LFG Well/Probe BMPs Responses to Comments on 9/24/08 Draft

1. **Probes should be constructed with longer screened segments (as opposed to shorter).**

   There were several comments submitted to wordsmith this BMP for greater clarity. Many of the suggestions were accepted.

2. **Probes should be assembled using materials and in a manner that provides an adequate seal and does not interfere with sampling trace constituents.**

   Several suggestions were made to make this BMP more material neutral. A number of changes have been made to this end while recognizing that PVC was the only material used for probes evaluated in the Functionality Study.

3. **Minimize the number of probe pipe connections by using longer sections of pipe.**

   Likewise, several suggestions were made to make this more material neutral and this was done.

4. **Probes should be constructed using a non-specialized valve on the probehead assembly.**

   Ball valve was added to the list of non-specialized valves. The list of example specialized valves was retained for illustrative purposes.

5. **LFG wells and probes should be properly labeled and identified.**

   A couple of comments expressed concern about the labels becoming cluttered by including too much information, i.e., the screened intervals. CIWMB staff believes that access to this information while monitoring as opposed to have to seek it at a separate location is valuable and will be retained as part of this BMP.

   One commenter suggested a standardized nomenclature for probes going forward. This approach may warrant further discussion, but CIWMB staff would be satisfied with consistent numbering and labeling for a given site at this time.

6. **LFG probes should be constructed to allow access by a bore monitor.**

   This BMP was revised to include a range of diameters to taking into account different pipe wall thicknesses to allow access for a borehole camera without being too large allowing the camera to wander within the probe.

7. **The depth of the water table in relation to probe(s) should be a design consideration.**

Several commenters continue to express concern regarding landfill gas monitoring below the high ground water level. CIWMB regulations [27 CCR 20925(c)(1)(E)] require probes to be installed above the "permanent low seasonal water table" ground water monitoring and landfill gas monitoring are not mutually exclusive. No change is warranted because it is inconsistent with current regulations.

With this said, as with ground water monitoring wells, the proper design and construction of landfill gas monitoring wells is essential to ensure that wells do not become conduits for fluids or gas that may contaminate ground water. We have expanded the TAG to include representatives of the State and Regional Water Boards and this BMP has been reviewed by them. Landfill operators who have specific ground water concerns may want to provide a courtesy copy of their landfill gas monitoring program plan to the Regional Water Board.

8. **Probes should be preferentially located as far away from surface vegetation as possible in order to avoid root intrusion into shallow probes.**

   This BMP has been re-ordered for clarity and proper emphasis.

9. **A certified engineering geologist/ registered civil engineer must "field design" the screened interval for the probes and certify installation/completion of wells/probes in the as-builts required by the regulations.**

   A number of edits were made to improve clarity.

   Several commenters suggested additional professionals who could design LFG monitoring systems or log borings. No change in the BMP is warranted because these changes would require a change in regulations.

   A couple of commenters suggested removing the phrase regarding the placement of the mid-depth probe to match the geology and zones most conducive to gas flow. No change is warranted as such placement is required by current regulations [27CCR 20925(c)(1)(D) and is part of the underlying basis for this BMP. The study found that despite the regulations many probes appear to be assembled and installed without regard to the geology encountered. However, this BMP does not preclude the consideration of alternatives under the regulations for depth or number of probes.

LFG Well/Probe BMPs (revised 10/07/08)

California Integrated Waste Management Board (CIWMB) staff has developed the following best management practices (BMPs) for landfill gas (LFG) probe design and construction to provide operators guidance for LFG probes built or modified during the interim before any modifications to 27 CCR §20925 are promulgated. CIWMB staff developed the BMPs based on recommendations adopted by the Board that were taken from the *Landfill Gas Monitoring Well Functionality at 20 California Landfills* study performed by SCS Engineers for CIWMB.

1. **Probes should be constructed with longer screened segments (as opposed to shorter).** The longest screened section practical for the given site-specific situation should be used. For example, within the zone of preferential path (e.g., sand lens), a longer screen encompassing the entire zone is preferred. Longer screened sections reduce the possibility of blockages by bentonite, dirt, roots and other organic material. In general, screened segments should not be shorter than 5 feet in length. However, in multi depth probes, screened sections should be installed so that they do not overlap at the same depths. In addition, in order to prevent cross-contamination of the ground water by fluids (perched water or LFG), probes should not be screened across confining layers separating perched water zones from the regional aquifer (see BMP No. 7). In very shallow wells, the screened length for probes should be as long as possible without compromising the well seal.

2. **Probes should be assembled using materials and in a manner that provides an adequate seal and does not interfere with sampling trace constituents.** Threaded and gasketed assemblies that prevent leaks at connection points or continuous pipe will help ensure that gas samples are collected from the screened portion of a probe as opposed to a leaking slip coupling or screwed together joint. Glued and/or solvent welded joints may also interfere with any trace gas sampling and should be avoided. It is understood that some portions of a probe (e.g., end-cap and wellhead) cannot be pre-constructed and thus, may require a slip-type fitting. PVC is not required for probes, but it was the only material used for probes evaluated in the study.

3. **Minimize the number of probe pipe connections by using longer sections of pipe.** The use of longer pipe sections will limit the number of points in the probe with any potential to leak ensuring the isolation of the monitored zone and well integrity. For PVC, the use of commercially available 10-20 foot sections of pipe is encouraged. Other materials such as HDPE are available in continuous spools, but no such materials were encountered during the study.

4. **Probes should be constructed using a non-specialized valve on the probehead assembly.** The use of a labcock, ball, or similar valve that is easily opened and closed without a special connection or adapter will help ensure that valid pressure and gas readings can be obtained from probes by on-site personnel as well as regulatory agencies. If a specialized or proprietary valve is used, such as a Schrader valve or quick-connect valve, then an adaptor should be provided and stored on-site at the first well or other readily accessible location.

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5. **LFG wells and probes should be properly labeled and identified.**
There should be a visible labeling method for locating and identifying monitoring wells in the field and a durable method for the labeling of probes. The minimum information on the label should include well identification, and probe identification (e.g., shallow, intermediate, deep). The labeling should be consistent for all wells at a particular site. For wells with more than three probes, the labeling should clearly identify the shallowest to deepest probes. Probe screen interval is also preferred on the labels. Non-oxidizing labels are preferred as some metal labels may rust and become unreadable. Labels should be replaced as necessary by the operator to allow easy identification of the wells and probes.

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6. **LFG probes should be constructed to allow access by a bore monitor.**
Probes should have an unobstructed bore interior with a inside diameter of ½ to ¾ inches to allow visual access by a bore monitor (i.e., down-hole camera).

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7. **The depth of the probe(s) in relation to the water table should be a design consideration.**
In order to maximize the effectiveness and life of the monitoring probe, the depth to the water table plus seasonal fluctuations in the water table should be taken into account when determining the depth of the well and screen interval of the probe(s). The screen interval should be long enough so that at least a portion of the screen interval will always be above the water table. An exception to this is when the longer screened interval would overlap with another probe screen (see BMP No. 1). Wells need to be designed and constructed to prevent cross-contamination of ground water through the well/probes by fluids (perched water or LFG). Wells need to be sealed at the surface, between perched zones, and above the high water mark if a probe is screened within the fluctuation zone. One design option would be to have one probe that extends to the seasonal high ground water level and a separate dedicated probe screened in the fluctuation zone to the permanent, seasonal low ground water level. During high water years or seasons this lower probe may be inundated, but would detect any migrating LFG during dry times.

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8. **Probes should be preferentially located as far away from surface vegetation as possible in order to avoid root intrusion into shallow probes.**
In order to minimize the possibility of root intrusion in a probe, the probe location should be placed as far away from deep-rooted vegetation as possible without compromising the ability to monitor for LFG and the probe should be periodically inspected and cleared of vegetation.
Probes that are located close to deep-rooted vegetation can experience some degree of root intrusion either in the screened interval or at the joints of the probe. Roots can crack probe casings, block visual monitoring, inhibit depth soundings, and provide a surface for debris build-up.

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9. **A certified engineering geologist/ registered civil engineer must "field design" the screened interval for the probes and certify installation/completion of wells/probes in the as-builts required by the regulations.**
The LFG regulations (Title 27, California Code of Regulations, Section 20923 and 20925) require

that 1) the monitoring network is designed by a registered civil engineer or certified engineering geologist; 2) monitoring wells are drilled by a licensed drilling contractor or a drilling crew under the supervision of a design engineer or engineering geologist; 3) wells are logged during drilling by a geologist or geotechnical engineer; 4) the specified depths of monitoring probes within the wellbore are adjusted based on geologic data obtained during drilling and probes placed adjacent to soils which are most conducive to gas flow; and 5) as-builts for each monitoring well are to be maintained by the operator and submitted to the EA upon request.

The lengths and depths of screened intervals of probes constructed should be based on subsurface conditions (i.e., lithology, contacts, geologic structure, and ground water) and should consider zones that are the most likely pathways for LFG migration. Correlating the geology to the screened lengths and depths is essential for the effective monitoring for LFG and is considered part of the design of the monitoring network that must be certified by a registered civil engineer or certified engineering geologist. The as-built description should include the rationale for screen placement based on the geology and preferential pathways for migration including placement of mid-depth probe(s).

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