



August 8, 2025

California Air Resources Board
1001 I St.
Sacramento, CA 95814

RE: “Community Meeting: Landfill Methane Emissions, Community Perspectives, and Potential Regulation Updates” Comments

Dear Chair Randolph,

The undersigned organizations appreciate the opportunity to comment on the material presented during the “Community Meeting: Landfill Methane Emissions, Community Perspectives, and Potential Regulation Updates” held on July 18, 2025. California has a critical opportunity to protect community health by adopting stronger, more comprehensive landfill methane regulations, and it can regain national leadership in curbing potent methane emissions, making good on its international commitments.

We commend the CARB Board Members and staff for recognizing the importance of updating the Landfill Methane Regulation (LMR) to incorporate advancements in technology and best practices with frontline communities in mind. Over 29 million children, elders and community members live within 5 miles of a municipal solid waste landfill in California - 66%, or 19 million, are Black, Indigenous or People of Color. With the urgency of toxic landfill pollutants harming Californians every day, the need to meet our statewide greenhouse gas reduction goals and

stymie burgeoning runaway heat events like Chiquita Canyon Landfill, we strongly urge CARB to accelerate its proposed timeline for rule adoption so that the rule is in effect in 2026, and include in its rule the below recommendations to ensure California remains a leader in emissions management, climate action, and environmental justice. Communities living by landfills that are beginning to ignite cannot afford to wait two years for landfill operators to even *begin* better monitoring and mitigation.

While past comments and recommendations, such as the January 2025 letters from Environmental Integrity Project et al.¹ and Californians Against Waste et al.² remain relevant and important to the development of the LMR, the below letter focuses on a response to the proposals presented at the July 2025 workshop, and finishes with a section on issues not addressed there.

ISSUE AREA I: Remote Sensing

CARB staff's recent proposals around remote sensing represent a promising step toward integrating more advanced monitoring technologies into the LMR. However, the staff proposal relies on an outdated foundation. Several improvements are needed to ensure monitoring efforts result in meaningful emissions reductions and improved community protections.

Utilization of remote sensing technologies should be mandatory for the entire surface of all landfills. CARB's suggestion to require the use of drones and other technologies in areas deemed "unsafe" for traditional surface emissions monitoring (SEM) is an important acknowledgement of the limitations of current practices. However, this approach is far too narrow because it assumes that traditional walking SEM is effective, while numerous studies and the U.S. EPA itself has shown the opposite. Carbon Mapper's aerial surveys have found 1,794 methane plumes emitting from California landfills.³ In September 2024 the U.S. EPA Enforcement Division issued a nationwide alert noting "wide spread" compliance issues it had found during more than 100 inspections of landfills.⁴ The alert stated in part, "EPA inspections revealed chronic compliance issues with landfill emissions monitoring, including technicians moving too quickly, improper exclusion of areas from monitoring...expired calibration gases, failure to fully inspect penetrations, and deviations from required monitoring procedures have led to inaccurate emissions data and missed pollution sources."⁵ California landfills span hundreds of acres, and limiting drone use to select portions utilizing an honor system relying on landfill operators and ineffective technology means large areas will still be poorly monitored, allowing major methane leaks to persist.

Rather than confining drones to inaccessible areas, CARB should require that remote sensing technologies be used to monitor the entire landfill surface. These tools should be deployed more frequently than current SEM standards allow, and with tighter transect spacing than the current 25-foot interval. Landfills are highly dynamic systems, with emissions fluctuating daily due to a wide range of both operational and environmental factors and quarterly inspections do not

¹ Kelly, L. et al. "Recommendations for Revisions to the Landfill Methane Regulation from Californians Against Waste, The Environmental Integrity Project, RMI and Industrious Labs." Electronic submission to <https://ww2.arb.ca.gov/>, January 24, 2025.

² Chandler, D. et al. "Public Workshop on Potential Updates to the Landfill Methane Regulation" Comments. Electronic submission to <https://ww2.arb.ca.gov/>, January 24, 2025.

³ Carbon Mapper, <https://data.carbonmapper.org/#1.13/30.8/50.5>

⁴ US, EPA. "Enforcement Alert: EPA Finds MSW Landfills Are Violating Monitoring and Maintenance Requirements" www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

⁵ U.S. EPA, 2024. *Enforcement Alert: EPA Finds MSW Landfills are Violating Monitoring and Maintenance Requirements*, <https://www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance>.

reflect this reality. At the very least, CARB should establish a transparent “persistent issue” standard that triggers mandatory comprehensive monitoring utilizing advanced technologies. The system will fail communities if it continues to rely on an honor system run and reported by the landfill operators. Instead, CARB could require advanced monitoring across the entire landfill if the super emitter response program finds recurring methane plumes over a specific time period. Only with high-resolution, frequent monitoring can California identify and mitigate leaks quickly and effectively.

CARB should also require that an initial survey of methane emissions be conducted using a drone-based methodology. This survey would provide a baseline assessment of emissions, providing critical insight into site-specific needs and guiding appropriate mitigation measures.

Adoption of drones and other remote sensing technologies offers a significant opportunity to enhance the efficiency and feasibility of many of the staff concepts presented in the workshop that will be discussed in detail throughout this letter.

Clear framework needed for emerging and alternative technologies. CARB has also proposed to “allow emerging alternative technologies to be evaluated and approved for use across the entire landfill.” We support flexibility in technology adoption but urge CARB to create a clear, comprehensive framework for evaluating and approving these tools. This framework should establish clear, rigorous performance standards, set timelines for technology review, and define criteria for deployment across the full landfill surface.

Most importantly, CARB must ensure that approved technologies are not just *permitted* for use, but *required*, to be used in meaningful, comprehensive ways. This could function as a requirement that operators use one of a list of approved technologies. As more technologies meet the clear performance requirements, the list of options would grow. The urgent need to reduce methane emissions demands mandatory utilization of proven technologies that offer safer, less labor-intensive, and more comprehensive monitoring than traditional ground-based methods.

As originally designed, the LMR required somewhat limited, episodic surface monitoring in recognition of the significant time and expense involved in walking a surface grid with a measuring device. Because drones can be programmed to measure surface emissions semi-autonomously, the cost considerations that limited monitoring have changed drastically, allowing much more frequent and thorough measurements.

Publishing advanced monitoring data. Additionally, continuous monitoring technologies are vital for providing real-time, actionable data on surface emissions, enabling landfill operators and regulators to promptly identify and mitigate methane leaks. To enhance transparency, CARB should require continuous monitoring and for emissions data be made publicly accessible. Continuous monitoring systems can empower nearby communities by delivering timely information on local air quality, helping to address public health concerns, and build trust. Providing this information ensures accountability, fosters community engagement, and underscores CARB’s commitment to reducing emissions and protecting vulnerable populations.

Super Emitter Response Program (SERP) for Landfills. We are encouraged to see staff’s proposal to adopt a satellite alert and response program in the LMR similar to what CARB has adopted for the Oil & Gas sector. This innovative approach represents a significant step forward in leveraging advanced technology to rapidly identify and mitigate large methane plumes. CARB’s plans to utilize Carbon Mapper data underscores the agency’s commitment to efficiently addressing landfill methane emissions and taking full advantage of the tens of millions of dollars that have been invested in the technology.

We strongly support the integration of a Super Emitter Response Program (SERP) into CARB's framework to address high-emission events more quickly and effectively. To ensure coordinated and effective responses, we recommend that notifications of super emitter events be shared not only with operators and CARB but also with the relevant local Air Quality Management Districts (Air Districts) and Local Enforcement Agencies (LEAs). Including Air Districts and LEAs in the notification process will enhance transparency, improve response times, and facilitate a unified approach to addressing emissions that may have significant regional impacts.

In addition, communities must be informed. Satellite alerts and monitoring data (whether from CARB or other third parties) should be made publicly available in real-time through an accessible data portal as it is provided to operators. Communities living near polluting facilities deserve timely notice of super-emitter events that may impact air quality. Access to timely data would allow residents to make informed decisions about their health, such as staying indoors, using air purifiers, or avoiding outdoor activities during high-emission periods.

The SERP should also allow for the incorporation of pre-qualified third-party monitoring efforts other than satellites, including aerial surveys using helicopters or planes and ground-based technologies like community monitoring or monitoring conducted by academic institutions. By enabling qualified third parties to detect and report super emitter events, CARB can expand the reach and effectiveness of its methane mitigation efforts.

To maximize the effectiveness of this initiative, we strongly recommend that CARB adopt a multi-tiered approach to landfill emissions monitoring and mitigation. As the EPA has noted⁶, "advanced satellite systems [like Carbon Mapper] offer the potential for more comprehensive and near real-time detection of methane and other greenhouse gases over large areas, providing broader scope of data collection than traditional ground-based methods." SERP data should serve as the top tier, providing a broad, high-level view to detect large methane plumes and prioritize areas for further investigation or action.

This top-tier program should be complemented by mid-tier technologies, such as drones and other remote sensing tools, for localized detection and quantification of emissions. Finally, traditional walking SEM should remain an essential component (with additional improvements discussed in this letter), serving to authenticate emissions sources, guide targeted mitigation, and confirm reductions. As the EPA states⁷, "aerial technologies could be used as a screening tool or *tiered approach* to identify sites that appear to have significant sources of methane emissions that merit a closer examination of on-site emissions using additional tools such as SEM (Method 21) and/or possible [drone] technologies to identify emission hotspots." This comprehensive approach ensures robust oversight and rapid mitigation at all scales of emissions.

Additionally, the SERP should be utilized to increase our understanding of super emitter events in relation to emissions from the active face, construction, downtime in gas collection systems, and malfunctioning collection wells (as well as improvements to landfill operations and monitoring processes). Research^{8,9,10} shows these events contribute disproportionately to overall emissions, but are often overlooked. CARB's proactive use of third-party data, such as Carbon Mapper satellite data, for pinpointing and mitigating these large emissions events would set a

⁶ US EPA Office of Air and Regulations (2024). White Paper - MSW Landfills: Aerial Monitoring for Examining Landfill Methane Emissions. <https://www.epa.gov/stationary-sources-air-pollution/non-regulatory-public-docket-municipal-solid-waste-landfills>

⁷ US EPA Office of Air and Regulations (2024). White Paper - MSW Landfills: Aerial Monitoring for Examining Landfill Methane Emissions. <https://www.epa.gov/stationary-sources-air-pollution/non-regulatory-public-docket-municipal-solid-waste-landfills>

⁸ Cusworth et al. "Using Remote Sensing to Detect, Validate, and Quantify Methane Emissions from California Solid Waste Operations" <https://doi.org/10.1088/1748-9326/ab7b99>

⁹ Cusworth et al., "Quantifying Methane Emissions from United States Landfills" <https://doi.org/10.1126/science.adi7735>

¹⁰ Duren et al. "California's Methane Super-Emitters" <https://doi.org/10.1038/s41586-019-1720-3>

strong precedent for other states and the EPA, ensuring comprehensive landfill emissions management.

CARB's current approach of purchasing third-party remote sensing data has been essential in identifying high-emitters within the Oil & Gas sector. However, this model depends on uncertain state funding and may not be financially sustainable in the long term. We recommend that CARB explore shifting the responsibility for purchasing and reporting methane detection data to landfill operators. Under this approach, operators would be required to procure verified third-party data and report all plume notifications to CARB and relevant local agencies. For this model to succeed, clear reporting protocols, standardized data quality requirements, and public transparency measures must be included to ensure integrity and prevent underreporting. If executed correctly, this model could ensure continuity of monitoring and would reduce reliance on public funds while still enabling CARB to maintain regulatory oversight.

Finally, we encourage CARB to consider the co-benefits of rapid leak detection and repair, particularly in reducing hazardous air pollutants that disproportionately impact disadvantaged communities. By addressing methane leaks promptly, CARB can simultaneously improve public health outcomes while advancing climate goals.

We strongly support CARB's leadership in pursuing innovative solutions to landfill methane emissions and urge the adoption of this multi-tiered monitoring framework, inclusive of a robust SERP incorporating aerial surveys, community-based monitoring, and local AQMD involvement, to achieve meaningful and lasting reductions.

Issue Area I Recommendations:

1. Require the integration of drones and other advanced remote sensing technologies into surface emissions monitoring (SEM) requirements to improve efficiency, frequency, and coverage.
2. Require an initial drone-based survey of methane emissions at all landfills to establish a baseline assessment and guide mitigation measures.
3. Create clear criteria for the approval of new technologies to satisfy mandatory remote sensing requirements
4. Mandate the use of continuous monitoring technologies to provide real-time, actionable data on emissions and make this data publicly accessible for increased transparency and community engagement.
5. Adopt a SERP for landfills, leveraging satellite data (e.g., Carbon Mapper) and aerial surveys to rapidly detect and mitigate large methane plumes.
6. Notify local Air Quality Management Districts (AQMDs) and CalRecycle's Local Enforcement Agencies of super emitter events to ensure a unified and transparent response.
7. Implement a multi-tiered monitoring framework that combines satellite data for broad detection, mid-tier technologies (e.g., drones, CEMS, rovers, etc.) for localized monitoring, and traditional walking SEM for verification and targeted mitigation.
8. Establish a framework in which landfill operators purchase satellite data to insulate against state funding fluctuations.
9. Include pre-qualified third-party monitors, such as aerial survey operators, in the SERP to enhance methane detection and mitigation. Streamline qualification processes and establish clear data validation guidelines.
10. Incorporate community-based monitoring initiatives in the SERP to provide a holistic view of emissions and their impacts on local air quality beyond methane.

11. Require monitoring and mitigating emissions from active faces, gas collection system downtime, malfunctioning wells, and construction activities, which contribute significantly to total emissions.

ISSUE AREA II: Improvements to Surface Emissions Monitoring (SEM)

Expanding frequency and coverage. CARB staff's proposal to allow the use of drones in inaccessible areas and to develop a framework for integrating advanced SEM technologies is a welcome first step. However, more substantive improvements to SEM are needed to ensure monitoring is both comprehensive and effective.

Current SEM protocols require 25-foot spacing intervals between walking paths, leaving large portions of the landfill surface (at least 20 feet between paths) unmonitored. This gap in coverage creates a significant risk of undetected methane emissions, especially because monitoring is terminated in wind speeds above 5 mph. We urge CARB to reduce the spacing interval to improve coverage of SEM.

Additionally, the current requirement of quarterly SEM is insufficient to account for the dynamic nature of landfills, where emissions conditions can change rapidly. We recommend increasing the monitoring frequency to at least twice per month, particularly when using drones or other advanced technologies that can enable higher frequency monitoring with less labor intensity. Importantly, this needs to be done during representative pressure conditions, as outlined below.

The current regulations also allow for expanded 100 foot spacing across the entire landfill if no exceedances have been detected for four consecutive quarters. We recommend eliminating this allowance, as it fails to reflect the highly dynamic nature of landfill emissions, which can shift rapidly in response to changes in temperature, barometric pressure, moisture levels, and waste composition. Methane hotspots may emerge intermittent and unpredictable, and relaxing monitoring standards based on quarterly trends risks missing these emission events. Consistent, close-interval monitoring is essential to ensuring accurate detection and timely response to fugitive emissions.

The weaknesses of current SEM are apparent. The current SEM process is labor intensive, time consuming, and prone to human error. Variations in walking pace and/or improper adherence to Method 21 guidelines can result in missed detections of methane exceedances, as highlighted by the EPA's recent enforcement alert¹¹. These inefficiencies undermine the effectiveness of SEM in identifying and mitigating emissions in a time when slashing emissions has never been more imperative. These improvements are essential to ensure SEM is responsive and reflects lessons learned and advancements in monitoring technology.

Integrating advanced technologies into SEM, such as drones equipped with methane sensors, can significantly enhance the feasibility, efficiency, and accuracy of SEM improvements. Unlike manual monitoring, which is labor-intensive and exposes personnel to hazardous conditions like steep slopes, construction zones, and unpredictable weather, drones can survey the entire landfill surface—including currently exempted areas—swiftly and systematically. Additionally, this reduces human inconsistencies, minimizes hazard risks for workers, and lowers labor costs over time, as highlighted by the EPA's *Unmanned Aircraft System (UAS) Technologies for Landfill*

¹¹ US, EPA. "Enforcement Alert: EPA Finds MSW Landfills Are Violating Monitoring and Maintenance Requirements" www.epa.gov/enforcement/enforcement-alert-epa-finds-msw-landfills-are-violating-monitoring-and-maintenance

Methane Monitoring whitepaper¹². While there are initial costs for drone-based systems, the EPA notes that these expenses can be offset through minimized long-term monitoring costs. Lastly, drones enable more frequent monitoring, making it feasible for landfills to meet twice-monthly requirements without adding significant operational burdens. By adopting these advanced methodologies, landfills can achieve safer, more effective, and comprehensive emissions monitoring at reduced cost.

Improving recordkeeping and reporting requirements. CARB has correctly identified that current reporting practices are time-consuming and inconsistent. Simplifying, streamlining, and aligning reporting processes with federal requirements, as proposed by CARB staff, will improve recordkeeping and reporting processes across the board, allowing operators to focus more time and resources on effective and efficient management. However, the solution must not only streamline review for regulations and processes for operators – it must also prioritize transparency and public accessibility.

We strongly support the creation of a publicly available data portal where all landfill monitoring and reporting data is uploaded in a standardized digital format. This should include real-time reporting from continuous emissions monitoring systems, enabling regulators and communities to identify emissions spikes as they happen. This would allow communities to react to air quality changes to protect their health.

We also recommend that CARB require landfill operators to report all SEM reading, not just exceedances. This data should include:

- GIS maps of all SEM walking and drone paths, with precise locations of each reading and clearly marked exceedances.
- All methane concentrations, dates, weather conditions, and any topographic factors influencing emission trends.
- Wellhead pressure, gas temperature, gas flow rate, and gas composition (methane, oxygen, and carbon dioxide).
- Mitigation measures taken in response to leaks (e.g., repairs to gas collection systems or landfill cover improvements).
- Emission trend analysis linking methane levels to environmental conditions like wind patterns or atmospheric pressure.

Publicly available reporting is vital for environmental justice and community trust. Impacted communities deserve to understand local air quality conditions and the measures being taken to reduce pollution from neighboring facilities. By enhancing SEM protocols, integrated advanced technologies, and ensuring real-time, transparent reporting, CARB can significantly improve its oversight of landfill emissions and ensure this program reflects the department's commitment to science-based solutions, accountability, and equity.

Persistent issues. We support CARB's proposal to hold landfills with persistent emissions exceedances accountable through increased monitoring, cover integrity inspections, and remediation. These measures are essential for addressing ongoing issues and ensuring that methane leaks are promptly identified and repaired. However, the current proposal does not fully address all scenarios in which increased monitoring may be necessary.

¹² US EPA Office of Air and Regulations (2024). White Paper - MSW Landfills: Unmanned Aircraft System (UAS) Technologies for Landfill Methane Monitoring
<https://www.epa.gov/stationary-sources-air-pollution/non-regulatory-public-docket-municipal-solid-waste-landfills>

In addition to CARB's proposed framework, we recommend granting Air Districts explicit discretion to go above and beyond the baseline regulatory requirements. This added flexibility would allow Air Districts to mandate additional mitigation measures tailored to the unique exceedance patterns, site-specific conditions, or community concerns within their jurisdictions. Such authority would enable more proactive and comprehensive response to persistent emissions issues.

Furthermore, while we support increased monitoring for landfills with persistent issues, we strongly advocate for more frequent and comprehensive SEM across *all* landfills to enhance early detection and prevention of methane leaks. Expanding monitoring requirements across the board will ensure a proactive approach to emissions mitigation, rather than a reactive one.

By broadening the scope of monitoring and empowering Air Districts to implement measures that exceed the regulatory baseline, CARB can foster a more comprehensive and adaptive strategy for reducing landfill emissions.

Issue Area II Recommendations:

1. Increase SEM frequency across all landfills, not just those with persistent issues, to ensure early detection and prevention of methane leaks.
2. Require SEM at least twice a month over the entire landfill surface (including the working face and steep slopes), with significantly reduced path spacing to less than 25 feet, eliminating exemptions and inconsistent spacing intervals to ensure comprehensive and accurate methane monitoring.
3. Eliminate the option to increase walking path spacing to 100 feet after four consecutive monitoring periods without exceedances, ensuring consistent monitoring across all landfills.
4. Mandate the use of advanced technologies, such as drones with methane sensors, to modernize SEM processes, enhance efficiency, improve safety, and enable systematic detection of emissions, including full assessment of leak extents with tighter spacing and re-monitoring of surrounding grids.
5. Incorporate barometric pressure considerations into SEM requirements, requiring representative monitoring conditions, submission of pressure ranges, and recording/reporting of barometric pressure during SEM events for accurate emissions data.
6. Require detailed recordkeeping and public reporting of SEM data, including GIS maps of monitoring paths, methane exceedance locations, spatial plume distributions, and trends linked to environmental conditions, to enhance transparency and guide mitigation efforts.
7. Grant Air Districts greater discretion to go above and beyond regulatory requirements, enabling them to develop tailored plans and procedures for landfills in their jurisdictions based on site-specific exceedance patterns and community concerns.
8. Provide resources and guidance for Air Districts to ensure consistent application of SEM enhancements and exceedance response measures across California.
9. Establish clear thresholds, timelines, and procedures for addressing persistent SEM exceedances, requiring increased monitoring, comprehensive cover integrity inspections, and prompt remediation to ensure consistent enforcement and proactive emissions management.

ISSUE AREA III: Gas Collection and Control Systems (GCCS)

Early installation. We support CARB's proposal to require earlier installation of gas collectors in new waste areas at large landfills and appreciate staff's recognition of the importance of early gas capture. However, the proposal is limited to "large landfills," a term that has not yet been defined. We urge CARB to apply this requirement to *all* landfills, not just the large ones, given the universal climate and public health risks posed by unchecked emissions.

Capturing methane emissions early is critical to mitigating their significant impact on climate change. Recent evidence from the EPA highlights the need for earlier installation of GCCS to address methane emissions from landfills. According to the EPA,¹³ 61 percent of methane generated by landfilled food waste escapes capture, as this waste decomposes quickly, often before GCCS are installed or expanded. In California, decomposing food and other organics account for an estimated 41 percent of total fugitive methane emissions from MSW landfills¹⁴. The EPA has shown that early installation of GCCS is both technically feasible and cost-effective, with systems capable of being implemented within a few months of waste placement using technologies like horizontal collectors or caisson wells. Reducing installation lag time, especially for areas undergoing expansion, could significantly decrease methane emissions. Additionally, the EPA¹⁵ argues that earlier installation within the first year of waste placement could reduce methane emissions by approximately 53,000,000 kilograms per million metric tons of waste disposed annually.

Given these findings, CARB should require GCCS installation within one year of Design Plan approval to align with EPA-supported feasibility and cost-effectiveness data. Accelerating timelines for plan submission and review would further enhance methane capture during critical early stages of waste decomposition. Additionally, the current threshold that requires installation of a gas collection and control system is 3 million Btu/hr heat input and 450,00 tons of waste-in-place. We recommend requiring landfill operators to conduct planning and engineering of GCCS prior to reaching this threshold to facilitate a proactive mitigations approach.

Related to CARB's proposed concept of requiring earlier installation of gas collectors in new waste areas at large landfills¹⁶, we additionally recommend that CARB require the installation of wells in new cells. However, to guard against the risk of Subsurface Elevated Temperature (SET events) and/or fire CARB should require that the operator first test the wells for a positive wellhead pressure reading. After that, the operator must sample again within 2 to 4 weeks to validate the result before connecting the wells to the GCCS. CARB should make clear that the wells installed in the new cells should be connected only when significant pressure is shown; allowing for connecting the wells to the system as early as 12 months if the pressure requirement is met.

Limiting Gas Collection System Downtime: We support CARB Staff's proposed steps to limit GCCS downtime and recognize this as a critical opportunity to reduce fugitive emissions. Requiring emission mitigation during downtime, limiting the duration and scope of downtime activities, and incorporating best practices already employed by some operators are all promising steps in the right direction. For instance, reconnecting wells to vacuum systems at the

¹³ US EPA Office of Air and Regulations (2024). White Paper - MSW Landfills: MSW Landfill Gas Collection and Control System (GCCS) Installation Lag Time and Nonmethane Organic Compound (NMOC) Destruction Efficiency

<https://www.epa.gov/stationary-sources-air-pollution/non-regulatory-public-docket-municipal-solid-waste-landfills>

¹⁴ Duren et al. "California's Methane Super-Emitters" <https://doi.org/10.1038/s41586-019-1720-3>

¹⁵ Id.

¹⁶ CARB 2025 LMR Workshop at 17.

end of each workday and implementing mitigation measures can help reduce emissions during component downtime. Another important example, exemptions for construction should be carefully defined and limited, as the current exemption allows for broad swaths of wells to be shut down for non-specified amounts of time and with minimal justification and oversight.

In addition to these measures, we strongly recommend that CARB implement robust recordkeeping requirements for downtime activities and make this information publicly available. Operators should document the duration of downtime, the reasons for disconnecting wells, the number of wells affected, and all mitigation efforts undertaken. This data will improve accountability, provide insights to operational practices, and ensure compliance with regulatory requirements. Transparency in downtime reporting would empower nearby communities with the information needed to identify potential connections between well downtime and odor or health impacts.

By defining clear thresholds for downtime durations, specifying best practices for mitigation, emphasizing comprehensive recordkeeping, and ensuring public access to downtime data, CARB can enhance the effectiveness of its landfill methane regulations while fostering trust and accountability between regulators, operators, and nearby communities.

Advanced Monitoring and Operational Enhancements. CARB's proposed updates to operational parameters from the December 2024 workshop (such as continuous vacuum monitoring, establishing and maintaining pressure setpoints, and requiring additional wellhead data collection) represent welcome progress toward reducing fugitive emissions. Additionally, we are supportive of CARB's 2025 concepts requiring more frequent liquid level monitoring, more frequent reporting, and the framework that requires action in response to trends, limit exceedances, and repeat issues. Liquid in landfills can adversely impact collection wells,¹⁷ including increasing the risk of subsurface elevated temperature events and/or fires. Excessive liquid impacts well performance which can result in air intrusion.

However, CARB must go further. Simply *encouraging* automated wellhead tuning and real-time monitoring is not enough. These tools must be required for *all* landfills, not just those with persistent issues. Automated wellhead tuning systems monitor gas composition, temperature, pressure, and liquid levels in real time, adjusting operations automatically to improve system efficiency and gas capture. These technologies have already proven successful in reducing system downtime, increasing gas collection, and providing granular data that enhances operational decision making.

Moreover, public transparency must be a core component across CARB's LMR. Data from continuous monitoring systems should be made publicly available, empowering communities with insights into local air quality, building public trust in regulatory action, and holding landfill operators accountable. By mandating these advanced systems and increasing transparency, CARB can drive substantial improvements in emissions mitigation and demonstrate its commitment to public health and safety.

Issue Area III Recommendations:

1. Require early installation at all landfills, not just "large" ones.
2. Mandate installation of gas collection systems within one year of Design Plan approval, aligning with EPA findings on feasibility and cost-effectiveness. Require advanced

¹⁷ "[l]iquid in the collection system (wells or piping) can impede gas flow, potentially leading to the buildup of heat and pressure. Therefore, it is crucial to address the management of both gas and liquids in landfills[...]" and EPA emphasizes the "importance of maintaining the leachate level below 30 percent of the total waste thickness to ensure high efficiency in LFG collection." EPA, White Paper Series: Municipal Solid Waste Landfills-Advancements in Technology and Operating Practices, "Increasing Landfill Gas Collection Rates" (Oct. 2024), 10 [hereinafter "GCCS White Paper"]

planning and engineering of GCCS before reaching the 3 million Btu/hr heat input or 450,000 tons of waste-in-place thresholds to ensure proactive emissions mitigation.

3. Require installation of wells in new cells— applying vacuum only after positive pressure is established.
4. Limit the duration and scope of GCCS downtime. Require recordkeeping and public reporting of downtime activities, including the number of wells affected, reasons for downtime, duration, and mitigation efforts.
5. Require continuous vacuum monitoring, pressure sensors, and automated wellhead tuning systems for all landfills. These technologies optimize gas capture, reduce downtime, and provide actionable data. Mandate public reporting of continuous monitoring data to enhance transparency and build trust.
6. Expand advanced monitoring and tuning requirements to all landfills, not just those with persistent issues. Hold sites with ongoing GCCS challenges accountable through increased monitoring, enhanced tuning, and public transparency.

ISSUE AREA IV: Temperature Monitoring and SET Event & Fire Prevention

We appreciate that CARB is considering a tiered framework for temperature and oxygen monitoring, including set thresholds that would trigger enhanced monitoring or corrective actions. However, as currently proposed, the framework remains too reactive and lacks the tools necessary for early detection and intervention. Specific recommendations are included in sections below, along with recommended considerations for proposed concepts that may relate to the risk of a subsurface elevated temperature (SET) event and/or fire.

Background on elevated temperature landfills. First, the most common type of landfill fire occurs between the surface and two feet below the landfill soil cover, i.e., surface fires, where fuel and oxygen are abundant. The other type of landfill fire is a subsurface fire or smolder that varies with depth depending¹⁸ on landfill operations, heat sources, available oxygen, and other factors. Subsurface smolder events (classified as SETs) can last multiple years to decades¹⁹ as the smolder thermally keeps breaking down surrounding combustible MSW. If not properly addressed, the SET Event will become a smolder and may spread to the entire landfill facility if it is not isolated and contained. SET Events present a significant environmental threat by emitting pungent odors (reduced sulfur compounds and organic acids), VOCs, such as benzene, and particulate matter.²⁰ In general, gas concentrations of NMOCs from MSW landfills double with every 18°F (7.7°C) increase in waste temperature.²¹

Next, SET events are mainly caused by oxygen intrusion, waste temperature increases, and leachate recirculation. Oxygen intrusion can occur from overdrawing the GCCS. The typical vacuum applied to a gas extraction well is approximately 125–250 mm (5–10 inches) of water column.²² When landfill operators use a higher vacuum to enhance methane recovery for energy production or to control odors and emissions, i.e., overdraw the gas collection system, oxygen can enter the landfill through damaged gas wellhead seals and cracks, cracks in the soil cover,

¹⁸ *Landfill Fires Guidance Document*, CalRecycle, <https://calrecycle.ca.gov/swfacilities/lffiresguide/>

¹⁹ Alan McNarie, Old fire, new tricks, *The Hawaii Independent*, (Oct. 20, 2008).

²⁰ Nammari, Emissions From a Controlled Fire in Municipal Solid Waste Bales, 24 *Waste Management* 9-18 (2004).

²¹ LFG Energy Project Development Handbook, Chapter 2: Landfill Gas Modeling, (Sept. 13, 2016), https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/pdh_chapter2.pdf, at 8.

²² United States Army Corps of Engineering, *Landfill Off-Gas Collection and Treatment Systems* 3-17 (2008).

alternative daily cover (“ADC”), poorly compacted cover soils especially on side slopes, and unsaturated subsurface materials. The use of insufficient daily cover—like ADC and fine grained covers²³—can contribute to oxygen intrusion and thus SET event risk.²⁴

Additionally, the temperature of waste itself is relevant to the risk of a SET event and the degradation of control equipment (e.g. the GCCS, leachate system, and liners). Smoldering of MSW can generate temperatures that can reach 1,225°F (665°C)^{25,26} and smoldering combustion has been documented to persist within an MSW landfill as low as 212 to 248°F (100 to 120°C)²⁷ and from 392 to 572°F (200 to 300°C) with measured temperatures as high as 1,292°F (700°C).²⁸ Deep subsurface fires have measured temperatures of 176 to 446°F (80 to 230°C).²⁹ As a result of smoldering combustion, waste temperatures can rise to sufficient levels to thermally degrade, pyrolyze, or char MSW.

The damage to control equipment can be seen with sustained temperatures as low as 150°F (65.5°C)³⁰ and high-density polyethylene (“HDPE”) can lose half its strength at every 60°F (33°C) rise in temperature. At 140°F (60°C), HDPE will buckle under small loads.³¹ HDPE can occasionally withstand short-term exposure to temperatures up to 180°F (82°C), but prolonged exposure can compromise the integrity of the liner/pipe. According to one manufacturer, the tensile strength of HDPE may drop by approximately 15-25% at 180°F (82°C).³² At 266°F (130°C), HDPE melts.³³ Various piping manufacturers report the maximum design temperature for HDPE geomembranes and polyvinyl chloride (“PVC”) piping is 140°F (60°C), while chlorinated polyvinyl chloride (“CPVC”) is 200°F (93°C). PVC begins to thermally break down and soften at 156 to 176°F³⁴ and starts to melt at 180°F (82°C).³⁵ As temperatures increase in a landfill, the concentration of some VOCs can increase by one to two orders of magnitude³⁶).

For the GCCS components and leachate control systems, when temperatures exceed 212°F (100°C), additional pressure is exerted on these systems. This pressure is directly related to

²³ “For example, air intrusion was initially facilitated by using a thin sand cover (which has a higher air conductivity than a fine-grained soil cover) at the Sint Maarten Landfill. Stark et al, Managing Hurricane Debris and Elevated Temperatures, Proceedings of Specialty Conf. GEO-EXTREME 2021, ASCE, Savannah, GA, November, Geotechnical Special Publication 328, 1-10 (2021).

²⁴ Aerobic decomposition can start from these and other actions that allow oxygen to enter the waste mass, such as, rapid settlement, poorly compacted or inadequate soil covers, especially on side slopes, abandoned gravel access roads, uncapped borings, leachate sumps, drainage systems, leaky penetrations and wells into the MSW, and passive venting systems. Changes in atmospheric pressure from cold fronts can also move landfill gas out or air into a landfill. Nastev et al, Gas Production and Migration in Landfills and Geological Materials, 52 Journal of Contaminant Hydrology 187-211 (2001).

²⁵ Virginia Tech Expert Panel, Bristol Landfill Expert Panel Report, (April 25, 2022), available at <https://www.bristolva.org/649/Bristol-Landfill-Expert-Panel-Report>.

²⁶ As measured in two MSWLFs undergoing smoldering combustion. Id.

²⁷ Ettala, Landfill Fires in Finland, 14 Waste Management & Research 61 (1996).

²⁸ Ettala, Emissions From Simulated Deep-Seated Fires in Domestic Waste, 14 Chemosphere 626-639 (2008).

²⁹ Lönnermark, Emissions From Simulated Deep-Seated Fires in Domestic Waste, 70 Chemosphere 626-639 (2008).

³⁰ over a year can impact geosynthetic bottom liner systems’ service life and integrity. High-density polyethylene can lose half its strength at every 60°F (33°C) rise in temperature, and at 140°F (60°C), high-density polyethylene will buckle at small loads. Tetra Tech, When Temperatures Rise—The Challenges of Hot Landfills, Tetra Tech (May 18, 2018), <https://www.tetratech.com/insights/when-temperatures-rise-the-challenges-of-hot-landfills/>.

³¹ Tetra Tech, When Temperatures Rise—The Challenges of Hot Landfills, Tetra Tech (May 18, 2018), <https://www.tetratech.com/insights/when-temperatures-rise-the-challenges-of-hot-landfills/>.

³² Sino Pipe, Understanding the Temperature Limits of HDPE Pipe: A Comprehensive Guide, (Sept. 11, 2024), <https://sinopipefactory.com/blog/hdpe-pipe-temperature-rating-2/>.

³³ Lyuba Rice, The Temperature Limits of HDPE Material, Legacy HDPE Boats (May 10, 2024), <https://legacyhdpe.com/the-temperature-limits-of-hdpe-material/>; Melting Point of Polymers and Plastics, Table <https://matmake.com/properties/melting-point-of-polymers-and-plastics.html>.

³⁴ Georg Fischer, Technical Manual: 80 PVC and CPVC, Schedule 40 PVC Piping Systems (July 12, 2010), available at https://kebechem.com/fiches_techniques/Fiche_technique_pvc_cpvc.pdf.

³⁵ Kabir Jindal, PVC Melting Point, The Ultimate Guide (Nov. 8, 2023), available at <https://plasticranger.com/pvc-melt-point-properties-applications-advantages-disadvantages/>.

³⁶ Id. at 1, 12.

water converting to steam and expanding 1,700 times in accordance with the ideal gas law ($PV=nRT$). The GCCS, landfill cover system, e.g., soil and/or geosynthetics, and leachate collect systems are not designed to resist this additional pressure and/or temperatures that exceed the allowable maximum temperatures.

The pollution impacts from fires and/or SET events can be significant considering that concentrations of some VOC emissions from MSW landfills double with every 18°F (10°C) temperature increase.³⁷ In general, gas concentrations of NMOCs from MSW landfills double with every 18°F (7.7°C) increase in waste temperature.³⁸ Some NMOCs are known or suspected carcinogens and are classified as hazardous air pollutants (“HAPs”). Benzene and methyl ethyl ketone are consistently found at elevated levels at the surface and in the collected LFG during SET event investigations.³⁹ The VOCs produced from smoldering MSW typically include acetonitrile, acetone, benzene, 2-butanone (MEK), carbon disulfide, and tetrahydrofuran. Other VOCs detected in smoldering incidents include ethyl acetate, toluene, vinyl acetate, and xylene.⁴⁰

Higher Operating Value Waivers. A critical gap in oversight stems from the widespread and often opaque use of Higher Operating Value (HOV) waiver approvals, which allow landfill gas wells to operate above the 131°F and 145°F thresholds intended to prevent SET events. Depending on the timing of the request and Clean Air Act authorities, it is our understanding that these waivers may be reviewed by either the US EPA or the local Air District, creating a fragmented process with inconsistent oversight. In many cases, HOV waivers appear to be approved with minimal scrutiny, limited documentation, and no public transparency. These very conditions undermine regulatory safeguards and may delay corrective action.

At Chiquita Canyon Landfill, the continued operation of high-temperature wells under such waivers with minimal oversight contributed to the escalation of the crisis, allowing conditions to worsen unchecked. As a coalition, we strongly oppose the issuance of these waivers in California. At a minimum, when such waivers are granted, denied, or approved with conditions, operators must be required to promptly notify both local and state regulators and post all related documentation on the landfill’s website for public access. Additionally, any waivers granted in California should have documented justification, robust monitoring and response protocols, and mandatory follow-up by both the operator and regulators. This transparency and response framework is essential to ensure timely regulatory intervention and to keep surrounding communities informed of risks that may impact their health and safety.

Require downwell temperature monitoring. Wellhead temperatures do not reliably reflect subsurface conditions where SET events occur. CARB’s proposal to monitor temperature at the wellhead is inadequate for detecting the conditions that give rise to subsurface fires and thermochemical reactions.

At Chiquita Canyon Landfill (CCL), CalRecycle’s investigation revealed that downwell temperatures in some gas wells exceeded 190°F— well above the temperature threshold at which subsurface reactions can damage infrastructure and worsen – yet the wellhead

³⁷ Agency for Toxic Substances and Disease Registry (ATSDR). (2001), “Chapter 2: Landfill gas basics. Landfill gas primer—An overview for environmental health professionals,” “Chapter 3: Landfill Gas Safety and Health Issues.”

³⁸ LFG Energy Project Development Handbook, Chapter 2: Landfill Gas Modeling, (Sept. 13, 2016), https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/pdh_chapter2.pdf, at 8.

³⁹ Data Evaluation of the Subsurface Smoldering Event at the Bridgeton Landfill, (June 16, 2013), <https://semspub.epa.gov/work/07/30286004.pdf>, at 8.

⁴⁰ *Id.*

temperatures remained below 120°F. This discrepancy highlights the failure of wellhead-only monitoring as an early detection tool.⁴¹

CalRecycle has clearly documented the inadequacies of using wellhead temperature monitoring alone to assess subsurface conditions and detect early signs of subsurface exothermic reactions (SET events). The Semi-Annual Reports from 2023-2024 for CCL indicate dramatic discrepancies between wellhead and downwell (TMP) temperatures – undermining the reliability of wellhead-only data.

As shown in Table 1 from the report (see below), differentials between the wellhead and downwell temperatures ranged from 25°F to 120°F. More importantly, some wells showing allowable temperatures at the wellhead (using CARB's proposed framework) exhibit drastically higher temperatures downwell. An example of this is gas well CV-24139, where wellhead temperature readings remained deceptively low throughout the first half of 2024 while downwell temperatures remained in the 180°F -194°F range.

Well ID	Date	Wellhead Temp (°F)	Downwell Temp (°F)	Downhole Depth (ft)	Temp (°F) Differential
CV-2201	6/27/23	135	171	20	36
CV-1902S	6/28/23	141	188	40	47
CV-1532A	12/5/23	148	194	34	45
CV-2310	11/16/23	184	226	125	42
CV-24034	1/6/24	166	196	11	30
CV-2001	1/17/24	60	165	37	105
CV-24139	1/31/24	74	180/194	15/25	106/120
CV-24140	1/31/24	99	175	12	76
CV-2352	8/26/24	104	166/200	15/25	62/96
CV-24017	8/29/24	140	165	3	25
CV-2341	11/10/24	140	165/170	3/33	25/30
CV-24139	11/17/24	127	190	13	63
CV-2339	12/26/24	168	195	12	27

Table 1: Selected Wellhead and Downwell Temperature Differential at Chiquita Canyon Landfill (Source: Semi-Annual Reports 2023 to 2024)

This discrepancy highlights the importance of downwell temperature monitoring in detecting early-stage temperature increases that could signal the development of worsening or expanding

⁴¹ CalRecycle. (2025, March 28). Review of the November 26, 2024, Revised Soil Reaction Break/Barrier Plan for the Chiquita Canyon Landfill Subsurface Elevated Temperature (SET) Event [Letter from Todd Thalhammer to Karen Gork]. California Department of Resources Recycling and Recovery. <https://dtsc.ca.gov/wp-content/uploads/sites/31/2025/04/2025-03-28-CalRecycle-Letter-to-LEA.pdf>

reaction areas. Importantly, CalRecycle's analysis concludes that using wellhead temperature data to define SET event boundaries is not only misleading but potentially dangerous.

"The TMPs provide a more accurate account of temperature than wellhead monitoring for two distinct reasons. First, TMPs provide more accurate and in-depth waste mass temperatures compared to wellhead temperatures. Second, TMPs provide real-time data, unlike collecting LFG data, which is typically done only one or twice a month." (Thalhammer, Page 9)

To prevent future scenarios like Chiquita Canyon Landfill:

- CARB should mandate continuous downwell temperature monitoring at all wells, or at a minimum, require representative downwell probes across each gas collection grid, including in high-risk areas such as the tow of the slope, wet zones, and areas with waste older than 5 years.
- This data should be used to flag temperature increases at depth that may not yet be observable at the surface.

Additionally, CARB should:

- Set a maximum allowable downwell temperature of 140°F, which reflects a conservative threshold based on infrastructure safety and the onset of elevated reaction risk. Several operators and industry experts use this threshold internally, and it aligns with the temperature at which PVC and HDPE piping and other GCCS components can begin to deform or fail.
- Lower the proposed wellhead temperature action thresholds from 131°F and 145°F to 110°F and 120°F, respectively. These lower thresholds are more appropriate given the findings from CCL.
- When a SET event is suspected, levels of CO should be confirmed with quantitative laboratory analysis and not field equipment.⁴²
- CARB should define "extremely high temperature" ideally as anything over 140°F.
- Any corrective action not completed at a wellhead with temperatures over 145°F should be considered a violation if not completed within 30 days following temperature monitoring.

Clarify and enforce corrective protocols when elevated temperatures are detected.

CARB's current proposal lacks adequate operational mandates when elevated temperatures are found, particularly at depth. As seen at CCL, once heat migration occurs, it is extremely difficult to reverse. Operators must be required to act quickly and uniformly when concerning temperature data is observed. We recommend the following corrective protocols:

- When downwell temperatures exceed 140°F, operators must immediately:
 - Cease vacuum application at the indicated well
 - Install TMPs in all adjacent wells to assess heat migration
 - Cease vacuum application to all affected or concerning wells with increasing or unstable TMP readings

⁴² For example, CO levels above 1,500 ppm indicate an active smolder and/or pyrolysis. Jafari, N.H., Stark, T.D., and Thalhamer, T., "Spatial and Temporal Characteristics of Elevated Temperatures in MSW Landfills". Waste Management Journal, Elsevier Science, Ltd., New York, NY, October, 2017, 59, 286–301, <http://dx.doi.org/10.1016/j.wasman.2016.10.052>. Levels between 1,000 and 1,500 ppm are considered suspicious and require further air and temperature monitoring. Id. Levels between 500 and 1,000 ppm may indicate pyrolysis, pre- or post-combustion conditions, but active combustion is typically absent. CO levels below 250 ppm with stable temperatures will confirm that smoldering and pyrolysis are not present or have been extinguished. Id.

- Conduct mapping of temperature trends across the area to inform further GCCS adjustments and consider temporary shutdown of additional wells if temperature gradients suggest lateral or vertical migration
- Submit a corrective action plan to the permitting agency and CARB
- Make all monitoring data and corrective actions publicly available

These measures take a more proactive response to preventing prolonged heating and may serve as a more robust response protocol to elevated temperatures.

Lower the oxygen action threshold. CARB's proposed 5 percent oxygen action threshold is too high to serve as an effective early warning, especially in high-temperature landfill areas. To prevent SET events and promote best practices:

1. CARB should establish a tiered oxygen response framework:
 - 2% oxygen by volume: initiate enhanced monitoring, investigate for potential cover integrity issues or vacuum overpull, and evaluate gas system tuning.
 - 3 - 4% oxygen: require cover system inspection and temporary GCCS adjustments.
 - $\geq 5\%$ oxygen: Mandate immediate corrective actions, including installation of supplemental wells, reduction of vacuum, or temporary shutdown in affected areas.
2. Operators must not be allowed to continue normal operations at wells with persistent oxygen above 2% without investigation or justification.

Wellhead monitoring framework. We support CARB's proposal to require action when monitoring values deviate from well-specific trends or exceed established limits. However, we encourage CARB to explicitly require cross-parameter evaluation. Subsurface fires and reactions often emerge through the interaction of multiple indicators (e.g., modest temperature rise coupled with a slight oxygen increase and drop in methane content). No single indicator may exceed a hard threshold, but the combination of trends signals elevated risk.

CARB should:

- Require that operators flag and report any combination of elevated oxygen, rising temperatures, shift in gas composition, and stagnant flow rates across a set of adjacent wells.
- Create a scoring or decision matrix that supports proactive intervention based on co-occurring deviations, even if each value is below its individual limit.

This kind of integrated analysis is a gap in the current regulatory framework that may contribute to new or continuing landfill mismanagement where individual data streams were reviewed in isolation which may delay meaningful action.

Issue Area IV Recommendations:

1. Prohibit the issuance of HOV waivers for wells. At minimum, require operators to notify local and state agencies when such waivers are granted, denied, or approved with conditions, and post all related documentation on the landfill's public website to ensure transparency and timely regulatory oversight.
2. Mandate continuous downwell temperature monitoring at all wells or, at minimum, require representative downwell probes across each gas collection grid, especially in high-risk areas (e.g., slopes, wet zones, older waste cells).

3. Set a maximum allowable downwell temperature of 140°F to align with infrastructure safety thresholds and risk mitigation standards used by operators and industry experts. Temperatures of 145°F should be an actionable violation if not remediated in 30 days.
4. Lower wellhead temperature action thresholds from the proposed 131°F and 145°F to 110°F and 120°F, respectively, to enable earlier intervention and reduce the risk of SET events.
5. Require lab testing of CO levels when evidence of a SET is present instead of using field equipment.
6. Establish clear corrective action protocols for elevated downwell temperatures, including mandatory vacuum shutdowns, adjacent well monitoring, mapping of temperature gradients, and corrective action plan submission to regulators.
7. Require a tiered oxygen response framework, with escalating mitigation actions starting at 2% oxygen, and mandatory corrective measures at or above 5% oxygen.
8. Prohibit continued normal operations at wells with persistent elevated oxygen without documented investigation and justification.
9. Mandate cross-parameter evaluation of wellhead and gas data—including oxygen, temperature, pressure, gas composition, and flow rates—to identify and act on emerging risk patterns.
10. Create a scoring or decision matrix to support proactive intervention based on co-occurring data anomalies, not just individual thresholds.

OUTSTANDING ISSUES NOT ADDRESSED

In addition to the priorities highlighted above, there are some important improvements that the July workshop did not mention. Although these have been briefly discussed in the past, the following changes must remain in the list of improvements CARB plans to implement to ensure the updated regulation prioritizes community transparency and environmental protection.

- **Lowering the methane violation concentration.** As initially suggested in CARB's 2010 LMR proposal and then suggested again in the December of 2024 workshop, the violation threshold for methane should be reduced to 200 ppmv from the current 500. Regulation already requires reporting of all readings above 200 ppmv to identify whether a reduction to 200 ppmv would be feasible. With over a decade of data, no evidence has emerged to suggest that reducing the threshold from 500 ppmv to 200 ppmv is unreasonable. In fact, the workshop presentation highlighted that between 2016 and 2020, many facilities were already maintaining emissions below 200 ppmv. While it is encouraging to see operators consistently operating below the 500 ppmv threshold, lowering the limit to 200 ppmv presents a valuable opportunity to further reduce landfill emissions.
- **Determining the Full Extent of Surface Leaks.** As acknowledged in previous workshops, a more comprehensive methodology is needed to determine the full extent of surface leaks. Techniques such as concentric circles near methane exceedances and adjacent area scans could help find the full breadth of problematic areas.
- **Decommissioned Wells.** While “decommissioned well” is not explicitly defined in the current regulations, the lack of clear guidance has allowed operators to misuse this concept. The intent behind the negative pressure exemption for decommissioned wells in the federal regulations was intended for wells in areas of landfills with verified declining gas generation. Instead of restricting decommissioning to wells that are

permanently closed or with declining gas flows, some operators in CA apply the term to wells that are malfunctioning or inadequately maintained, leading to increased point-source emissions. CARB should define “decommissioned well” in the LMR as one that is permanently closed following proper closure procedures and/or experiencing declining flows with proper documentation.

- **Surface Cover Improvements to prevent fire and slow methane emissions.** Staff previously suggested cover integrity and collection system analysis around problematic areas, recognizing the risk of emissions from poor cover materials. However, CARB must go further to effectively address this critical source of emissions and a possible contributor to SET events. In addition to previously proposed staff concepts, we urge CARB to:
 - Consider banning or greatly limiting Alternative Daily Cover (ADC). The use of ADC has not been proven to reduce emissions and can also increase the risk of fires and SET events. For example, the material properties of auto shredder fluff, a typical ADC, can increase the fire spread rate because of its low density, porosity, and flammability⁴³. If ADC is to be allowed, only non-flammable, low-porosity materials should be used. Organic material definitely should not be used as ADC, as it contributes to methane generation and should be diverted to meet the goals of SB 1383 anyway.
 - Require shorter use of daily covers to minimize methane escape during active landfill operations.
 - Require landfills to implement robust cover design plans, emphasizing the timely placement of protective covers designed to slow methane emissions.
- **Monitoring Conditions.** As industry experts have stated time and time again, meteorological conditions greatly contribute to the emissions from a landfill in any given moment.⁴⁴⁴⁵ The effectiveness of gas collection and control systems (GCCS) is influenced by local atmospheric pressure, as wellheads are operated relative to this pressure. Since vacuum pressure is typically adjusted on a monthly basis, short-term fluctuations in atmospheric pressure can affect surface emissions. During periods of rising atmospheric pressure, emissions are reduced, whereas falling pressure leads to increased emissions.

If monitoring is meant to be representative of an entire day, week, month, or quarter, then it must be done in average atmospheric conditions for that period of time. Because of this, landfill operators should

- (1) define and submit the average local pressure range,
- (2) record and report barometric pressure during each SEM event to ensure compliance, and
- (3) ensure that measurements are taken in representative conditions.

⁴³ Denbo, Don “Considerable Risk,” Recycling Today (June 26, 2019) <https://www.recyclingtoday.com/article/insurance-risks-for-recycling-companies/#:~:text=The%20production%20and%20storage%20of,older%20buildings%20can%20be%20shocking>.

⁴⁴ Hanson, James L. et al. “Estimation and Comparison of Methane, Nitrous Oxide, and Trace Volatile Organic Compound Emissions and Gas Collection System Efficiencies in California Landfills”. https://ww2.arb.ca.gov/sites/default/files/2020-06/CalPoly_LFG_Flux_and_Collection_Efficiencies_3-30-2020.pdf

⁴⁵ Aghdam, Ehsan Fathi, et al. “Impact of Meteorological Parameters on Extracted Landfill Gas Composition and Flow.” <https://doi.org/10.1016/j.wasman.2018.01.045>

- **Banning Leachate Recirculation.** Leachate recirculation, which involves re-injecting liquid waste into a landfill explicitly to accelerate decomposition and create more space, leads to a rapid increase in methane generation, thereby exacerbating fugitive emissions. This practice not only undermines efforts to minimize leaks, but also raises serious odor, landfill instability, and runaway heat events risk concerns. The objectives of leachate recirculation—accelerating decomposition and increasing landfill capacity—are fundamentally at odds with CARB's proposed measures to reduce methane emissions and improve landfill oversight.
- **Flares and Destruction Efficiencies.** Effective capture of landfill gas is rendered an absolute waste if that same gas is then concentrated and poured out a single stack at the landfill. Landfill gas flares are designed to combust the gases collected from the landfill, continuously treating excess gas via combustion. Flare efficiency is measured by destruction efficiency, expressed as a percentage. For example, a 99% efficiency indicates that 99% of the gases and chemicals routed to the flare are combusted⁴⁶. However, ensuring this efficiency in practice presents significant challenges.

Currently, landfill flare efficiency is difficult to measure continuously and is only sporadically monitored by landfill operators. This results in suboptimal combustion conditions resulting in dangerous emissions from landfill flaring systems. Research⁴⁷ has highlighted that destruction efficiencies are often much below 99% and that there are compounds such as Acetaldehyde, benzene, toluene, *p*-cymene, limonene, hydrogen sulfide, and methane escaping. Flares should be continually monitored to ensure effective flare destruction.

These findings make it clear that CARB must mandate advanced monitoring technologies for landfill flares, including the use of Continuous Emissions Monitoring Systems (CEMS) to track and verify flare performance in real time.

European industry leaders have shown⁴⁸ how much well tested monitoring technology is available for accurate flare efficiency control. Adopting similar solutions in California would enhance transparency, ensure compliance with efficiency standards, and protect public health by minimizing harmful emissions from landfill gas flaring systems.

- **Clarifications for third-party GCCS operators.** It is imperative that third-party operators that *receive* landfill gas are also regulated under the LMR. We support CARB staff's proposal to ensure that all entities involved in the treatment and combustion of landfill gas are held accountable. This is essential for achieving the 99% destruction efficiency target, detecting and repairing leaks, and maintaining consistent and accurate reporting. This clarification will close existing regulatory gaps and provide greater oversight of landfill gas upgrading facilities.

Outstanding Issues Not Addressed – Recommendations

⁴⁶ "ATSDR - Landfill Gas Primer - Chapter 5: Landfill Gas Control Measures." *Cdc.gov*, 2019, www.atsdr.cdc.gov/HAC/landfill/html/ch5.html

⁴⁷ Wang, Yujing, et al. "Flare Exhaust: An Underestimated Pollution Source in Municipal Solid Waste Landfills." *Chemosphere*, vol. 325, 1 June 2023, pp. 138327–138327, <https://doi.org/10.1016/j.chemosphere.2023.138327>

⁴⁸ Flare Combustion Efficiency: Best Measurement Techniques - TP-Europe. *TP-Europe*. tp-europe-em.com/flare-combustion-efficiency-best-measurement-techniques/

1. Lower the methane exceedance threshold from 500 ppmv to 200 ppmv, as originally proposed by CARB and supported by a decade of operator-reported data and emissions trends.
2. Require comprehensive surface leak assessments, including use of concentric circle or grid-based re-monitoring techniques to determine the full extent of surface exceedances.
3. Define “decommissioned wells” clearly to prevent misuse; limit the exemption to permanently closed wells or those with declining gas generation, with required documentation.
4. Restrict or ban the use of Alternative Daily Cover (ADC)—especially flammable or organic materials—and require only low-porosity, non-flammable materials if ADC is permitted.
5. Require timely application of effective landfill covers and enforce shorter active cover usage windows to minimize methane release during active operations.
6. Mandate monitoring under representative meteorological conditions, including:
 - a. Defining and submitting local average pressure ranges,
 - b. Recording barometric pressure during each SEM event, and
 - c. Conducting monitoring under average or typical pressure conditions.
7. Prohibit leachate recirculation, given its role in accelerating methane generation, increasing odors, and raising risk of heat events and landfill instability.
8. Mandate continuous emissions monitoring (CEMS) for landfill flares, and require real-time public reporting of flare destruction efficiency to ensure proper combustion and minimize toxic emissions.
9. Clarify regulatory accountability for third-party landfill gas operators, ensuring that all entities involved in gas treatment, upgrading, or combustion meet monitoring, destruction, and reporting standards under the LMR.

CONCLUSION

California’s ability to protect the health, safety, and well-being of its residents—particularly those living near landfills—depends on taking decisive, timely action to reduce methane emissions. A 2027 implementation timeline is too slow to address worsening climate impacts, ongoing community exposure to harmful pollutants, and escalating landfill hazards like those seen at Chiquita Canyon. CARB has the data, the tools, and broad public support to act now. By adopting the recommendations in this letter—including mandatory comprehensive advanced monitoring, stronger accountability for operators, and real-time transparency—CARB can deliver meaningful protections for millions of Californians and ensure that no community is left behind in our state’s response to the climate and public health crisis.

Sincerely,

Erica Parker, Policy Associate
Californians Against Waste

Jennifer Elkins, President
Val Verde Civic Association

Marilyn Price Co-Chair
Sustainable Mill Valley

Katherine Blauvelt, Executive Director
Full Circle Future

Pauline Seales, Organizer
Santa Cruz Climate Action Network

Bradley Angel, Executive Director
Greenaction for Health and Environmental Justice

Lisa Swanson, Policy Chair Climate Reality Project
Orange County Chapter

Dave Shukla, Operations
Long Beach Alliance for Clean Energy

Bianca Lopez
Valley Improvement Projects

Gabriela Facio, Senior Policy Strategist
Sierra Club California

Daniel Chandler, Steering Committee
350 Humboldt

Charles Miller, Chair
Los Angeles Climate Reality Project

Ricardo Pulido, Board Chairman
Coalition For A Safe Environment

Thomas Helme, Coordinator
California Environmental Justice Coalition

Will Brieger, Chair, Legislation & Policy Team
350 Sacramento

Janet Cox, CEO
Climate Action California

Michael Mulligan, Legislative Analyst
NorCal Elders Climate Action

Richard Burke, Chapter Leader
SoCal Elders Climate Action

Eric Gudz, Sacramento Chapter President
United Nations Association - California

Bill Magavern, Policy Director
Coalition for Clean Air

Barry Vesser, Chief Program Officer
The Climate Center

Nayamin Martinez, Executive Director
Central California Environmental Justice Network

Denaya Shorter, Senior Director US & Canada
Global Alliance for Incinerator Alternatives