

Chiquita Canyon Landfill
Castaic, California

Post Remediation Assessment of Air Emissions From Landfill Surfaces



Sampling Protocol

Revision 1

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1. Revision History

This protocol was first produced in 2023. Since then, several modifications have been incorporated by addenda, including the following:

- Addendum No. 1, dated December 30, 2024.
- Addendum No. 2, dated April 14, 2025.
- Addendum No. 3, dated June 25, 2025.

This Revision No. 1 incorporates the previous addenda as well as adds new scope changes discussed at the meetings between Chiquita and South Coast Air Quality Management District (SCAQMD) staff on January 30, 2026 and April 30, 2026. This section identifies all significant changes to the original 2023 document, as follows:

1. Landfill Surface Nomenclature (p. 1) has been changed to include membranes and membrane/soil interface. Additional source category added to cover “Anomalous Areas”, as defined below. The source categories are now: Landfill with Soil Covered Area, Membrane Covered Area, Membrane/Soil Interface Area, Anomalous Areas, and Exceedance Area.
2. Odor assessment has been removed.
3. TO-14 analysis has been added.
4. USEPA Contract Laboratory Program Data Package (CLP) for TO-15 has been added.
5. The addition of 1,1 Difluoroethane (1,1-DFA) as a tracer for flow determination.
6. Scope (Table 3.1) has been changed to reflect the new number (4) of source categories.

2. Introduction

Landfill Surface Nomenclature

For the purposes of this protocol, the landfill surface was divided into the following areas:

Non-Reaction Area (Now Landfill with Soil Cover)

This is the portion of the Landfill that is not affected by the landfill reaction and that did not exceed the SCAQMD Rule 1150.1 integrated data limit of 25 parts per million by volume (ppmv) on the most recent SEM (surface emissions monitoring) event. As of May 2026, this area will be designated as “Landfill with Soil Cover”.

Reaction Area

This is the portion of the Landfill designated as being affected by the landfill reaction and that did not exceed the SCAQMD Rule 1150.1 integrated data limit on the most recent SEM event. As of May 2026, there will be no reaction area not covered by polymer membrane; therefore, this will no longer be a separate source category.

Membrane Covered Area

This was previously a subset of the Reaction Area that is covered with a HDPE membrane per Photo 2.1. As of March 2026, this will include the entire Reaction Area as well as portions of the non-reaction area that are covered by membrane.

Membrane/Soil Cover Interface Area

These are the SEM Grid Cells that have partial soil cover and partial HDPE membrane cover.

Exceedance Area

This is the portion of the Landfill that was designated as being affected by the landfill reaction and that exceeded the SCAQMD Rule 1150.1 integrated data limit on the most recent SEM event. This portion of the Landfill was considered separately to assess any impact that the grid cells that exceeded the Rule 1150.1 integrated data criteria would have on total site surface emissions. Note that these grid cells are subject to a strict remediation schedule, so any emissions from these cells, over and above those from a reaction area cell not in exceedance, would be a temporary phenomenon.

Anomalous Areas

This is the portion of the Landfill where conditions exist at the time of testing, which are expected to result in increased flux rates. These areas of the Landfill will be assessed separately as a new source category. The selection of the anomalous areas will occur at a meeting to be scheduled the Thursday of the week prior to each flux testing event. The attendees will include SCAQMD staff; Tom Card and/or Chuck Schmidt; SCS Engineers (SCS) consulting staff; and site personnel. Decisions will be made at this meeting in terms of grid and test cell locations for the anomalous source category based on a review and discussion of the following data: (1) SEM data, (2) drone data, (3) wellhead data, (4) information on wells that are offline, and (5) field conditions related to the landfill cover and other conditions that could affect emissions. Preliminarily, the following conditions would be considered anomalous for the purpose of this source category; however, this list may evolve based on discussions during the aforementioned meetings:

- Areas where wells are offline due to cover installation or other construction activities.
- Wells with positive pressure above 2 inches of water column during the most recent wellhead monitoring event proceeding the Thursday meetings.
- Wells with any repeat readings of positive pressure during the most recent two months of wellhead monitoring proceeding the Thursday meetings.
- Areas where multiple adjacent wells exhibit positive pressure during the most recent wellhead monitoring event proceeding the Thursday meetings.
- Areas of known cover disturbance as identified by site personnel (e.g., excessive erosion, construction, earthmoving, etc.)
- Areas with elevated methane or total organic compound readings based on the most recent SEM and drone monitoring.
- Areas identified by site personnel where elevated surface emissions are known or expected.

Photo 2.1 Flux Chamber on Membrane Covering Portion of Landfill.



Background

The Chiquita Canyon Landfill (CCL) is a municipal solid waste (MSW) landfill located in northern Los Angeles County. An area of the Landfill has experienced elevated gas temperatures and surface subsidence, with accompanying elevated gas generation, due to a subsurface reaction..

In accordance with Condition 12.d of the Stipulated Order for Abatement (SOFA) (Case No. 6177-4) between the South Coast Air Quality Management District (SCAQMD) and Chiquita Canyon, LLC, CCL is required to conduct additional flux chamber studies as a follow-up to a flux chamber study previously completed under the direction of the Los Angeles County Department of Public Health, which was submitted to the SCAQMD by October 31, 2023. Procedures for this study, as detailed in the SOFA, are provided below.

Respondent has conducted an initial flux chamber study pursuant to the direction of the Los Angeles County Department of Public Health. Respondent shall conduct landfill gas flux studies for, at a minimum, methane, non-methane organic compounds (“NMOC”), speciated hydrocarbons (C2-C12), toxic air contaminants (TAC) analyzed by EPA Method TO-15 (including acrolein and additionally at least the ten highest concentration tentatively identified compounds), total reduced sulfur (“TRS”), and speciated sulfur compounds to determine the surface flux throughout the landfill starting with Quarter Four 2024 and once every four months thereafter. The studies shall be conducted through the use of dynamic flux chambers oriented at various locations throughout the landfill site, according to a South Coast AQMD approved protocol. Respondent shall prepare a proposed protocol(s) for the studies and shall submit the protocol(s) to South Coast AQMD [Baitong Chen, Air Quality Engineer, (bchen@aqmd.gov); Nathaniel Dickel, Senior Air Quality Engineer, (ndickel@aqmd.gov), and Christina Ojeda, Air Quality Inspector, (cojeda@aqmd.gov)] for review and approval at least 75 days prior to the start of the month in which the test is planned, unless otherwise approved in writing by South Coast AQMD. A previous flux study protocol, reviewed and approved by South Coast AQMD, may be used if the proposed testing will follow all aspects of the prior South Coast AQMD approved protocol, with the exception of the testing/sampling locations on site. Reports detailing the operational conditions, methodology, quantity of tests and locations, sampling location determination, sampling results, data analysis, emission results, discussion of the results, and comparison of previous flux chamber test results to the current results shall be submitted by no later than 45 days after the end of the month during which a test was conducted, or no later than 90 days after South Coast AQMD approves the protocol, whichever is later, to South Coast AQMD [Baitong Chen, Air Quality Engineer, (bchen@aqmd.gov); Nathaniel Dickel, Senior Air Quality Engineer, (ndickel@aqmd.gov), and Christina Ojeda, Air Quality Inspector, (cojeda@aqmd.gov)], unless otherwise approved in writing by South Coast AQMD. The initial flux study report, covering the flux study for the fourth quarter of year 2024, shall be submitted earlier than the schedule indicated above, by January 15, 2025 to South Coast AQMD [Baitong Chen, Air Quality Engineer, (bchen@aqmd.gov); Nathaniel Dickel, Senior Air Quality Engineer, (ndickel@aqmd.gov), and Christina Ojeda, Air Quality Inspector, (cojeda@aqmd.gov)], unless otherwise approved in writing by South Coast AQMD. Respondent shall provide notice of the test date for each test to South Coast AQMD [Baitong Chen, Air Quality Engineer, (bchen@aqmd.gov); Nathaniel Dickel, Senior Air Quality Engineer, (ndickel@aqmd.gov), and Christina Ojeda, Air Quality Inspector, (cojeda@aqmd.gov)] at least 14 days prior to the scheduled test.

This test protocol is intended to address the requirements in the SOFA as well as provide an emissions assessment to determine the landfill emissions of toxic and odorous substances in the *as is* condition **post remediation**, for both the “non reaction area” and “reaction area,” which is now covered with a membrane. This testing is termed “post remediation” because significant site improvements have occurred to exceedance areas since the last test was completed (and will continue to occur up until the date this testing occurs), which are expected to reduce surface emissions of LFG. Note that testing of the prior affected areas of the landfill will be conducted in the historic footprint of those portions of the landfill that experienced the effect of the subsurface reaction known as the reaction area.

Regarding the testing technologies to be used for the post-remediation testing event, as with the prior studies, the U.S. Environmental Protection Agency (USEPA) surface emission isolation flux chamber (flux chamber) technology will be used. This preferred USEPA technology as modified and described by SCAQMD Rule 1133.3, Attachment A, is a dynamic chamber method for direct measurement on advective area sources. This approach is further described in Section 5.

In addition, data will be collected that will allow for the accurate estimation of past and future emissions based on past and future SEM events.

Site Location

The test site, Chiquita Canyon Landfill, 29201 Henry Mayo Drive, Castaic, California, 91384.

Figure 2.1 –Site Location Map.



Objectives

The objective of this Emission Assessment is to quantify by field measurement, the air emissions of odorous chemicals, fixed gases (including methane, carbon dioxide, nitrogen, and carbon monoxide), reduced sulfur compounds, and speciated volatile organic compounds (VOC's) from the active and non-active landfill areas post remedial activities conducted at the landfill. The air emissions will be directly

measured using the USEPA Surface Emission Isolation Flux Chamber (flux chamber) following the USEPA User's Guidance document. Whole air samples will be collected from the flux chamber by lined Summa® canister and Tedlar® bag with analysis by

- ASTM D-1945/USEPA Method 3C for fixed gases (including methane, carbon dioxide, hydrogen, and carbon monoxide; as well as Helium when used as a tracer),
- USEPA Method TO-15 (MS) for 1-1-DFA (trace gas added for advective flow determination),
- SCAQMD Method 307-91 for organic reduced sulfur (ORS),
- USEPA Method TO-14/15 for speciated VOCs (including toxic air contaminants), and
- USEPA Method TO-12 for total non-methane VOC.

Testing will be conducted for the post-remediation condition as was done before using the same sampling (USEPA dynamic flux chamber technology) as described in the SCAQMD Rule 1133.3, Attachment A, for advective flow area sources.

Facility Description

Chiquita Canyon Landfill is an inactive MSW disposal facility.

3. Sampling Scope

This project is focused on the assessment of air emissions from the landfill disposal unit, including the soil covered area, the membrane covered area, and exceedance area post-remediation of the landfill. Each landfill area will be tested using the flux chamber technology.

The landfill fugitive emissions testing will be conducted by utilizing existing SEM screening data on the landfill surface and then conducting flux chamber testing on selected grids within the landfill cells based on emission potential, as shown by the SEM data. The grid cells selected for testing will depend on the screening levels based on monitoring data. In addition, data will be taken from out-of-compliance grids to determine the impact of exceedance cells on site air emissions.

The proposed scope of work for the landfill assessment for the purpose of determining representative emissions is given below in Table 3.1.

The product of the measurement program, which is based on the screening or monitoring data for air emission potential, is an average flux of NMOC/Sulfur/speciated VOC/TAC emissions per category of grid cell. These grid cell flux data multiplied by the number of grid cells in these categories when summed, will represent the air emissions of compounds from the landfill.

Table 3.1 Landfill Emissions Flux Chamber Testing Scope.

SOURCE	Flux Chamber Tests	TAC/Fixed Gas/VOC Sampling	Comment
Soil Covered Landfill Surfaces			
High Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Mid Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Low Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell

Membrane Covered Landfill Surfaces			
High Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Mid Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Low Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Exceedance Area Testing			
Intent to quantify difference in grid testing	4	4	Samples taken at same or distributed within levels of emission potential within category of grid cell
INTERFACE AREA			
High Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Mid Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Low Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
ANOMALOUS AREAS			
High Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Mid Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
Low Emission Category Grid Cell	4	4	Samples distributed within levels of emission potential within category of grid cell
QC Blank Samples		5	Minimum of 5% Blank Samples
QC Replicate Samples		5	Minimum of 5% Blank Samples
Total	52	62	

4. Quality Control

Quality control (QC) procedures that are used to assure data quality from flux chamber measurement are listed and described below. USEPA recommends no specific QC requirements except that a flow meter is used to introduce the sweep air at rate of 5.0 liters per minute (l/min), which requires calibration (i.e., multiple trials at single point of use calibration using a primary standard current for the year). The rotometer used as part of the emission measurement test should not be used for other applications, insuring the clean operation of the air introduction system. Operation of the chamber should follow the specific protocol for use described in the USEPA User's Guide. This includes using a 5.0 l/min sweep airflow rate and allowing for five residence times to achieve equilibration prior to sample collection. Other sampling quality control procedures are listed below.

- Media Blank Sample -- A media blank sample is obtained by filling sampling media with ultra high purity air, water, or impinger solution in the field, and handling the media blank samples as field samples. The frequency of media blank samples is a minimum of 5%, or one per trip. Media blank samples will be collected daily, and these data will be used to establish the system baseline.
- Replicate Sample -- Determine sample precision by collecting a replicate sample immediately after a sample is collected and analyzing both the field sample and the field replicate sample. The frequency of replicate sample collection will be a minimum of 5%; a replicate sample will be collected daily. The criteria for acceptable field precision is $\pm 50\%$ relative percent difference (RPD).

- Specific Method Performance -- Specific method QC is conducted as per analytical method requirements. This includes laboratory blanks, species recovery, and adherence to other method performance objectives such as calibration and retention time identifications. The laboratories will follow the method QA requirements for all listed methods.
- Sample Management -- Sample management is defined by the specific sampling method used to satisfy the program objectives. Sample management typically includes all activities involving the recording, preserving, storing, handling, and shipping of the field samples. A summary of the sample management information for the proposed field measurement activities is given in Tables 4.1 and 4.2.

Table 4.1 Summary of Sample Management Information

Analytical Method	Sample Container	Hold Time	Preservation	Special Considerations	Comment
USEPA Method TO-15/ TO-14/TO-12	6-Liter Canister	28-days	None	Ship in Cardboard	None
SCAQMD 307-91	1-Liter Tedlar® Bag	24 hours	None	Ship in Cardboard	None
ASTM D-1945/USEPA Method 3C	6-Liter Canister	30-days	None	Ship in Cardboard	None

Data qualifiers that will be used to assist in data usage include:

- J-estimated value or below method reporting limit (MRL);
- B-value found in blank sample and baseline corrected; and
- E-value found at level that exceeds calibration range.

Laboratory recovery and precision data, as well as field precision data, will be used to qualify data usage for the site flux chamber program.

Field QC Summary

The field QC activities scheduled for the field testing are summarized in Table 4.2. Deviation in schedule or frequency of QC activities will require corrective action, including documentation of corrective action in the field notebook and notifying a SCS project manager of the deviation and corrective action.

Table 4.2. Summary of Field Quality Control Information

Sampling Method	Activity	Frequency	Criteria	Comment
Flux Chamber	Rotometer Single-Point Calib.	Once per year	Define Rotometer Setting	None
Field Blank	All media	Minimum of 5%	None	Use As Baseline Data
Replicate Sample	All media	Minimum of 5%	± 50% RPD	Qualify Exceedances

5. Sampling Strategy

Selection of Sampling Locations

Sample locations will be selected based on data obtained from landfill gas screening per the SCAQMD Rule 1150.1 SEM program. The SCAQMD protocol is based on surveying the landfill surface on a track using a field portable, calibrated instrument sensitive to methane and total non-methane hydrocarbon (TNMHC). Using this methodology, locations will be selected for flux chamber testing.

Test Cell Selection Methodology

The landfill fugitive emissions assessment will be conducted by analyzing the periodic SEM data. At this site, SEM events happen as often as every two weeks. The proposed scope of work for the landfill assessment includes the analysis of recent SEM events followed by the flux chamber testing described in Table 3.1.

The Rule 1150.1 SEM event requires an instrument fit with a flame ionization detector (FID) used along with global positioning system (GPS) location recording to map fugitive surface hydrocarbon concentrations following a pattern per each grid cells applied to the site. Concentration data and location information are collected and stored for ranking grid cells on the landfill. The target data set from the screening is both instantaneous fugitive concentration data determined by walking a trek across each landfill grid cell (25' spacing) and integrated concentration data per grid cell with each grid at approximately 50,000 square feet. The integrated grid cell data is used to 'rank' the grid cells into categories of high, medium, and low, and the instantaneous fugitive concentration data is used to select representative locations for flux chamber testing where flux data for VOCs/Sulfur/TACs will be collected. The flux from these cells will be used to estimate air emissions from entire surface of these cells.

The grid pattern over the landfill is shown in Figure 5.1. The average integrated data for each cell is accumulated to determine total emissions for the source-category group. It is then broken into three equal emission groups. The high group, medium group, and low group.

In addition to these cells, targeted by the integrated SEM values, a cell will be selected that fails the 25 ppmv integrated value criteria and will be tested in the post remediation condition to determine the overall emissions impact of exceedance cells. All cell selection will be subject to field conditions at time of sampling.

Selecting Test Points in a Cell

Using survey flags, the proscribed serpentine route in a cell will be walked and FID readings will be periodically noted on planted flags. Flux chamber samples will be taken at the following locations:

1. Peak FID reading on serpentine walk
2. Mid-point of highest one third of readings
3. Mid-point of mid one third of readings
4. Mid-point of lowest one third of readings

Assign areas to each flux chamber samples by number of flags represented by each sample. Figure 5.2 shows the cell screening form to be used. Cells will be screened twice, one screening event a day or two prior to sampling, and one event immediately prior to sampling. Results will be recorded on same form using different ink colors. Photo 4.1 shows typical field screening activity.

Figure 5.1 Chiquita Canyon Landfill Cell Gridding

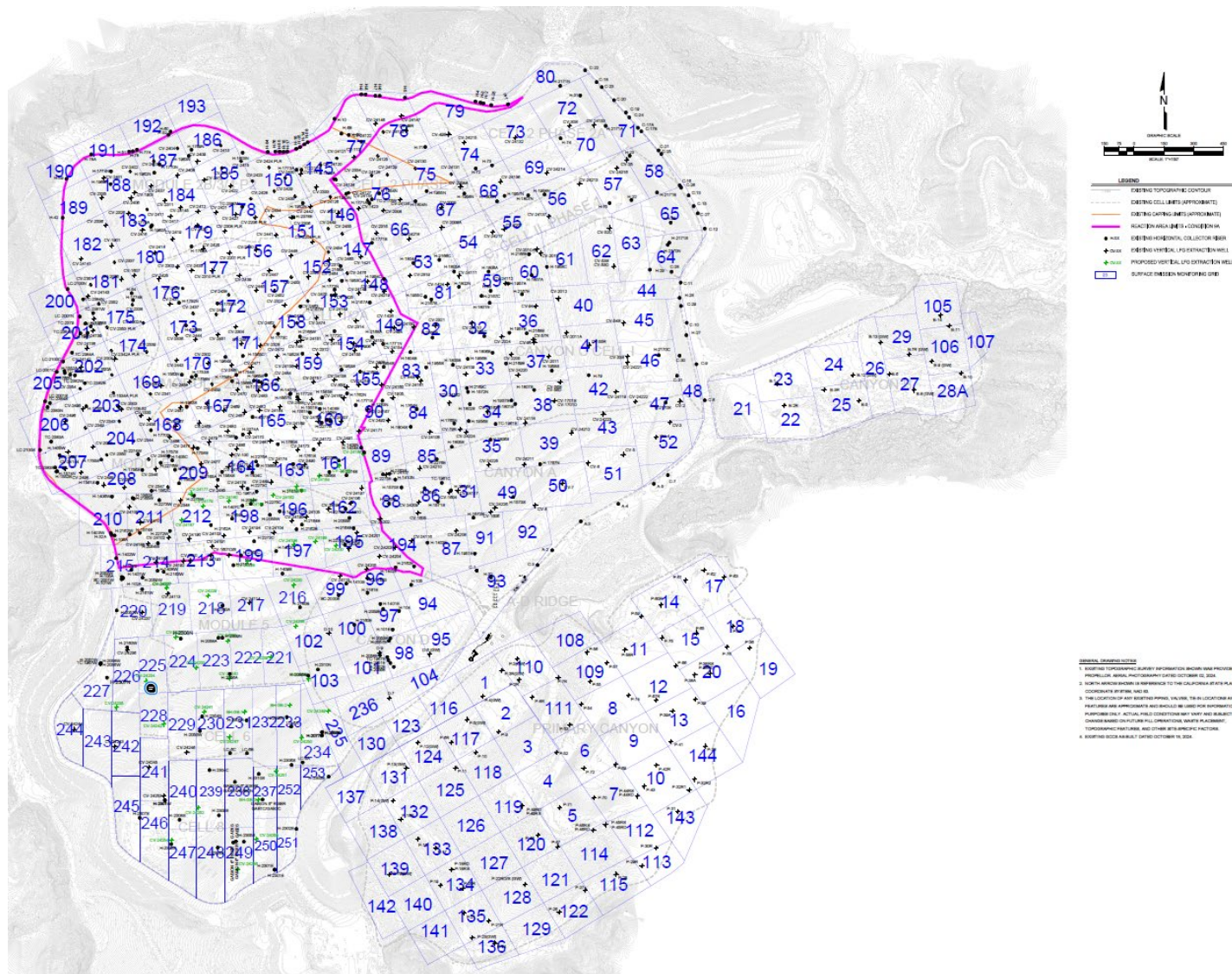


Figure 5.2 Grid Cell Screening Form

Chiquita Canyon Landfill
Cell Screening Form

Date _____

Time _____

Grid ID _____

Windpeed/Dir _____

Instrument _____

Samplers _____

Baseline _____

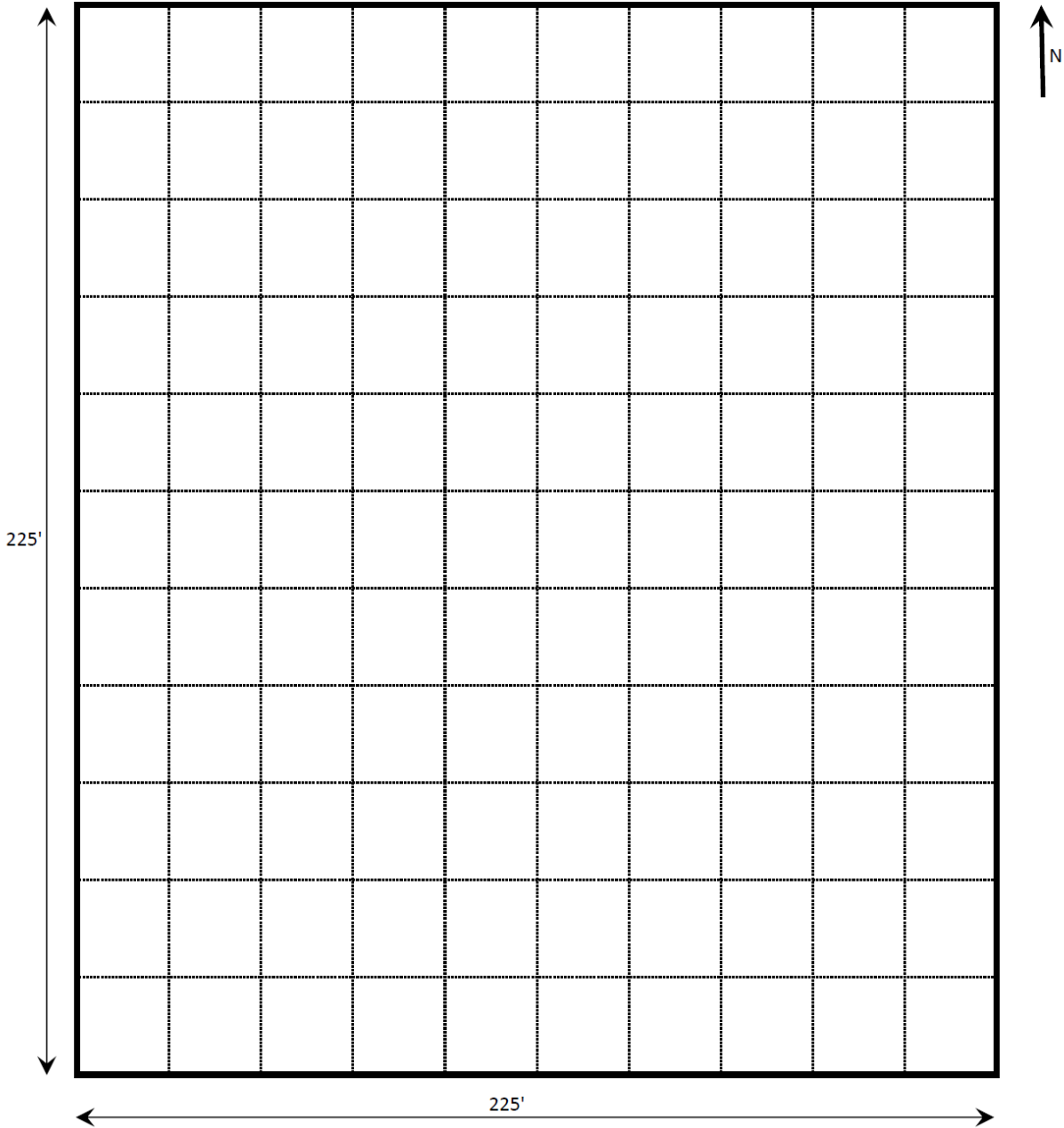


Photo 5.1 Typical Field Screening to Determine Flux Chamber Sampling Locations.



6. Sampling Methods

Flux Chamber Sampling

Dynamic vs. Static Chamber Technologies

Direct measurement using portable environmental chambers has been around now for many decades. USEPA and the Environmental Monitoring Systems Laboratory (EMSL-Las Vegas) in the early 1980's was interested in providing a direct emission measurement technology for 'area' sources that would compliment point source assessment and mobile source assessment technologies. Both 'static' and 'dynamic' chambers were explored looking at the efficacy of both approaches for use on hazardous and non-hazardous sites with area sources. The evaluation included criteria such as accuracy, precision, repeatability, cost, and easy of operation or level of expertise needed.

Looking at both static and dynamic chamber technologies, static chamber technologies were generally considered for screening applications verse quantitative assessment of emissions. The dynamic chamber technology approach was selected for their research and method development. Although static chambers are considered low-tech in that they do not need a sweep gas as with dynamic chambers and easy to use by comparison, the problems associated with collecting valid data focused their attention on dynamic chambers.

Basically, a static chamber on an area source, will collect surface emissions until an equilibrium is achieved in the chamber. That equilibration time is different with various compounds and type of source being tested. So the key parameter in measuring 'flux' of compounds (mass transfer of compounds from the surface- mass/time, surface area) which is equilibration 'time' from an area surface was unknown and would have to be assumed when the air sample from the static chamber was made. In addition, static chambers have significant wall effects from compound interaction, but more so, as you pull chamber air out of a static chamber which is a sealed vessel, a vacuum is created in the chamber resulting in a bias in the measurement.

These problems with static chamber technologies are overcome by using a dynamic chamber that is well mixed by design, uses a sweep air, and given that the dynamic chamber is vented to the atmosphere prevents unwanted pressure effects on collecting samples from the chamber. This results in an accurate, precise, and reliable assessment of surface flux from area sources.

The USEPA flux chamber technology which provides a protocol for this technology standardizing the design and use of the method as described in the USEPA Guidance document is considered a preferred, in-depth assessment technology. This Guidance and technology overcomes the issues with static chambers (recommended only for screening purposes) by using a standard chamber design, construction materials, sweep air, and standard operating protocol. As such the sweep air added to the chamber reduces or eliminates chamber wall effects, and allows for sampling the air in the chamber at steady state conditions (equilibration time constant) without influencing the flux event- sample collection is maintained by protocol at a rate in a vented chamber so that the pressure (negative or positive) in the dynamic chamber does not exceed 0.1 pascal pressure.

Even though the dynamic flux chamber requires a higher level of expertise to use, is more cumbersome to use, and require a companion compressed air cylinder of ultra high purity air as a sweep gas, the dynamic flux chamber is an agency approved technology for this application providing the most reliable

assessment of area sources available. In addition, as modified by the SCAQMD (Rule 1133.3, Attachment A), this dynamic area source assessment technology has been approved for us with advective sources that allow, by use of a trace gas (10% helium), quantitation of the advective flow for each location tested.

Flux Chamber Methodology Used for This Project

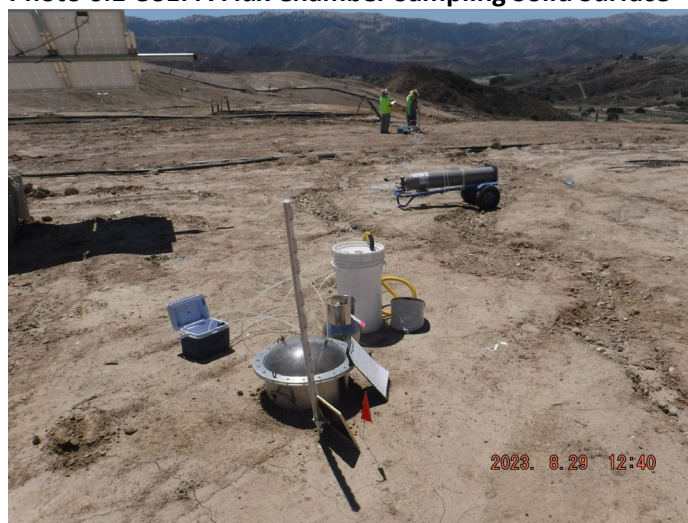
The surface emission isolation flux chamber (flux chamber) can be used on any liquid surface and on solid surfaces. The only requirement regarding application is that there must be access to the surface for testing. If the surface cannot support the chamber, the chamber must be suspended or equipped with a flotation device or suspended from overhead.

For sampling natural or uncontrolled systems, the most critical issue regarding application is that the location and number of locations for testing be sufficient so that these data can be used to calculate the total emissions from the emitting surface area. Photographs of the flux chamber used to measure VOC/Sulfur/TAC emissions from landfill operations are shown in Photo 6.1.

The operation of the flux chamber involves the following:

1. Identifying the test area or test surface
2. Initiating sweep gas flow rate to the flux chamber
3. Operating the chamber for at least four residence times
4. Collecting exhaust gas for analysis and/or recording instrument response
5. Decontaminating the chamber
6. Relocating the measurement equipment to the next test area

Photo 6.1 USEPA Flux Chamber Sampling Solid Surface



The specific operating protocol for flux chamber sampling is as follows:

1. Locate the flux chamber, sweep gas, sample collection equipment, and field documents at the test location.
2. Document site information, location information, equipment information, name of sampler, date, and time on the Field Data Sheet (Figure 6.1).
3. Select the exact test location and place the chamber approximately 1/4 inch into test surface or sealed on an adaptor box apparatus. The chamber should be sealed along the base to prevent air infiltration. Place thermocouples to monitor soil/air temperature inside and outside of the chamber. Temperature data are used to show that the emission event was not disturbed during the measurement or to correlate emission rate to temperature.
4. Initiate the sweep gas flow rate and set the rotometer at 5.0 liters per minute. Constant sweep gas flow rate is critical. Record time.
5. Collect instrument background data (thermocouple) and record data.

6. Connect the purge pump. A total of 5.0 liters per minute is added to the chamber and the gas not sampled is exhausted out the pressure equalization port in the top of the chamber. The chamber is operated at near atmospheric pressure. Do not exceed an exhaust gas sample/purge rate of 2.5 liters per minute. This will prevent entraining of ambient air into the chamber and maintain an exhaust rate of at least 2.5 liters per minute out of the pressure equalization port.
7. Operate the chamber sweep air flow rate at 5.0 liters per minute and record data every residence time (6 minutes) for four to five residence times or 24 to 30 minutes. Record data. The chamber is at steady-state. Purge the sample line from the flux chamber with at least 10 line volumes of air.
8. Interface the Tedlar® bag media to the sample line, purge the sample line and bag, and collect the bag sample. After the bag sample, connect the sample line to the evacuated canister and collect the canister sample. Do not exceed a collection rate of 2.5 liters per minute at any time. This will prevent unwanted dilution of chamber exhaust gas by ambient air. After the canister
9. Label sample bag and sample canister, record sample collection on the data sheet.
10. Store the sample(s) in the appropriate storage and/or shipping container.
11. Document sample collection in field master log book.
12. Discontinue the flux measurement, shut off the sweep air, remove chamber, and secure equipment.
13. Decontaminate the chamber where contact was made with the soil using a clean paper towel and water (if needed) to remove any soil and condensation from the inside of the chamber. Purge the sample lines with sweep gas (5 liters per minute) for 2 minutes.
14. Relocate equipment to the next test location or test setting, and repeat steps 1 through 14.

Canister Sampling

Grab samples using Summa® polished, evacuated stainless steel canisters will be collected from the exhaust line of the flux chamber at steady-state conditions for speciation by gas chromatography. Sampling rate will be maintained at less than 2.5 liters per minute from the flux chamber. Canister samples will be collected by connecting the canister to the sampling line from the flux chamber using the 1/4-inch Swage-lock fittings, drawing a vacuum as motive from the canister and filling the canister. All canisters will be batch certified by the laboratory and sampled to full capacity (atmospheric pressure) given as they are grab samples.

Bag Sampling

Grab samples using Tedlar® bags will be collected from the exhaust line of the flux chamber at steady-state conditions for speciation by gas chromatography. Sampling rate will be maintained at less than 2.5 liters per minute from the flux chamber. Bag samples will be collected by connecting the bag evacuation chamber to the sampling line from the flux chamber using the 1/4-inch Swage-lock fittings/silicone tubing, drawing a vacuum as motive from the evacuation chamber and filling the bag. All bags will be conditioned by filling the bag one half full of sample, then purging prior to taking the final sample.

Sample Handling

Chain of Custody – All sampling media will be recorded using a chain-of-custody sheet, as shown on Figure 6.2. A copy of the chain-of-custody will be kept with the field samplers, and a copy will be shipped to the lab along with the samples. The lab will review the chain-of-custody, make any necessary annotations, and return a copy of the chain-of-custody with the reporting of the lab results.

Shipping

Samples will be packaged according to media preservation and shipping instructions; all samples will be shipped using commercial shippers allowing for sample hold times to be met by the laboratories. Shipping receipts will be retained by the field crew.

Figure 6.1 Flux Chamber Data Form.

SURFACE FLUX MEASUREMENT DATA FORM

DATE _____ SAMPLERS _____

LOCATION _____

SURFACE DESCRIPTION _____

CURRENT ACTIVITY _____

INSTRUMENT TYPE _____ I.D. NO. _____ TYPE _____ ID NO. _____

INSTRUMENT BASELINE _____

PROJECT QC: BACKGROUND MEASUREMENTS BLANK MEASUREMENTS REPLICATE MEASUREMENTS
 AMBIENT CONCENTRATIONS _____

CHAMBER I.D. _____ PHOTO TAKEN: Yes No _____

CHAMBER SEAL _____ CONDENSATION: Yes No BARM PRESS _____

AMBIENT CONDITIONS: Sun P.Sun Cloudy Wind at 5', _____ mph Wind at Seal, _____ mph

TEMP _____ RAIN: Yes No Comment _____

PRIOR CHAMBER CLEANING: Full Wash Wet Wipe Dry Wipe None _____

SAMPLE LINE: BACK FLUSHED PRIOR TO START PURGED PRIOR TO SAMPLING New Used

SWEEP AIR _____ CC _____ SUPPLIER _____ PSIG START _____ PSIG STOP _____

Time	Sweep Air (L/min)	Residence Number	Temperature (°F)				Real-Time (ppmv)		Sample Number	Comments
			Chamber		Ambient					
			Surf	Air	Surf	Air				
		0								
		1								
		2								
		3								
		4								
		5								

COMMENTS:

SITE DIAGRAM

7. Analytical Methods

SCAQMD Method 307-91 for Organic Reduced Sulfur

Sulfur species will be analyzed from a Tedlar® bag using a GC/SCD. The target analyte list is shown on Table 7.1.

Table 7.1 Target Analyte List for H₂S/ORS.

Hydrogen sulfide
Carbonyl sulfide
Methyl mercaptan
Ethyl mercaptan
Dimethyl sulfide (DMS)
Carbon disulfide
isopropyl mercaptan
t-butyl mercaptan
n-propyl mercaptan
s-Butyl mercaptan
i-Butyl mercaptan
Dimethyl disulfide
Tetrahydrothiophene
Unidentified sulfurs
Total reduced sulfur (TRS)

ASTM D-1945/USEPA Method 3C for Fixed Gases

Fixed gases will be analyzed from a Summa® canister using a GC/TCD. The target analyte list is shown on Table 7.2.

Table 7.2 Target Analyte List for Fixed Gases.

Methane
Carbon dioxide
Oxygen
Nitrogen
Hydrogen
Carbon monoxide
Helium (when used as a tracer for flow determination)

USEPA TO-12/14 for VOCs or NMOCs

The C₂ to C₁₂ hydrocarbons and total non-methane hydrocarbons (TNMHC) taken as VOC emissions is determined using fused silica capillary column on an HP 5890 GC with a FID detector. A 200 ml sample is loaded using a flow controller onto a glass bead freeze out trap immersed in liquid oxygen. The components are desorbed onto a cryo-focusing loop and separated using a 100-meter, 0.25-micron fused silica PetroCol capillary column. The column is programmed from -20 °C to 225 °C at 4 °C /min. On the FID, hydrocarbons have a uniform response based on the number of carbon atoms and the total area is used to calculate the TNMHC. The instrument is calibrated using a NIST Traceable, 10 ppmv hexane standard. The data will be reported as TNMHC as methane. In addition, data will be provided as to distributions of functional groups and molecular weights/carbon counts.

USEPA TO-15 for VOC Species

USEPA Method TO-15 GC/MS method uses a cryo-trapping system with a high-resolution capillary column to analyze for TAC using GC/MS. This method can be used for many saturated and unsaturated organic compounds, and includes alcohol compounds. The method can measure most compounds down to 0.2 ppbv. The target compound list is provided in Table 7.3

Samples are analyzed on an HP 5890 Series II gas chromatograph. A gas phase internal standard mixture is injected with each sample prior to sample loading. The freeze-out loop is constructed of 1/8" x 8" nickel tubing packed with glass beads and is immersed in liquid oxygen while the sample is drawn through the loop using a vacuum pump connected to a mass flow controller adjusted to a flow of 50 ml/min. After the sample is trapped, it is thermally desorbed at 150 °C using an electric heater and is cryo-focused onto the beginning of a 0.32 mm ID deactivated fused silica capillary column. The cryo-focused loop is then warmed and the compounds are injected onto a 60 meter, DB-5, 0.25 mm ID fused silica capillary column in the GC. The GC is temperature programmed from -10 °C to 220 °C at a ramp rate of 13 °C /min. As the column is heated, the compounds elute off the column and enter the detector.

The laboratory report will be compliant with USEPA Contract Laboratory Program (CLP) Data Package requirements.

Table 7.3 Target List for TO-15 HAP/TAC Speciated Hydrocarbon Analysis.

Propylene	Cyclohexane	Isopropyltoluene
Dichlorodifluoromethane	Benzene	Benzyl chloride
Methanol	Carbon tetrachloride	1,4-Dichlorobenzene
Chloromethane	t-Amyl methyl ether	n-Butylbenzene
1,2-	2,2,4-Trimethylpentane	1,2-Dichlorobenzene
Dichlorotetrafluoroethane	n-Heptane	1,2-Dibromo-3-
Vinyl chloride	1,2-Dichloropropane	chloropropane
1,3-Butadiene	1,4 Dioxane	1,2,4-Trichlorobenzene
Bromomethane	Dibromomethane	Naphthalene
Chloroethane	Trichloroethene (TCE)	1,2,3-Trichlorobenzene
Ethanol	Bromodichloromethane	Hexachlorobutadiene
Acrolein	Methyl methacrylate	
Trichlorofluoromethane	4-Methyl-2-pentanone	
Acetone	(MIBK)	
2-propanol	cis-1,3-Dichloropropene	
(isopropylalcohol)	Toluene	
t-Butyl alcohol	trans-1,3-Dichloropropene	
Methyl iodide	1,1,2-Trichloroethane	
1,1-Dichloroethene	Ethyl methacrylate	
Acrylonitrile	2-Hexanone	
1,1,2-	1,3-Dichloropropane	
Trichlorotrifluoroethane	Octane	
Allyl chloride	Dibromochloromethane	
Methylene chloride	1,2-Dibromoethane (EDB)	
Carbon disulfide	Tetrachloroethene (PCE)	
trans-1,2-Dichloroethene	Chlorobenzene	
Methyl tert butyl ether	1,1,1,2-Tetrachloroethane	
Propionitrile	Ethylbenzene	
1,1-Dichloroethane	m,p-Xylenes	
Ethyl tert butyl ether	Nonane	
Vinyl acetate	Styrene	
2-Butanone (MEK)	Bromoform	
Diisopropyl ether	o-Xylene	
Hexane	1,1,2,2-Tetrachloroethane	
Methacrylonitrile	1,2,3-Trichloropropane	
Ethyl acetate	t-1,4-Dichloro-2-butene	
Bromochloromethane	n-Propylbenzene	
Methyl acrylate	Isopropylbenzene	
Tetrahydrofuran	4-Ethyltoluene	
Isobutyl alcohol	1,3,5-Trimethylbenzene	
cis-1,2-Dichloroethene	Decane	
2,2-Dichloropropane	tert-butyl benzene	
Chloroform	1,2,4-Trimethylbenzene	
1,1,1-Trichloroethane	i-Butylbenzene	
1,2-Dichloroethane	sec-butylbenzene	
1,1-Dichloropropene	1,3-Dichlorobenzene	

8. Data Analysis and Reporting

Data Validation

All field and sample data will be reviewed and challenged against the method QC specifications. Data not meeting method specifications will be flagged appropriately.

Data Analysis

Landfill Air Emissions Assessment

All cells will be quantitatively screened by FID for the integrated concentration. The cells will be placed into three groups based on emission levels for this screening. Cells will be assessed (one high level, one mid-level, and one low level) in detail by further screening and flux chamber measurement. The emissions from the representative cells will be used to estimate the emissions for the entire group, for the initial three groups.

Report

The data will be presented in a report that provides a description of the sampling effort and tabular emission rates for each process. All field notes, chain-of-custody forms, and laboratory reports will be included in the report.

9. Project Implementation

Schedule

The project will be executed on the schedule given below. The project team will arrive the morning of testing at 0700. All equipment and field supplies will be inventoried that day. The first order of business will be to review health and safety issues. All field progress will be recorded on field data sheets and all chain-of-custody will be completed on the day of sample collection. All shipping records will be retained as part of the field data set and the person shipping samples is responsible for contacting the laboratory prior to sample receipt.

Table 9.1 Project Schedule

Revised Protocol	February 2026
Field Sampling	Three times per year, March, July, November
Report	Within 3 to 4 weeks of receipt of laboratory data

Laboratory Shipping Addresses

Canister Analysis

EAS

173 Cross Street
San Luis Obispo, CA 93401
Contact: Steve Hoyt, (805) 781-3585

Sulfur Analysis

AAC

2225 Sperry Avenue
Ventura, CA 93003
(805) 650-1642

Project Equipment

All sampling media (prepared per method specifications) will be provided by the contract laboratory, including clean, evacuated canisters. Dr. C.E. Schmidt will supply all other sampling equipment and expendable supplies. Following are the necessary field equipment and expendable supplies for the proposed field testing:

- USEPA flux chambers per USEPA design, including stainless steel Swage-lock fittings
- Support cooler with a mounted rotometer (0-to-5 liter per minute) through the cooler walls
- Brass, 2-stage regulator for bottled air (CGA 590 fitting for air and 1/4" Swage-lock (male) adapter fitting)
- Ten-foot, 1/4-inch Teflon® line with female fittings
- Ten-foot, 1/4-inch Teflon® air inlet/outlet support line
- Large size plastic support cooler
- Set of miscellaneous hand-tools including an adjustable crescent wrench for the CGA 580 regulator fitting, small adjustable crescent wrench for the 1/4-inch swage fittings, assorted medium- and small-size screw drivers
- Two 12-inch Type K thermocouple wires and temperature readout
- Rigid-wall shipping/storage crate for the flux chamber mounted on roller wheels
- Decontamination supplies, including Alconox soap, paper towels, and wash water
- Ultra high-purity air bottles with trace gas helium (4, size 150)
- Purge pump for sample line purging
- Canister media
- Sample shipping containers
- Hand tools
- Camera
- Hard hat
- Safety glasses
- Decompression lung samplers (2) for bag sample collection
- TVA-100B with support and calibration gases
- Jerome 631X analyzer

10. Health and Safety

All field work will be in conformance with the SCS Site Health and Safety Plan. Specific requirements are:

- Hard hat,
- Safety shoes,
- Eye protection,
- Visibility clothing, and
- Personal gas monitoring.

11. Works Cited

U.S. Environmental Protection Agency (USEPA). 1986. *Measurement of Gaseous Emission Rates from Land Surfaces Using an Emission Isolation Flux Chamber- User's Guide*, EPA 600/8-86-008 (NTIS PB86-223161).

SCAQMD Rule 1133.3, Attachment A.

