and has one older, closed area and one active area, which are physically separated on the landfill property. The overall site is subject to the NSPS and has a GCCS in place. Because the older area is such a large distance from the main active area and because of the poor quality of LFG from this area, the older area has its own separate GCCS with an activated carbon unit for a control device.

The older area can only generate approximately 30-35 scfm of LFG on a continuous basis with a methane content of 29-32 % on average (about 20 scfm at 50% methane). None of the wells in the older area can meet NSPS wellhead standards without an HOV allowance, and surface emissions have not been detected in this area, even before the GCCS was installed.

For the above reasons, it was felt that this older area of the site would be a good candidate for an exemption from having to operate a GCCS in compliance with the NSPS. However, the only option available under the rule was to demonstrate that the area's NMOC emissions were less than 1% of the total NMOC emissions for the site. When this analysis was completed using NSPS protocols, it was discovered that the older areas was still purportedly generating over 10% of the site-wide total for NMOCs and would not drop to 1% until the year 2050.

However, when the actual LFG flow data from this area is used to complete an NMOC emissions analysis, the percentage drops to 0.81 % in 2006. Clearly, with all of the above information, this area of the site should not be required to have a GCCS under the NSPS rule but the 1% threshold and the requirement to operate the GCCS for a minimum of 15 years prevents this exemption from being granted.

Landfill B is located in a desert region of the Southwestern United States and has one recently closed area and one active area, which are physically separated on the landfill property. The overall site is subject to the NSPS and has a GCCS in place for the recently closed area; the active area is not required to have control under the NSPS at this time.

The site was originally required to install a GCCS under the NSPS because of projected NMOC emissions of greater than 50 Mg/year using NSPS protocols. This was primarily due an extremely high NMOC concentration that was detected during a Tier 2 study. Since the GCCS has been installed, the site is only able to produce approximately 217 scfm of LFG on a continuous basis with a methane content of 29 % on average (about 126 scfm at 50% methane). Most of the wells at the site cannot meet NSPS wellhead standards without an HOV allowance, and no surface emissions have been detected, even before the GCCS was installed. Also, the amount of LFG at the site is not enough to continuously operate the LFG flare, so the GCCS is on a timer system with two hours of operation per day.

For the above reasons, it was felt that the NSPS applicability for this site should be re-evaluated, and a Tier 2 study was recently conduct using samples collected from the main header to the LFG system. These data are much more representative of the average NMOC concentration for the site (because the GCCS draws from the entire refuse volume) as compared to the previous Tier 2 study completed with the probe method where only the newer, uppermost waste could be sampled.

Using the new Tier 2 value, the site's NMOC emissions are projected to be less than 50 Mg/year for the landfill's entire life with the highest value being 21 Mg/year. In 2006, the NMOC emissions would be 14.1 Mg/year using NSPS protocols but only 0.36 Mg/year using actual LFG flow data from the site.

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This site is another example of a landfill that should not be required to have a GCCS under the NSPS but the requirement to operate the GCCS for a minimum of 15 years prevents this from changing. The NSPS never established any provisions to allow a site that was incorrectly classified as requiring a GCCS to subsequently demonstrate that the emissions are less than 50 Mg/year and avoid the requirement without first operating for 15 years.

Landfill C received a small expansion in volume prior to its closure in 1993, and has been subject to the NSPS since promulgation of the regulations in 1996. The active gas collection system at the landfill was installed during closure activities in the 1990's. Collected gas is sent to a five engine plant. An open flare is available to provide backup control. Three gas compressors at the plant are the "gas mover" equipment. A utility flare is available as backup.

A site-specific NMOC sample was collected several years ago from this facility and based on existing gas flow rates and this concentration, the facility's NMOC emissions are well below the 50 Mg/year threshold. However, the USEPA denied a request to establish the "start date" for the gas system operations as when the first well was installed, vs. the date of the initial NSPS performance test, since the facility could not demonstrate that it had conducted all required

NSPS monitoring and recordkeeping from the date the gas system was installed (which was prior to the promulgation of the NSPS regulations). NSPS compliance at this facility has cost over $1,000,000 to date.

OTHER SPECIFIC COMMENTS:

Temperature Monitoring We agree that eliminating initial performance test for sources not of concern, such as the 44 megawatts boilers is a good simplification of the regulatory burden. This principle of not testing insignificant source should apply to small boilers or heaters as well.

Bioreactor Provisions SWANA and NSWMA support USEPA's clarification that the moisture content of the waste should be measured on a weight wet basis, which is consistent with how the industry already performs this calculation.

Definition of Household Waste - The definition of household waste needs to be expanded to not only exclude yard waste but also non-putrescible construction and demolition materials. There is a concern, for example, that roof shingle from a residential home could be deemed to make a construction and demolition landfill into a "municipal solid waste" landfill for NSPS purposes, and impose unnecessary and unduly expensive Title V permitting obligations on these facilities and result in enforcement action. Title V permitting for such facilities would potentially be required even though such facilities would not require gas collection and control systems, based solely on the size of the C&D landfill and the acceptance of a single roof shingle. If construction and demolition material from houses after a hurricane or other disaster are deemed to be "municipal waste", then C&D landfills would have a disincentive to accept such material because they would be unnecessarily subject to Title V permitting as a result of Landfill NSPS applicability. Given the public policy implications, the definition of household waste should specifically exclude non-putrescible construction and demolition materials.

Design Plan Approvals – We appreciate the EPA for addressing the issue of design plan approvals. The review and approval of the NSPS Design Plans has not been consistent from state to state, or even within the same state, from district to district. Some states have never approved design plans, even though we are now on the 10 year anniversary of the NSPS promulgation.

The agency's suggestion to allow landfills to have a "de facto" approval of their design plan after a certain time period has elapsed is an excellent option, and we support this.

With respect to the time frame for agency review of an initial design plan, the USEPA's February, 1999 document "Municipal Solid Waste Landfills, Volume 1:

Summary of the Requirements for the New Source Performance Standards and Emission Guidelines for Municipal Solid Waste Landfills" stated the following (on page 2-38):

> "The implementing agency must approve the design of a gas collection and control system prior to installation. The review and comment interval for approving a design plan is expected to take approximately 6 months from the date the plan is submitted, leaving approximately 12 months for installing the alternative gas collection and control system."

This six month timeframe for review and approval of the initial design plans is very reasonable, since it leaves at least one year for the landfill to prepare construction level drawings and specifications for the first phase of the approved design, as well as solicit bids, and ultimately install the system. Therefore, since the design plan has to be professionally designed and certified by a Professional Engineer along with ultimately achieving compliance through quarterly surface emissions monitoring and monthly testing and monitoring, we strongly support the De Facto approval of design plans if approval is not provided by the Administrator after 6 months of submittal.

With respect to time frames for updates or revisions to design plans, a four month time frame should be more than adequate, as the proposed revisions to an existing plan should require a less extensive review than a brand new plan prepared from scratch.

A related issue is the absence of consistent regulatory review and approval of higher operating value demonstrations, alternative timeline requests and well decommissioning requests. Some state agencies have established internal procedures to review and approve these requests on a timely basis, while other state agencies have no internal programs. The lack of response by an agency leaves a site in an awkward compliance position. If an alternative timeline as allowed in 40 CFR §60.755(a) and (c) is requested and no written response provided by the Agency, is the facility operating in or out of compliance with the NSPS? Because facilities have only two options for addressing wellhead and surface emission exceedances, i.e., expand the system within 120 days of the initial exceedance or seek approval for an alternative remedy/timeline, the facility could be considered out of compliance if the approval is never granted and the system is not expanded within the 120-day timeframe. Since expanding the system is not always the best way to correct an exceedance, and a facility may not be able to determine the appropriate course of action within 15 days of an initial well exceedance, we propose two different options to address these situations. One is to replace the 15-day timeframe with 60 days to address the initial exceedance prior to having to submit an alternative timeline request or decommission a well. Secondly if the well or area still exhibits an exceedance of the operating criteria which will occur for more than 60 days we believe that the

Administrator should have a much shorter timeframe to review the requests before a "de facto" approval would be allowed; i.e. 30 days. If the approval is not granted within an expeditious timeframe, it would leave little time to perform the expansion activity. Again, since the wellfield is required to be monitored monthly along with performing quarterly surface emissions monitoring we believe that the performance of the wellfield will not be impacted.

Cover penetrations - The third issue the EPA has asked for comment deals with surface monitoring locations and requests comment on the interpretation of cover penetrations. The EPA has taken the draft position that the quarterly monitoring path should include the monitoring of every cover penetration, since "cover penetrations can be observed visually and are clearly a place where gas would be escaping from the cover, so monitoring of them would be required by the regulatory language." We disagree with this interpretation.

To assume that all cover penetrations, including gas extraction wells, are a place where gas is escaping is unwarranted since the gas system is under vacuum. Also, it has been our experience that most cover penetrations do not leak, and therefore, there should not be a default assumption that they represent places where surface emissions are likely occurring. In addition, there are several facilities which are closed and are capped with a flexible membrane liner. This type of cover is very effective in not allowing gas to escape.

Further, if visual or other observations (e.g., breach in seal around penetration, desiccation of the cover material at the interface of penetration and the cover material, LFG odor in immediate vicinity, etc.) indicate possible elevated concentrations of landfill gas around cover penetrations in the solid waste area where the collection system is required those areas are currently being monitored as a part of the quarterly surface emissions testing.

The proposed requirement would be very difficult to perform at many landfills especially since there are landfills which have over 1,000 cover penetrations with only a small fraction of them potentially causing surface emissions. Therefore SWANA and NSWMA recommends the following rule changes as described below.

The Agency should clarify that any obligation to perform surface monitoring in the vicinity of a penetration of the landfill cap is limited to the area within the perimeter of the municipal waste disposal area. Second, any requirement to perform surface monitoring in the vicinity of a penetration in the cap should apply only where such penetration extends fully through the cap, rather than constitutes a surficial breach or inconsistency. This limitation would eliminate the need to automatically perform surface monitoring around survey poles, gas line or leachate line markers and other commonplace items that are intentionally placed within the cap but only within the top several inches of the surface. Third, the obligation to perform surface monitoring in the vicinity of a landfill cap penetration should not apply to gas collection wells or other components maintained under vacuum unless there are visible signs of a crack or breach in the seal around the penetration as noted above. Finally, we would like to point out the regulation for monitoring surface penetrations needs to be clear that monitoring is to be performed at the landfill surface (i.e. at a point within 5 to 10 cm of the surface).

<u>Previous Request for Rule Clarification</u>

A letter from SWANA dated October 14, 2004 detailed 22 issues within the NSPS rule where SWANA sought clarification. These issues were discussed with USEPA staff in a meeting on November 10, 2005, which was summarized in meeting notes dated, January 24, 2006. Several of these issues are covered in the draft rulemaking; however, others are not.

For the issues not addressed in the rulemaking, we hereby request that EPA either specifically cover those issues in the draft rulemaking or clarify in the preamble that certain issues will be handled in another manner, such as through applicability determinations or revisions to one of the guidance documents associated with the NSPS rule.

Thank you in advance for consideration of our views. We look forward to working with EPA on this very important issue and offer to meet with you to discuss these comments as part of the final rulemaking process. If you have any questions regarding these collective comments, please contact Mr. Frank Caponi, SWANA's Landfill Gas Technical Division Director at (562) 699-7411 x2460, or Mr. Ed Repa of NSWMA at 202-244-4700.

Respectfully submitted,

John H Skinner

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Appendix B
HELP Model Analysis of Alternative Cover Design

CALCULATION SHEET

AECOM

Page 1 **Of** 5

Project No. 60197394

Client County of Kaua’i **Subject** Final Cover Equivalency Analysis

Project Kekaha Landfill Cell 2, Phase II

Prepared By TCR **Date** 8/9/12

Reviewed By NKW **Date** 8/9/12

Approved By KJB **Date** 8/10/12

FINAL COVER EQUIVALENCY ANALYSIS

Objective

Evaluate and compare the infiltration through the proposed Kekaha Landfill Phase II cover and the permitted bottom liner to determine the effectiveness of the proposed cover. Infiltration through the cover and bottom liner is estimated using the USEPA Hydraulic Evaluation of Landfill Performance Version 3.07 (HELP) computer modeling program.

Design Criteria and Assumptions

1. This analysis was performed to evaluate the effectiveness of the proposed final cover for the Phase II landfill.
2. The required cover specified in HAR Section 11-58.1-17 requires the same or less infiltration as the bottom liner.
3. The bottom liner will be evaluated with 12 inches of head, which is the maximum head allowed by HAR during the post closure care period.

HELP Model Version 3.07 Input:

1. Solar radiation data can be default data, user input or synthetically generated by the HELP model. Synthetically generated solar radiation data for Honolulu, Hawaii was used to simulate site weather conditions.
2. Temperature, precipitation, and average wind speed data was obtained from site records from January 2001 through December 2010. Missing data is viewed by the model as a “0”. Therefore, to avoid skewing the data, missing temperature data for 2001, 2002, and 2008 was filled in using temperatures from days adjacent to the missing data. The data missing in 2004 was filled in using data from the same dates in 2003. Data is missing for a total of 5 days in April of 2001 and 2002. Data from 2004 is missing from April 9 through May 3, and May 26 through June 19. For 2008 data is missing from January 30 through February 3rd. There is no missing data from 2003, 2005, 2006, 2007, 2009, and 2010.
3. Geomembrane liner pinhole density and size were assumed to account for possible manufacturing defects during geomembrane production. The HELP Model User’s Guide for Version 3.07 states that the pinhole density for a typical geomembrane is 0.5 to 1 pinhole per acre. One pinhole per acre was assumed to be present.
4. The placement quality for the geomembrane liner was assumed to be “good”. A placement quality of “good” according to the HELP Model User’s Guide “assumes good field installation with well prepared, smooth soil surface and geomembrane wrinkle control”. The HELP Model User’s Guide suggests 1 to 4 installation defects for an installation quality of “good”. Two installation defects per acre were assumed for the geomembrane liner. This also reflects full time CQA during geomembrane installation.
5. Only the relatively gentle top slopes of the landfill are used in the HELP analysis. The relatively gentle slopes allow the maximum infiltration through the cover.
6. The initial moisture content of the final cover layers was computed by the HELP model software to be steady state conditions.

7. For the cover analysis the curve number was calculated by the HELP model based on the soil type and final cover slopes. Through the use of top deck diversion berms or other engineered features, the shallowest, longest slope for the cover will be 3 percent and 200 feet. The slope and length are based on the flatter top areas of the landfill.

8. The HAR allows a maximum of 1 foot of head on the bottom liner during the post closure period. The head on the bottom liner directly affects the amount of infiltration through the bottom liner. A larger head produces greater infiltration. To determine the performance of the permitted bottom liner with a maximum of 1 foot of head the HELP model analysis of the bottom liner includes the GCL, geomembrane and only 1 foot of the drainage layer. The bottom liner HELP analysis was performed only to determine infiltration through the liner with a maximum of 1 foot of head. Therefore, rainfall and weather data does not impact the results but were input to allow the HELP model software to perform the desired calculations.

9. To maintain a head at a maximum of 1 foot during the bottom liner analysis, only the bottom liner was modeled, no run-off was allowed, and the top sand layer was modeled as a vertical percolation layer. This analysis setup maintained the head on the liner near the HAR allowed depth.

10. The permitted bottom liner system consists of a GCL and 60-mil HDPE geomembrane.

11. A one-acre design area was used for modeling purposes to compute unit quantities.

12. Permitted Bottom Liner Inputs for existing Phase II (see also Table 2):

    - 12 inches of drainage layer
    - Geomembrane
    - GCL
    - No vegetation on cover (does not affect this analysis)
    - Evaporative zone depth = 1 inch (minimum required for HELP Model software requirements) (does not affect this analysis)
    - Maximum leaf area index = 0 (recommended by HELP Model for Bare ground conditions) (does not affect this analysis)
    - Fraction of area allowing runoff = 0 percent
    - Runoff curve number = 84.7 (HELP model calculated, Soil No. 2, 0.51 percent slope-minimum allowed by HELP software, 1-foot slope length) (does not affect this analysis)
    - Length of model run = 10 years (length of run based on length of available data, solar radiation data was synthetically generated for 10 years)

13. Proposed Final Cover Inputs (see also Table 1):

    - 6 inch topsoil/vegetative layer
    - 12 inch vegetative/protective soil layer
    - Geocomposite drainage layer
    - Geomembrane
    - 6 inches soil grading layer (the top 6 inches of intermediate cover)
    - Good vegetation on cover
    - Evaporative zone depth = 22 inches (recommended by HELP Model for fair vegetation conditions for Honolulu, Hawaii) Note that the HELP model uses an actual evaporative zone depth based on the cover soil depths. The maximum evaporative zone depth is

limited to 22 inches.

- Maximum leaf area index = 2 (recommended by HELP Model for fair vegetation conditions)
- Fraction of area allowing runoff = 100 percent
- Runoff curve number = 82.2 (HELP model calculated, Soil No. 9, 3 percent slope, 200-foot slope length)
- Length of model run = 10 years (length of run based on length of available data, solar radiation data was synthetically generated for 10 years)

Help Model General Layout

Table 1: Proposed Final Cover – HELP Model Layout

(Layer Number) Layer Description	Flow	Thickness	Saturated Hydraulic Conductivity	Soil Type/ Texture Number
(1)vertical percolation	↓	6 inches	1.9×10^{-4} cm/sec	Topsoil/Vegetative Layer/#9
(1)vertical percolation	↓	12 inches	4.2×10^{-5} cm/sec	Vegetative/Protective Soil Layer/#12
(12)lateral drainage	→	0.197 inches	$1.0 \times 10^{+1}$ cm/sec	Geocomposite/ #20
(13)40-mil LDPE geomembrane Liner	↓	0.04 inch	4.0×10^{-13} cm/sec	LDPE geomembrane/#36
(14)barrier soil layer	↓	6 inches	1.2×10^{-4} cm/sec	Soil grading layer /#10

Table 2: Bottom Liner – HELP Model Layout

(Layer Number) Layer Description	Flow	Thickness	Saturated Hydraulic Conductivity	Soil Type/ Texture Number
(1)vertical percolation	↓	12 inches	6.0×10^{-3} cm/sec	Drainage Layer/#61
(13)60-mil HDPE geomembrane Liner	↓	0.06 inch	2.0×10^{-13} cm/sec	HDPE geomembrane/#35
(14)Geosynthetic Clay Layer	↓	0.24 inches	3.0×10^{-9} cm/sec	Bentonite mat/#17

Table 3: Soil Texture Properties

Soil Texture	Soil Classification		Comments, Properties, and Uses
	USDA	USCS	
61	FS	SW	Sand drainage layer. Based on HELP model default soil no. 2 with the hydraulic conductivity changed from 5.8x10^{-3} cm/sec to 6x10^{-3} cm/sec.
36	---	---	HELP model default parameters for Low Density Polyethylene (LDPE) geomembrane.
20	---	---	HELP model default parameters for geocomposite (drainage net, 0.5 cm/ 0.197 inches thick)
18	---	---	HELP model default parameter for municipal solid waste.
17	**---**	**---**	HELP model default parameter for a bentonite mat (0.6 cm/0.24 in. thick).
12	SiCL	CL	Used for vegetative/protective cover. HELP model default parameter.
10	SCL	SC	Used for soil grading layer. HELP model default parameter.
9	SiL	ML	Used for topsoil/vegetative cover. HELP model default parameter.

Note: All soil properties are defaults of the HELP Model, Version 3.07 unless otherwise designated.

Calculations

Calculations performed by the HELP Model are included in the output located in Attachments 1 and 2. See Table 4 for the modeling results based on peak average annual values.

Table 4: Calculated Results From HELP Analysis Output

Parameter	Average Annual Value	
	Proposed Final Cover	Permitted Bottom Liner
Total Rainfall	18.94 inches	18.94 inches
Average head: Cover Geomembrane	0.017 inches	---
Infiltration through final cover	6.755 cf/acre	---
Average head: Bottom Liner Geomembrane	---	11.450 inches
Infiltration through bottom liner system	---	8.019 cf/acre

NOTE: Refer to the attached HELP model output files Attachment 1 for the bottom liner, file name “BotLine1.out”, and Attachment 2 for the proposed final cover, file name “PropCov2.out”.

Conclusion

The evaluation of the proposed cover shows that the proposed cover allows less infiltration than the permitted bottom liner (see Table 4). The proposed final cover which includes a geocomposite, 40-mil geomembrane, and grading layer allows approximately 6.755 cf/acre of surface water infiltration. The permitted bottom liner which includes a 60-mil geomembrane and GCL allows approximately 8.019 cf/acre of infiltration.

CALCULATION SHEET

Page 5 **Of** 5
Project No. 60197394
Client County of Kaua’i **Subject** Final Cover **Prepared By** TCR **Date** 8/9/12
Project Kekaha Landfill Equivalency Analysis **Reviewed By** NKW **Date** 8/9/12
Cell 2, Phase II **Approved By** KJB **Date** 8/10/12

References

1. “Engineering Report, Kekaha Landfill Phase II, Kekaha, Kauai, Hawaii,” prepared by Harding Lawson Associates, dated August 5, 1993.
2. “Engineering Report, Kekaha Landfill Phase II, Second Vertical Expansion to 85’ MSL, Kekaha, Kauai, Hawaii,” prepared by Earth Tech, dated November 2004.

Attachment 1

Permitted Bottom Liner HELP Model Output

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    c:\temp\KEK10BOT.D4
TEMPERATURE DATA FILE:      C:\temp\KEK10BOT.D7
SOLAR RADIATION DATA FILE:  c:\temp\KEK10BOT.D13
EVAPOTRANSPIRATION DATA:    c:\temp\KEK10BOT.D11
SOIL AND DESIGN DATA FILE:  c:\temp\BOTLINE2.D10
OUTPUT DATA FILE:           c:\temp\BOTLINE2.OUT


TIME:  13:42     DATE:   1/10/2013


******************************************************************************

     TITLE:  Kekaha Landfill Phase II- Bottom Liner Analysis- 12" Head

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER  61
           THICKNESS                 =    12.00   INCHES
           POROSITY                  =     0.4370 VOL/VOL
           FIELD CAPACITY            =     0.0620 VOL/VOL
           WILTING POINT             =     0.0240 VOL/VOL
           INITIAL SOIL WATER CONTENT  =     0.4153 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.600000005000E-02 CM/SEC
```

```
                           LAYER  2
                           --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                 MATERIAL TEXTURE NUMBER  35
   THICKNESS                   =      0.06   INCHES
   POROSITY                    =      0.0000 VOL/VOL
   FIELD CAPACITY              =      0.0000 VOL/VOL
   WILTING POINT               =      0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.199999996000E-12 CM/SEC
   FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS    =      2.00   HOLES/ACRE
   FML PLACEMENT QUALITY       =  3 - GOOD



                           LAYER  3
                           --------

                 TYPE 3 - BARRIER SOIL LINER
                 MATERIAL TEXTURE NUMBER  52
   THICKNESS                   =      0.24   INCHES
   POROSITY                    =      0.7500 VOL/VOL
   FIELD CAPACITY              =      0.7470 VOL/VOL
   WILTING POINT               =      0.4000 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.7500 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.499999997000E-08 CM/SEC



           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 2 WITH BARE
          GROUND CONDITIONS, A SURFACE SLOPE OF  1.% AND
          A SLOPE LENGTH OF    1. FEET.

SCS RUNOFF CURVE NUMBER             =     84.70
FRACTION OF AREA ALLOWING RUNOFF    =      0.0    PERCENT
AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
EVAPORATIVE ZONE DEPTH              =      1.0    INCHES
INITIAL WATER IN EVAPORATIVE ZONE   =      0.176  INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE  =      0.437  INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.024  INCHES
INITIAL SNOW WATER                  =      0.000  INCHES
INITIAL WATER IN LAYER MATERIALS    =      5.163  INCHES
TOTAL INITIAL WATER                 =      5.163  INCHES
TOTAL SUBSURFACE INFLOW             =      0.00   INCHES/YEAR


            EVAPOTRANSPIRATION AND WEATHER DATA
```

```
                    -----------------------------------

         NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                  HONOLULU              HAWAII

             STATION LATITUDE                       =  21.33 DEGREES
             MAXIMUM LEAF AREA INDEX                =   0.00
             START OF GROWING SEASON (JULIAN DATE)  =      0
             END OF GROWING SEASON (JULIAN DATE)    =    367
             EVAPORATIVE ZONE DEPTH                 =   1.0  INCHES
             AVERAGE ANNUAL WIND SPEED              =   3.47 MPH
             AVERAGE 1ST QUARTER RELATIVE HUMIDITY  =  72.00 %
             AVERAGE 2ND QUARTER RELATIVE HUMIDITY  =  66.00 %
             AVERAGE 3RD QUARTER RELATIVE HUMIDITY  =  66.00 %
             AVERAGE 4TH QUARTER RELATIVE HUMIDITY  =  70.00 %


         NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE         HAWAII
                  WAS ENTERED FROM AN ASCII DATA FILE.


         NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE         HAWAII
                  WAS ENTERED FROM AN ASCII DATA FILE.


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    HONOLULU            HAWAII
                    AND STATION LATITUDE  =  21.33 DEGREES


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2001
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            9.41          34158.316    100.00

  RUNOFF                                   0.000             0.000      0.00

  EVAPOTRANSPIRATION                       9.396         34107.504     99.85

  PERC./LEAKAGE THROUGH LAYER  3           0.003047         11.060      0.03

  AVG. HEAD ON TOP OF LAYER  2            11.5015

  CHANGE IN WATER STORAGE                  0.011            39.752      0.12

  SOIL WATER AT START OF YEAR              5.163         18742.437

  SOIL WATER AT END OF YEAR                5.174         18782.189

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00
```

```
  SNOW WATER AT END OF YEAR                0.000            0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000           0.001      0.00

*******************************************************************************



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2002
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            6.03          21888.908    100.00

  RUNOFF                                   0.000            0.000      0.00

  EVAPOTRANSPIRATION                       6.190         22471.096    102.66

  PERC./LEAKAGE THROUGH LAYER  3           0.003014         10.940      0.05

  AVG. HEAD ON TOP OF LAYER  2            11.4241

  CHANGE IN WATER STORAGE                 -0.163          -593.130     -2.71

  SOIL WATER AT START OF YEAR              5.174         18782.189

  SOIL WATER AT END OF YEAR                5.011         18189.061

  SNOW WATER AT START OF YEAR              0.000            0.000      0.00

  SNOW WATER AT END OF YEAR                0.000            0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000           0.003      0.00

*******************************************************************************



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2003
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.37          48533.125    100.00

  RUNOFF                                   0.000            0.000      0.00

  EVAPOTRANSPIRATION                      12.366         44887.062     92.49

  PERC./LEAKAGE THROUGH LAYER  3           0.002993         10.863      0.02

  AVG. HEAD ON TOP OF LAYER  2            11.3681
```

```
  CHANGE IN WATER STORAGE                   1.001          3635.182      7.49

  SOIL WATER AT START OF YEAR               5.011         18189.061

  SOIL WATER AT END OF YEAR                 5.424         19688.801

  SNOW WATER AT START OF YEAR               0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                 0.588          2135.442      4.40

  ANNUAL WATER BUDGET BALANCE               0.0000            0.014      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2004
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            23.64          85813.227    100.00

  RUNOFF                                    0.000             0.000      0.00

  EVAPOTRANSPIRATION                       18.271         66321.961     77.29

  PERC./LEAKAGE THROUGH LAYER  3            0.003018         10.955      0.01

  AVG. HEAD ON TOP OF LAYER  2            11.4073

  CHANGE IN WATER STORAGE                   5.366         19480.303     22.70

  SOIL WATER AT START OF YEAR               5.424         19688.801

  SOIL WATER AT END OF YEAR                 5.424         19688.801

  SNOW WATER AT START OF YEAR               0.588          2135.442      2.49

  SNOW WATER AT END OF YEAR                 5.955         21615.744     25.19

  ANNUAL WATER BUDGET BALANCE               0.0000            0.003      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2005
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                            15.52          56337.633    100.00
```

```
  RUNOFF                                 0.000          0.000     0.00

  EVAPOTRANSPIRATION                    21.885      79442.008   141.01

  PERC./LEAKAGE THROUGH LAYER  3         0.003084      11.193     0.02

  AVG. HEAD ON TOP OF LAYER  2          11.5947

  CHANGE IN WATER STORAGE               -6.368     -23115.570   -41.03

  SOIL WATER AT START OF YEAR            5.424      19688.801

  SOIL WATER AT END OF YEAR              5.011      18188.975

  SNOW WATER AT START OF YEAR            5.955      21615.744    38.37

  SNOW WATER AT END OF YEAR              0.000          0.000     0.00

  ANNUAL WATER BUDGET BALANCE            0.0000        -0.001     0.00

******************************************************************************


******************************************************************************

                         ANNUAL TOTALS FOR YEAR 2006
------------------------------------------------------------------------------
                                       INCHES        CU. FEET     PERCENT
                                      --------      ----------    -------
  PRECIPITATION                         34.76      126178.836   100.00

  RUNOFF                                 0.000          0.000     0.00

  EVAPOTRANSPIRATION                    34.757     126168.187    99.99

  PERC./LEAKAGE THROUGH LAYER  3         0.003057      11.099     0.01

  AVG. HEAD ON TOP OF LAYER  2          11.5251

  CHANGE IN WATER STORAGE                0.000         -0.445     0.00

  SOIL WATER AT START OF YEAR            5.011      18188.975

  SOIL WATER AT END OF YEAR              5.011      18188.529

  SNOW WATER AT START OF YEAR            0.000          0.000     0.00

  SNOW WATER AT END OF YEAR              0.000          0.000     0.00

  ANNUAL WATER BUDGET BALANCE            0.0000        -0.005     0.00

******************************************************************************
```

```
*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2007
-------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------        ----------    -------
  PRECIPITATION                          23.58          85595.414    100.00

  RUNOFF                                  0.000             0.000      0.00

  EVAPOTRANSPIRATION                     15.166         55053.887     64.32

  PERC./LEAKAGE THROUGH LAYER  3          0.002973         10.792      0.01

  AVG. HEAD ON TOP OF LAYER  2           11.3162

  CHANGE IN WATER STORAGE                 8.411         30530.736     35.67

  SOIL WATER AT START OF YEAR             5.011         18188.529

  SOIL WATER AT END OF YEAR               5.424         19688.801

  SNOW WATER AT START OF YEAR             0.000             0.000      0.00

  SNOW WATER AT END OF YEAR               7.997         29030.465     33.92

  ANNUAL WATER BUDGET BALANCE             0.0000            0.000      0.00

*******************************************************************************


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2008
-------------------------------------------------------------------------------
                                        INCHES          CU. FEET     PERCENT
                                       --------        ----------    -------
  PRECIPITATION                          28.54         103600.219    100.00

  RUNOFF                                  0.000             0.000      0.00

  EVAPOTRANSPIRATION                     21.822         79214.789     76.46

  PERC./LEAKAGE THROUGH LAYER  3          0.003079         11.178      0.01

  AVG. HEAD ON TOP OF LAYER  2           11.5602

  CHANGE IN WATER STORAGE                 6.715         24374.223     23.53

  SOIL WATER AT START OF YEAR             5.424         19688.801

  SOIL WATER AT END OF YEAR               5.424         19688.801

  SNOW WATER AT START OF YEAR             7.997         29030.465     28.02
```

```
  SNOW WATER AT END OF YEAR                 14.712         53404.687     51.55

  ANNUAL WATER BUDGET BALANCE                0.0000            0.026      0.00

*******************************************************************************



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2009
-------------------------------------------------------------------------------
                                           INCHES          CU. FEET     PERCENT
                                          --------        ----------    -------
  PRECIPITATION                             13.56          49222.816    100.00

  RUNOFF                                     0.000             0.000      0.00

  EVAPOTRANSPIRATION                        28.275        102636.484    208.51

  PERC./LEAKAGE THROUGH LAYER  3             0.003061         11.113      0.02

  AVG. HEAD ON TOP OF LAYER  2              11.5382

  CHANGE IN WATER STORAGE                  -14.718        -53424.703   -108.54

  SOIL WATER AT START OF YEAR                5.424         19688.801

  SOIL WATER AT END OF YEAR                  5.418         19668.785

  SNOW WATER AT START OF YEAR               14.712         53404.687    108.50

  SNOW WATER AT END OF YEAR                  0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE                0.0000           -0.076      0.00

*******************************************************************************



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2010
-------------------------------------------------------------------------------
                                           INCHES          CU. FEET     PERCENT
                                          --------        ----------    -------
  PRECIPITATION                             20.98          76157.414    100.00

  RUNOFF                                     0.000             0.000      0.00

  EVAPOTRANSPIRATION                        12.483         45314.129     59.50

  PERC./LEAKAGE THROUGH LAYER  3             0.002949         10.705      0.01

  AVG. HEAD ON TOP OF LAYER  2              11.2592
```

```
  CHANGE IN WATER STORAGE                 8.494        30832.564    40.49

  SOIL WATER AT START OF YEAR             5.418        19668.785

  SOIL WATER AT END OF YEAR               5.424        19688.801

  SNOW WATER AT START OF YEAR             0.000            0.000     0.00

  SNOW WATER AT END OF YEAR               8.488        30812.547    40.46

  ANNUAL WATER BUDGET BALANCE             0.0000           0.017     0.00

*******************************************************************************




*******************************************************************************

         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2010
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.17     1.55     3.20     0.84     0.45     0.73
                           0.28     1.03     0.97     1.08     2.15     4.48

    STD. DEVIATIONS        2.80     1.80     6.51     0.68     0.39     0.46
                           0.25     1.33     0.63     1.60     2.10     5.94

  RUNOFF
  ------
    TOTALS                 0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

    STD. DEVIATIONS        0.000    0.000    0.000    0.000    0.000    0.000
                           0.000    0.000    0.000    0.000    0.000    0.000

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 1.988    2.003    2.934    2.451    1.360    1.208
                           0.264    1.008    0.996    0.791    1.543    1.516

    STD. DEVIATIONS        1.357    1.537    1.702    2.363    2.030    1.869
                           0.196    1.206    0.696    0.949    0.780    1.400

  PERCOLATION/LEAKAGE THROUGH LAYER  3
  ------------------------------------
    TOTALS                 0.0003   0.0002   0.0003   0.0002   0.0003   0.0002
                           0.0003   0.0003   0.0002   0.0003   0.0003   0.0003

    STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
```

```
-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  2
  -------------------------------------
    AVERAGES              11.5872  11.5423  11.6710  11.4410  11.2596  11.3905
                          11.2796  11.3416  11.4295  11.4851  11.5575  11.4088

    STD. DEVIATIONS        0.3422   0.3722   0.3122   0.4197   0.3200   0.3595
                           0.2892   0.3352   0.2779   0.3855   0.2597   0.3964

*******************************************************************************


*******************************************************************************

     AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2010
-------------------------------------------------------------------------------
                                     INCHES            CU. FEET       PERCENT
                               -------------------   -------------   ---------
 PRECIPITATION                  18.94    (   8.940)      68748.6     100.00

 RUNOFF                          0.000   (  0.0000)         0.00      0.000

 EVAPOTRANSPIRATION             18.061   (  8.8180)     65561.71     95.364

 PERCOLATION/LEAKAGE THROUGH     0.00303 (  0.00005)       10.990     0.01599
   LAYER  3

 AVERAGE HEAD ON TOP            11.449 (    0.112)
   OF LAYER  2

 CHANGE IN WATER STORAGE         0.875   (  7.2057)       3175.89      4.620

*******************************************************************************
```

```
******************************************************************************

                PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2010
   ------------------------------------------------------------------------
                                                (INCHES)      (CU. FT.)
                                               ----------   -------------
      PRECIPITATION                             10.69         38804.699

      RUNOFF                                     0.000            0.0000

      PERCOLATION/LEAKAGE THROUGH LAYER  3       0.000009         0.03233

      AVERAGE HEAD ON TOP OF LAYER  2           12.000

      SNOW WATER                                 0.00             0.0000


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                  0.4370

      MINIMUM VEG. SOIL WATER (VOL/VOL)                  0.0240

******************************************************************************




******************************************************************************

                   FINAL WATER STORAGE AT END OF YEAR 2010
    ----------------------------------------------------------------------
                    LAYER        (INCHES)       (VOL/VOL)
                    -----        --------       ---------
                      1            5.2439         0.4370

                      2            0.0000         0.0000

                      3            0.1800         0.7500

                  SNOW WATER       8.488

******************************************************************************
******************************************************************************
```

Attachment 2

Proposed Final Cover HELP Model Output

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************



PRECIPITATION DATA FILE:    c:\temp\KEK10TOP.D4
TEMPERATURE DATA FILE:      C:\temp\KEK10TOP.D7
SOLAR RADIATION DATA FILE:  c:\temp\KEK10TOP.D13
EVAPOTRANSPIRATION DATA:    c:\temp\KEK10TOP.D11
SOIL AND DESIGN DATA FILE:  c:\temp\PROPCOV3.D10
OUTPUT DATA FILE:           c:\temp\PROPCOV3.OUT


TIME:  13:44     DATE:   1/10/2013



******************************************************************************

     TITLE:  Kekaha Landfill Phase II- Lateral Exp. Final Cover Analysis

******************************************************************************



     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.



                                   LAYER  1
                                   --------

                     TYPE 1 - VERTICAL PERCOLATION LAYER
                         MATERIAL TEXTURE NUMBER   9
           THICKNESS                   =      6.00   INCHES
           POROSITY                    =      0.5010 VOL/VOL
           FIELD CAPACITY              =      0.2840 VOL/VOL
           WILTING POINT               =      0.1350 VOL/VOL
           INITIAL SOIL WATER CONTENT  =      0.1493 VOL/VOL
           EFFECTIVE SAT. HYD. COND.   =  0.190000006000E-03 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  3.00
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

```
                         LAYER  2
                         --------

               TYPE 1 - VERTICAL PERCOLATION LAYER
                   MATERIAL TEXTURE NUMBER  12
THICKNESS                  =     12.00   INCHES
POROSITY                   =      0.4710 VOL/VOL
FIELD CAPACITY             =      0.3420 VOL/VOL
WILTING POINT              =      0.2100 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.2066 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.419999997000E-04 CM/SEC




                         LAYER  3
                         --------

                 TYPE 2 - LATERAL DRAINAGE LAYER
                   MATERIAL TEXTURE NUMBER  20
THICKNESS                  =      0.20   INCHES
POROSITY                   =      0.8500 VOL/VOL
FIELD CAPACITY             =      0.0100 VOL/VOL
WILTING POINT              =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.1968 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =   10.0000000000     CM/SEC
SLOPE                      =      3.00   PERCENT
DRAINAGE LENGTH            =    200.0    FEET




                         LAYER  4
                         --------

                 TYPE 4 - FLEXIBLE MEMBRANE LINER
                   MATERIAL TEXTURE NUMBER  36
THICKNESS                  =      0.04   INCHES
POROSITY                   =      0.0000 VOL/VOL
FIELD CAPACITY             =      0.0000 VOL/VOL
WILTING POINT              =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.  =  0.399999993000E-12 CM/SEC
FML PINHOLE DENSITY        =      1.00   HOLES/ACRE
FML INSTALLATION DEFECTS   =      2.00   HOLES/ACRE
FML PLACEMENT QUALITY      =  3 - GOOD




                         LAYER  5
                         --------

                   TYPE 3 - BARRIER SOIL LINER
                   MATERIAL TEXTURE NUMBER  52
THICKNESS                  =      0.24   INCHES
```

```
            POROSITY                   =      0.7500 VOL/VOL
            FIELD CAPACITY             =      0.7470 VOL/VOL
            WILTING POINT              =      0.4000 VOL/VOL
            INITIAL SOIL WATER CONTENT =      0.7500 VOL/VOL
            EFFECTIVE SAT. HYD. COND.  =  0.499999997000E-08 CM/SEC




                    GENERAL DESIGN AND EVAPORATIVE ZONE DATA
                    ----------------------------------------

          NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
                 SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
                 FAIR STAND OF GRASS, A SURFACE SLOPE OF  3.%
                 AND A SLOPE LENGTH OF  200. FEET.

          SCS RUNOFF CURVE NUMBER            =     82.20
          FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
          AREA PROJECTED ON HORIZONTAL PLANE =      1.000  ACRES
          EVAPORATIVE ZONE DEPTH             =     18.2    INCHES
          INITIAL WATER IN EVAPORATIVE ZONE  =      3.414  INCHES
          UPPER LIMIT OF EVAPORATIVE STORAGE =      8.825  INCHES
          LOWER LIMIT OF EVAPORATIVE STORAGE =      3.331  INCHES
          INITIAL SNOW WATER                 =      0.000  INCHES
          INITIAL WATER IN LAYER MATERIALS   =      3.594  INCHES
          TOTAL INITIAL WATER                =      3.594  INCHES
          TOTAL SUBSURFACE INFLOW            =      0.00   INCHES/YEAR




                     EVAPOTRANSPIRATION AND WEATHER DATA
                     -----------------------------------

          NOTE:  EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
                 HONOLULU              HAWAII

               STATION LATITUDE                        =  21.33 DEGREES
               MAXIMUM LEAF AREA INDEX                 =   2.00
               START OF GROWING SEASON (JULIAN DATE)   =      0
               END OF GROWING SEASON (JULIAN DATE)     =    367
               EVAPORATIVE ZONE DEPTH                  =  18.2  INCHES
               AVERAGE ANNUAL WIND SPEED               =   3.47 MPH
               AVERAGE 1ST QUARTER RELATIVE HUMIDITY   =  72.00 %
               AVERAGE 2ND QUARTER RELATIVE HUMIDITY   =  66.00 %
               AVERAGE 3RD QUARTER RELATIVE HUMIDITY   =  66.00 %
               AVERAGE 4TH QUARTER RELATIVE HUMIDITY   =  70.00 %



          NOTE:  PRECIPITATION DATA FOR     KEKAHA/SITE         HAWAII
                 WAS ENTERED FROM AN ASCII DATA FILE.



          NOTE:  TEMPERATURE DATA FOR     KEKAHA/SITE         HAWAII
```

```
                  WAS ENTERED FROM AN ASCII DATA FILE.


         NOTE:  SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
                  COEFFICIENTS FOR    HONOLULU            HAWAII
                    AND STATION LATITUDE  =  21.33 DEGREES


*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2001
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           9.41          34158.316    100.00

  RUNOFF                                  0.365          1325.132      3.88

  EVAPOTRANSPIRATION                      9.046         32835.191     96.13

  DRAINAGE COLLECTED FROM LAYER  3        0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  5          0.000000          0.000      0.00

  AVG. HEAD ON TOP OF LAYER  4            0.0000

  CHANGE IN WATER STORAGE                -0.001            -2.023     -0.01

  SOIL WATER AT START OF YEAR             3.594         13045.956

  SOIL WATER AT END OF YEAR               3.593         13043.934

  SNOW WATER AT START OF YEAR             0.000             0.000      0.00

  SNOW WATER AT END OF YEAR               0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE             0.0000            0.015      0.00

*******************************************************************************



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2002
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           6.03          21888.908    100.00

  RUNOFF                                  0.000             0.000      0.00

  EVAPOTRANSPIRATION                      6.112         22187.967    101.37
```

```
  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  5           0.000000          0.000      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0000

  CHANGE IN WATER STORAGE                 -0.082          -299.058     -1.37

  SOIL WATER AT START OF YEAR              3.593         13043.934

  SOIL WATER AT END OF YEAR                3.511         12744.876

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000           -0.002      0.00

*******************************************************************************



*******************************************************************************

                          ANNUAL TOTALS FOR YEAR 2003
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.37          48533.125    100.00

  RUNOFF                                   0.004            13.176      0.03

  EVAPOTRANSPIRATION                      12.464         45244.805     93.22

  DRAINAGE COLLECTED FROM LAYER  3         0.0000            0.000      0.00

  PERC./LEAKAGE THROUGH LAYER  5           0.000000          0.000      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0000

  CHANGE IN WATER STORAGE                  0.902          3275.111      6.75

  SOIL WATER AT START OF YEAR              3.511         12744.876

  SOIL WATER AT END OF YEAR                4.413         16019.986

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.034      0.00

*******************************************************************************
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*******************************************************************************

                        ANNUAL TOTALS FOR YEAR 2004
-------------------------------------------------------------------------------
                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                           23.64          85813.227    100.00

  RUNOFF                                   1.699          6166.105      7.19

  EVAPOTRANSPIRATION                      16.340         59313.301     69.12

  DRAINAGE COLLECTED FROM LAYER  3         2.3715         8608.397     10.03

  PERC./LEAKAGE THROUGH LAYER  5           0.000003          0.009      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0117

  CHANGE IN WATER STORAGE                  3.230         11725.398     13.66

  SOIL WATER AT START OF YEAR              4.413         16019.986

  SOIL WATER AT END OF YEAR                7.643         27745.385

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.015      0.00

*******************************************************************************


*******************************************************************************

                        ANNUAL TOTALS FOR YEAR 2005
-------------------------------------------------------------------------------
                                          INCHES          CU. FEET     PERCENT
                                         --------        ----------    -------
  PRECIPITATION                           15.52          56337.633    100.00

  RUNOFF                                   2.583          9376.111     16.64

  EVAPOTRANSPIRATION                      10.433         37871.871     67.22

  DRAINAGE COLLECTED FROM LAYER  3         6.6364        24090.125     42.76

  PERC./LEAKAGE THROUGH LAYER  5           0.000007          0.025      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0327

  CHANGE IN WATER STORAGE                 -4.132        -15000.510    -26.63

  SOIL WATER AT START OF YEAR              7.643         27745.385

  SOIL WATER AT END OF YEAR                3.511         12744.876
```

```
  SNOW WATER AT START OF YEAR               0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                 0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE               0.0000            0.007      0.00

********************************************************************************


********************************************************************************

                          ANNUAL TOTALS FOR YEAR 2006
--------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------       ----------     -------
  PRECIPITATION                            34.76         126178.836    100.00

  RUNOFF                                    4.935         17915.826     14.20

  EVAPOTRANSPIRATION                       19.167         69576.062     55.14

  DRAINAGE COLLECTED FROM LAYER  3         10.6575        38686.891     30.66

  PERC./LEAKAGE THROUGH LAYER  5            0.000011          0.041      0.00

  AVG. HEAD ON TOP OF LAYER  4              0.0520

  CHANGE IN WATER STORAGE                   0.000             0.000      0.00

  SOIL WATER AT START OF YEAR               3.511         12744.876

  SOIL WATER AT END OF YEAR                 3.511         12744.876

  SNOW WATER AT START OF YEAR               0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                 0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE               0.0000            0.013      0.00

********************************************************************************


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                          ANNUAL TOTALS FOR YEAR 2007
--------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------       ----------     -------
  PRECIPITATION                            23.58          85595.414    100.00

  RUNOFF                                    2.830         10273.613     12.00

  EVAPOTRANSPIRATION                       14.101         51187.535     59.80
```

```
  DRAINAGE COLLECTED FROM LAYER  3         5.8811        21348.545     24.94

  PERC./LEAKAGE THROUGH LAYER  5           0.000006          0.023      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0288

  CHANGE IN WATER STORAGE                  0.767          2785.679      3.25

  SOIL WATER AT START OF YEAR              3.511         12744.876

  SOIL WATER AT END OF YEAR                4.278         15530.556

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.017      0.00

*******************************************************************************



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                          ANNUAL TOTALS FOR YEAR 2008
-------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           28.54         103600.219    100.00

  RUNOFF                                   9.007         32694.285     31.56

  EVAPOTRANSPIRATION                      13.622         49446.723     47.73

  DRAINAGE COLLECTED FROM LAYER  3         4.8139        17474.564     16.87

  PERC./LEAKAGE THROUGH LAYER  5           0.000005          0.019      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0234

  CHANGE IN WATER STORAGE                  1.098          3984.601      3.85

  SOIL WATER AT START OF YEAR              4.278         15530.556

  SOIL WATER AT END OF YEAR                5.376         19515.156

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.024      0.00

*******************************************************************************
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                          ANNUAL TOTALS FOR YEAR 2009
--------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           13.56          49222.816    100.00

  RUNOFF                                   0.588          2136.029      4.34

  EVAPOTRANSPIRATION                      14.495         52617.121    106.90

  DRAINAGE COLLECTED FROM LAYER  3         0.0126           45.607      0.09

  PERC./LEAKAGE THROUGH LAYER  5           0.000000          0.000      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0001

  CHANGE IN WATER STORAGE                 -1.536         -5575.955    -11.33

  SOIL WATER AT START OF YEAR              5.376         19515.156

  SOIL WATER AT END OF YEAR                3.840         13939.201

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.014      0.00

********************************************************************************


********************************************************************************

                          ANNUAL TOTALS FOR YEAR 2010
--------------------------------------------------------------------------------
                                         INCHES          CU. FEET     PERCENT
                                        --------        ----------    -------
  PRECIPITATION                           20.98          76157.414    100.00

  RUNOFF                                   3.066         11128.597     14.61

  EVAPOTRANSPIRATION                      11.540         41890.117     55.00

  DRAINAGE COLLECTED FROM LAYER  3         3.9776        14438.622     18.96

  PERC./LEAKAGE THROUGH LAYER  5           0.000004          0.015      0.00

  AVG. HEAD ON TOP OF LAYER  4             0.0194

  CHANGE IN WATER STORAGE                  2.397          8700.039     11.42

  SOIL WATER AT START OF YEAR              3.840         13939.201
```

```
  SOIL WATER AT END OF YEAR                6.237         22639.240

  SNOW WATER AT START OF YEAR              0.000             0.000      0.00

  SNOW WATER AT END OF YEAR                0.000             0.000      0.00

  ANNUAL WATER BUDGET BALANCE              0.0000            0.023      0.00

*******************************************************************************
```

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         AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 2001 THROUGH 2010
-------------------------------------------------------------------------------

                         JAN/JUL  FEB/AUG  MAR/SEP  APR/OCT  MAY/NOV  JUN/DEC
                         -------  -------  -------  -------  -------  -------
  PRECIPITATION
  -------------
    TOTALS                 2.17     1.55     3.20     0.84     0.45     0.73
                           0.28     1.03     0.97     1.08     2.15     4.48

    STD. DEVIATIONS        2.80     1.80     6.51     0.68     0.39     0.46
                           0.25     1.33     0.63     1.60     2.10     5.94

  RUNOFF
  ------
    TOTALS                 0.258    0.126    0.469    0.001    0.000    0.000
                           0.000    0.059    0.000    0.043    0.169    1.383

    STD. DEVIATIONS        0.817    0.293    1.419    0.001    0.000    0.000
                           0.000    0.185    0.000    0.136    0.477    2.802

  EVAPOTRANSPIRATION
  ------------------
    TOTALS                 1.344    1.575    1.761    1.239    0.437    0.728
                           0.296    0.930    1.015    0.807    1.296    1.306

    STD. DEVIATIONS        0.867    0.789    1.405    1.084    0.403    0.422
                           0.233    1.139    0.610    0.999    0.633    1.100

  LATERAL DRAINAGE COLLECTED FROM LAYER  3
  ----------------------------------------
    TOTALS                 0.5937   0.1169   1.0072   0.0725   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0428   0.0768   1.5251

    STD. DEVIATIONS        1.8731   0.2537   2.9888   0.2294   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.1352   0.2429   2.1790

  PERCOLATION/LEAKAGE THROUGH LAYER  5
  ------------------------------------
    TOTALS                 0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                           0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
```

```
   STD. DEVIATIONS        0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0000   0.0000   0.0000


-------------------------------------------------------------------------------
               AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)
-------------------------------------------------------------------------------


  DAILY AVERAGE HEAD ON TOP OF LAYER  4
  -------------------------------------
   AVERAGES               0.0347   0.0075   0.0589   0.0044   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0025   0.0046   0.0891

   STD. DEVIATIONS        0.1095   0.0163   0.1747   0.0139   0.0000   0.0000
                          0.0000   0.0000   0.0000   0.0079   0.0147   0.1274

*******************************************************************************



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    AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 2001 THROUGH 2010
-------------------------------------------------------------------------------
                                      INCHES            CU. FEET      PERCENT
                                -------------------   -------------   ---------
 PRECIPITATION                   18.94    (   8.940)      68748.6     100.00

 RUNOFF                           2.508   (  2.7897)       9102.89     13.241

 EVAPOTRANSPIRATION              12.732   (  3.7176)      46217.07     67.226

 LATERAL DRAINAGE COLLECTED       3.43506 (  3.63372)     12469.274   18.13750
   FROM LAYER  3

 PERCOLATION/LEAKAGE THROUGH      0.00000 (  0.00000)         0.013    0.00002
   LAYER  5

 AVERAGE HEAD ON TOP              0.017 (    0.018)
   OF LAYER  4

 CHANGE IN WATER STORAGE          0.264   (  2.0421)        959.33      1.395

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             PEAK DAILY VALUES FOR YEARS 2001 THROUGH 2010
   ------------------------------------------------------------------------
                                               (INCHES)      (CU. FT.)
                                              ----------    -------------
      PRECIPITATION                            10.69          38804.699

      RUNOFF                                    8.091         29369.3809

      DRAINAGE COLLECTED FROM LAYER  3          1.23090        4468.16846

      PERCOLATION/LEAKAGE THROUGH LAYER  5      0.000001          0.00499

      AVERAGE HEAD ON TOP OF LAYER  4           2.230

      MAXIMUM HEAD ON TOP OF LAYER  4           3.903

      LOCATION OF MAXIMUM HEAD IN LAYER  3
            (DISTANCE FROM DRAIN)              24.9 FEET

      SNOW WATER                                0.00             0.0000


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                 0.4533

      MINIMUM VEG. SOIL WATER (VOL/VOL)                 0.1831


       ***  Maximum heads are computed using McEnroe's equations.  ***

            Reference:  Maximum Saturated Depth over Landfill Liner
                        by Bruce M. McEnroe, University of Kansas
                        ASCE Journal of Environmental Engineering
                        Vol. 119, No. 2, March 1993, pp. 262-270.

******************************************************************************

******************************************************************************

                FINAL WATER STORAGE AT END OF YEAR 2010
    ----------------------------------------------------------------------
                   LAYER        (INCHES)       (VOL/VOL)
                   -----        --------       ---------
                     1            1.5793         0.2632

                     2            4.4124         0.3677

                     3            0.0650         0.3299

                     4            0.0000         0.0000

                     5            0.1800         0.7500

                  SNOW WATER      0.000

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Appendix C
Final Cover Drainage Layer Capacity and Slope Stability

AECOM

CALCULATION SHEET

Page 1 **Of** 7

Project No. 60135722

Client County of Kaua'i	**Subject** Final Cover	**Prepared By**	KJB	**Date**	8/26/13
Project Kekaha Landfill	Drainage Layer Capacity	**Reviewed By**	BPS	**Date**	8/26/13
Phase II Vertical Expansion	And Slope Stability	**Approved By**	KJB	**Date**	8/26/13

FINAL COVER DRAINAGE LAYER CAPACITY AND SLOPE STABILITY

Objective

Evaluate the final cover slope stability under static and seepage conditions for the proposed Phase II and Cell 1 Vertical Expansion at Kekaha Landfill that incorporates the use of geosynthetics and soil materials.

Design Criteria & Assumptions

1. The attached final cover cross section is applicable (Figure 1).
2. A 100-year 24-hour rain event of 12 inches is the assumed rain event for the seepage condition.
3. Interface friction angle testing as well as transmissivity testing should be completed prior to construction and use of the proposed materials. This calculation is completed to evaluate the acceptability of the proposed drainage materials under expected normal loadings and minimum interface friction angles. Material and interface friction angle testing requirements are presented in accompanying Engineering Report.
4. The geocomposite drainage layer will consist of a HDPE geonet with a nonwoven geotextile heat-bonded to both sides.
5. A factor of safety of 1.5 will be used to determine slope stability under static conditions (consistent with past permitted approvals). A factor of safety of 1.2 and a drainage layer capacity greater than one (DLC >=1) will be used to assess stability for seepage conditions (short-term condition) in defining minimum material requirements. By defining a DLC >=1 all infiltration through the protective cover soil will be managed in the thickness of the geocomposite drainage layer. Under short-term conditions, the final cover protective cover soil layer above the geocomposite drainage layer is assumed to be at field capacity, a temporary condition.
6. This analysis is completed only on the final cover sideslope (3.5:1) as this represents the steepest slopes, required overall stability of the cover system, and drainage performance of the geocomposite.
7. The calculation also assumes that the drainage from the proposed crown of the facility is day lighted or drained prior to the 3.5:1 slopes.
8. Seismic analysis will not be completed as the site specific horizontal peak ground acceleration is 0.06 g and is less than 0.10 g required by Subtitle D for analysis (Reference 1).

Calculations

The stability of the final cover is primarily dependent upon the shear resistance of the weakest interface, slope length, slope inclination, and the seepage condition. The following information was collected/selected before conducting the actual stability analysis.

Material/Design Properties

Final cover material properties are based upon Appendix B of Reference 1 for unit weight. Final cover soil is expected to be imported to the facility for construction.

Protective Cover Soil (well graded sand, Reference 1):

Unit weight, moist	γ_{moist} = 110 pcf = 17.3 kN/m^3
Unit weight, saturated (assumed)	$\gamma_{saturated}$ = 120 pcf = 18.9 kN/m^3
Permeability	$k_{c.s.}$ = varies
Thickness (permitted)	$h_{c.s.}$ = 18 inches = 457.2 mm
Internal friction angle	$\phi_{c.s.}$ = 30 degrees (conservative)

Runoff Coefficient:

Runoff coefficient (RC) is an estimated percentage of precipitation allowed to runoff the final cover. The runoff coefficient is dependant upon the type of soils and slope steepness. The proposed protective cover soil will consist of on-site well graded sands. The runoff coefficient based upon Reference 5 (Attachment 1) is estimated at:

Clayey soils, slopes greater than 7% RC = 0.25 to 0.35
Sandy soils, slopes greater than 7% RC = 0.15 to 0.20

For conservative design, a runoff coefficient of RC = 0.15 has been used for the 3.5:1 slope (28.6% slope). If a lower permeable soil is used (i.e. clayey soils), then the amount of expected runoff will increase and reduce the overall infiltration to the geocomposite, further increasing this calculation conservatism.

Slope Inclination:

Slope inclination: β = 3.5H:1V = tan^{-1} (1/3.5) = 15.9 degrees

Design rainfall intensity (Reference 7):

100-year, 24-hour storm event I = 12 inches/24 hours
I = (12/24) inches/hour = 0.50 inches/hr
I = 12.7 mm/hr

AECOM

CALCULATION SHEET

Page 3 **Of** 7
Project No. 60135722

Client County of Kaua’i	**Subject** Final Cover	**Prepared By** KJB	**Date** 8/26/13
Project Kekaha Landfill	Drainage Layer Capacity	**Reviewed By** BPS	**Date** 8/26/13
Phase II Vertical Expansion	And Slope Stability	**Approved By** KJB	**Date** 8/26/13

Geocomposite Drainage Layer Properties:

Geocomposite thickness (geonet only): $t_{composite}$ = 200 mil or 5 mm
(Per GSE, Attachment 2)

Transmissivity is determined by applying the following equation (References 8 and 9)

$$\theta_{allow} = \left(\frac{\theta_{100}}{\mathrm{RF}_{\mathrm{CR}} * RF_{CC} * RF_{BC}} \right)$$

where:

θ_{allow} = allowable transmissivity, m^2/sec
θ_{100} = 100 hour transmissivity data, m^2/sec
RF_{CR}= Reduction factor for creep
RF_{CC}= Reduction factor for chemical clogging
RF_{BC}= Reduction factor for biological clogging

Gradient for transmissivity testing is equal to sin β (Reference 9) or sin (15.9 degrees) = 0.274.

Since this is a final cover system, the overburden or loading applied to the geocomposite is equal to the thickness of the final cover soils multiplied by the unit weight. For the proposed final cover cross section the overburden is (1.5 feet * 120 pcf) = 180 psf. Accounting for construction equipment placing the soils, which would include a dozer with a maximum 5 psi surface pressure, the resulting overburden is (180 psf +(5 psi * 144 in^2/sf)) = 900 psf. Equipment loading is considered temporary. Therefore, assuming an overburden loading of 1,000 psf for 100 hours is conservative.

The 100 hour transmissivity data (θ_{100}) for 200 mil GSE Fabrinet geocomposite with a 6 or 8 oz geotextile with a boundary condition of soil to geocomposite to geomembrane is determined using Figure A-3 of Reference 9 (Attachment 3) for 1,000 psf loading, 100 hour seat time, at a gradient of 0.27:

$\theta_{100} = 1.7\text{x}10^{-4}$ m^2/sec, say → $1.5\text{x}10^{-4}$ m^2/sec

Reduction factors of RF_{CC} and RF_{BC} are selected from Table 4.4 of Reference 9:

RF_{CC}= 1.1 (assumes low alkaline soils)
RF_{BC}= 1.5 (assumes very little to no root growth into geocomposite)

Reduction factor of RF_{CR} (creep) is determined based upon increasing overburden stress. Creep reduction factors for cover applications are much smaller than those for liner systems. Based upon Section 4.3.4 and Appendix B - Table B-1 of Reference 9, RF_{CR} = 1.1 for GSE 200 mil HyperNet Geonet (geonet core for the geocomposite).

CALCULATION SHEET

Page 4 **Of** 7

Project No. 60135722

Client	County of Kaua'i	**Subject**	Final Cover	**Prepared By**	KJB	**Date**	8/26/13
Project	Kekaha Landfill		Drainage Layer Capacity	**Reviewed By**	BPS	**Date**	8/26/13
Phase II Vertical Expansion			And Slope Stability	**Approved By**	KJB	**Date**	8/26/13

Solving allowable transmissivity:

$$\theta_{allow} = \left(\frac{1.5x10^{-4}\,m^2/\sec}{1.1*1.1*1.5}\right) = \left(\frac{1.5x10^{-4}\,m^2/\sec}{1.82}\right) = 8.24x10^{-5}\,m^2/\sec$$

Permeability:

$$k_d = \left(\frac{8.24\mathrm{x}10^{-5}\ \mathrm{m}^2/\mathrm{sec}}{5\ \mathrm{mm}}\right)\left(\frac{100\ \mathrm{cm}}{1\ \mathrm{m}}\right)^2\left(\frac{10\ \mathrm{mm}}{1\ \mathrm{cm}}\right) = 1.65\ \mathrm{cm/sec}$$

Maximum slope length (Reference 2):

Maximum slope length for the 3.5:1 cover slope (east sideslope across from the leachate evaporation pond) based upon longest change in elevation

$$(\mathrm{El}.114 - \mathrm{El}.52)\left(\sqrt{3.5^2 + 1^2}\right) = 225.7\ \mathrm{feet} \Rightarrow 230\ \mathrm{feet\ or}\ 70.1\ \mathrm{m}$$

Infinite Slope Stability

The infinite slope stability is determined by force summation along the sideslope angle resulting in a factor of safety (Reference 6) without a buttress effect at the toe of slope or:

$$FS = \frac{\text{resisting forces}}{\text{driving forces}} = \frac{F}{W\sin\beta} = \frac{N\tan\delta}{W\sin\beta} = \frac{W\cos\beta\tan\delta}{W\sin\beta}$$

$$FS = \frac{\tan\delta}{\tan\beta}$$

where:

FS = Factor of Safety
δ = critical interface friction angle
β = sideslope angle

Solving for 3.5:1 slope (15.9 degrees) and Factor of Safety of 1.5, the minimum critical interface friction angle is:

$$FS = \frac{\tan\delta}{\tan\beta} \Rightarrow 1.5 = \frac{\tan\delta_{3.5:1}}{\tan 15.9} \Rightarrow \delta_{3.5:1} = \tan^{-1}(1.5*\tan 15.9)$$

$$\delta_{3.5:1} = 23.1\ \text{degrees}$$

The infinite slope stability is not dependent upon cover soil thickness, slope length, or cover soil permeability.

Methodology for Drainage Layer Capacity Analysis

The degree of submergence of the final cover under the design precipitation should be determined prior to conducting the final cover stability analysis. In order to quantify the degree of submergence, the drainage layer capacity (DLC) of the design option will be determined first. The procedure is based upon those presented by Soong and Koerner, 1997 (Reference 3).

The procedure is:

$$DLC = \frac{FLUX_{allow}}{FLUX_{req'd}}$$

For geocomposite drainage layer:

$FLUX_{allow}$ = Allowable flux (flow rate per unit width of final cover)
= $k_d iA$
= $k_d \sin\beta(t*1)$
= $(k_d*t)\sin\beta$
= $\theta\sin\beta$

where:

k_d = permeability of drainage material
i = hydraulic gradient = $\sin\beta$
β= slope angle
A = cross-sectional area of the drainage layer per unit width of final cover
t = thickness of drainage layer
θ = transmissivity of geocomposite

$FLUX_{req'd}$ = Required flux per unit width of sideslope
= (PERC)L*$\cos\beta$(1.0)

where:

$$\text{PERC = percolation} = \begin{cases} I & (k_{\text{cover soil}} \geq I) \\ k_{\text{cover soils.}} & (k_{\text{cover soils}} < I) \end{cases}$$

I = design rainfall intensity
$k_{\text{cover soils}}$ = permeability of vegetative/protective cover
L = slope length
β = slope angle

Methodology for Seepage Slope Stability Analysis

The final cover stability analysis is conducted using procedures developed specifically for veneer cover situations; see Koerner and Soong, 1998 (Reference 4). A spreadsheet program, based on the procedures recommended in the above referenced literature for seepage conditions was constructed, calibrated, and used in this analysis. Note that the input values were previously converted as needed into SI units for ease of spreadsheet input and analysis.

Results

The following conditions have been considered in the final cover stability analyses:

1. Static condition: Determine the minimum interface friction angle based upon infinite slope stability analysis (see "infinite slope stability" section above) to achieve a factor of safety of 1.5; and,

2. Seepage condition: Determine the correlations between the maximum length of continuous geocomposite drainage layer, permeability of protective soils and the critical interface friction angle. A minimum factor of safety of 1.2 is targeted for the seepage (short term) condition.

The typical permeability of the imported final cover soil was varied between $1x10^{-4}$ cm/sec and $1.0 \, x10^{-5}$ cm/sec for the seepage analysis to assess the maximum allowable uninterrupted slope installation length for the proposed geocomposite while soil thickness, design slope, precipitation, soil parameters, and liner shear strength were held constant.

The results of the static final cover stability have been completed (see "infinite slope stability" section above)and on spreadsheets with the results attached and summarized below in Table 1.

Table 1
Summary of Slope Stability Results For Static and Seepage Conditions

Condition	Slope (H:V)	Rain Event	Maximum Protective Cover Permeability (cm/sec)	Slope Length Feet, (meters)	Cover Soil Thickness Feet, (mm)	Critical Friction Angle	Factor of Safety	DLC	Figure
Static	3.5:1	Infinite slope stability analysis, these parameters are not applied.				23.1	1.50 = 1.50	NA	NA
Seepage	3.5:1	100-year	$*1x10^{-4}$	77.1 (23.5)	1.5 (457.2)	23.1	1.55 > 1.20	1.0 = 1.0	2
			$3.35x10^{-5}$	230 (70.1)			1.51 > 1.20	1.0 = 1.0	3
			$1x10^{-5}$	770.8 (234.9)			1.49 > 1.20	1.0 = 1.0	4

* Equals maximum allowable permeability per the final cover/base liner equivalency calculation.

Client County of Kaua'i **Subject** Final Cover **Prepared By** KJB **Date** 8/26/13
Project Kekaha Landfill Drainage Layer Capacity **Reviewed By** BPS **Date** 8/26/13
Phase II Vertical Expansion And Slope Stability **Approved By** KJB **Date** 8/26/13

Conclusions and Discussion

Based upon the above static infinite slope analysis, the weakest peak shear strength as represented by the friction angle phi (Φ) for any interface within the final cover system should be a minimum of 23.1 degrees. Based on the seepage analysis, the maximum 3.5:1 slope length (230 feet or 70.1 meters) can be covered with a continuous layer of geocomposite if the protective cover soil layer immediately overlying the geocomposite has a maximum permeability of 3.35×10^{-5} cm/sec. If the permeability of the cover soils is greater than 3.35×10^{-5} cm/sec, then the specific geocomposite proposed for this project will need to be day lighted along the slope length at the maximum slope length intervals listed.

If the transmissivity and correlating permeability of a site specific geocomposite is greater than the design requirement, this calculation should be revisited and slope lengths may potentially increase for a continuous layer of geocomposite with higher permeability protective cover soils. Please note continuous geocomposite slope lengths cannot be increased by increasing the critical friction angle since the DLC factor governs the suitability of the geocomposite. The overall factor of safety would increase, but the performance of the geocomposite still governs maximum continuous geocomposite slope length.

Interface friction angle testing should be completed prior to final acceptance of final cover liner system materials. Transmissivity testing should also be performed at 100 hour seat time at 1,000 psf load with actual site soil and geosynthetic materials to further substantiate the design assumptions.

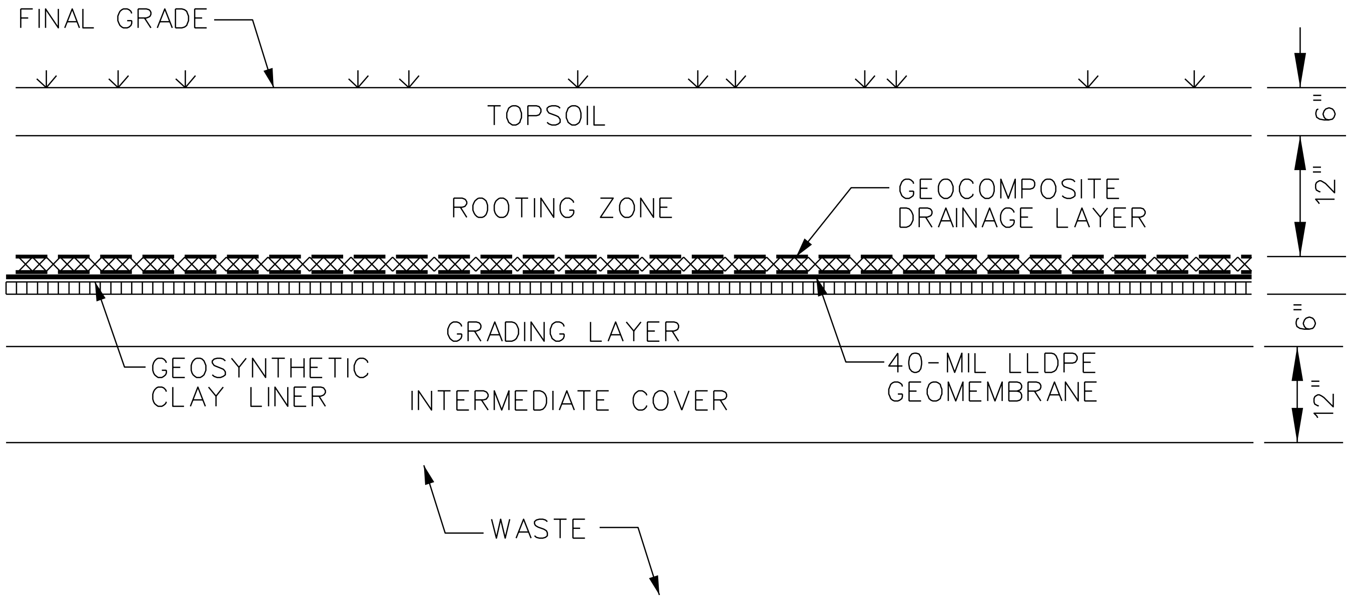
This calculation should be revisited if a geocomposite other than GSE FabriNet geocomposite is selected for final cover installation.

References

1. "Addendum Operations Manual For Kekaha Sanitary Landfill – Phase II," prepared by EMCON, May 1998.
2. Drawings titled, "Engineering Report, Kekaha Landfill Phase II Vertical Expansion, Kekaha Sanitary Landfill", prepared by AECOM, dated August 2013.
3. Soong, T.-Y. and Koerner, R.M. (1997) "The Design of Drainage Systems Over Geosynthetically Lined Slopes", Report #19, Geosynthetic Research Institute, Philadelphia, PA 19104, 88 pgs.
4. Koerner, R. M. and Soong, T.-Y. (1998), "Analysis and Design of Veneer Cover Soils*" Proc. 6th Int. Conf. on Geosynthetics, Atlanta*, USA, IFAI, pp. 1-23.
5. Daniel, David E., "Geotechnical Practice for Waste Disposal", page 216.
6. Koerner, R. M., "Designing with Geosynthetics," Fourth Edition, pps. 478 and 480.
7. Department of Engineering, County of Kauai. 2001. Stormwater Runoff System Manual. July. Lihue, Kauai, Hawaii
8. Standard Guide for "Determination of the Allowable Flow Rate of a Drainage Geocomposite", Geosynthetic Research Institute, GRI Standard GC8, Revision 1: January 9, 2013.
9. "The GSE Drainage Design Manual", Second Edition, GSE Environmental.

FIGURE 1

TYPICAL FINAL COVER LINER CROSS SECTION



FINAL COVER SYSTEM 1

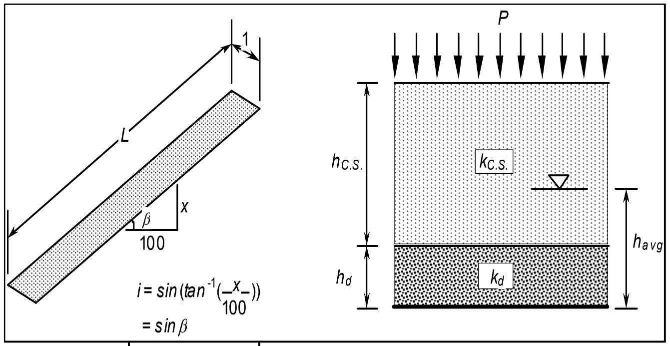
NTS

FIGURES 2 THROUGH 4

SLOPE STABILITY UNDER SEEPAGE CONDITIONS FIGURES 3.5:1 SLOPE, VARIOUS SLOPE LENGTHS, 18-INCH PROTECTIVE COVER THICKNESS

Calculation of stability under seepage condition

Calculation of DLC and PSR



77.1 ft

L = 23.5 m

β = 15.9 °

$h_{C.S.}$ = 457.2 mm

h_d or t_{GS} = 5.0 mm

$k_{C.S.}$ = 1.00E-04 cm/s

k_d or k_{GS} = 1.65E+00 cm/s

P = 12.70 mm/hr

RC = 0.15

i = *0.2740*

$L(\cos\beta)$ = *22.60* m

x = *6.44* m

$h_{C.S.}$ = *0.5* m

h_d or t_{GS} = *0.01* m

$h_{C.S.} + h_d$ = *0.46* m

$k_{C.S.}$ = *1.0E-06* m/s

k_d or k_{GS} = *1.7E-02* m/s

P (RC) = *1.9* mm/hr

Actual runoff = *9.10* mm/hr

PERC = *3.60* mm/h

$FLUX_{actual}$ = *0.081* m^3/hr

$FLUX_{allow}$ = *0.081* m^3/hr **DLC = *0.9999***

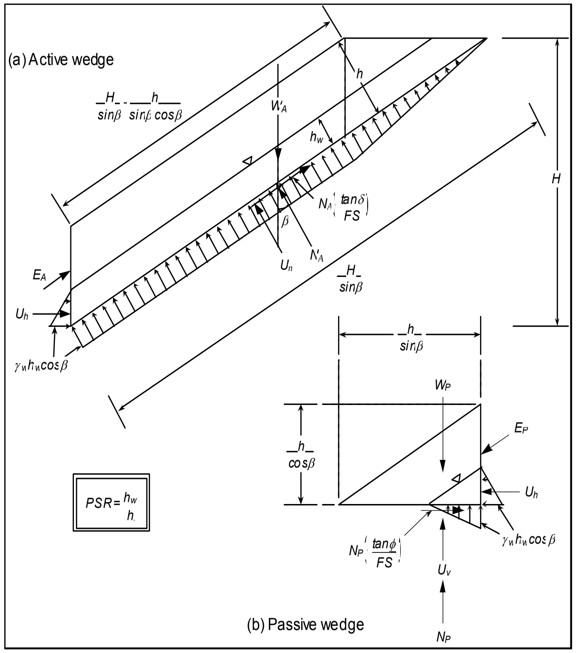
q = *2.3E-05* m^3/sec

h_{avg} = *0.01* m

PSR = *0.020*

Results:

DLC	***1.000***
PSR	***0.020***
FS	***1.550***



thickness of cover soil = h = *0.46* m

length of slope measured along the top of clay layer = L = *24* m

soil slope angle along top of clay = β = *15.9* ° = *0.28* (rad.)

vertical height of the slope measured from the toe = H = *6.4* m

parallel submergence ratio = PSR = *0.02*

depth of the water surface measured from the top of clay layer = h_w = *0.01* m

dry unit weight of the cover soil = γ_{moist} = 17.3 kN/m^3

saturated unit weight of the cover soil = $\gamma_{sat'd}$ = 18.9 kN/m^3

unit weight of water = γ_w = 9.81 kN/m^3

friction angle of the cover soil = ϕ = 30.0 ° = *0.52* (rad.)

critical interface = δ = 23.1 ° = *0.40* (rad.)

Calculation of FS

Active Wedge:

W_A = *181.262 kN*

U_n = *2.07626 kN*

U_h = *0.00043 kN*

N_A = *172.251 kN*

Passive Wedge:

W_P = *7.01372 kN*

U_V = *0.00151 kN*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = *47.8*

b = *-81.5*

c = *11.6*

FS= 1.550

Note: numbers in boxes are input values

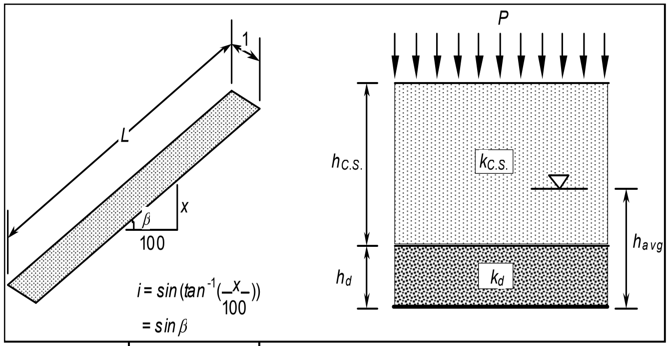
numbers in Italics are calculated values

Constructed by Te-Yang Soong

Figure 2

Calculation of stability under seepage condition

Calculation of DLC and PSR



230.0 ft

L = 70.1 m

β = 15.9 °

$h_{C.S.}$ = 457.2 mm

h_d or t_{GS} = 5.0 mm

$k_{C.S.}$ = 3.35E-05 cm/s

k_d or k_{GS} = 1.65E+00 cm/s

P = 12.70 mm/hr

RC = 0.15

i = *0.2740*

$L(\cos\beta)$ = *67.42* m

x = *19.21* m

$h_{C.S.}$ = *0.5* m

h_d or t_{GS} = *0.01* m

$h_{C.S.} + h_d$ = *0.46* m

$k_{C.S.}$ = *3.4E-07* m/s

k_d or k_{GS} = *1.7E-02* m/s

P (RC) = *1.9* mm/hr

Actual runoff = *11.49* mm/hr

PERC = *1.21* mm/h

$FLUX_{actual}$ = *0.081* m^3/hr

$FLUX_{allow}$ = *0.081* m^3/hr **DLC = 1.0003**

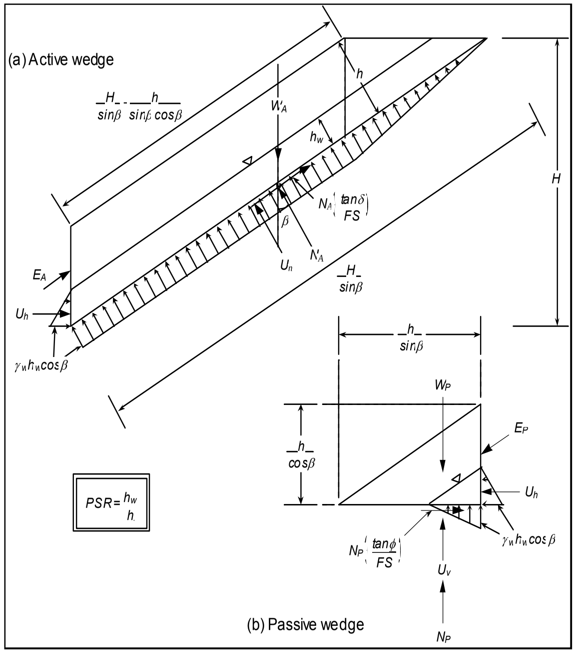
q = *2.3E-05* m^3/sec

h_{avg} = *0.00* m

PSR = 0.011

Results:

DLC	***1.000***
PSR	***0.011***
FS	***1.511***



thickness of cover soil = h = *0.46* m

length of slope measured along the top of clay layer = L = *70* m

soil slope angle along top of clay = β = *15.9* ° = *0.28* (rad.)

vertical height of the slope measured from the toe = H = *19.2* m

parallel submergence ratio = PSR = *0.01*

depth of the water surface measured from the top of clay layer = h_w = *0.00* m

dry unit weight of the cover soil = γ_{moist} = 17.3 kN/m^3

saturated unit weight of the cover soil = $\gamma_{sat'd}$ = 18.9 kN/m^3

unit weight of water = γ_w = 9.81 kN/m^3

friction angle of the cover soil = ϕ = 30.0 ° = *0.52* (rad.)

critical interface = δ = 23.1 ° = *0.40* (rad.)

Calculation of FS

Active Wedge:

W_A = *554.103* *kN*

U_n = *3.30568* *kN*

U_h = *0.00012* *kN*

N_A = *529.598* *kN*

Passive Wedge:

W_P = *7.01353* *kN*

U_V = *0.00043* *kN*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = *146.0*

b = *-244.3*

c = *35.7*

FS= 1.511

Note: numbers in boxes are input values

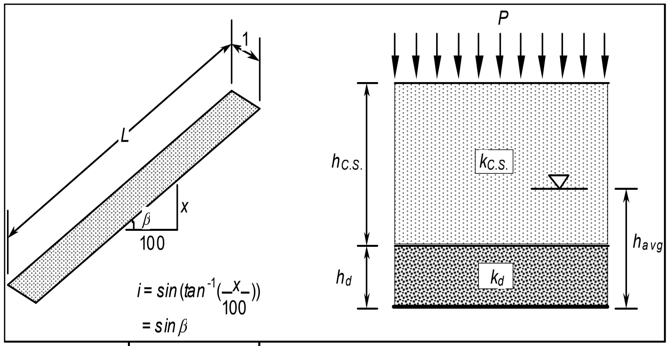
numbers in Italics are calculated values

Constructed by Te-Yang Soong

Figure 3

Calculation of stability under seepage condition

Calculation of DLC and PSR



$i = \sin(\tan^{-1}(\frac{x}{100}))$
$= \sin\beta$

	770.8	ft
L =	234.9	m
β =	15.9	°
$h_{C.S.}$ =	457.2	mm
h_d or t_{GS} =	5.0	mm
$k_{C.S.}$ =	1.00E-05	cm/s
k_d or k_{GS} =	1.65E+00	cm/s
P =	12.70	mm/hr
RC =	0.15	

i = *0.2740*
$L(\cos\beta)$ = *225.95* m
x = *64.36* m
$h_{C.S.}$ = *0.5* m
h_d or t_{GS} = *0.01* m
$h_{C.S.} + h_d$ = *0.46* m

$k_{C.S.}$ = *1.0E-07* m/s
k_d or k_{GS} = *1.7E-02* m/s

P (RC) = *1.9* mm/hr
Actual runoff = *12.34* mm/hr
PERC = *0.36* mm/h
$FLUX_{actual}$ = *0.081* m³/hr
$FLUX_{allow}$ = *0.081* m³/hr **DLC = 1.0003**

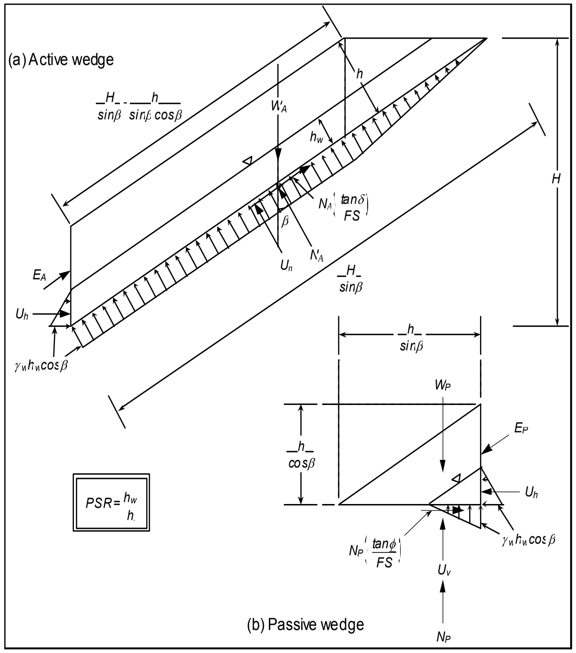
q = *2.3E-05* m³/sec

h_{avg} = *0.00* m

PSR = 0.011

Results:

DLC	***1.000***
PSR	***0.011***
FS	***1.495***



thickness of cover soil = h = *0.46* m
length of slope measured along the top of clay layer = L = *235* m
soil slope angle along top of clay = β = *15.9* ° = *0.28* (rad.)
vertical height of the slope measured from the toe = H = *64.4* m
parallel submergence ratio = PSR = *0.01*
depth of the water surface measured from the top of clay layer = h_w = *0.00* m

dry unit weight of the cover soil = γ_{moist} =	17.3	kN/m³
saturated unit weight of the cover soil = $\gamma_{sat'd}$ =	18.9	kN/m³
unit weight of water = γ_w =	9.81	kN/m³
friction angle of the cover soil = ϕ =	30.0	° = *0.52* (rad.)
critical interface = δ =	23.1	° = *0.40* (rad.)

Calculation of FS

Active Wedge:
W_A = *1873.47 kN*
U_n = *11.0795 kN*
U_h = *0.00012 kN*
N_A = *1790.72 kN*

Passive Wedge:
W_P = *7.01353 kN*
U_V = *0.00043 kN*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

where a = *493.6*
b = *-818.8*
c = *120.8*

FS= 1.495

Note: numbers in boxes are input values
numbers in Italics are calculated values

Constructed by Te-Yang Soong

Figure 4

ATTACHMENT 1

RUNOFF COEFFICIENT REFERENCE

10.2.1 Thornthwaite method

The earliest, comprehensive method for water balance analysis was developed by Thornthwaite and Mather (1957). Fenn *et al.* (1975) developed for the US Environmental Protection Agency (EPA) a water balance method for predicting leachate generation for solid waste disposal sites based on the Thornthwaite method, proposing runoff coefficients for landfills and moisture storage values for municipal waste. The water balance method employs average monthly values of precipitation and other climatic parameters. To determine monthly infiltration (*IN*) into the cover, one subtracts monthly runoff (*R*) from monthly precipitation (*P*).

$$IN = P - R \tag{10.1}$$

Runoff can be calculated from precipitation, as follows

$$R = CP \tag{10.2}$$

where C is a runoff coefficient that can be estimated from the guidance provided by Fenn *et al.* (1975):

description of the grass-covered soil	slope of ground surface	runoff coefficient (C)
sandy soil	flat (<2%)	0.05–0.10
[illegible]	mild (2 – 7%)	0.10–0.15
→	steep (>7%)	0.15–0.20
clayey soil	flat (<2%)	0.13–0.17
[illegible]	mild (2 – 7%)	0.18–0.22
→	steep (>7%)	0.25–0.35

Potential evapotranspiration (*PET*), which depends on mean temperature, heat index, and hours of sunlight, can be calculated from tables provided by Thornthwaite and Mather (1957). The cumulative monthly infiltration minus potential evapotranspiration (*IN* – *PET*) is calculated. A negative number for *IN* – *PET* indicates that the cover has a tendency to dry out; a positive value indicates that there is a tendency for the cover soil to become wetter. If *IN* – *PET* is negative, water may evapotranspire from the cover soil, but if the soil is already dry, no further drying will occur. The amount of drying depends not only on *IN* – *PET* but also on the water content of the soil.

If *IN* – *PET* is positive, water may be stored in the cover soil (which would produce an increase in water content). However, if the water content is already very high, the soil can store no additional water and water will percolate downward through the cover soil. The field capacity of the soil is the maximum water content that a soil can attain without draining water by gravity. Field capacity can be determined by

REFERENCES: "GEOTECHNICAL PRACTICE FOR WASTE DISPOSAL", DANIEL, DAVID E., PG 216.

ATTACHMENT 2

TYPICAL GEOCOMPOSITE PROPERTIES

PRODUCT DATA SHEET

GSE FabriNet 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/yd^2 to 16 oz/yd^2. 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		
Geocomposite			6 oz/yd^2	8 oz/yd^2	10 oz/yd^2
Transmissivity(2), gal/min/ft, (m^2/sec) Double-Sided Composite Single-Sided Composite	ASTM D 4716	1/540,000 ft^2	 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 ft^2	1.0	1.0	1.0
Geonet Core(3) – GSE HyperNet					
Transmissivity(2), gal/min/ft (m^2/sec)	ASTM D 4716		9.6 (2 x 10^{-3})	9.6 (2 x 10^{-3})	9.6 (2 x 10^{-3})
Density, g/cm^3	ASTM D 1505	1/50,000 ft^2	0.94	0.94	0.94
Tensile Strength (MD), lb/in	ASTM D 5035/7179	1/50,000 ft^2	45	45	45
Carbon Black Content, %	ASTM D 1603(6)/4218	1/50,000 ft^2	2.0	2.0	2.0
Geotextile(3,4)					
Mass per Unit Area, oz/yd^2	ASTM D 5261	1/90,000 ft^2	6	8	10
Grab Tensile, lb	ASTM D 4632	1/90,000 ft^2	160	220	260
Puncture Strength, lb	ASTM D 4833	1/90,000 ft^2	90	120	165
AOS, US sieve(1), (mm)	ASTM D 4751	1/540,000 ft^2	70 (0.212)	80 (0.180)	100 (0.150)
Permittivity, sec^{-1}	ASTM D 4491	1/540,000 ft^2	1.5	1.3	1.0
Flow Rate, gpm/ft^2	ASTM D 4491	1/540,000 ft^2	110	95	75
UV Resistance, % retained	ASTM D 4355 (after 500 hours)	per formulation	70	70	70
NOMINAL ROLL DIMENSIONS					
Geonet Core Thickness, mil	ASTM D 5199	1/50,000 ft^2	200	200	200
Roll Width(5), ft			14.5	14.5	14.5
Roll Length(5), ft	Double-Sided Composite Single-Sided Composite		270 300	260 300	230 290
Roll Area, ft^2	Double-Sided Composite Single-Sided Composite		3,915 4,350	3,770 4,350	3,335 4,205

[Product specifications continued on back]

PRODUCT DATA SHEET

[*]

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

Product Specifications [continued]

NOTES:

- (1)AOS in mm is a maximum average roll 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)Refer to geotextile product data sheet for additional specifications.
- (5)Roll widths and lengths have a tolerance of ±1%.
- (6)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.

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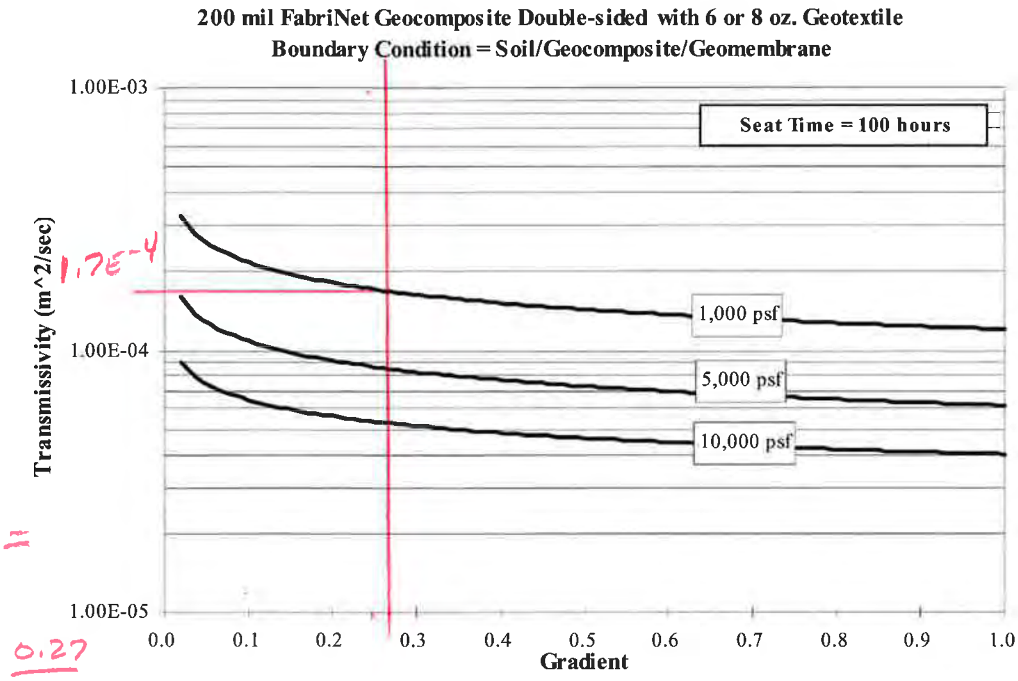
[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

ATTACHMENT 3

Figure A-3, Performance Transmissivity of a 200 mil FabriNet Geocomposite under Soil



GRADIENT =

sin β =

sin (15.9) = 0.27

Figure A-3. Performance Transmissivity of a 200 mil FabriNet Geocomposite under Soil.

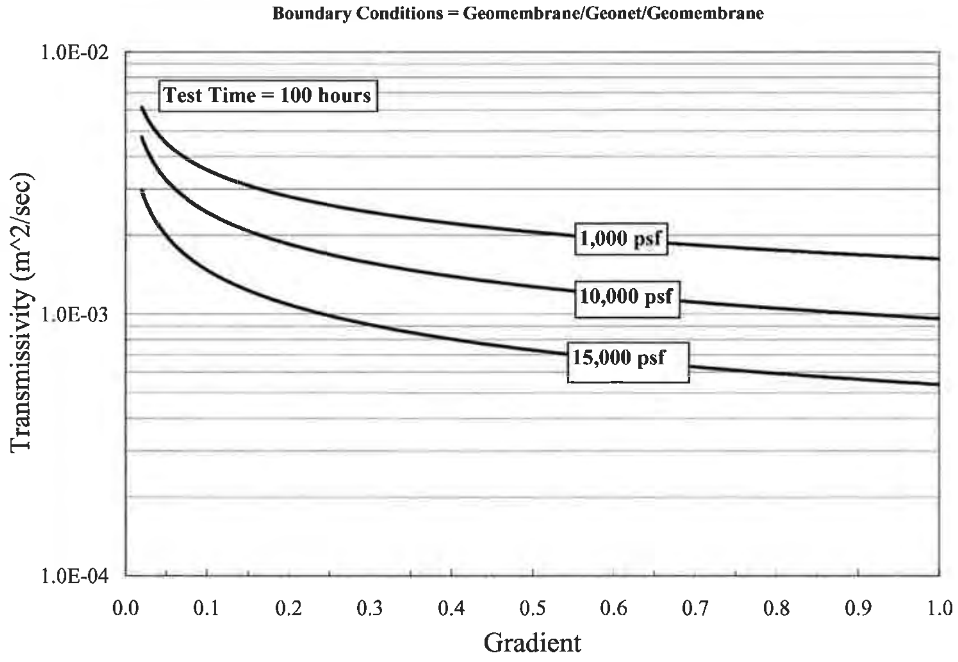


Figure A-4. Performance Transmissivity of a 250 mil GSE HyperNet HF geonet.

Appendix D
Landfill Inspection Form

Landfill Inspection Form

Kekaha Landfill Phase II, Kekaha, Hawaii

Date Landfill Closed:_____________________ Current Date:____________________________

Date of Last Inspection:___________________ Inspection By:__________________________

Type of Inspection: QUARTERLY ANNUAL OTHER ____

	Good	Adequate	Needs Attention	Not Applicable
A. Final Cover and Erosion Control Vegetation:				
1. Top Deck (Good Drainage, No Erosion/Settlement/ /Other Deterioration)				
2. Side Slopes (Good Drainage, No Erosion/Settlement/Other Deterioration)				
3. Vegetation Quality and Density				
4. Surveyed benchmarks				
5. Monitoring well accessibility/visibility/condition				
6. Landfill Gas or Leachate Collection System				
7. No Waste Exposed				
8. Perimeter Cover Termination				
B. Surface Water Drainage:				
1. Are Run-on and Runoff Controls Appropriate				
2. Swales				
3. Swale Crossings				
4. Diversion Berms				
5. Cover Drainage Layer Outlet Pipes				
6. Infiltration Ditch				
C. Leachate Control Systems:				
1. Collection Manholes				
2. Evaporation Lagoon & Aerating Equipment				
3. Following Leachate Management Plan				
4. Wet wells				
5. Leachate Holding Tanks and Containment Areas				
D. Gas Control System:				
1. Gas flares, vents, pipes				
2. Odor/Gas migration off-site				
3. Probes/detection system				

	Good	Adequate	Needs Attention	Not Applicable
E. Monitoring Wells:				
1. Well Condition				
2. Well visible				
E. Security and Access:				
1. Perimeter Fencing				
2. Signs Posted				
3. Access Roads				
4. Undesirable Uses Prevented				

Comments (Reference Item No.): ______________________________

Items That Need Immediate Attention: ______________________________